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About this document

This document describes the syntax of the TCP/IP application programming interface (API). The APIs described in this document can be used to create TCP/IP client and server applications or modify existing applications to communicate using TCP/IP. The information in this document supports both IPv6 and IPv4. Unless explicitly noted, information describes IPv4 networking protocol. IPv6 support is qualified within the text.

To provide flexibility in writing new applications and adapting existing applications, the following programming languages and interfaces are described:
- C sockets
- X/Open Transport Interface (XTI)
- Assembler, PL/I, and COBOL sockets
- REXX™ sockets
- Pascal language

Who should read this document

This document is intended for experienced programmers familiar with MVS™, the IBM® multiple virtual storage operating system, TCP/IP protocols, UNIX® sockets, and data networks.

To use this document, you should be familiar with MVS and the IBM timesharing option (TSO).

You should also be familiar with z/OS® Communications Server and installing and customizing any required programming products for your network.

Depending on the design and function of your application, you should be familiar with one or more of the following programming languages:
- Assembler
- C
- COBOL
- Pascal
- PL/I
- REXX

How this document is organized

This document is organized into the following parts:


Part 2, “Designing programs,” on page 23 describes ways to design various types of programs.

Part 3, “Application program interfaces,” on page 101 describes the following socket application program interfaces (APIs):
- C Socket application programming interface (API)
- X/Open Transport Interface (XTI)
- Macro application programming interface (API)
- CALL instruction application programming interface (API)
- REXX socket application programming interface (API)
- Pascal application programming interface (API)

"Part 4, 'Appendices'" provides additional information for this document.

"Notices" contains notices and trademarks used in this document.

"Bibliography" contains descriptions of the documents in the z/OS Communications Server library.

### How to use this document

To use this document, you should be familiar with z/OS TCP/IP Services and the TCP/IP suite of protocols.

### Determining whether a publication is current

As needed, IBM updates its publications with new and changed information. For a given publication, updates to the hardcopy and associated BookManager® softcopy are usually available at the same time. Sometimes, however, the updates to hardcopy and softcopy are available at different times. The following information describes how to determine if you are looking at the most current copy of a publication:

- At the end of a publication’s order number there is a dash followed by two digits, often referred to as the dash level. A publication with a higher dash level is more current than one with a lower dash level. For example, in the publication order number GC28-1747-07, the dash level 07 means that the publication is more current than previous levels, such as 05 or 04.

- If a hardcopy publication and a softcopy publication have the same dash level, it is possible that the softcopy publication is more current than the hardcopy publication. Check the dates shown in the Summary of Changes. The softcopy publication might have a more recently dated Summary of Changes than the hardcopy publication.

- To compare softcopy publications, you can check the last two characters of the publication’s file name (also called the book name). The higher the number, the more recent the publication. Also, next to the publication titles in the CD-ROM booklet and the readme files, there is an asterisk (*) that indicates whether a publication is new or changed.

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Outside of the United States or Puerto Rico, contact your local IBM representative or your authorized IBM supplier.

If you would like to provide feedback on this publication, see “Communicating Your Comments to IBM” on page 921.

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**Conventions and terminology used in this document**

Commands in this book that can be used in both TSO and z/OS UNIX environments use the following conventions:

- When describing how to use the command in a TSO environment, the command is presented in uppercase (for example, NETSTAT).
- When describing how to use the command in a z/OS UNIX environment, the command is presented in bold lowercase (for example, netstat).
- When referring to the command in a general way in text, the command is presented with an initial capital letter (for example, Netstat).

All of the exit routines described in this document are *installation-wide exit routines*. You will see the installation-wide exit routines also called installation-wide exits, exit routines, and exits throughout this document.

The TPF logon manager, although shipped with VTAM®, is an application program. Therefore, the logon manager is documented separately from VTAM.

Samples used in this book might not be updated for each release. Evaluate a sample carefully before applying it to your system.

For definitions of the terms and abbreviations used in this document, you can view the latest IBM terminology at the IBM Terminology Web site.

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**Clarification of notes**

Information traditionally qualified as *Notes* is further qualified as follows:

- **Note** Supplemental detail
- **Tip** Offers shortcuts or alternative ways of performing an action; a hint
- **Guideline** Customary way to perform a procedure
- **Rule** Something you must do; limitations on your actions
- **Restriction** Indicates certain conditions are not supported; limitations on a product or facility
- **Requirement** Dependencies, prerequisites
- **Result** Indicates the outcome
How to read a syntax diagram

This syntax information applies to all commands and statements that do not have their own syntax described elsewhere.

The syntax diagram shows you how to specify a command so that the operating system can correctly interpret what you type. Read the syntax diagram from left to right and from top to bottom, following the horizontal line (the main path).

Symbols and punctuation

The following symbols are used in syntax diagrams:

Symbol Description

➤➤ Marks the beginning of the command syntax.
➤ Indicates that the command syntax is continued.
| Marks the beginning and end of a fragment or part of the command syntax.
➤➤ Marks the end of the command syntax.

You must include all punctuation such as colons, semicolons, commas, quotation marks, and minus signs that are shown in the syntax diagram.

Commands

Commands that can be used in both TSO and z/OS UNIX environments use the following conventions in syntax diagrams:

- When describing how to use the command in a TSO environment, the command is presented in uppercase (for example, NETSTAT).
- When describing how to use the command in a z/OS UNIX environment, the command is presented in bold lowercase (for example, netstat).

Parameters

The following types of parameters are used in syntax diagrams.

Required
Required parameters are displayed on the main path.

Optional
Optional parameters are displayed below the main path.

Default
Default parameters are displayed above the main path.

Parameters are classified as keywords or variables. For the TSO and MVS console commands, the keywords are not case sensitive. You can code them in uppercase or lowercase. If the keyword appears in the syntax diagram in both uppercase and lowercase, the uppercase portion is the abbreviation for the keyword (for example, OPERand).

For the z/OS UNIX commands, the keywords must be entered in the case indicated in the syntax diagram.
Variables are italicized, appear in lowercase letters, and represent names or values you supply. For example, a data set is a variable.

**Syntax examples**

In the following example, the USER command is a keyword. The required variable parameter is `user_id`, and the optional variable parameter is `password`. Replace the variable parameters with your own values.

```
USER user_id password
```

**Longer than one line**

If a diagram is longer than one line, the first line ends with a single arrowhead and the second line begins with a single arrowhead.

```
USER user_id password

The first line of a syntax diagram that is longer than one line

The continuation of the subcommands, parameters, or both
```

**Required operands**

Required operands and values appear on the main path line.

```
REQUIRED_OPERAND
```

You must code required operands and values.

**Optional values**

Optional operands and values appear below the main path line.

```
OPERAND
```

You can choose not to code optional operands and values.

**Selecting more than one operand**

An arrow returning to the left above a group of operands or values means more than one can be selected, or a single one can be repeated.

```
REPEATABLE_OPERAND_OR_VALUE_1

REPEATABLE_OPERAND_OR_VALUE_2

REPEATABLE_OPERAND_OR_VALUE_1

REPEATABLE_OPERAND_OR_VALUE_2
```

About this document  xxiii
Nonalphanumeric characters

If a diagram shows a character that is not alphanumeric (such as parentheses, periods, commas, and equal signs), you must code the character as part of the syntax. In this example, you must code OPERAND=(001,0.001).

\[
\text{OPERAND} = (001, 0.001)
\]

Blank spaces in syntax diagrams

If a diagram shows a blank space, you must code the blank space as part of the syntax. In this example, you must code OPERAND=(001 FIXED).

\[
\text{OPERAND} = (001 \text{ FIXED})
\]

Default operands

Default operands and values appear above the main path line. TCP/IP uses the default if you omit the operand entirely.

\[
\text{DEFAULT} \quad \text{OPERAND}
\]

Variables

A word in all lowercase italics is a variable. Where you see a variable in the syntax, you must replace it with one of its allowable names or values, as defined in the text.

\[
\text{variable}
\]

Syntax fragments

Some diagrams contain syntax fragments, which serve to break up diagrams that are too long, too complex, or too repetitious. Syntax fragment names are in mixed case and are shown in the diagram and in the heading of the fragment. The fragment is placed below the main diagram.

\[
\text{Syntax fragment}
\]

Syntax fragment:

\[
\text{1ST OPERAND}, \text{2ND OPERAND}, \text{3RD OPERAND}
\]
Prerequisite and related information

z/OS Communications Server function is described in the z/OS Communications Server library. Descriptions of those documents are listed in “z/OS Communications Server information” on page 903, in the back of this document.

Required information

Before using this product, you should be familiar with TCP/IP, VTAM, MVS, and UNIX System Services.

Related information

This section contains subsections on:

- “Softcopy information”
- “Other documents” on page xxvi
- “Redbooks” on page xxvi
- “Where to find related information on the Internet” on page xxvii
- “Using LookAt to look up message explanations” on page xxviii
- “Using IBM Health Checker for z/OS” on page xxix

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<td>SK3T-4269</td>
<td>This is the CD collection shipped with the z/OS product. It includes the libraries for z/OS V1R9, in both BookManager and PDF formats.</td>
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<tr>
<td>z/OS Software Products Collection</td>
<td>SK3T-4270</td>
<td>This CD includes, in both BookManager and PDF formats, the libraries of z/OS software products that run on z/OS but are not elements and features, as well as the Getting Started with Parallel Sysplex® bookshelf.</td>
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<tr>
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<td>This collection includes the libraries of z/OS (the element and feature libraries) and the libraries for z/OS software products in both BookManager and PDF format. This collection combines SK3T-4269 and SK3T-4270.</td>
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<td>The Redbooks selected for this CD series are taken from the IBM Redbooks inventory of over 800 books. All the Redbooks that are of interest to the zSeries platform professional are identified by their authors and are included in this collection. The zSeries subject areas range from e-business application development and enablement to hardware, networking, Linux, solutions, security, parallel sysplex, and many others.</td>
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Other documents

For information about z/OS products, refer to z/OS Information Roadmap (SA22-7500). The Roadmap describes what level of documents are supplied with each release of z/OS Communications Server, as well as describing each z/OS publication.

Relevant RFCs are listed in an appendix of the IP documents. Architectural specifications for the SNA protocol are listed in an appendix of the SNA documents.

The following table lists documents that might be helpful to readers.

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<td>System z9 and zSeries OSA-Express Customer’s Guide and Reference</td>
<td>SA22-7935</td>
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Redbooks

The following Redbooks™ might help you as you implement z/OS Communications Server.
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<td>Communications Server for z/OS V1R8 TCP/IP Implementation, Volume 1: Base Functions, Connectivity, and Routing</td>
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<tr>
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<td>Threadsafe Considerations for CICS</td>
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**Where to find related information on the Internet**

**z/OS**

This site provides information about z/OS Communications Server release availability, migration information, downloads, and links to information about z/OS technology


**z/OS Internet Library**

Use this site to view and download z/OS Communications Server documentation


**IBM Communications Server product**

The primary home page for information about z/OS Communications Server


**IBM Communications Server product support**

Use this site to submit and track problems and search the z/OS Communications Server knowledge base for Technotes, FAQs, white papers, and other z/OS Communications Server information


**IBM Systems Center publications**

Use this site to view and order Redbooks, Redpapers, and Technotes


**IBM Systems Center flashes**
Search the Technical Sales Library for Techdocs (including Flashes, presentations, Technotes, FAQs, white papers, Customer Support Plans, and Skills Transfer information)

http://www.ibm.com/support/techdocs/atsmastr.nsf

RFCs

Search for and view Request for Comments documents in this section of the Internet Engineering Task Force Web site, with links to the RFC repository and the IETF Working Groups Web page

http://www.ietf.org/rfc.html

Internet drafts

View Internet-Drafts, which are working documents of the Internet Engineering Task Force (IETF) and other groups, in this section of the Internet Engineering Task Force Web site

http://www.ietf.org/ID.html

Information about Web addresses can also be found in information APAR III1334.

Note: Any pointers in this publication to Web sites are provided for convenience only and do not in any manner serve as an endorsement of these Web sites.

DNS Web sites

For more information about DNS, see the following USENET news groups and mailing addresses:

USENET news groups
comp.protocols.dns.bind

BIND mailing lists
http://www.isc.org/ml-archives/

BIND Users
- Subscribe by sending mail to bind-users-request@isc.org.
- Submit questions or answers to this forum by sending mail to bind-users@isc.org.

BIND 9 Users (This list might not be maintained indefinitely.)
- Subscribe by sending mail to bind9-users-request@isc.org.
- Submit questions or answers to this forum by sending mail to bind9-users@isc.org.

Using LookAt to look up message explanations

LookAt is an online facility that lets you look up explanations for most of the IBM messages you encounter, as well as for some system abends and codes. Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

You can use LookAt from these locations to find IBM message explanations for z/OS elements and features, z/VM®, VSE/ESA®, and Clusters for AIX® and Linux™:
• Your z/OS TSO/E host system. You can install code on your z/OS systems to access IBM message explanations using LookAt from a TSO/E command line (for example: TSO/E prompt, ISPF, or z/OS UNIX System Services).
• Your Microsoft® Windows® workstation. You can install LookAt directly from the z/OS Collection (SK3T-4269) or the z/OS and Software Products DVD Collection (SK3T-4271) and use it from the resulting Windows graphical user interface (GUI). The command prompt (also known as the DOS > command line) version can still be used from the directory in which you install the Windows version of LookAt.
• Your wireless handheld device. You can use the LookAt Mobile Edition from [www.ibm.com/servers/eserver/zseries/zos/bbserv/lookatm.html](http://www.ibm.com/servers/eserver/zseries/zos/bbserv/lookatm.html) with a handheld device that has wireless access and an Internet browser (for example: Internet Explorer for Pocket PCs, Blazer or Eudora for Palm OS, or Opera for Linux handheld devices).

You can obtain code to install LookAt on your host system or Microsoft Windows workstation from:
• A CD-ROM in the z/OS Collection (SK3T-4269).
• The z/OS and Software Products DVD Collection (SK3T-4271).
• The LookAt Web site (click **Download** and then select the platform, release, collection, and location that suit your needs). More information is available in the LOOKAT.ME files available during the download process.

### Using IBM Health Checker for z/OS

IBM Health Checker for z/OS is a z/OS component that installations can use to gather information about their system environment and system parameters to help identify potential configuration problems before they impact availability or cause outages. Individual products, z/OS components, or ISV software can provide checks that take advantage of the IBM Health Checker for z/OS framework. This book might refer to checks or messages associated with this component.


SDSF also provides functions to simplify the management of checks. See z/OS SDSF Operation and Customization for additional information.

### How to send your comments

Your feedback is important in helping to provide the most accurate and high-quality information. If you have any comments about this document or any other z/OS Communications Server documentation:
• Go to the z/OS contact page at: [http://www.ibm.com/servers/eserver/zseries/zos/webqs.html](http://www.ibm.com/servers/eserver/zseries/zos/webqs.html)
  There you will find the feedback page where you can enter and submit your comments.
• Send your comments by e-mail to comsvrcf@us.ibm.com. Be sure to include the name of the document, the part number of the document, the version of z/OS
Communications Server, and, if applicable, the specific location of the text you are commenting on (for example, a section number, a page number or a table number).
Summary of changes

Summary of changes
for SC31-8788-06
z/OS Version 1 Release 9

This document contains information previously presented in SC31-8788-05, which supports z/OS Version 1 Release 8.

The information in this document includes descriptions of support for both IPv4 and IPv6 networking protocols. Unless explicitly noted, descriptions of IP protocol support concern IPv4. IPv6 support is qualified within the text.

This document refers to Communications Server data sets by their default SMP/E distribution library name. Your installation might, however, have different names for these data sets where allowed by SMP/E, your installation personnel, or administration staff. For instance, this document refers to samples in SEZAINST library as simply in SEZAINST. Your installation might choose a data set name of SYS1.SEZAINST, CS390.SEZAINST or other high-level qualifiers for the data set name.

Changed information

• ML2V2 and IGMPv3 support, see:
  - Chapter 9, “Designing multicast programs,” on page 73
  - Chapter 12, “Macro application programming interface,” on page 259
  - Chapter 13, “CALL instruction application programming interface,” on page 453
  - Chapter 14, “REXX socket application programming interface,” on page 659
  - “Sockets return codes (ERRNOs)” on page 835
  - Appendix C, “Address family cross reference,” on page 857
  - Appendix D, “GETSOCKOPT/SETSOCKOPT command values,” on page 863

• IPv6 scoped address architecture API, see:
  - “GETADDRINFO” on page 285
  - “GETADDRINFO” on page 469
  - “GETADDRINFO” in Chapter 14, “REXX socket application programming interface”

• Enable application identifier in NMI, SMF, and Netstat, see:
  - “IOCTL” on page 333
  - “IOCTL” on page 513
  - “IOCTL” in Chapter 14, “REXX socket application programming interface”

• REXX socket API documentation improvements, see Chapter 14, “REXX socket application programming interface.”

• AT-TLS API enhancements, see:
  - “IOTCL” in Chapter 14, “REXX socket application programming interface”
  - “Sockets return codes (ERRNOs)” on page 835

Deleted information

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xxxi
The APPC Application Suite is removed from the z/OS V1R9 Communications Server product and therefore documentation describing APPC Application Suite support has been deleted.

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

You might notice changes in the style and structure of some content in this document—for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.

Summary of changes for SC31-8788-05 z/OS Version 1 Release 7

This document contains information previously presented in SC31-8788-04, which supports z/OS Version 1 Release 6.

The information in this document includes descriptions of support for both IPv4 and IPv6 networking protocols. Unless explicitly noted, descriptions of IP protocol support concern IPv4. IPv6 support is qualified within the text.

This document refers to Communications Server data sets by their default SMP/E distribution library name. Your installation might, however, have different names for these data sets where allowed by SMP/E, your installation personnel, or administration staff. For instance, this document refers to samples in SEZAINST library as simply in SEZAINST. Your installation might choose a data set name of SYS1.SEZAINST, CS390.SEZAINST or other high level qualifiers for the data set name.

New Information

- Application Transparent Transport Layer Security (AT-TLS) function
  - SIOCTTLSCTL IOCTL information, which enables control of Application Transparent TLS (AT-TLS) for the connection. See “IOCTL” on page 513 for call instruction information, “IOCTL” on page 333 for assembler program macro information, or “IOCTL” in Chapter 14, “REXX socket application programming interface” for REXX socket information.

Changed information

- C socket API
  - Updated getsockopt() information, see “getsockopt()” on page 152

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

You might notice changes in the style and structure of some content in this document—for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.
Summary of changes
for SC31-8788-04
z/OS Version 1 Release 6

This document contains information previously presented in SC31-8788-03, which supports z/OS Version 1 Release 5. The information in this document supports both IPv6 and IPv4. Unless explicitly noted, information describes IPv4 networking protocol. IPv6 support is qualified within the text.

New Information
- Commands and select examples are enabled for z/OS library center advanced searches.

Changed information
- Updated getsockopt() information, see "getsockopt()" on page 152

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Starting with z/OS V1R4, you may notice changes in the style and structure of some content in this document—for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Starting with z/OS V1R4, you may notice changes in the style and structure of some content in this document—for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.

This document supports z/OS.e.
Part 1. Overview

For native IPv4 addresses, the application must create an AF_INET address family socket. For native IPv6 addresses and IPv4-mapped IPv6 addresses, the application must create an AF_INET6 address family socket. Refer to z/OS Communications Server: IPv6 Network and Application Design Guide and the SOCKET command under the APIs that support IPv6 for details.

For details on which TCP/IP APIs and commands support the AF_INET6 (IPv6) address family, see Appendix C, “Address family cross reference,” on page 857.
Chapter 1. Introducing TCP/IP concepts

This information explains basic TCP/IP concepts and sockets programming.

TCP/IP concepts

Conceptually, the TCP/IP protocol stack consists of four layers, each layer consisting of one or more protocols. A protocol is a set of rules or standards that two entities must follow so as to allow each other to receive and interpret messages sent to them. The entities could, for example, be two application programs in an application protocol, or the entities might be two TCP protocol layers in two different IP hosts (the TCP protocol).

Figure 1 illustrates the TCP/IP protocol stack.

![TCP/IP protocol stack diagram]

Figure 1. The TCP/IP protocol stack

Programs are located at the process layer; here they can interface with the two transport layer protocols (TCP and UDP), or directly with the network layer protocols (ICMP and IP).

TCP  Transmission Control Protocol is a transport protocol providing a reliable, full-duplex byte stream. Most TCP/IP applications use the TCP transport protocol.

UDP  User Datagram Protocol is a connectionless protocol providing datagram services. UDP is less reliable because there is no guarantee that a UDP datagram ever reaches its intended destination, or that it reaches its destination only once and in the same condition as it was passed to the sending UDP layer by a UDP application.

ICMP  Internet Control Message Protocol is used to handle error and control information at the IP layer. The ICMP is most often used by network control applications that are part of the TCP/IP software product itself, but ICMP can be used by authorized user processes as well. PING and TRACEROUTE are examples of network control applications that use the ICMP protocol.

IP  Internet Protocol provides the packet delivery services for TCP, UDP, and ICMP. The IP layer protocol is unreliable (called a best-effort protocol). There is no guarantee that IP packets arrive, or that they arrive only once and are error-free. Such reliability is built into the TCP protocol, but not
into the UDP protocol. If you need reliable transport between two UDP applications, you must ensure that reliability is built into the UDP applications.

**ARP/ND**

The IPv4 networking layer uses the Address Resolution Protocol (ARP) to map an IP address into a hardware address. In the IPv6 networking layer, this mapping is performed by the Neighbor Discovery (ND function). On local area networks (LANs), such an address would be called a media access control (MAC) address.

**RARP** Reverse Address Resolution Protocol is used to reverse the operation of the ARP protocol. It maps a hardware address into an IPv4 address. Note that both ARP packets and RARP packets are not forwarded in IP packets, but are themselves media level packets. ARP and RARP are not used on all network types, as some networks do not need these protocols.

---

**Understanding sockets concepts**

A socket uniquely identifies the endpoint of a communication link between two application ports.

A port represents an application process on a TCP/IP host, but the port number itself does not indicate the protocol being used: TCP, UDP, or IP. The application process might use the same port number for TCP or UDP protocols. To uniquely identify the destination of an IP packet arriving over the network, you have to extend the port principle with information about the protocol used and the IP address of the network interface; this information is called a socket. A socket has three parts: protocol, local-address, local-port.

**Figure 2** illustrates the concept of a socket.

![Figure 2](image_url)

**Figure 2. Socket concept**

The term association is used to specify completely the two processes that comprise a connection:

(udp,local-address,local-port,foreign-address,foreign-port).

The terms socket and port are sometimes used as synonyms, but note that the terms port number and socket address are not like one another. A port number is one of the
three parts of a socket address, and can be represented by a single number (for example, 1028) while a socket address can be represented by (tcp,myhostname,1028).

A socket descriptor (sometimes referred to as a socket number) is a binary integer that acts as an index to a table of sockets; the sockets are currently allocated to a given process. A socket descriptor represents the socket, but is not the socket itself.

**Programming with sockets**

A socket is an endpoint for communication able to be named and addressed in a network. From the perspective of the application program, it is a resource allocated by the address space; it is represented by an integer called the socket descriptor.

The socket interface was designed to provide applications a network interface that hides the details of the physical network. The interface is differentiated by the different services provided: Stream, datagram, and raw sockets. Each interface defines a separate service available to applications.

The MVS socket APIs provide a standard interface using the transport and internetwork layer interfaces of TCP/IP. These APIs support three socket types: stream, datagram, and raw. Stream and datagram socket types interface with the transport layer protocols; raw socket types interface with the network layer protocols. Choose the most appropriate interface for your application.

**Selecting sockets**

You can choose among the following types of sockets:

- Stream
- Datagram
- Raw

Stream sockets perform like streams of information. There are no record lengths or character boundaries between data, so communicating processes must agree on their own mechanisms for distinguishing information. Usually, the process sending information sends the length of the data, followed by the data itself. The process receiving information reads the length and then loops, accepting data until all of it has been transferred. Because there are no boundaries in the data, multiple concurrent read or write socket calls of the same type, on the same stream socket, will yield unpredictable results. For example, if two concurrent read socket calls are issued on the same stream socket, there is no guarantee of the order or amount of data that each instance will receive. Stream sockets guarantee to deliver data in the order sent and without duplication. The stream socket defines a reliable connection service. Data is sent without error or duplication and is received in the order sent. Flow control is built in to avoid data overruns. No boundaries are imposed on the data; the data is treated as a stream of bytes.

Stream sockets are most common because the burden of transferring the data reliably is handled by TCP/IP, rather than by the application.

The datagram socket is a connectionless service. Datagrams are sent as independent packets. The service provides no guarantees. Data can be lost or duplicated, and datagrams can arrive out of order. The size of a datagram is limited to the size able to be sent in a single transaction. Currently, the default value is 8192 bytes, and the maximum value is 65 535. The maximum size of a datagram is 65 535 for UDP and 65 535 bytes for raw.
The raw socket allows direct access to lower layer protocols, such as IP and the ICMP. This interface is often used to test new protocol implementation, because the socket interface can be extended and new socket types defined to provide additional services. For example, the transaction type sockets can be defined for interfacing to the Versatile Message Transfer Protocol (VMTP). 1 Transaction-type sockets are not supported by TCP/IP. Because socket interfaces isolate you from the communication function of the different protocol layers, the interfaces are largely independent of the underlying network. In the MVS implementation of sockets, stream sockets interface with TCP, datagram sockets interface with UDP, and raw sockets interface with ICMP and IP.

Notes:
1. The TCP and UDP protocols cannot be used with raw sockets.
2. If you are communicating with an existing application, you must use the same protocols used by the existing application. For example, if you communicate with an application that uses TCP, you must use stream sockets.

You should consider the following factors for these applications:
• Reliability
  Stream sockets provide the most reliable connection. Datagrams and raw sockets are unreliable because packets can be discarded or duplicated during transmission. This characteristic might be acceptable if the application does not require reliability or if the application implements reliability beyond the socket interface.
• Performance
  Overhead associated with reliability, flow control, and connection maintenance degrades the performance of stream sockets so that they do not perform as well as datagram sockets.
• Data Transfer
  Datagram sockets limit the amount of data moved in a single transaction. If you send fewer than 2048 bytes of data at one time, use datagram sockets. When the amount of data in a single transaction is greater, use stream sockets.

If you are writing a new protocol to use on top of IP, or if you want to use the ICMP protocol, you must choose raw sockets; but to use raw sockets, you must be authorized by way of RACF® or APF.

**Socket libraries**

Figure 3 on page 7 illustrates the TCP/IP networking API relationship on z/OS.

---

When we create a sockets program, we use something that generally is called a sockets library. A sockets library consists of both compile-time structures, statically linked support modules, and run-time support modules.

There are two main sockets execution environments in z/OS with available libraries:
- Native TCP/IP (implemented by TCP/IP in z/OS Communications Server)
- UNIX (implemented by z/OS UNIX System Services [Language Environment])

**Native TCP/IP**
A non-UNIX socket program can only use one TCP/IP protocol stack at a time. The native TCP/IP C socket library is not POSIX compliant and it should not be used for new C socket program development. The non-C native TCP/IP socket libraries (sockets extended: call and assembler macro, REXX sockets, CICS® sockets, and IMS™ sockets) are available for development of new socket application programs. The following TCP/IP Services APIs are included in this library:

**Pascal API**
The Pascal IPv4 socket application programming interface enables you to develop TCP/IP applications in the Pascal language. Supported environments are normal MVS address spaces. The Pascal programming interface is based on Pascal procedures and functions that implement conceptually the same functions as the C socket interface. The Pascal routines, however, have different names than the C socket calls. Unlike the other APIs, the Pascal API does not interface with z/OS UNIX System Services; it uses an internal interface to communicate with the TCP/IP protocol stack.

**IMS sockets**
The Information Management System (IMS) IPv4 socket interface supports development of client/server applications in which one part of the application executes on a TCP/IP-connected host and the other part executes as an IMS application program. The programming interface used by both application parts is the socket programming interface, and the communication protocols are either TCP, UDP, or RAW. For more information, refer to the z/OS Communications Server: IP IMS Sockets Guide.

Chapter 1. Introducing TCP/IP concepts 7
CICS sockets
The CICS socket interface enables you to write CICS applications that act as IPv4 or IPv6 clients or servers in a TCP/IP-based network. Applications can be written in C language, using the C sockets programming, or they can be written in COBOL, PL/I or assembler, using the Extended Sockets programming interface. For more information, refer to the z/OS Communications Server: IP CICS Sockets Guide.

z/OS CS TCP/IP C/C++ Sockets
The C/C++ Sockets interface supports IPv4 socket function calls that can be invoked from C/C++ programs.

Note: Use of the UNIX C socket library is encouraged.

Sockets Extended macro API
The Sockets Extended macro API is a generalized assembler macro-based interface to IPv4 and IPv6 socket programming. It includes extensions to the socket programming interface, such as support for asynchronous processing on most sockets function calls.

Sockets Extended Call Instruction API
The Sockets Extended Call Instruction API is a generalized call-based interface to IPv4 and IPv6 sockets programming. The functions implemented in this call interface resemble the C-sockets implementation, with some extensions similar to the sockets extended macro interface.

REXX sockets
The REXX sockets programming interface implements facilities for IPv4 and IPv6 socket communication directly from REXX programs by way of an address rxsocket function. REXX socket programs can execute in TSO, online, or batch.

UNIX
A UNIX socket program can use up to eight TCP/IP protocol stacks at once. The stacks may be a combination of any TCP/IP protocol stack that is supported by z/OS UNIX System Services. The following APIs are provided by the UNIX element of z/OS and are not addressed in detail in this publication:

z/OS C sockets
z/OS UNIX C sockets is used in the z/OS UNIX environment. Programmers use this API to create IPv4 and IPv6 applications that conform to the POSIX or XPG4 standard (a UNIX specification). Applications built with z/OS UNIX C sockets can be ported to and from platforms that support these standards. For more information, refer to the z/OS XL C/C++ Run-Time Library Reference.

z/OS UNIX Assembler Callable Services
z/OS UNIX Assembler Callable Services is a generalized call-based interface to z/OS UNIX IPv4 and IPv6 sockets programming. The functions implemented in this call interface resemble the z/OS UNIX C sockets implementation, with some extensions similar to the sockets extended macro interface. For more information, refer to the z/OS UNIX System Services Programming: Assembler Callable Services Reference.

Address families
Address families define different styles of addressing. All hosts in a given address family understand and use the same scheme for addressing socket endpoints. TCP/IP supports addressing families AF_INET and AF_INET6. See “Socket libraries” on page 6 to determine which APIs support the AF_INET or both the
AF_INET and AF_INET6 address families. The AF_INET domain defines addressing for the IPv4 internet domain. The AF_INET6 domain defines addressing for the IPv6 internet domain.

**Addressing sockets in an Internet domain**

This section describes how to address sockets in an Internet domain.

**Internet addresses**

Internet addresses are 32-bit quantities (AF_INET) or 128-bit quantities (AF_INET6) that represent a network interface. Every Internet address within an administered AF_INET domain must be unique. Every Internet address within a scope for AF_INET6 domain must be unique. An internet host can also have multiple Internet addresses. In fact, a host has at least as many Internet addresses as it has network interfaces. For IPv4 interfaces, there must be one unique address per interface. However, the same is not true for IPv6 interfaces. Refer to the [z/OS Communications Server: IPv6 Network and Application Design Guide](https://www.ibm.com/support/docview.wss?uid=swg27029580) for more information.

**Ports**

A port is used to differentiate among different applications using the same network interface. It is an additional qualifier used by the system software to get data to the correct application. Physically, a port is a 16-bit integer. Some ports are reserved for particular applications; they are labeled as well-known ports.

In the client/server model, the server provides a resource by listening for clients on a particular port. Some applications, such as FTP, SMTP, and Telnet, are standardized protocols and listen on a well-known port. Such standardized applications use the same port number on all TCP/IP hosts. For your client/server applications, however, you need a way to assign port numbers to represent the services you intend to provide. An easy way to define services and their ports is to enter them into data set hlq.ETC.SERVICES. In C, the programmer uses the `getservbyname()` function to determine the port for a particular service. Should the port number for a particular service change, only the hlq.ETC.SERVICES data set needs to be modified.

**Note:** Note that hlq is the high-level qualifier. z/OS Communications Server ships with a default hlq of TCPIP. Use this default or override it using the DATASETPREFIX statement in the PROFILE.TCPIP and TCPIP.DATA configuration files. TCP/IP is shipped with data set hlq.ETC.SERVICES that contains the well-known services of FTP, SMTP, and Telnet. Data set hlq.ETC.SERVICES is described in the [z/OS Communications Server: IP Configuration Reference](https://www.ibm.com/support/docview.wss?uid=swg27022985).

A socket program in an IP host identifies itself to the underlying TCP/IP protocol layers by port number.

A port number is a 16-bit integer ranging from 0 to 65 535. A port number uniquely identifies this application to the protocol underlying this TCP/IP host (TCP, UDP, or IP). Other applications in the TCP/IP network can contact this application by way of reference to the port number on this specific IP host.

[Figure 4 on page 10](#) shows the port concept.
Both server applications and client applications have port numbers. A server application uses a specific port number to uniquely identify this server application. The port number can be reserved to a particular server, so no other process ever uses it. In an IBM TCP/IP Services environment, you can do this using the PORT statement in the hlq.PROFILE.TCP/IP configuration data set. When the server application initializes, it uses the bind() socket call to identify its port number. A client application must know the port number of a server application in order to contact it.

Because advance knowledge of the client’s port number is not needed, a client often leaves it to TCP/IP to assign a free port number when the client issues the connect() socket call to connect to a server. Such a port number is called an ephemeral port number; this means it is a port number with a short life. The selected port number is assigned to the client for the duration of the connection, and is then made available to other processes. It is the responsibility of the TCP/IP software to ensure that a port number is assigned to only one process at a time.

Well-known official Internet port numbers are in the range of 0 to 255. Go to http://www.iana.org/assignments/multicast-addresses for details. In addition, port numbers in the range of 256 to 1023 are reserved for other well-known services. Port numbers in the range of 1024 to 5000 are used by TCP/IP when TCP/IP automatically assigns port numbers to client programs that do not use a specific port number. Your server applications should use port numbers above 5000.

Figure 4. The port concept

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Figure 5. Port number assignments

Before you select a port number for your server application, consult the hlq.ETC.SERVICES data set. This data set is used to assign port numbers to server applications. The server application can use socket call getservbyname() to retrieve the port number assigned to a given server name. Add the names of your server
applications to this data set and use socket call getservbyname(). With this technique, you avoid hard coding the port number into your server program. The client program must know the port number of the server on the server host. There is no socket call to obtain that information from the server host. To compensate, synchronize the contents of data sets ETC.SERVICES on all TCP/IP hosts in your network. Client application can then use the getservbyname() socket call to query its local ETC.SERVICES data set for the port number of the server. Use this technique to develop your own local well-known services.

Network byte order
Ports and addresses are usually specified by calls using the network byte ordering convention. Network byte order is also known as big endian byte ordering, where the high order byte defines significance. Network byte ordering allows hosts using different architectures to exchange address information. See "accept()" on page 115, "bind()" on page 117, "htonl()" on page 160, "htons()" on page 161, "ntohl()" on page 173, and "ntohs()" on page 174 for more information about network byte order.

Notes:
1. The socket interface does not handle application data byte ordering differences. Application writers must handle byte order differences themselves, or use higher level interfaces such as remote procedure calls (RPC). For description of the RPC calls, refer to the z/OS Communications Server: IP Programmer’s Guide and Reference.

2. If you use the socket API, your application must handle the issues related to different data representations on different hardware platforms. For character based data, some hosts use ASCII, while other hosts use EBCDIC. Your application must handle translation between the two representations.

Maximum number of sockets
For most socket interfaces, the maximum number of sockets allowed per each connection between an application and the TCP/IP sockets interface is 65 535. The exceptions to this rule are the C sockets interface and the C sockets interface for CICS, where the maximum allowed for both of these interfaces is 2000.

Programmers need to be aware that for an application using a sockets interface that uses Sockets Transform (for example, the EZASMI macro API, the callable EZASOKET API, CICS Sockets, or IMS Sockets) approximately 68 bytes of storage per socket in the application’s address space is allocated when the application connects to the TCP/IP sockets interface. Each time a REXX client opens a socket, approximately 208 bytes of storage is allocated. If an application using a sockets interface that uses sockets transform requests 65 535 sockets, then approximately 4.25 MB (65 535*68 bytes) of storage in the application’s address space is allocated just for the socket array. If a REXX client opens 65 535 sockets, then approximately 13 MB (65 535*208 bytes) of storage is allocated for the socket chain. The monitoring and processing of this many sockets is also costly in terms of performance and CPU utilization.

The number of sockets than an application can open is also limited by the MAXFILEPROC UNIX System Services parameter in the BPXPRMxx parmlib member. This parameter determines the number of sockets each z/OS UNIX System Services process can have open. Each address space is usually a z/OS UNIX System Services process. Thus, in most cases the combined number of sockets opened by all the applications within an address space is limited to the MAXFILEPROC parameter. If MAXFILEPROC is 65 535 and two different applications within the same address space both request 65 535 sockets, then the
two applications will not be able to concurrently have 65 535 sockets open. If one of the applications has 65 000 sockets open, then the other application will not be able to have more than 535 sockets open even though it has allocated 65 535 sockets.

The number of sockets that an application can open in a particular addressing family is also limited by the MAXSOCKETS parameter in BPXPRMxx parmlib member's NETWORK statement that corresponds to the addressing family. This value determines how many sockets for a particular addressing family can be opened in the entire system. If MAXSOCKETS for the AF_INET addressing family is set to 60000 and there are already 50 000 AF_INET sockets open in the system, then a new application will not be able to open more than 10000 AF_INET sockets even if it requests a higher number when it connects to the TCP/IP sockets interface.

For details on the BPXPRMxx member, refer to the following publications:
- z/OS UNIX System Services Planning
- z/OS MVS Initialization and Tuning Reference
- z/OS UNIX System Services File System Interface Reference

**AF_INET socket addresses in an Internet domain**
A socket address in an Internet addressing family comprises four fields:
- The address family (AF_INET)
- The Internet address
- A port
- A character array

The structure of an Internet socket address is defined by the following sockaddr_in structure, which is found in header file IN.H:

```
struct in_addr
{
    u_long s_addr;
};
struct sockaddr_in
{
    short sin_family;
    u_short sin_port;
    struct in_addr sin_addr;
    char sin_zero[8];
};
```

The sin_family field is set to AF_INET. The sin_port field is the port used by the application, in network byte order. sin_addr field specifies a 32-bit Internet address. The sin_addr field is the Internet address of the network interface used by the application; it is also in network byte order. The sin_zero field should be set to zeros.

**AF_INET6 socket addresses in an Internet domain**
Refer to the z/OS Communications Server: IPv6 Network and Application Design Guide for parts of the AF_INET6 family. The structure of an Internet socket address is defined by the following sockaddr_in6 structure, which is found in header file IN.H:

```
struct in6_addr
{
    union
    {
        uint8_t _56_u8[16];
        uint32_t _56_u32[4];
    }
};
```
The sin6_family field is set to AF_INET6. The sin6_port field is a halfword binary field that is the port used by the application, in network byte order. The sin6_addr field specifies a 128-bit Internet address. The sin6_addr field is the Internet address of the network interface used by the application; it is also in network byte order. The sin6_flowinfo field is a fullword binary field specifying the traffic class and flow label. This field is currently not implemented. The sin6_scope_id field identifies a set of interfaces as appropriate for the scope of the address carried in the sin6_addr field.
Chapter 2. Organizing a TCP/IP application program

This information explains how to organize a TCP/IP application program. All examples are shown using an address family of AF_INET (IPv4). All concepts described below can also be applied to an address family of AF_INET6 (IPv6).

- Client and server socket programs
- Call sequence in socket programs
- Blocking, nonblocking, and asynchronous socket calls
- Testing a program using a miscellaneous server
- Testing a local machine using a loopback address
- Accessing required data sets

Client and server socket programs

The terms client and server are common within the TCP/IP community, and many definitions exist. In the TCP/IP context, these terms are defined as follows:

**Server** A process that waits passively for requests from clients, processes the work specified, and returns the result to the client that originated the request.

**Client** A process that initiates a service request.

The client and server distribution model is structured on the roles of master and slave; the client acts as the master and requests service from the server (the slave). The server responds to the request from the client. This model implies a one-to-many relationship; the server typically serves multiple clients, while each client deals with a single server.

No matter which socket programming interface you select, function is identical. The syntax might vary, but the underlying concept is the same.

While clients communicate with one server at a time, servers can serve multiple clients. When you design a server program, plan for multiple concurrent processes. Special socket calls are available for that purpose; they are called concurrent servers, as opposed to the more simple type of iterative server.

To distinguish between these generic socket program categories, the following terms are used:

- **Client program** identifies a socket program that acts as a client.
- **Iterative server program** identifies a socket program that acts as a server, and processes fully one client request before accepting another client request.
- **Concurrent server main program** identifies that part of a concurrent server that manages child processes, accepts client connections, and schedules client connections to child processes.
- **Concurrent server child program** identifies that part of a concurrent server that processes the client requests.

In a concurrent server main program, the child program might be active in many parallel child processes, each processing a client request. In an MVS environment, a process is either an MVS task, a CICS transaction, or an IMS transaction.
Iterative server socket programs

An iterative server processes requests from clients in a serial manner; one connection is served and responded to before the server accepts a new client connection.

Figure 6 shows the iterative server main logic.

Figure 6. Iterative server main logic

The following list describes the iterative server socket process.

1. When a connection request arrives, it accepts the connection and receives the client data.
2. The iterative server processes the received data and does whatever has to be done to build a reply.
3. The server sends the data back to the client.
4. The iterative server closes the socket and waits for the next connection request from the network.

An MVS iterative server can be implemented as follows:

- As a batch job or MVS task started manually, or by automation software. The job remains active until it is closed by operator intervention.
- As a TSO transaction. For a production implementation, submit a job that executes a batch terminal monitor program (TMP).
- As a long-running CICS task. The task normally begins during CICS startup, but it can be started by an authorized CICS operator entering the appropriate CICS transaction code.
- As a batch message program (BMP) in IMS.

From a socket programming perspective, there is no difference between an iterative server that runs in a native MVS environment (batch job, started task, or TSO) and one that runs as a CICS task, or as a BMP under IMS.

You can terminate the server process in various ways. For jobs that execute in traditional MVS address spaces (batch job, started task, TSO, IMS BMP), you can implement functions in the server to enable an operator to use the MVS MODIFY command to signal stop; for example F SERVER,STOP. (This technique cannot be used for CICS tasks.) Alternatively, you can include a shutdown message in the application protocol. By doing so, you can develop a shutdown client program that connects to the server and sends a shutdown message. When the server receives a shutdown message from a socket client, it terminates itself.
**Concurrent server socket programs**

A concurrent server accepts a client connection, delegates the connection to a child process of some kind, and immediately signals its availability to receive the next client connection.

The following list describes the concurrent server process.

1. When a connection request arrives in the main process of a concurrent server, it schedules a child process and forwards the connection to the child process.
2. The child process takes the connection from the main process.
3. The child process receives the client request, processes it, and returns a reply to the client.
4. The connection is closed, and the child process terminates or signals to the main process that it is available for a new connection.

You can implement a concurrent server in the following MVS environments:

- Native MVS (batch job, started task, or TSO). In this environment you implement concurrency by using traditional MVS subtasking facilities. These facilities are available from assembler language programs or from high-level languages that support multitasking or multithreading; for example, C/370™.

- CICS. The concurrent main process is started as a long-running CICS task that accepts connection requests from clients, and initiates child processes by way of the EXEC CICS START command. CICS sockets include a generic concurrent server main program called the CICS LISTENER.

- IMS. The concurrent main process is started as a BMP that accepts connection requests from clients and initiates child processes by way of the IMS message switch facilities. The child processes execute as IMS message processing programs (MPP). IMS sockets include a generic concurrent server main program called the IMS LISTENER.

In the iterative and concurrent server scenarios described above, client and server processes could have exchanged a series of request and reply sequences before closing the connection.

**Call sequence in socket programs**

The following sections describe call sequence concepts for different types of socket sessions.

**Call sequence in stream socket sessions**

This section describes a typical stream socket session.

Use stream sockets for both passive (server) and active (client) processes. While some calls are necessary for both types, others are role specific. See “Sample C socket programs” on page 219 for sample socket communication client and server programs. All connections exist until closed by the socket. During the connection, data is delivered, or an error code is returned by TCP/IP.

Figure 7 on page 18 shows the general sequence of calls for most socket routines using stream sockets.
Call sequence in datagram socket sessions

Datagram socket processes, unlike stream socket processes, are not clearly distinguished by server and client roles. The distinction lies in connected and unconnected sockets. An unconnected socket can be used to communicate with any host, but a connected socket can send data to and receive data from one host only.

Both connected and unconnected sockets transmit data without verification. After a packet has been accepted by the datagram interface, neither its integrity nor its delivery can be assured.

Figure 8 shows the general sequence of calls for socket routines using datagram sockets.
Blocking, nonblocking, and asynchronous socket calls

A socket is in blocking mode when an I/O call waits for an event to complete. If the blocking mode is set for a socket, the calling program is suspended until the expected event completes.

If nonblocking is set by the FCNTL() or IOCTL() calls, the calling program continues even though the I/O call might not have completed. If the I/O call could not be completed, it returns with ERRNO EWOULDBLOCK. (The calling program should use SELECT() to test for completion of any socket call returning an EWOULDBLOCK.)

**Note:** The default mode is blocking.

If data is not available to the socket, and the socket is in blocking and synchronous modes, the READ call blocks the caller until data arrives.

All IBM TCP/IP Services socket APIs support nonblocking socket calls. Some APIs, in addition to nonblocking calls, support asynchronous socket calls.

**Blocking**

The default mode of socket calls is blocking. A blocking call does not return to your program until the event you requested has been completed. For example, if you issue a blocking recvfrom() call, the call does not return to your program until data is available from the other socket application. A blocking accept() call does not return to your program until a client connects to your socket program.

**Nonblocking**
Change a socket to nonblocking mode using the ioctl() call that specifies command FIONBIO and a full word (four byte) argument with a nonzero binary value. Any succeeding socket calls against the involved socket descriptor are nonblocking calls.

Alternatively, use the fcntl() call using the F_SETFL command and FNDELAY as an argument.

Nonblocking calls return to your program immediately to reveal whether the requested service was completed. An error number may mean that your call would have blocked had it been a blocking call.

If the call was, for example, a recv() call, your program might have implemented its own wait logic and reissued the nonblocking recv() call at a later time. By using this technique, your program might have implemented its own timeout rules and closed the socket, failing receipt of data from the partner program, within an application-determined period of time.

A new ioctl() call can be used to change the socket from nonblocking to blocking mode using command FIONBIO and a fullword argument of value 0 (F’0’).

**Asynchronous**

Like nonblocking calls, asynchronous calls return control to your program immediately. But in this case, there is no need to reissue the call. Asynchronous calls are available with the macro API. For more information, see “Task management and asynchronous function processing” on page 265.

Table 1 lists the actions taken by the socket programming interface.

**Table 1. Socket programming interface actions**

<table>
<thead>
<tr>
<th>Call type</th>
<th>Socket state</th>
<th>blocking</th>
<th>Nonblocking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of read() calls</td>
<td>Input is available</td>
<td>Immediate return</td>
<td>Immediate return</td>
</tr>
<tr>
<td></td>
<td>No input is available</td>
<td>Wait for input</td>
<td>Immediate return with EWOULDBLOCK error number (select() exception: READ)</td>
</tr>
<tr>
<td>Types of write() calls</td>
<td>Output buffers available</td>
<td>Immediate return</td>
<td>Immediate return</td>
</tr>
<tr>
<td></td>
<td>No output buffers available</td>
<td>Wait for output buffers</td>
<td>Immediate return with EWOULDBLOCK error number (select() exception: WRITE)</td>
</tr>
<tr>
<td>accept() call</td>
<td>New connection</td>
<td>Immediate return</td>
<td>Immediate return</td>
</tr>
<tr>
<td></td>
<td>No connections queued</td>
<td>Wait for new connection</td>
<td>Immediate return with EWOULDBLOCK error number (select() exception: READ)</td>
</tr>
<tr>
<td>connect() call</td>
<td></td>
<td>Wait</td>
<td>Immediate return with EINPROGRESS error number (select() exception: WRITE)</td>
</tr>
</tbody>
</table>
Testing pending activity on a number of sockets in a synchronous program by using the select() call. Pass the list of socket descriptors that you want to test for activity to the select() call; specify by socket descriptor the following type of activity you want to test to find:

- Pending data to read
- Ready for new write
- Any exception condition

When you use select() call logic, you do not issue any socket call on a given socket until the select() call tells you that something has happened on that socket; for example, data has arrived and is ready to be read by a read() call. By using the select() call, you do not issue a blocking call until you know that the call cannot block.

The select() call can itself be blocking, nonblocking, or, for the macro API, asynchronous. If the call is blocking and none of the socket descriptors included in the list passed to the select() call have had any activity, the call does not return to your program until one of them has activity, or until the timer value passed on the select() call expires.

The select() call and selectex() call are available. The difference between select() and selectex() calls is that selectex() call allows you to include nonsocket related events in the list of events that can trigger the selectex() call to complete. You do so by passing one or more MVS event control blocks (ECBs) on the selectex() call. If there is activity on any of the sockets included in the select list, if the specified timer expires, or if one of the external events completes, the selectex() call returns to your program.

Typically, a server program waits for socket activity or an operator command to shut it down. By using the selectex() call, a shutdown ECB can be included in the list of events to be monitored for activity.

### Testing a program using a miscellaneous server

To test your program using either a stream or a datagram socket session, you can use the MISCserv server. You must start MISCserv before a client application can connect to it. If Ports 7, 9, or 19 are used by another application, or using another copy of MISCserv, this MISCserv command cannot operate properly. Available MISCserv servers are:

<table>
<thead>
<tr>
<th>Tool</th>
<th>Server description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo</td>
<td>Specify Port 7 when you want MISCserv to return data exactly as it is received (stream and datagram sessions).</td>
</tr>
<tr>
<td>Discard</td>
<td>Specify Port 9 when you want MISCserv to discard the data.</td>
</tr>
<tr>
<td>Character Generator</td>
<td>Specify Port 19 when you want MISCserv to return random data regardless of the data it receives. For a stream session, data is returned continuously until you end the session; the received data stream is discarded. For a datagram session, random data is returned for each datagram received; the received datagram is discarded.</td>
</tr>
</tbody>
</table>

**Note:** The server uses MAXSOC=50. This value limits the sockets available to the server.
For more information, see RFC 862, RFC 863, RFC 864, and the z/OS Communications Server: IP Configuration Reference.

Testing a local machine using a loopback address

You can use a local loopback address to test your local TCP/IP host without accessing the network. For the AF_INET family, the class A network address 127.0.0.0 is the default loopback address. For AF_INET6, the network address ::1 is the default loopback address. Depending on the address family, you can specify 127.0.0.0 (AF_INET) or ::1 (AF_INET6). Additional loopback addresses can be configured by your TCP/IP administrator.

You can use the loopback address with any TCP/IP command that accepts IP addresses, although you might find it particularly useful in conjunction with FTP and PING commands. When you issue a command with a loopback address, the command is sent from your local host client to the local TCP/IP host where it is recognized as a loopback address and is sent to your local host server.

Using a loopback address on commands allows you to test client and server functions on the same host for proper operation.

Note: Any command or data that you send using the loopback address never actually leaves your local TCP/IP host.

The information you receive reflects the state of your system and tests the client and server code for proper operation. If the client or server code is not operating properly, a command message is returned.

Accessing required data sets

Table 2 lists the data sets and applications to which TCP/IP applications must have access to compile and link-edit.

Table 2. TCP/IP data sets and applications

<table>
<thead>
<tr>
<th>Data set</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEZACMAC</td>
<td>Client Pascal macros, C headers, and assembler macros</td>
</tr>
<tr>
<td>SEZACMTX</td>
<td>Sockets and Pascal API</td>
</tr>
<tr>
<td>SEZADPII</td>
<td>SNMP DPI®</td>
</tr>
<tr>
<td>SEZALIBN</td>
<td>NCS</td>
</tr>
<tr>
<td>SEZAOLDX</td>
<td>X Release 10 compatibility routines</td>
</tr>
<tr>
<td>SEZANMAC</td>
<td>C headers and assembler macros for z/OS UNIX and TCP/IP Services APIs</td>
</tr>
<tr>
<td>SEZARNT1</td>
<td>Sockets, X11, and PEXlib (reentrant)</td>
</tr>
<tr>
<td>SEZARNT2</td>
<td>Athena widget (reentrant)</td>
</tr>
<tr>
<td>SEZARNT3</td>
<td>Motif widget (reentrant)</td>
</tr>
<tr>
<td>SEZARPCL</td>
<td>Remote procedure calls</td>
</tr>
<tr>
<td>SEZAXAWL</td>
<td>Athena widget set</td>
</tr>
<tr>
<td>SEZAXMLB</td>
<td>OSF/Motif-based widget set</td>
</tr>
<tr>
<td>SEZAXTLB</td>
<td>Xt Intrinsics</td>
</tr>
<tr>
<td>SEZAX11L</td>
<td>Xlib, Xmu, Xext, and Xau routines</td>
</tr>
</tbody>
</table>
Part 2. Designing programs
Chapter 3. Designing an iterative server program

This information uses an address family of AF_INET (IPv4). All the concepts described also can be applied to an address family of AF_INET6 (IPv6).

- Allocating sockets
- Binding sockets
- Listening for client connection requests
- Accepting client connection requests
- Transferring data between sockets
- Closing a connection

Allocating sockets

The server must allocate a socket to provide an endpoint to which clients connect. All commands that pass a socket address must be consistent with the address family specified when the socket was opened.

- If the socket was opened with an address family of AF_INET, then any command for that socket that includes a socket address must use an AF_INET socket address.
- If the socket was opened with AF_INET6, then any command for that socket that includes a socket address must use an AF_INET6 socket address.

A socket is actually an index into a table of connections to the TCP/IP address space, so socket numbers are usually assigned in ascending order. In C, the programmer issues the socket() call to allocate a new socket, as shown in the following example:

```c
int s;
```

```c
s = socket(AF_INET, SOCK_STREAM, 0);
```

The socket function requires specification of the address family (AF_INET), the type of socket (SOCK_STREAM), and the particular networking protocol to be used. When 0 is specified, the TCP/IP address space automatically uses the protocol appropriate to the socket type specified. A new socket is allocated and returned.

An application must first get a socket descriptor using the socket() call, as seen in the following example. For a complete description, see "socket() on page 211".

```c
int socket(int domain, int type, int protocol);
:: int s;
:: s = socket(AF_INET, SOCK_STREAM, 0);
```

The code fragment allocates socket descriptor s in the internet addressing family. The domain parameter is a constant that specifies the domain in which the communication is taking place. A domain is a collection of applications using a single addressing convention. The type parameter is a constant that specifies the type of socket; it can be SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW. The protocol parameter is a constant that specifies the protocol to be used. This parameter is ignored, unless type is set to SOCK_RAW. Passing 0 chooses the default protocol. If successful, the socket() call returns a positive integer socket descriptor.
The server obtains a socket by way of the socket call. You must specify the domain to which the socket belongs, and the type of socket you want.

**Figure 9** lists the socket call() variables using the CALL API.

```
*---------------------------------------------------------------*
* Variables used for the SOCKET call                           *
*---------------------------------------------------------------*
01 afilet            pic 9(8) binary value 2.                 
01 soctype-stream    pic 9(8) binary value 1.                 
01 proto             pic 9(8) binary value 0.                 
01 socket-descriptor pic 9(4) binary value 0.                
*---------------------------------------------------------------*
* Get us a socket descriptor                                  *
*---------------------------------------------------------------*
   call 'EZASOKET' using socket/socket
      afilet
      soctype-stream
      proto
      erro
      retcode.
      if retcode < 0 then
          - process error -
      else
          Move retcode to socket-descriptor.
```

**Figure 9. Socket call variables**

The internet domain has a value of 2. A stream socket is requested by passing a type value of 1. The proto field is normally 0, which means that the socket API should choose the protocol to be used for the domain and socket type requested. In this example, the socket uses TCP protocols.

A socket descriptor representing an unnamed socket is returned from the socket() call. An unnamed socket has no port and no IP address information associated with it; only protocol information is available. The socket descriptor is a 2-byte binary field and must be passed on subsequent socket calls as such.

A socket is an inconvenient concept for a program because it consists of three different items: a protocol specification, a port number, and an IP address. To represent the socket conveniently, we use the socket descriptor.

The socket descriptor is not in itself a socket, but represents a socket and is used by the socket library routines as an index into the table of sockets owned by a given MVS TCP/IP client. On all socket calls that reference a specific socket, you must pass the socket descriptor that represents the socket with which you want to work.

**Figure 10** lists the MVS TCP/IP socket descriptors.

```
<table>
<thead>
<tr>
<th>Socket Descriptor</th>
<th>Socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Our listen socket</td>
</tr>
<tr>
<td>1</td>
<td>Our connected socket</td>
</tr>
</tbody>
</table>
```

**Figure 10. MVS TCP/IP socket descriptor table**

The first socket descriptor assigned to your program is 0 (for a sockets extended program). If your program is written in C, socket descriptors 0, 1, and 2 are
reserved for std.in, std.out and std.err, and the first socket descriptor assigned for
your AF_INET sockets is numeral 3 or higher.

When a socket is closed, the socket descriptor becomes available; it is returned as a
new socket descriptor representing a new socket in response to a succeeding
request for a socket.

**Note:** In reference documentation, the socket descriptor is normally represented by
a single letter: S, or by two letters: SD.

When you possess the socket descriptor, you can request the socket address
structure from the socket programming interface by way of call getsockname(). A
socket does not include both port and IP addresses until after a successful bind(),
connect(), or accept() call has been issued.

If your socket program is capable of handling sockets simultaneously, you must
keep track of your socket descriptors. Build a socket descriptor table inside of your
program to store information related to the socket and the status of the socket. This
information is sometimes needed, and can help in debug situations.

**Binding sockets**

At this point in the process, an entry in the table of communications has been
reserved for your application. However, the socket has no port or IP address
associated with it until you use the bind() function. The bind() function requires
three parameters:
- The socket just given to the server.
- The number of the port to which the server is to provide service.
- The IP address of the network connection from which the server is to accept
  connection. If this address is 0, the server accepts connection requests from any
  address.

**Binding with a known port number**

In C, the server puts the port number and IP address into structure sockaddr_, x,
passing it, and the socket, to the bind() function. For example:

```c
bind(s, (struct sockaddr *)&x, sizeof(struct sockaddr));
```

After an application possesses a socket descriptor, it can explicitly bind() a unique
address to that socket, as in the example listed in Figure 11 on page 28. For more
information about binding, see “bind()” on page 117.
This example binds socket descriptor s to the address 129.5.24.1, and port 1024 to the internet domain. Servers must bind to an address and port to be accessible to the network. The example in Figure 11 lists two utility routines:

- Socket call inet_addr() takes an internet address in dotted decimal form and returns it in network byte order. For a description, see "inet_addr()" on page 162.
- Socket call htons() takes a port number in host byte order and returns the port number in network byte order. For a description, see "htons()" on page 161.

**Binding using socket call gethostbyname**

Figure 12 shows another example of socket call bind(). It uses the utility routine gethostbyname() to find the internet address of the host, rather than using socket call inet_addr with a specific address.

```c
int bind(int s, struct sockaddr *name, int namelen);
.
.
int rc;
int s;
struct sockaddr_in myname;

/* clear the structure to clear the sin_zero field */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
myname.sin_port = htons(1024);
.
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
```

**Figure 11. An application using the bind() call**

**Binding a socket to a specific port number**

By binding the socket to a specific port number, you avoid having an ephemeral port number assigned to the socket.

```c
int bind(int s, struct sockaddr *name, int namelen);
.
.
int rc;
int s;
char *hostname = "myhost";
struct sockaddr_in myname;
struct hostent *hp;

hp = gethostbyname(hostname);

/* clear the structure to clear the sin_zero field */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr.s_addr = *((unsigned long *)hp->h_addr);
myname.sin_port = htons(1024);
.
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));
```

**Figure 12. A bind() call using gethostbyname()**
Servers find it inconvenient to have an ephemeral port number assigned, because clients have to connect to a different port number for every instance of the server. By using a predefined port number, clients can be developed to always connect to a given port number.

Client programs can use the socket call bind(), but client programs rarely benefit from using the same port number every time they execute. [Figure 13](#) shows a list of BIND call variables.

```
*---------------------------------------------------------------------*
* Variables used for the BIND Call                                    *
*---------------------------------------------------------------------*
01 server-socket-address.                                          
  05 server-afinet pic 9(4) binary value 2. 
  05 server-port pic 9(4) binary value 9998. 
  05 server-ipaddr pic 9(8) binary value 0. 
  05 filler pic x(8) value low-value. 
01 socket-descriptor pic 9(4) binary. 
*---------------------------------------------------------------------*
* Bind socket to our server port number                              *
*---------------------------------------------------------------------*
  call 'EZASOKET' using socket-bind 
    socket-descriptor 
    server-socket-address 
    errno 
    retcode. 
    if retcode < 0 then 
      - process error - 
```

[Figure 13. Variables used for the BIND call](#)

Before you issue this call, you must build a socket address structure for your own socket using the following information:

- The address family is two, indicating (AF_INET). Refer to the [z/OS Communications Server: IPv6 Network and Application Design Guide](#) for a description of binding to an AF_INET6 socket.
- Port number for your server application. For a socket extended program, you have to create a predefined port number; this is either a constant in your program, or a variable passed to your program as an initialization parameter. If you develop your socket program in C, you can issue a getservbyname() call to locate the port number reserved for your server application in data set hlq.ETC.SERVICES.
- IP address on which your server application is to accept incoming requests. If your application is executing on a multihomed host, and you want to accept incoming requests over all available network interfaces, you must set this field to binary zeros.
- For TCP connections, 0 allows a server to accept incoming connections to the specified port regardless of which destination IP address for this host is used.
- For UDP, 0 allows a server to receive all datagrams destined for the specified port and any destination address for this host.
- For TCP and UDP client applications, specifying a 0 address for the BIND() indicates that TCP/IP will select the source IP address to be used.

Normally, the IP address is set to INADDR_ANY, but there are situations in which you might want to use a specific IP address. Consider the case of a TCP/IP system address space having been configured with two virtual IP addresses (VIPA). One VIPA address is returned by the named server when clients resolve one host name,
and the other VIPA address is returned by the name server when clients resolve
the other host name. In fact, both host names represent the same TCP/IP system
address space, but the host names can be used to represent two different major
socket applications on that MVS host. If your Server A and your Server B can
generate a very high amount of network traffic, your network administrator might
want to implement what is known as session traffic splitting. This means that IP
traffic for one server comes in on one network adapter while traffic for the other
server comes in on another adapter. To facilitate such a setup, you must be able to
bind the server listener socket to one of the two VIPA addresses.

At this point in the process, you have not told TCP/IP anything about the purpose
of the socket you obtained. You are free to use it as a client to issue connect
requests to servers in the IP network, or use it to become a server yourself. In
terms of the socket, it is, at the moment, active; this is the default status for a
newly created socket.

### Listening for client connection requests

After the bind is issued, the server has been specified a particular IP address and
port. It now must notify the TCP/IP address space that it intends to listen for
connections on this socket. The listen() function puts the socket into passive open
mode and allocates a backlog queue for pending connections. In passive open
mode, the socket is open to client contact. For example:

```c
listen(s, backlog_number);
```

The server gives to the socket on which it will be listening the number of requests
that can be queued (the backlog_number). If a connection request arrives before
the server can process it, the request is queued until the server is ready.

When you call listen, you inform TCP/IP that you intend to be a server and accept
incoming requests from the IP network. By doing so, socket status is changed from
active status to passive.

A passive socket does not initiate a connection; it waits for clients to connect to it.

The listen() call variables are shown in Figure 14

---

![Variables used by the listen call](image)

---

Figure 14. Variables used by the listen call

The backlog queue value is used by the TCP/IP system address space when a
connect request arrives and your server program is busy processing the previous
client request. TCP/IP queues new connection requests to the number you specify
in the backlog queue parameter. If additional connection requests arrive, they are silently ignored by TCP/IP, since there is a limit to the size of the backlog queue parameter.

The system-wide limit is set in the TCP/IP system address space PROFILE.TCP/IP configuration data set by parameter SOMAXCONN. The default value of SOMAXCONN is ten, but you can configure it higher as follows:

```c
#define SOMAXCONN 100
```

The value you specify on the listen() call in the backlog parameter cannot exceed the value set for SOMAXCONN in TCPIP.PROFILE. If you specify a backlog parameter of 200 and SOMAXCONN is set to 20, no error is returned, but your backlog queue size will be set to 20 instead of the 200 you requested.

There is a C header file called SOCKET.H (datasetprefix.SEZACMAC member SOCKET) in which there is a variable called SOMAXCONN. The shipped value of this variable is 10, as illustrated below:

```c
/*
 * Maximum queue length specifiable by listen
*/
#define SOMAXCONN 10
```

The listen() call does not establish connections; it merely changes the socket to a passive state, so it is prepared to receive connection requests coming from the IP network. If a connection request for this server arrives between the time of the listen() call and the succeeding accept() call, it is queued according to the backlog value passed on the listen() call.

---

**Accepting client connection requests**

To this point in the process, the server has allocated a socket, bound the socket to an IP address and port, and issued a passive open. The next step is for the server to connect with a client. The accept() call blocks the server until a connection request arrives; if there are connection requests in the backlog queue, a connection is established with the first client in the queue. The following is an example of the accept() call:

```c
client_sock = accept(s);
```

The server passes its socket to the accept call. When the connection is established, the accept call returns a new socket representing the connection with the client. When the server wishes to communicate with the client, or to end the connection, it uses this new socket, client_sock. The original socket s is now ready to accept connection to other clients. The original socket is still allocated, bound, and passively opened. To accept another connection, the server calls accept() again. By repeatedly calling accept(), the server can establish simultaneous sessions with multiple clients.

The accept() call dequeues the first queued connection request or blocks the caller until a connection request arrives over the IP network.

The accept() call uses the variables listed in **Figure 15 on page 32**.
This call works with the following socket descriptors:

- The first socket descriptor represents the socket that was obtained, bound to the server port and (optionally) the IP address, and changed to the passive state using the listen() call.
- The accept() call returns a new socket descriptor, to represent a complete association:
  
  Accepted_socket_descriptor represents:
  [TCP, server IP address, server port, client IP address, client port]

The original socket, which was passed to the accept() call, is unchanged and is still representing our server half association only:

Original_socket_descriptor represents:
[TCP, server IP address, server port]

When control returns to your program, the socket address structure passed on the call has been filled with the socket address information of the connecting client. Figure 16 on page 33 illustrates the socket states.
When a socket is created, we know the protocol we are going to use with this socket, but nothing else. When a server calls the bind() function, a local address is assigned to the socket, but the socket still only represents a half-association; the remote address is still empty. When the client connects to the listener socket and a new socket is created, this new socket represents a fully bound socket possessing both a local address (that of the listener socket) and a remote address (that of the client socket). Figure 16 illustrates a fully bound socket.

Subsequent socket calls for the exchange of data between the client and the server use the new socket descriptor. The original socket descriptor remains unused until the iterative server has finished processing the client request and closed the new socket. The iterative server then reissues the accept() call using the original socket descriptor and waits for a new connection.

**Figure 16. Socket states**

Transferring data between sockets


Closing a connection

Closing a socket imposes some problems because the TCP protocol layer must ensure that all data has been successfully transmitted and received before the socket resources can be safely freed at both ends.

The following sections describe various ways to close a connection.

**Active and passive closing**

The program that initiates the closedown process by issuing the first close() call is said to initiate an active close. The program that closes in response to the initiation is said to initiate a passive close.
Figure 17 illustrates socket closing.

**Figure 17. Closing sockets**

In Figure 17, Program A initiates the active close, while Program B initiates the passive close. When a program calls the close socket function, the TCP protocol layer sends a segment known as FIN (FINish). When Program B receives the final acknowledgment segment, it knows that all data has been successfully transferred and that Program A has received and processed the FIN segment. The TCP protocol layer for Program B can then safely remove the resources that were occupied by the Program socket. The TCP protocol layer for Program A sends an acknowledgment to the FIN segment it received from Program B, but the Program A TCP protocol layer does not know whether that ACK segment arrived at the Program B TCP protocol layer. It must wait a reasonable amount of time to see whether the FIN segment from Program B is retransmitted, indicating that Program B never received the final ACK segment from Program A. In that case, Program A must be able to retransmit the final ACK segment. The Program A socket cannot be freed until this time period has elapsed. The time period is defined as twice the maximum segment life time, normally in the range of one to four minutes, depending on the TCP implementation.

If Program A is the client in a TCP connection, this TIMEWAIT state does not create any major problems. A client normally uses an ephemeral port number; if the client restarts before the TIMEWAIT period has elapsed, it is merely assigned another ephemeral port number. If Program A, on the other hand, is the server in a TCP connection, this TIMEWAIT state does create a problem. A server binds its socket to a predefined port number; if the server tries to restart and bind the same port number before the TIMEWAIT period has elapsed, it receives an EADDRINUSE error code on the bind() call. This situation could arise when a server crashes and you try to restart it before the TIMEWAIT period has elapsed. You must wait to restart your server.

If the server cannot wait for one to four minutes, you can use the setsockopt() call in the server to specify SO_REUSEADDR before it issues the bind() call. In that case, the server will be able to bind its socket to the same port number it was using before, even if the TIMEWAIT period has not elapsed. However, the TCP protocol layer still prevents it from establishing a connection to the same partner.
socket address. As clients normally initiate connections and clients use ephemeral port numbers, the likelihood of this is low.

**Shutdown call**

If you want to close the stream in one direction only, use the shutdown socket call instead of the close() call. On the shutdown() call, you can specify the direction in which the stream is to be closed.

When a shutdown() call is issued for receive and there is unread data queued to the socket, the connection is aborted. If data arrives inbound on a connection that has been shut down for receive, the connection is aborted. When the connection is aborted, all outstanding socket calls on the socket will be posted with an ECONNABORTED error. The abort discards all unsent and unreceived data on the local and remote end of the connection, and the connection is destroyed. The application should issue a close() on the socket.

See Table 3 for a list of the effect on read and write calls when the stream is shut down in one or both directions.

**Table 3. Effect of shutdown socket call**

<table>
<thead>
<tr>
<th>Socket calls in local program</th>
<th>Local program</th>
<th>Remote program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shutdown SEND</td>
<td>Shutdown RECEIVE</td>
</tr>
<tr>
<td>Write calls</td>
<td>Error number EPIPE on first call</td>
<td>Error number EPIPE on second call*</td>
</tr>
<tr>
<td>Read calls</td>
<td>Zero length return code</td>
<td>Zero length return code</td>
</tr>
</tbody>
</table>

* If you issue two write calls immediately, both might be successful, and an EPIPE error number might not be returned until a third write call is issued.

**Linger option**

By default, a close socket call returns control to your program immediately, even where there is unsent data on the socket. This data will be transmitted by the TCP protocol layer, but your program is not notified of any error. This is true of both blocking and nonblocking sockets.

You can request that no control be returned to your program before unsent data has been transmitted and acknowledged by the receiver. To do so, issue the SO_LINGER option on call setsockopt. Before you issue the actual close() call, pass the following option value fields:

**ONOFF**

This full word is used to enable or disable the SO_LINGER option. Any nonzero value enables the option; a 0 value disables it.

**LINGER**

This is the linger time, in seconds; this is the maximum delay the close call observes. If data is successfully transmitted before this time expires, control is returned to your program. If this time interval expires before data has been successfully transmitted, control is returned to your program also. You cannot distinguish between the two return events.
**Note:** If you set a 0 linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.
Chapter 4. Designing a concurrent server program

This information describes concurrent server programs. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). These programs include the following:

- An overview
- Concurrent servers in the native MVS environment
- MVS subtasking considerations
- Understanding the structure of a concurrent server program
- Selecting requests
- Client connection requests
- Transferring data between sockets
- Closing a concurrent server program

For the MVS address space examples presented in this section, the more traditional MVS subtasking facilities are used; the main process and the child process operate as tasks within the same address space.

You can implement your concurrent server in an IMS, a CICS, or a traditional MVS address space environment, but unlike the implementation of an iterative server, the implementation of a concurrent server is unique to its environment. In this section, the implementation of a concurrent server in an MVS address space is used as an example.

Overview

A server handling more than one client simultaneously acts like a dispatcher. The server receives client requests and then creates and dispatches tasks to handle each client.

In the UNIX operating system, a new process is dispatched using the fork() system call after the server has established the connection; this new process automatically inherits the socket attached to the client. In MVS, an independent task is started using the supervisor call instruction ATTACH. A server can complete the call after each connection is established (similar to the UNIX operating system), or it can repeatedly request an ATTACH when it begins execution, and pass clients to tasks that already exist. In either case, the server must manually give the new socket to the subtask. Because each task has its own socket table, it is not sufficient to pass only the socket number to the subtask; for example, socket Number 4 for Task A is not the same as socket Number 4 for Task B. You must specify the task as well as the socket number.

Concurrent servers in native MVS environment

The concurrent server is complicated to implement. Logic must be split into a main program and a child program. In addition, you have to manage all processes within your application.

In the MVS environment, you implement such logic by means of the UNIX fork() call. Because this call is not available in a traditional MVS environment, you must improvise.
In the UNIX environment, the fork function is implemented using APPC/MVS to schedule and initiate a child process in an MVS address space other than the address space of the original process.

**Note:** For simplicity, the scope of our applications is limited to the AF_INET addressing family and stream sockets.

If you want to implement a high-performance server application that creates or accesses MVS resource of various kinds (especially MVS data sets), you will probably implement your server as a concurrent server in an MVS address space. This address space can be TSO, batch, or started task.

To implement concurrence in an MVS address space, use MVS multitasking facilities. This limits available programming interfaces to the sockets extended assembler macro programming interface or to C sockets.

For the sockets extended assembler macro interface, use standard MVS subtasking facilities: ATTACH and DETACH assembler macros.

For C sockets, use the subtasking facilities that are part of the IBM implementation of C in an MVS environment.

The following sections show sockets extended assembler macro examples to illustrate the implementation of a concurrent server in an MVS address space environment.

---

**MVS subtasking considerations**

Using multiple tasks in a single address space brings unique challenges that apply equally to assembler programming and to high-level languages that support subtasking.

For example, tasks might be concurrently dispatched on different processors, for example, running your application on an n-way system. Two or more tasks might execute in parallel, one perhaps passing the other.

**Access to shared storage areas**

If two tasks access the same storage area, you need full control over the use of the storage area unless the storage is read-only. If the storage area is used to pass parameters between the tasks, you must serialize access to the shared resource (the storage area).

In an MVS environment, you can use MVS latching services or traditional enqueue and dequeue system calls to access the shared resource. For MVS latching services, use the ISGLOBT and ISGLREL callable services. In assembler, use the ENQ and DEQ macros for enqueue and dequeue functions.

Figure 18 on page 39 illustrates access to a shared storage area.
The following steps describe this process.

1. At time t1, Task 1 issues a serialize request by means of an enqueue call. On the enqueue() call it passes two character fields to uniquely identify the resource in question. The literal value of these two fields does not matter; the other tasks must use these same values when they access this storage area. As no other task has issued an enqueue for the resource in question, Task 1 gets access to it and continues to modify the storage area.

2. At time t2, Task 2 needs to access the same storage area, and issues an enqueue() call using the same resource names used by Task 1. Because Task 1 has enqueued, Task 2 is placed in a wait and stays there until Task 1 releases the resource.

3. At time t3, Task 1 releases the resource with a dequeue system() call, and Task 2 is immediately taken out of its wait and begins to modify the shared storage area.

4. At time t4, Task 2 has finished updating the shared storage area and releases the resource with a dequeue system() call. (In this example, we assumed we need serialized access only when the tasks need to update information in the shared storage area.)

There are situations in which this assumption does not suffice. If you use a storage area to pass parameters to some kind of service task inside your address space, you must ensure that the service task has read the information and acted on it before another task in your address space tries to pass information to the service task using the same storage area, like running a log or trace. This is illustrated in Figure 19 on page 40.

---

**Figure 18.** Serialized access to a shared storage area

---

![Diagram of serialized access to a shared storage area](image-url)
Follow these steps to synchronize a common service task:

1. At time t1, Task 1 gains access to the common storage area to implicitly use the service task in question.
2. At time t2, Task 2 also needs to use the service task services, but it is placed into a wait, because Task 1 already has the resource.
3. At time t3, Task 1 has finished placing values into the common storage area, and signals the service task to start processing it. This is done with a POST system call. Immediately following this call, Task 1 enters a wait, where it stays until the service task has completed its processing. The service task starts, processes the data in the common storage, and prints.
4. At time t4, the service task has finished its work and signals to Task 1 that Task 1 can continue, while the service task enters a new wait and waits for a new work request.
5. At time t5, Task 1 releases the lock it obtained at time t1, and Task 2 is immediately taken out of its wait and starts filling its values into the common storage area before posting the same service task to process a new request.

This technique is relatively simple. It can be made more complicated, and more efficient, by using internal request queues so the requesting task does not need to wait for the service task to complete the active request.

When you use the enqueue system call, you have the option to test whether a resource is available. In some situations, you might choose this to avoid the wait at a particular point in your processing, so you can divert to some other actions when the resource is not available.
Data set access

When you access MVS data sets in a multitasking environment, observe these general rules:

- A given DD-name can be used by only one open data control block (DCB) at a time. If you need to have more DCBs open for the same data set, you must use different DD names. This strategy works best for read access only.
- Only the task that opens a DCB can issue read and write requests using that DCB. You cannot let your main task open a DCB, and then have your subtasks issue read or write requests to that DCB. You can deal with this by using the technique described, but include a special services task that opens a DCB to a particular data set. Other tasks then issue requests to this service task for access to the data set. Such a service task is generally called a data services task (DST). One very common implementation of a DST is the example used above: print log and trace information to a sysout file.
- Authorization checking for access to a data set is done when the data set is opened, not for every read or write request. If you develop a multitasking server where you establish task level security environments for each transaction entering your server, you must plan to authorize access to the information in a data set owned by a DST. You can, of course, open and close the data set for each transaction, but that might degrade performance.

Task and workload management

When a program is started by MVS, it runs as the main task of the address space in which it was started. In the examples in this section, the main task is used as the main process of our concurrent server implementation. The child processes are then started as subtasks to the main.

Generally, there are two ways to manage your processes:

- Each time a connection request arrives, a new subtask is started. The subtask makes one connection and then terminates.
- During initialization, the main task starts a number of subtasks. Each subtask initializes and enters wait-for-work status. When a connection request arrives, the main process selects the first subtask waiting for work and schedules the connection to that subtask. The subtask processes the connection and, when complete, reenters wait-for-work status.

The second process is most efficient because it limits the overhead of creating new tasks to one time during server startup. But, it is also more complicated to implement than the other process because of the following:

- You must decide on the number of server subtasks to be started during initialization. If more connection requests arrive than you have server subtasks available, you must include code to deal with that situation. (Reject the connection or dynamically change the number of subtasks in your concurrent server address space. This is called workload management.)
- The subtasks must be reusable and include logic to enter wait-for-work status; they must be able to process connection requests serially.
- The main process must be able to manage situations in which a server subtask abends or terminates.
- To achieve a graceful shutdown, you must implement a technique to terminate subtasks in an orderly manner. A simple technique is to post the subtask from the main process with a return code. For example, use a return code of 0 for work and some other value for termination.
In the concurrent MVS server example (Figure 20 on page 43), the technique using a pool of subtasks that waited for work was presented. We did not implement a dynamic increase of subtasks, but sent a negative reply back to the requester when no server subtasks were available.

Security considerations

When you start your server address space in MVS, a security environment is established for that address space. This environment is based on the user ID of your batch job or TSO user, or based on the started task user ID associated with the started task procedure named in the RACF started task table (ICHRIN03).

Unless you specify otherwise, all tasks in your address space execute under the security environment of the address space. MVS resources access authorization is based on the MVS address space security environment.

If this setup does not meet your needs, MVS allows you to build and delete task-level security environments using the RACROUTE REQUEST=VERIFY function in MVS. The task must run in an authorized state.

Reentrant code

Reentrant code is not required but is efficient. Non-reentrant code is loaded into virtual storage as many times as subtasks requiring it are started. Reentrant code is loaded once.

High-level languages usually make reentrancy a compile option. In assembler language, it might be more complicated; however, good use of macros for program initiation and termination can simplify the process.

Understanding the structure of a concurrent server program

Figure 20 on page 43 shows the basic logic in a multitasking concurrent server.
Selecting requests

At this point in the process, the server is ready to handle requests on this port from any client on a network from which the server is accepting connections. Until this point however, it had been assumed that the server was handling one socket only. Now, an application is not limited to one socket. Typically, a server listens for clients on a particular socket, but it allocates a new socket for each client it handles. For maximum performance, a server should operate only on those sockets ready for communication. The select() call allows an application to test for activity on a group of sockets.

To test any number of sockets with one call to select(), place the sockets to test into a bit set, passing the bit set to the select() call. A bit set is a string of bits where each member of the set is represented by 0 or 1. If the members bit is 0, the member is not in the set; if the members bit is 1, the member is in the set. For example, if socket 3 is a member of a bit set, then bit 3 is set; otherwise, bit 3 is cleared.

In C language, the following functions are used to manipulate the bit sets:

**FD_SET**
Sets the bit corresponding to a socket.

**FD_ISSET**
Tests whether the bit corresponding to a socket is set or cleared.

**FD_ZERO**
Clears the entire bit set.
If a socket is active, it is ready for read or write data. If the socket is not active, an exception condition might have occurred. Therefore, the server specifies three bit sets of sockets in its call to the select() call as follows:

- One bit set for sockets on which to receive data
- One bit set for sockets on which to write data
- Any sockets with exception conditions

The select() call tests each socket in each bit set for activity and returns only those sockets that are active.

A server that processes many clients at once can be written to process only those clients that are ready for activity.

When all initialization is complete, and the server main process is ready to enter normal work, it builds a bit mask for a select() call. The select() call is used to test pending activity on a list of socket descriptors owned by this process. Before issuing the select() call, construct three bit strings representing the sockets you want to test, as follows:

- Pending read activity
- Pending write activity
- Pending exceptional activity

The length of a bit string must be expressed as a number of fullwords. If the highest socket descriptor you want to test is socket descriptor number 3, you must pass a 4-byte bit string, because this is the minimum length. If the highest number is 32, you must pass 8 bytes (2 fullwords).

The number of fullwords in each select mask can be calculated as follows:

\[ \text{INT} \left( \frac{\text{highest socket descriptor}}{32} \right) + 1 \]

Table 4 shows the first fullword passed using a bit string.

Table 4. First fullword passed in a bit string select()

<table>
<thead>
<tr>
<th>Socket descriptor numbers represented by byte</th>
<th>Bit 0</th>
<th>Bit 1</th>
<th>Bit 2</th>
<th>Bit 3</th>
<th>Bit 4</th>
<th>Bit 5</th>
<th>Bit 6</th>
<th>Bit 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte 0</td>
<td>31</td>
<td>30</td>
<td>29</td>
<td>28</td>
<td>27</td>
<td>26</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Byte 1</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>18</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Byte 2</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Byte 3</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Using standard assembler numbering notation, the leftmost bit or byte is relative to 0.

If you want to test socket descriptor number 5 for pending read activity, you raise bit 2 in byte 3 of the first fullword (X'00000020'). To test both socket descriptors 4 and 5, raise both bit 2 and bit 3 in byte 3 of the first fullword (X'00000030').

To test socket descriptor Number 32, pass 2 fullwords, where the numbering scheme for the second fullword resembles that of the first. Socket descriptor
Number 32 is bit 7 in byte 3 of the second fullword. To test socket descriptors Number 5 and Number 32, pass 2 fullwords with the following content: X'0000020000000001'

The bits in the second fullword represent the socket descriptor numbers shown in

Table 5. Second fullword passed in a bit string using select()

<table>
<thead>
<tr>
<th>Socket descriptor numbers represented by byte</th>
<th>Bit 0</th>
<th>Bit 1</th>
<th>Bit 2</th>
<th>Bit 3</th>
<th>Bit 4</th>
<th>Bit 5</th>
<th>Bit 6</th>
<th>Bit 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byte 4</td>
<td>63</td>
<td>62</td>
<td>61</td>
<td>60</td>
<td>59</td>
<td>58</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td>Byte 5</td>
<td>55</td>
<td>54</td>
<td>53</td>
<td>52</td>
<td>51</td>
<td>50</td>
<td>49</td>
<td>48</td>
</tr>
<tr>
<td>Byte 6</td>
<td>47</td>
<td>46</td>
<td>45</td>
<td>44</td>
<td>43</td>
<td>42</td>
<td>41</td>
<td>40</td>
</tr>
<tr>
<td>Byte 7</td>
<td>39</td>
<td>38</td>
<td>37</td>
<td>36</td>
<td>35</td>
<td>34</td>
<td>33</td>
<td>32</td>
</tr>
</tbody>
</table>

To set and test these bits in another way, use the following assembler macro, found in file SEZACMAC:
* Part Name: TPIMASK
* SMP/E Distribution Name: EZABCTPI
* Component Name: SOK
* Copyright: Licensed Materials - Property of IBM
* This product contains "Restricted Materials of IBM"
* 5645-001 5655-HAL (C) Copyright IBM Corp. 1996.
* All rights reserved.
* US Government Users Restricted Rights -
* Use, duplication or disclosure restricted by
* GSA ADP Schedule Contract with IBM Corp.
* See IBM Copyright Instructions.
* Status: TCP/IP for MVS
* Function: Macro used to set or test bits in the
* read, write and exception masks used
* in the SELECT/SELECTEX macro or calls.
* Part Type: MACRO - assembler
* Usage:
* TPIMASK SET,MASK=READMASK,SD=SOCKDESC
* or TEST, or WRITEMASK,
* or EXCEPTMASK,
* SET - Set the SD bit on in MASK
* TEST - Test SD bit in MASK for on/off
* Follow the macro invocation with:
* BE (Branch Equal) - Bit was on
* BNE (Branch Not Equal) - Bit was off
* Change Activity:
* CFD List:
* $xn= workitem release date pgmr: description
* End CFD List:

MACRO TPIMASK &TYPE, SET or TEST bit setting X
 &MASK=, Read, Write or Except array X
 &SD= Socket descriptor TOR PARAMETER
 SR 14,14 Clear Reg14
 AIF ('&SD'((1,1) EQ '(').SDREG
 LH 15,&SD Get Socket Descriptor
 AGO .SDOK
 .SDREG ANOP
 LR 15,&SD Get Socket Descriptor

Figure 21. To set/test bits for SELECT calls (Part 1 of 2)
Figure 21. To set/test bits for SELECT calls (Part 2 of 2)

If you develop your program using another programming language, you might be able to benefit from the EZACIC06 routine, which is provided as part of TCP/IP Services. This routine translates between a character string mask (1 byte per flag) and a bit string mask (1 bit per flag). If you use the select() call in COBOL, EZACIC06 can be very useful.

Build the three bit strings for the socket descriptors you want to test, and the select() call passes back three corresponding bit strings with bits raised for those of the tested socket descriptors with activity pending. Test the socket descriptors using the following sample:

```cobol
*---------------------------------------------------------------------*
* Test for socket descriptor activity with the SELECT call             *
*---------------------------------------------------------------------*
EZASMI TYPE=SELECT,      *Select call C
MAXSOC=TPIMMAXD,         *Max. this many descr. to test C
TIMEOUT=SELTIMEO,        *One hour timeout value C
RSNDMSK=RSNDMASK,        *Read mask C
RRETMSK=RRRTASK,         *Returned read mask C
WSNDMSK=WSNDMASK,        *Write mask C
WRETMASK=WRTASK,         *Returned write mask C
ESNDMSK=ESNDMASK,        *Exception mask C
ERETMSK=ERETASK,         *Returned exception mask C
ECB=ECBSELE,             *Post this ECB when activity occurs C
ERRNO=ERRNO,             *=- ECB points to an ECB plus 100 C
RETCODE=RETCODE,         *=- bytes of workarea for socket C
ERROR=EZAERROR,          *=- interface to use. C
ICM R215,RETCODE         *If Retcode < zero it is
BM EZAERROR              *=- an error
* SelMaskS DS OF         *Read mask
RSNDMSK DC XLB'000000000'  *Read mask
RRRTASK DC XLB'000000000'  *Returned read mask
WSNDMSK DC XLB'000000000'  *Write mask
WRTASK DC XLB'000000000'   *Returned write mask
ESNDMSK DC XLB'000000000'  *Exception mask
ERETASK DC XLB'000000000'  *Returned exception mask
* NSelLCD DC A(0)         *Keep track of selected sd's
SELTIMEO DC A(3600,0)     *One hour timeout
ECBSELE DC A(0)          *Select ECB
DC 100X 00               *Required by EZASMI
* TPIMMAXD DC AL4(50)     *Maximum descriptor number
```

Chapter 4. Designing a concurrent server program  47
In the above select() call, the asynchronous facilities of the socket assembler macro interface is used. By placing an ECB parameter on the EZASMI macro call, the select() call does not block the process; we receive control immediately, even if none of the specified socket descriptors had activity. Use this technique to enter a wait, which waits for a series of events of which the completion of a select() call is just one. In the sample application, the main process was placed into a wait from which it would return when any of the following events occurred:

- Socket descriptor activity occurred, and the select() call was posted.
- One of your subtasks terminated unexpectedly.
- The MVS operator issued a MODIFY command to stop the server.

The number of socket descriptors with pending activity is returned in the RETCODE field. You must process all selected socket descriptors before you issue a new select() call. A selected socket descriptor is selected only once.

When a connection request is pending on the socket for which the main process issued the listen() call, it is reported as a pending read.

When the main process has given a socket, and the subtask has taken the socket, the main process socket descriptor is selected with an exception condition. The main process is expected to close the socket descriptor when this happens.

Applications can handle multiple sockets. In such situations, use the select() call to determine the sockets that have data to be read, those that are ready for data to be written, and the sockets that have pending exceptional conditions. An example of how the select() call is used is shown in Figure 22.

```c
fd_set readsocks;
fd_set writesocks;
fd_set exceptsocks;
struct timeval timeout;
int number_of_sockets;
int number_found;
...
/* set bits in read write except bit masks.
 * To set mask for a descriptor's use
 * FD_SET(s, &readsocks)
 * FD_SET(s, &writesocks)
 * FD_SET(s, &exceptsocks)
 * 
 * set number of sockets to be checked (plus 1)
 * number_of_sockets = x;
 */
...
number_found = select(number_of_sockets,
    &readsocks, &writesocks, &exceptsocks, &timeout)
```

**Figure 22. An application using the select() call**

In this example, the application uses bit sets to indicate that the sockets are being tested for certain conditions, and also indicates a timeout. If the timeout parameter is NULL, the call does not wait for any socket to become ready. If the timeout parameter is nonzero, the select() call waits for the amount of time required for at least one socket to become ready under the indicated condition. This process is
useful for applications servicing multiple connections that cannot afford to block, thus waiting for data on one connection. For a description, see “select()” on page 184.

**Client connection requests**

As shown in Figure 20 on page 43, the listener socket is selected with a pending read. Then, a new connection request arrives, and the following socket() call must accept.

Figure 23 illustrates this type of connection request.

<table>
<thead>
<tr>
<th>ACCEPT the connection from a client</th>
</tr>
</thead>
<tbody>
<tr>
<td>EZASMI TYPE=ACCEPT, *Accept new connection C</td>
</tr>
<tr>
<td>S=TPIMSNO , *On listener socket descriptor C</td>
</tr>
<tr>
<td>NAME=SOCSTRUC, *Returned client socket structure C</td>
</tr>
<tr>
<td>ERRNO=ERRNO, C</td>
</tr>
<tr>
<td>RETCODE=RETCODE,C</td>
</tr>
<tr>
<td>ERROR=EZAERROR</td>
</tr>
<tr>
<td>ICM R15,15,RETCODE *OK ?</td>
</tr>
<tr>
<td>BM EZAERROR *- No, error indicated</td>
</tr>
<tr>
<td>STH R15,NEWSOC *Returned new socket descriptor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>SOCSTRUC DS OF *ACCEPT Socket address structure</td>
</tr>
<tr>
<td>SSTRFAM DC AL2(2) *TCP/IP Addressing family</td>
</tr>
<tr>
<td>SSTRPORT DC AL2(0) *Port number</td>
</tr>
<tr>
<td>SSTRADDR DC AL4(0) *IP Address</td>
</tr>
<tr>
<td>SSTRRESV DC BX'00' *Reserved</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>TPIMSNO DC AL2(0) *Listen socket descriptor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>NEWSOC DC AL2(0) *Returned socket descriptor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ERRNO DC A(0) *Error number from EZASMI</td>
</tr>
<tr>
<td>RETCODE DC A(0) *Returncode from EZASMI</td>
</tr>
</tbody>
</table>

Figure 23. Accepting a client connection

The accept call returns a new socket descriptor representing the connection with the client. The original listen socket descriptor is available to a new select() call.

**Passing sockets**

This section contains concepts and tasks information about passing sockets.

**Common interface concepts**

To help you better understand socket passing, the following sections explain common interface concepts.

- **Blocking versus nonblocking**

  A socket is in blocking mode when an I/O() call waits for an event to complete. If blocking mode is set for a socket, the calling program is suspended until the expected event completes.

  If nonblocking is set by calls FCNTL() or IOCTL(), the calling program continues even though the I/O() call might not have completed. If the I/O() call could not be completed, it returns with ERRNO 35 (EWOULDBLOCK). The calling program should use select() to test for completion of any socket call returning an ERRNO 35.

  The default mode is blocking.
If data is not available for the socket, and the socket is in blocking and synchronous modes, the read() call blocks the caller until data arrives.

**Concurrent servers versus iterative servers**

An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks to process those client requests.

When a subtask is created, the concurrent server gets a new socket, passes the new socket to the subtask, and disassociates itself from the connection. (The CICS listener program is an example of a concurrent server.)

- To pass a socket, the concurrent server first calls givesocket(). If the subtask address space name and subtask ID are specified in the givesocket() call, only a subtask having a matching address space and subtask ID can take the socket. If this field is set to blanks, any MVS address space requesting a socket can take this socket.
- The concurrent server starts the subtask and passes to it the socket descriptor and concurrent server ID obtained from earlier socket() and getclientid() calls.
- The subtask calls takesocket() using the concurrent server ID and socket descriptor.
- The concurrent server issues the select() call to test the socket for the takesocket-completion exception condition.
- When takesocket() has successfully completed, the concurrent server issues the close() call to free the socket.

If the queue has no pending connection requests, accept() blocks the socket when blocking mode is set on. You can set the socket to nonblocking by calling FCNTL or IOCTL.

Issuing a select() call before the accept() call ensures that a connection request is pending. Using the select() call in this way prevents the accept() call from blocking.

TCP/IP does not screen clients, but you can control the connection requests accepted by closing a connection immediately after you determine the identity of the client.

A given TCP/IP host can have multiple aliases and multiple host internet addresses.

A server handling more than one client simultaneously acts like a dispatcher at a messenger service. A messenger dispatcher gets telephone calls from people who want items delivered, and the dispatcher sends out messengers to do the work. In a similar manner, the server receives client requests, and then spawns tasks to handle each client.

Tasks can pass sockets with the givesocket() and takesocket() calls. The task passing the socket uses givesocket(), and the task receiving the socket uses takesocket(). The following sections describe these processes.

**givesocket and takesocket**

In the UNIX operating system, a new process is dispatched with the fork() system call after the server has established the connection; the new process automatically inherits the socket attached to the client. In MVS, an independent task is started using the attach() supervisor call instruction. A server can perform an attach() call for a subtask after each connection is established in a way similar to the UNIX operating system, or it can request an attach() several times when it begins execution and pass clients to tasks that already exist. In either case, the server must manually give the new socket to the subtask. Because each task has its own socket
table, it is not sufficient to pass only the socket number to the subtask. Socket Number 4 for Task A is not the same as socket Number 4 for Task B.

For C programs using TCP/IP Services, each task is given a unique 8-byte name. The task uses the getclientid() call to determine its unique name. The main server task passes the following arguments to the givesocket() call:
- The socket number it wants to give
- Its own name
- The name of the task to which it wants to give the socket

If the server does not know the name of the subtask to receive the socket, it blanks out the name of the subtask. The first subtask calling takesocket() using the server unique name receives the socket. However, the subtask must know the main task unique name, and the number of the socket it is to receive. This information can be passed in a common work area that you define.

When takesocket() acquires the socket, it assigns a new socket number for the subtask to use, but the new socket number represents the same line of communication as the parent socket. The transferred socket can be referred to as socket Number 4 by the parent task, and as socket Number 3 by the subtask. However, both sockets represent the same connection to the TCPIP address space.

After the socket has successfully been transferred, the TCPIP address space posts an exception condition on the parent socket. The parent uses the select() call to test for this condition. After the notification, the parent task must issue close() call on its socket to deallocate the socket.

Appendix A, “Multitasking C socket sample program,” on page 819 contains examples of a server, a subtask, and a client. Three examples are written in C, and one example is written in System/370™ assembler language.

The C sample programs are included as members of the file SEZAINST partitioned data set. The member names are:
- MTCSRVR
- MTCCSUB
- MTCCLNT

For information about the JCL needed to use the multitasking facility (MTF), refer to the IBM C/370 User’s Guide.

**Giving a socket to a subtask**
The socket represented by the new socket descriptor has to be passed to an available subtask. Which technique the main process uses to find an available subtask is not important. Assume that the main process has located an available subtask to which it gives the socket by way of a givesocket() call as shown in Figure 24 on page 52
If you are programming in C, you might not be able to determine the full client ID of the subtask. In that case, you can pass the task ID field as eight blanks on the givesocket() call, which means that any task within your own address space can take the socket, but only the task to which you pass the socket descriptor number will actually take it.

After you have issued the givesocket() call, you must include the given socket descriptor in the exception select mask on the next select() call.

Your main process is now ready to wake up the selected subtask by way of a post system call.

If no other sockets were selected on the previous select() call, your main process can build a new set of select masks, and issue a new select() call.

**Taking sockets from the main process**

As shown in Figure 20 on page 43, the subtask is reactivated by the post() call issued from the main process, and immediately issues a takesocket() call to receive the socket passed from the main process. Figure 25 on page 53 illustrates this process.
In order to take a socket, the subtask must know the client ID of the task that gave the socket, and the socket descriptor used by that task. These values must be passed to the subtask from the main process before a takesocket() call can be issued.

On the takesocket() call, you specify the full client ID of the process that gave the socket, and you specify the socket descriptor number used by the process that gave the socket.

A new socket descriptor number to be used by the subtask is returned in the RETCODE when the takesocket() call is successful. As soon as your subtask has taken the socket, the main process is posted in its pending select with a pending exception activity; this means that the main process must close its socket descriptor.

In Figure 25 the client sends its request to the subtask, which processes it and sends back a reply.

Finally, the client process and the server subtask close their sockets, and the server subtask reenters wait-for-work status.

### Transferring data between sockets

See Chapter 7, “Transferring data between sockets,” on page 61

### Closing a concurrent server program

See Chapter 3, “Designing an iterative server program,” on page 25
Chapter 5. Designing a client program

This information explains how to design a client program. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6).

- “Allocating a socket”
- “Connecting to a server”
- “Transferring data between sockets” on page 57
- “Closing a client program” on page 57

Allocating a socket

From their own perspective, clients must first issue the socket() call to allocate a socket from which to communicate as follows:

```c
s = socket(AF_INET, SOCK_STREAM, 0);
```

For more information, see “Allocating sockets” on page 25.

Connecting to a server

To connect to a server, the client must know the server name. This section describes how to determine a server name and connect to that server.

**Note:** Examples are written in C language and REXX.

To connect to the server, the client places the port number and the IP address of the server into a sockaddr_in structure like the bind() call. If the client does not know the server IP address, but it does know the server host name, the gethostbyname() call is called to translate the host name into its IP address. Any trailing blanks will be removed from the specified name prior to trying to resolve it to an IP address.

The client then calls connect() as shown in the following C language example of the connect() call:

```c
connect(s, name, namelen);
```

When the connection is established, the client uses its socket to communicate with the server.

If you need to determine a server name while writing in REXX and you know only the host name, you must resolve the host name into one or more IP addresses using the gethostbyname() call as shown in Figure 26 on page 56.
The REXX gethostbyname() call returns a list of IP addresses if the host is multiply defined as a home host. You can parse the REXX string and place the IP addresses into a REXX stem variable using the following piece of REXX code:

```rexx
/*------------------------------------------*/
/* Parse returned IP address list */
/*------------------------------------------*/
umips = words(servipaddr)
do i = 1 to numips
   sipaddr.i = word(servipaddr, i)
end
sipaddr.0 = numips
```

When you issue a connect call to an IP address currently not available, your connect call eventually times out with an error number of 60 (ETIMEDOUT). The socket you used on such a failed connect call cannot be reused for another connect() call. You have to close the existing socket and get a new socket before you reissue the connect call using the next IP address in the list of IP addresses returned by the gethostbyname() call.

The connect call can be placed in a loop that terminates when a connect is successful, or the list of IP addresses is exhausted. The following sample illustrates this process.

```rexx
/*------------------------------------------*/
/* Get a socket and try to connect to the server */
/*------------------------------------------*/
/* If connect fails (ETIMEDOUT), we must close the socket, */
/* get a new one and try to connect to the next IP address */
/* in the list, we received on the gethostbyname call. */
/*------------------------------------------*/
i=1
connected = 0
do until (i > sipaddr.0 | connected)
   sockdescr = DoSocket('Socket')
   if sockrc <> 0 then do
      say 'Socket failed, rc=' sockrc
      exit(sockrc)
   end
   name = 'AF_INET ' || tpiport || ' ' || sipaddr.i
   sockval = DoSocket('Connect', sockdescr, name)
   if sockrc = 0 then do
      connected = 1
      end else do
         sockval = DoSocket('Close', sockdescr)
         if sockrc <> 0 then do
            say 'Close failed, rc=' sockrc
            exit(sockrc)
         end
   end
end
```

Figure 26. Finding the IP address of a server host using gethostbyname()
\[ i = i + 1 \]
end
if connected then do
  say 'Connect failed, rc='sockrc
  exit(sockrc)
end

Transferring data between sockets


Closing a client program

Chapter 6. Designing a program to use datagram sockets

This information explains how to design a program to use datagram sockets. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). Topics include:

- Datagram socket characteristics
- Understanding datagram socket program structure
- Allocating a socket
- Binding sockets to port numbers
- Streamline data transfer using connect call
- Transferring data between sockets

Datagram socket characteristics

The most significant characteristics of datagram sockets follow:

- Datagram sockets are connectionless.
  There is no connection setup affected by the UDP protocol layer. No data is exchanged between sending and receiving UDP protocol layers until your application issues its first send call.
  If your UDP server program has not been started or it resides on a host that cannot be reached from your client host, your client UDP application can wait forever to receive a reply to the datagram it sent to a UDP server. You have to implement timeout logic in your client UDP program to recognize this situation.
- The UDP protocol layer does not implement reliability functions.
  The implicit significance of this fact is that a datagram sent from one UDP program to another might never arrive. Neither the sending program nor the target program ever learns from the UDP protocol layer that such a condition exists.
  If your UDP application must be reliable, you must add reliability code to your UDP client and server programs. Such code must include the ability to detect missing datagrams, datagrams arriving out of sequence, duplicate datagrams, and corrupt datagrams.
  Because implementation of such function is complicated, it is recommend that you use TCP protocols instead of UDP protocols if your application must be reliable.

- Unlike a TCP socket, where there is no one-to-one relationship between send() and recv() calls, UDP socket send corresponds exactly to a UDP socket recv() call.

Understanding datagram socket program structure

The datagram socket program terms client and server can be misleading. Two socket programs that have each bound a socket to a local address can send any number of datagrams to each other in any sequence. The program that sends the first data will act as a client. Any datagram sent to a destination address for which no program has bound a socket is lost. Care must be taken so that the program you intend to be the client does not begin sending datagrams until the server program has bound its socket to the destination address expected.
Typically, the structure for a datagram socket resembles the iterative server discussed in Chapter 3, “Designing an iterative server program,” on page 25.

**Allocating a socket**

See “Allocating sockets” on page 25.

**Binding sockets to port numbers**

The server program must bind its socket to a predefined server port number, so the clients know the port to which they should send their datagrams. In the socket address structure that the server passes on the bind() call, it can specify if it will accept datagrams from the available network interfaces, or whether only from a specific network interface. This is done by setting the IP address field of the socket address structure to either INADDR_ANY, or a specific IP address.

The client program needs to bind its socket to a local address if it wants the server program to be able to return a datagram to it. In contrast to the server, the client does not need to specify a specific port number on the bind() call; an ephemeral port number chosen by the UDP protocol layer is sufficient. This is called a dynamic bind.

**Streamline data transfer using connect call**

While you can use the connect() call on a datagram socket, it does not act for a datagram socket as it acts for a stream socket.

On a connect() call, you specify the remote socket address with which you want to exchange datagrams. This serves the following purposes:
- On succeeding calls to send datagrams, you can use the send() call without specifying a destination socket address; the datagram is sent to the socket address you specified on the connect() call.
- On succeeding calls to receive datagrams, only datagrams that originate from the socket address specified on the connect() call are passed to your program from the UDP protocol layer.

**Note:** A connect() call for a datagram socket does not establish a connection. No data is exchanged over the IP network as the result of the connect() call. The functions performed are local, and control is returned immediately to your application.

**Transferring data between sockets**

Chapter 7. Transferring data between sockets

This section contains information about transferring data between sockets. All examples are shown using an address family of AF_INET (IPv4). All concepts also can be applied to an address family of AF_INET6 (IPv6). The following topics are included:

- Overview
- Streams and messages
- Data representation

AF_INET6 (IPv6) sockets can communicate with AF_INET (IPv4) sockets using mapped addresses. Refer to the z/OS Communications Server: IPv6 Network and Application Design Guide for details.

- Using send() and recv() calls
- Using sendto() and recvfrom() calls

Overview

Transferring data over a datagram socket is similar to working with MVS records. You send and receive data records. One send() call results in exactly one recv() call.

If your sending program sends a datagram of 8192 bytes, and your receiving program issues a recv() call in which it specifies a buffer size of, for example, 4096 bytes, it will receive the 4096 bytes it requested. The remaining 4096 bytes in the datagram are discarded by the UDP protocol layer without further notification to either sender or receiver.

z/OS Communications Server includes a performance enhancement that when both the source and destination of a packet are known to and managed by a single TCP/IP stack, the IP layer can be bypassed. This provides an overall pathlength savings when processing such packets, and the decrease in pathlength through the stack results in an overall throughput improvement for applications that reside on the same MVS systems and communicate with each other through the same TCP/IP stack. Socket application programmers can take advantage of this performance enhancement by using a non-loopback home address when sending data between applications that reside on the same MVS system and communicate with each other through the same TCP/IP stack. Refer to the z/OS Communications Server: New Function Summary for additional information.

Streams and messages

This section describes how to design an application protocol so that the partner program can divide the receive stream into individual messages.

Some socket applications are simple, and the receiver can continue to receive data until the sender closes the socket, for example, a simple file transfer application. Most applications are not that simple and usually require that the stream can be divided into a number of distinct messages.

A message exchanged between two socket programs must imbed information so that the receiver can decide how many bytes to expect from the sender and (optionally) what to do with the received message.
A few common techniques are used to imbed information about the length of a message into the stream, as follows:

- The message type identifier technique

  If your messages are fixed length, you can implement a message ID per message type worked with. Each message type has a predefined length that is known by your client and server programs. If you place the message ID at the start of each message, the receiving program can determine how long the message is if it knows the content of the first few bytes in the message. This is illustrated in Figure 27

```
*---------------------------------------------------------------*
* Layout of a message between TPI client and TPI server        *
*---------------------------------------------------------------*
01 tpi-message.
  05 tpi-message-id  pic x.
  88 tpi-request-add  value '1'.
  88 tpi-request-update  value '2'.
  88 tpi-request-update  value '2'.
  88 tpi-request-query  value '3'.
  88 tpi-request-query  value '3'.
  88 tpi-request-delete  value '4'.
  88 tpi-query-reply  value 'A'.
  88 tpi-response  value 'B'.
  05 tpi-constant  pic x(4).
  88 tpi-identifier  value 'TPI '.
```

Figure 27. Layout of a message between a TPI client and a TPI server

Each message ID is associated with a fixed length known to your application.

- The record descriptor word (RDW) technique

  If your messages are variable length, you can implement a length field in the beginning of each message. Normally, you would implement the length in a binary halfword with the value encoded in network byte order, but you can implement it as a text field, as shown in Figure 28

```
*---------------------------------------------------------------*
* Transaction Request Message segment                        *
*---------------------------------------------------------------*
01 TRM-message.
  05 TRM-message-length  pic 9(4) Binary Value 20.
  05 filler  pic x(2) Value low-value.
  05 TRM-identifier  pic x(8) Value '*TRNREQ*'.
  05 TRM-trancode  pic x(8) Value '?????'.
```

Figure 28. Transaction request message segment

- The end-of-message marker technique

  A third technique most often seen in C programs is to send a null-terminated string. A null-terminated string is a string of bytes terminated by a byte of binary 0. The receiving program reads whatever data is on the stream and then loops through the received buffer separating each record at the point where a null-byte is found. When the received records have been processed, the program issues a new read for the next block of data on the stream.

  If your messages contain only character data, you can designate any non-display byte value as your end-of-message marker. Although this technique is most often seen in C programs, it can be used with any programming language.

- The TCP/IP buffer flushing technique

  This technique is based on the observed behavior of the TCP protocol, where a send() call followed by a recv() call forces the sending TCP protocol layer to
flush its buffers and forward whatever data might exist on the stream to the receiving TCP protocol layer. You can use this method to implement a half-duplex, flip-flop application protocol, where your two partner programs acknowledge the receipt of each message with, for example, a 1-byte application acknowledgment message.

Figure 29 shows the TCP buffer flush technique.

In Figure 29 the client sends an 80-byte message. The server has issued a recv() call for 1000 bytes, but receives only the 80 bytes (RETCODE=80). This presents a problem because there is no guarantee the server will receive the full 80-byte message on its receive call. It might only receive 30 bytes, but with this technique it has no way of knowing that it is missing another 50 bytes. The smaller the messages are, the less likely the server will receive only a part of the full message.

Note: This technique is widely used, but you should use it only in controlled environments, or in programs where you use non-blocking socket calls to implement your own timeout logic.

The message type identifier and the record descriptor word techniques require that the receiving program be able to learn the content of the first bytes in the message before it reads the entire message.
If this is a problem for your application, use the peek flag on a recv socket() call.

A recv() call with the peek flag on does not remove the data from the TCP buffers, but copies the number of bytes you requested into the application buffer you specified on the recv() call.

For example, if your message length field or message ID field is located within the first 5 bytes of each message, issue the following recv() call:

```
*---------------------------------------------------------------*
* Peek buffer and length fields for RECV call                   *
*---------------------------------------------------------------*
01 soket-recv       pic x(16) value 'RECV'.
01 recv-flag-peek  pic 9(8) binary value 2.
01 recv-peek-len   pic 9(8) binary value 5.
01 recv-peek-buffer.
   05 message-id   pic x value space.
      88 tpi-query-reply value 'A'.
      88 tpi-response value 'B'.
   05 message-constant pic x(4).
      88 tpi-identifier value 'TPI'.
01 socket-descriptor pic 9(4) binary value 0.
01 errno           pic 9(8) binary value 0.
01 retcode         pic s9(8) binary value 0.
*---------------------------------------------------------------*
* Peek at first 5 bytes of client data                         *
*---------------------------------------------------------------*
    call 'EZASOKET' using soket-recv
       socket-descriptor
       recv-flag-peek
       recv-peek-len
       recv-peek-buffer
       errno
       retcode.
    if retcode < 0 then
       - process error -
    if retcode = 0 then
       - process client closed socket -
    if not TPI-identifier then
       - translate recv-peek-buffer from ASCII to EBCDIC -
```

The recv() call blocks until some bytes have been received or the sender closes its socket. The above example is not complete since you cannot be sure that you actually received the 5 bytes requested. Your call might come back to you with only 1 byte received. In order to manage the situation, you need to repeat your recv() call until all 5 bytes have been received and recognized as such.

If the other half of the connection closes the socket, the recv() call returns 0 in the retcode field.

The data is copied into your application program buffer only, but it is still available to a recv() call, in which you can specify the full length of the message you now know to be available.

**Data representation**

If you use the socket API, your application must handle the issues related to different data representations occurring on different hardware platforms. For character-based data, some hosts use ASCII, while other hosts use EBCDIC. Translation between the two representations must be handled by your application.
For integers, some hardware platforms use big endian byte order (S/370/390, Motorola style), while others use little endian byte order (Intel® style). An example of the difference between big and little endian byte orders is shown in Figure 30.

![Figure 30. Big or little endian byte order for a 2-byte integer](image)

IBM S/370™ and IBM S/390-based computers all use big endian byte order, while the IBM PS/2 uses the little endian byte order. TCP/IP has defined a network byte order standard to be used for all 16-bit and 32-bit integers that appear in protocol headers. This network byte order is based on the big endian byte order. This is the reason you find the following in the C-socket interface:

- **htons** Translates a short integer (two bytes) from host byte order to network byte order
- **ntohs** Translates a short integer from network byte order to host byte order
- **htonl** Translates a long integer (four bytes) from host byte order to network byte order
- **ntohl** Translates a long integer from network byte order to host byte order

The socket-based application should manage the application data portion of a message. If you develop a server that serves clients on different hardware platforms, define your own standard and implement it as part of your application protocol.

In some cases, it is easier to base your messages on text data. If you, as part of your message design, define a fixed text string in the beginning of each message, your application can test the contents of this string and decide whether the data is in EBCDIC or ASCII. If the data is in ASCII, you can translate the full message from ASCII to EBCDIC on input, and translate from EBCDIC to ASCII on output from MVS. An example of this design is the transaction request message (TRM) format used by the IMS Listener program. Bytes 4 to 11 have a fixed value of “TRNREQ”, which is used both to distinguish this message from other messages and to find out whether the client is transmitting data in ASCII or EBCDIC.

If you mix text data and binary data in your messages, be sure to only apply translation between ASCII and EBCDIC to the text fields in your message.

If you use binary integer fields in your messages, it is recommended that you use the network byte order standard that TCP/IP uses for all integers in protocol headers. If you design your messages according to the network byte order standard, your MVS programs do not need to translate or rearrange the bytes in binary integer fields. Your programs executing on little endian hosts must use the
integer conversion routines to convert integers between local format and the
format used in the messages they exchange with your MVS programs.

Text data and binary 2- and 4-byte integers are easy to handle in a heterogeneous
computer environment. In more complex data types like floating point numbers or
packed decimal, it becomes much more complicated because there is no generally
accepted standard and there is no easy support for transformation between the
formats. If you include these data types in your messages, be sure that the partner
program knows how to interpret them. If the two computer systems use the same
architecture, this is valid. If you exchange messages by way of socket programs
between two MVS systems, you do not need to be concerned about conversion.

---

### Using send() and recv() calls

This section provides information about sending and receiving calls.

#### The conversation

Client and server communicate using send() and recv() as shown below:
```c
num = send(s, addr_of_data, len_of_data, 0);
num = recv(s, addr_of_buffer, len_of_buffer, 0);
```

The send() and recv() calls specify:
- The socket `s` on which to communicate
- The address in storage of the buffer that contains, or will contain, the data
  `(addr_of_data, addr_of_buffer)`
- The size of this buffer `(len_of_data, len_of_buffer)`
- A flag that tells how the data is to be sent

Flag 0 tells TCP/IP to transfer the data normally. The server uses the socket that is
returned from the accept() call.

These functions return the amount of data that was sent or received. Because
stream sockets send and receive information in streams of data, it can take more
than one send() or recv() to transfer all of the data. It is up to the client and the
server to agree on some mechanism to signal that all of the data has been
transferred.

When the conversation is over, both the client and the server call close() to end the
connection. Close() also deallocates the socket, freeing its space in the table of
connections. To end a connection with a specific client, the server closes the socket
returned by accept(). If the server closes its original socket, it can no longer accept
new connections, but it can still converse with the clients to which it is connected.
The close() call is represented as follows:
```c
close(s);
```

If you are writing a client application, you might want to verify the processes the
server will use. Both client applications and the servers with which they
communicate must be aware of the sequence of events each will follow.

### Using socket calls in a network application

You can use the following example to write a socket network application. The
example is written using C socket syntax conventions, but the principles described
apply to all of the following APIs:
- TCP/IP C socket API
Clients and servers wanting to transfer data have many calls from which to choose. The `read()` and `write()`, `readv()` and `writev()`, and the `send()` and `recv()` calls can be used only on sockets that are connected. The `sendto()` and `recvfrom()`, and `sendmsg()` and `recvmsg()` calls can be used at any time. The example listed in Figure 31 illustrates the use of `send()` and `recv()` calls:

```c
int send(int socket, char *buf, int buflen, int flags);
int recv(int socket, char *buf, int buflen, int flags);
.
.
.
int bytes_sent;
int bytes_received;
char data_sent[256];
char data_received[256];
int s;
.
.
bytes_sent = send(s, data_sent, sizeof(data_sent), 0);
.
.
bytes_received = recv(s, data_received, sizeof(data_received), 0);
```

Figure 31. An application using the `send()` and `recv()` calls

The example in Figure 31 shows an application sending data to a connected socket and receiving data in response. The flags field can be used to specify additional options to `send()` or `recv()`, such as sending out-of-band data. For more information about these routines, see the following:

- “`read()`” on page 175
- “`readv()`” on page 176
- “`recv()`” on page 178
- “`send()`” on page 190
- “`write()`” on page 216
- “`writev()`” on page 217

There are three groups of calls to use for reading and writing data over sockets:

**read and write**

These calls can only be used with connected sockets. No processing flags can be passed on these calls.

**recv and send**

These calls also work with connected sockets only. You can pass processing flags on these calls:

- NOFLAG — read or write data as a read call or a write call would.
- OOB — read or write Out Of Band data (expedited data).
- PEEK — peek at data, but do not remove data from the buffers.
recvfrom and sendto

These calls work with both connected and non-connected sockets. You can pass addressing information directly (as parameters) on these calls. The available flags are the same as those for recv and send.

A connected socket is either a stream socket for which a connection has been established, or it is a datagram socket for which you have issued a connect() call to specify the remote datagram socket address.

Reading and writing data from and to a socket

Stream sockets during read and write calls might behave in a way that you would expect to be an error. The read() call might return fewer bytes, and the write() call may write fewer bytes, than requested. This is not an error, but a normal situation that your programs must deal with when they read or write data over a socket.

You might need to use a series of read calls to read a given number of bytes from a stream socket. Each successful read() call returns in the retcode field the number of bytes actually read. If you know you have to read, for example, 4000 bytes and the read call returns 2500, you have to reissue the read call with a new requested length of 4000 minus the 2500 already received (1500).

If you develop your program in COBOL, the following example shows an implementation of such logic. In this example, the message to be read has a fixed size of 8192 bytes:

```
*---------------------------------------------------------------*
* Variables used by the READ call                               *
*---------------------------------------------------------------*
01 read-request-read pic 9(8) binary value 0.
01 read-request-remaining pic 9(8) binary value 0.
01 read-buffer-total pic x(8192) value space.
05 read-buffer-byte redefines read-buffer-total pic x occurs 8192 times.
*---------------------------------------------------------------*
* Read 8K block from server                                      *
*---------------------------------------------------------------*
move zero to read-request-read.
move 8192 to read-request-remaining.
perform until read-request-remaining = 0
  call 'EZASOKET' using soket-read
    socket-descriptor
    read-request-remaining
    read-buffer-byte(read-request-read + 1)
    errno
    retcode
  if retcode < 0 then
    - process error and exit -
  end-if
  add retcode to read-request-read
  subtract retcode from read-request-remaining
  if retcode = 0 then
    Move zero to read-request-remaining
  end-if
end-perform.
```

An actual execution of the program, following the above logic, used four read calls to retrieve 8K of data. The first call returned 1960 bytes, the second call 3920 bytes, the third call 1960 bytes and the final call 352 bytes. It is not possible to predict
how many calls will be needed to retrieve the message. That depends on the internal buffer utilization of a TCP/IP. In some cases, only two calls were needed to retrieve 8K of data.

It is good programming practice, whenever you know the number of bytes to read, to issue read calls imbedded in logic, which is similar to the method described above.

If you work with short messages, you usually receive the full message on the first read() call, but there is no guarantee.

The behavior of a write() call is similar to that of a read() call. You might need to repeat more write() calls to write out all the data you want written. The following example illustrates this technique.

*---------------------------------------------------------------*
* Buffer and length fields for write operation                  *
*---------------------------------------------------------------*
01 send-request-sent   pic 9(8) binary value 0.
01 send-request-remaining  pic 9(8) binary value 0.
01 send-buffer.        pic x(8192) value space.
05 send-buffer-total   pic x(8192) value space.
05 send-buffer-byte    redefines send-buffer-total
                       pic x occurs 8192 times.
*---------------------------------------------------------------*
* Send 8K data block                                            *
*---------------------------------------------------------------*
move 8192 to send-request-remaining.
move 0 to send-request-sent.
Perform until send-request-remaining = 0
   call 'EZASOKET' using socket-write
   socket-descriptor
   send-request-remaining
   send-buffer-byte(send-request-sent + 1)
   errno
   retcode
   if retcode < 0 then
      - process error and exit -
   end-if
   add retcode to send-request-sent
   subtract retcode from send-request-remaining
   if retcode = 0 then
      Move zero to send-request-remaining
   end-if
end-perform.

Using sendto() and recvfrom() calls

If the socket is not in a connected state, additional address information must be passed to sendto() and can be (optionally) returned from recvfrom(). An example of the sendto() and recvfrom() calls is listed in Figure 32 on page 70.
The `sendto()` and `recvfrom()` calls take additional parameters to allow the caller to specify the recipient of the data, or to be notified of the sender of the data. See `"recvfrom()" on page 180`, `"sendmsg()" on page 192`, and `"sendto()" on page 194` for more information about these additional parameters. Usually, `sendto()` and `recvfrom()` are used for datagram sockets, and `send()` and `recv()` are used for stream sockets.
Chapter 8. Designing IPv6 programs

The following contain details on how to enable an IPv6 application:

- IBM z/OS Communications Server: IPv6 Network and Application Design Guide
- RFC 2553, Basic Socket Interface Extensions for IPv6. The Basic Socket API extension covers the socket calls that the majority of TCP/IP applications use.
- See “Socket libraries” on page 6 for information on which APIs support IPv6.
- See Appendix C, “Address family cross reference,” on page 857 for information on which commands support IPv6. Refer to the description and syntax for each command that was enhanced for IPv6 support.
Chapter 9. Designing multicast programs

This section describes IP multicasting and how an application can exploit multicasting using the TCP/IP socket APIs. IP multicasting concepts in IPv4 and IPv6 protocols are very similar; however there are some differences, such as the IP addresses used for multicasting with each protocol. The section that follows introduces the basic concepts for IP multicasting with an emphasis on IPv4. However, most of the concepts described here apply to IPv6 multicast applications as well. A more detailed description of IPv6 multicast options follows in the next section.

IPv4 has three types of IP addresses: unicast, broadcast, and multicast. When an IP datagram is sent to an individual IP address, it is called a unicast IP datagram. The process of sending the datagram is called unicasting. Unicasting is used when two IP nodes are communicating with each other.

When an IP datagram is sent to all nodes on a specific network, it is called broadcasting. Broadcasting support can be both limited and directed.

Multicasting is used to send an IP datagram to a group of systems identified by a class D address. The class D address is used as the destination address. When an application program requests that it receive datagrams with a particular class D destination IP address, it is said to have joined a multicast group. Multicast datagrams (datagrams with a class D destination address) are discarded by a host system unless an application on that host has joined the matching multicast group. The UDP application must bind in order to receive multicast datagrams, after which the application can then receive an IP datagram. The application can receive an IP datagram in two ways:

- The application must bind to the same port that is being used by the sender of the multicast datagram.
- The application can bind to a unicast address, inaddr_any, or to a class D address. However, if multiple applications need to receive datagrams for the same multicast group, they should bind to the class D address and set the SO_REUSEADDR socket option.

When a host is added to a group that group is referred to as a host group. A host group may span multiple networks. Hosts may join and leave a host group as necessary and there is no restriction to the number of hosts involved in a group. A host does not have to belong to a group to send a message to that group. Any hosts on an IP Internet can join a multicast group. The hosts need not be on a single LAN and may be separated by routers. When an application joins a group, it joins the multicast group on a specific interface. Routers use this information to determine if multicast datagrams should be forwarded from one interface to another.

Routers and hosts use a multicast routing protocol called Internet Group Management Protocol (IGMP) to share information about multicast groups. Through this protocol, hosts inform routers when they join or leave a multicast group. Routers can query hosts about groups they have joined and use this information in determining whether to forward multicast datagrams. Some multicast group addresses are referred to as permanent host groups. These addresses are assigned by the Internet Assigned Numbers Authority group as
well-known addresses similar to the well-known TCP and UDP port numbers. For example, 224.0.0.1 means all systems on this subnet, and 224.0.0.2 means all routers on this subnet. For a review of The Internet Assigned Number RFC to familiarize yourself with more of the well-known standard multicast address see [http://www.iana.org/assignments/multicast-addresses](http://www.iana.org/assignments/multicast-addresses) for IPv4 multicast address assignments and RFC 2375 for IPv6 multicast address assignments.

**Note:** z/OS (OMPROUTE) does not support a multicast routing protocol.
Multicast source filters

Source filter APIs enable an application to filter the datagrams that it receives based on the source address. There are two categories of source filter APIs: Basic and advanced. Both categories enable multicast receiver applications to designate the unicast addresses (source addresses) and the multicast group (destination address).

Basic (delta-based) APIs

Some applications need the simplicity of a delta-based API in which each function call specifies a single source address to be added to or removed from the filter. Such applications typically fall into the following types:

Any-source multicast

By default, all source addresses are accepted. Individual source addresses can be turned off and back on as needed. This type is also known as the exclude mode, because the source filter contains a list of excluded sources. The following SETSOCKOPT options are included.

<table>
<thead>
<tr>
<th>Address family</th>
<th>SETSOCKOPT options</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv4</td>
<td>IP_ADD_MEMBERSHIP</td>
</tr>
<tr>
<td></td>
<td>IP_BLOCK_SOURCE</td>
</tr>
<tr>
<td></td>
<td>IP_DROP_MEMBERSHIP</td>
</tr>
<tr>
<td></td>
<td>IP_UNBLOCK_SOURCE</td>
</tr>
<tr>
<td>Protocol independent</td>
<td>MCAST_BLOCK_SOURCE</td>
</tr>
<tr>
<td></td>
<td>MCAST_JOIN_GROUP</td>
</tr>
<tr>
<td></td>
<td>MCAST_LEAVE_GROUP</td>
</tr>
<tr>
<td></td>
<td>MCAST_UNBLOCK_SOURCE</td>
</tr>
</tbody>
</table>

Source-specific multicast

Only the source addresses that are specified in a list are accepted. The list is initially empty; IP addresses can be added to or deleted from the list one at a time. This filter type also is known as the include mode, because the source filter contains a list of included sources. The following SETSOCKOPT options are included.

<table>
<thead>
<tr>
<th>Address family</th>
<th>SETSOCKOPT options</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv4</td>
<td>IP_ADD_SOURCE_MEMBERSHIP</td>
</tr>
<tr>
<td></td>
<td>IP_DROP_MEMBERSHIP</td>
</tr>
<tr>
<td></td>
<td>IP_DROP_SOURCE_MEMBERSHIP</td>
</tr>
<tr>
<td>Protocol independent</td>
<td>MCAST_JOIN_SOURCE_GROUP</td>
</tr>
<tr>
<td></td>
<td>MCAST_LEAVE_GROUP</td>
</tr>
<tr>
<td></td>
<td>MCAST_LEAVE_SOURCE_GROUP</td>
</tr>
</tbody>
</table>

Advanced (full-state) APIs

These APIs enable an application to use a source filter that is comprised of zero or more source addresses. The application can retrieve the current filter or replace it with a new filter. The following IOCTL commands are included:

- SIOCGIPMSFILTER
Consider the following points about multicast source filters:

- Sockets cannot mix IPv4 group-membership APIs with protocol-independent group-membership APIs. Within each API type, delta-based options cannot be mixed with full-state options. Mixing these calls for the same socket results in an EINVAL error.
- The number of groups that can be joined depends on the socket type; there is a maximum of 20 groups for UDP sockets and a maximum of 256 groups for RAW sockets. Exceeding this limit results in an ETOOMANYREFS error.
- Within each group or group and interface pair, an application can use calls for only one type of basic API, either any-source multicast or source-specific multicast. Mixing options will result in an EINVAL error. However, an application can use different methods for different sockets.
- If the filter mode is set to include and the source list is empty, then the entry corresponding to the requested interface and multicast address is deleted, if present. If no such entry is present, then the request is ignored.
- For each socket, you can specify a maximum of 64 source filters for each multicast address and interface address pair. If the call causes the number of filters to exceed this maximum, an ENOBUFS error is returned.

**Tip:** z/OS UNIX Assembler Callable Services and z/OS Language Environment® C/C++ APIs also support the multicast source filter APIs. See [z/OS XL C/C++ Run-Time Library Reference](https://www.ibm.com/support/docview.wss?uid=swg27013275) and [z/OS UNIX System Services Programming: Assembler Callable Services Reference](https://www.ibm.com/support/docview.wss?uid=swg27013275) for more information.

### IPv4 multicast options

IPv4 multicast supports the following socket options for the Macro, Callable, and REXX Sockets APIs:

- IP_ADD_MEMBERSHIP
- IP_ADD_SOURCE_MEMBERSHIP
- IP_BLOCK_SOURCE
- IP_DROP_MEMBERSHIP
- IP_DROP_SOURCE_MEMBERSHIP
- IP_MULTICAST_IF
- IP_MULTICAST_LOOP
- IP_MULTICAST_TTL
- IP_UNBLOCK_SOURCE

IPv4 multicast supports the following socket options for the C Sockets API:

- IP_ADD_MEMBERSHIP
- IP_DROP_MEMBERSHIP
- IP_MULTICAST_IF
- IP_MULTICAST_LOOP
- IP_MULTICAST_TTL

Use the C, Macro, Callable, or REXX Sockets API SETSOCKOPT call to set these options. Use the C, Macro, Callable or REXX Sockets API GETSOCKOPT call to get
the current settings. The status of the IP_ADD_MEMBERSHIP, IP_DROP_MEMBERSHIP, IP_ADD_SOURCE_MEMBERSHIP, IP_DROP_SOURCE_MEMBERSHIP, IP_BLOCK_SOURCE, and IP_UNBLOCK_SOURCE options are exceptions, because they are SETSOCKOPT options only.

**IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP**

Use the IP_ADD_MEMBERSHIP option to join an IPv4 multicast group on a local IPv4 interface. Use the SETSOCKOPT API and specify the address of the IP_MREQ structure that contains these addresses. The application can join multiple multicast groups on a single socket; it also can join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups for a single UDP socket, and there is a maximum limit of 256 groups for a single RAW socket. The stack chooses a default multicast interface if an interface with the value 0 is passed. The format of the IP_MREQ structure is in the BPXYSOCK macro. The assembler program example in Figure 33 shows this socket option using the EZASMI macro:
**Issue INITAPI to connect to interface**

```
POST ECB,1  NEXT IS ALWAYS SYNCH
EZASMI TYPE=INITAPI, ISSUE INITAPI MACRO X
  SUBTASK=SUBTASK, SPECIFY SUBTASK IDENTIFIER X
  MAXSOC=MAXSOC, SPECIFY MAXIMUM NUMBER OF SOCKETS X
  MAXNO=MAXNO, (HIGHEST SOCKET NUMBER ASSIGNED) X
  ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
  RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
  ERROR=ERROR, ABEND IF ERROR ON MACRO X
BAL R14,RCHECK  --> DID IT WORK?
```

**Issue SOCKET Macro to obtain a datagram socket descriptor**

```
EZASMI TYPE=SOCKET, ISSUE SOCKET MACRO X
  AF='INET', INET OR IUCV X
  SCOTYPE='DATAGRAM', DATAGRAM(UDP) X
  PROTO=ZERO, PROTOCOL X
  ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
  RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
  ERROR=ERROR, ABEND IF MACRO ERROR X
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
```

**Get socket descriptor number**

```
STH R8,S  SAVE RETCODE (=SOCKET DESCRIPTOR)
```

**ISSUE GETHOSTID CALL**

```
EZASMI TYPE=GETHOSTID, ISSUE GETHOSTID MACRO X
  RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
  ERROR=ERROR, ABEND IF MACRO ERROR X
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
ST R8,ADDR  SAVE OUR ID
```

**Issue SETSOCKOPT to allow multiple application on the same stack to bind to the same multicast address and port.**

```
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
  S=S, SOCKET DESCRIPTOR X
  OPTLEN=OPTLEN4, OPTION LENGTH X
  OPTNAME='SO_REUSEADDR', OPTION NAME X
  OPTVAL=OPTVALON, OPTION VALUE X
  RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
  ERROR=ERROR, ABEND IF MACRO ERROR X
BAL R14,RCCHECK  --> CHECK IT
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 1 of 4)
**Issue BIND socket**

```assembly
MVC PORT(2),PORTS Load port #
MVC ADDRESS(4),ADDR Load IP address
EZASMI TYPE=BIND, ISSUE BIND MACRO X
S=S, DATAGRAM X
NAME=NAME, SOCKET ADDRESS STRUCTURE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
```

* Here you will add code to set the multicast interface, time-to-live, or determine if outgoing datagrams are copied to loopback. See the next sections for the details.

**Issue SETSOCKOPT - IP_ADD_MEMBERSHIP**

```assembly
MVC IMR_MULTIADD,MY_MULTICAST_ADDRESS
MVC IMR_INTERFAC,MY_MULTICAST_INTERFACE
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN8, OPTION LENGTH X
OPTNAME='IP_ADD_MEMBERSHIP', OPTION NAME X
OPTVAL=IP_MREQ, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT
```

* Here your program will perform normal processing such as sending or receiving message.

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 2 of 4)

**Issue SETSOCKOPT - IP_DROP_MEMBERSHIP**

```assembly
MVC IMR_MULTIADD,MY_MULTICAST_ADDRESS
MVC IMR_INTERFAC,MY_MULTICAST_INTERFACE
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN8, OPTION LENGTH X
OPTNAME='IP_DROP_MEMBERSHIP', OPTION NAME X
OPTVAL=IP_MREQ, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT
```

Figure 33. IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP (Part 3 of 4)
To remove the host from the multicast host group you must issue a SETSOCKOPT call with the IP_DROP_MEMBERSHIP option. Using this call is similar to using the IP_ADD_MEMBERSHIP option; both use the IP_MREQ structure to declare the IPv4 multicast address and the local IPv4 address interface. You can also use the IP_DROP_MEMBERSHIP option to remove all sources for a given multicast group (see Figure 33 on page 78).
While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the `Netstat DEvlinks/-d` command. To see the multicast groups that are joined on a socket, use the `Netstat ALL/-A` command.

**IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP**

Use the `IP_ADD_SOURCE_MEMBERSHIP` option to join an IPv4 multicast group on an IPv4 interface and specify the IPv4 source-filter address. Set these values by using the `SETSOCKOPT` API and specifying the address of the `IP_MREQ_SOURCE` structure that contains these addresses. The application can join multiple source multicast groups on a single socket and can also join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket. The stack chooses a default multicast interface if an interface with the value 0 is passed. The format of the `IP_MREQ_SOURCE` structure is in the `BPXYSOCK` macro. The assembler program example in Figure 34 shows this socket option using the EZASMI macro:

```
***********************************************************************
* Issue SETSOCKOPT - IP_ADD_SOURCE_MEMBERSHIP                         *
***********************************************************************
MVC IMRS_MULTIADD,MY_MULTICAST_ADDRESS
MVC IMRS_SOURCEADDR,MY_MULTICAST_SOURCE
MVC IMRS_INTERFAC,MY_MULTICAST_INTERFACE
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
 S=S, SOCKET DESCRIPTOR X
 OPTLEN=OPTLEN12, OPTION LENGTH X
 OPTNAME='IP_ADD_SOURCE_MEMBERSHIP', OPTION NAME X
 OPTVAL=IP_MREQ_SOURCE, OPTION VALUE X
 RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
 ERROR=ERROR ABEND IF MACRO ERROR
 BAL R14,RCCHECK -- CHECK IT

* Here your program will perform normal processing such as sending or
* receiving message.
*
Figure 34. IP_ADD_SOURCE_MEMBERSHIP and IP_DROP_SOURCE_MEMBERSHIP (Part 1 of 2)
```
To remove the host from the source multicast host group you must issue a
SETSOCKOPT call with the IP_DROP_SOURCE_MEMBERSHIP option. Using this
call is similar to using the IP_ADD_SOURCE_MEMBERSHIP option; both use the
IP_MREQ_SOURCE structure to declare the IPv4 multicast address, IPv4 source
address, and the local IPv4 interface address.

While the application is a member of the source multicast host group, datagrams
can be sent or received as required. To see the multicast groups that are joined on
an interface, use the Netstat DEvlks/-d command. To see the multicast groups
that are joined on a socket, use the Netstat ALL/-A command.

**IP_BLOCK_SOURCE and IP_UNBLOCK_SOURCE**

The IP_BLOCK_SOURCE socket option enables the application to block IPv4
multicast packets that have a source address that matches the given IPv4 source
address. The specified multicast group must have been joined previously. The
IP_UNBLOCK_SOURCE socket option enables the application to unblock a
previously blocked source for a given multicast group.

To block or unblock IPv4 multicast packets, use the SETSOCKOPT API and specify
the IP_MREQ_SOURCE structure containing IPv4 multicast address, IPv4 source
address, and the local IPv4 interface address. The format of the
IP_MREQ_SOURCE structure is in the BPXYSOCK macro. The assembler program
example in Figure 35 on page 83 shows this socket option using the EZASMI
macro:
While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.
**IP_MULTICAST_IF**

In order to control which interface multicast datagrams will be sent on, the API provides the IP_MULTICAST_IF socket option. This option can be used to set the interface for sending outbound multicast datagrams from the sockets application. Multicast datagrams can be transmitted on only one interface at a time. You can determine the interface being used by the way of the GETSOCKOPT API with IP_MULTICAST_IF as the OPTNAME. Figure 36 illustrates the use of IP_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

---

Figure 36. IP_MULTICAST_IF
IP_MULTICAST_LOOP

The API uses IP_MULTICAST_LOOP socket option to enable or disable the loopback of outgoing multicast datagrams. The default is enabled. This option is used to enable an application with multiple senders and receivers on a system to loop datagrams back so that each process receives the transmissions of the other senders on the system. Figure 37 illustrates the use of IP_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

Figure 37. IP_MULTICAST_IF (Part 1 of 2)

***********************************************************************
* Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_LOOP ENABLED *
***********************************************************************
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IP_MULTICAST_LOOP', OPTION NAME X
OPTVAL=OPTVALON, OPTION VALUE X
RETCODE=RETCode, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCHECK --> CHECK IT

* XC OPTVAL4,OPTVAL4
EZASMI TYPE=GETSOCKOPT, ISSUE GETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IP_MULTICAST_LOOP', OPTION NAME X
OPTVAL=OPTVAL4, OPTION VALUE X
RETCODE=RETCode, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCHECK --> CHECK IT

Figure 37. IP_MULTICAST_IF (Part 2 of 2)

***********************************************************************
* Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_LOOP DISABLED *
***********************************************************************
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IP_MULTICAST_LOOP', OPTION NAME X
OPTVAL=OPTVALOFF, OPTION VALUE X
RETCODE=RETCode, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCHECK --> CHECK IT

* XC OPTVAL4,OPTVAL4
EZASMI TYPE=GETSOCKOPT, ISSUE GETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IP_MULTICAST_LOOP', OPTION NAME X
OPTVAL=OPTVAL4, OPTION VALUE X
RETCODE=RETCode, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCHECK --> CHECK IT
**IP_MULTICAST_TTL**

The IP_MULTICAST_TTL socket option allows the application to primarily limit the lifetime of the packet in the Internet and prevent it from circulating indefinitely. This option also serves to allow the application to specify administrative boundaries. This administrative region is specified in terms such as "this site", "this company", or "this state", and is relative to the starting point of the packet. The region associated with a multicast packet is called its **scope**. The default value is 1, meaning multicast is available only to the local subnet. Figure 38 illustrates the use of IP_MULTICAST_TTL by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
***********************************************************************
*                                                                   *
*   Issue SETSOCKOPT/GETSOCKOPT - IP_MULTICAST_TTL                 *
*                                                                   *
***********************************************************************

* SET TTL TO SAME SITE

EZASMI   TYPE=SETSOCKOPT,   ISSUE SETSOCKOPT   X
  S=S,   SOCKET DESCRIPTOR   X
  OPTLEN=OPTLEN1,   OPTION LENGTH   X
  OPTNAME='IP_MULTICAST_TTL', OPTION NAME   X
  OPTVAL=SAMESITE,   OPTION VALUE   X
  RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)   X
  ERROR=ERROR   ABEND IF MACRO ERROR
BAL   R14,RCHECK   --> CHECK IT

* DISPLAY TTL, SHOULD BE 32

X   OPTVAL4,OPTVAL4
EZASMI   TYPE=GETSOCKOPT,   ISSUE GETSOCKOPT   X
  S=S,   SOCKET DESCRIPTOR   X
  OPTLEN=OPTLEN1,   OPTION LENGTH   X
  OPTNAME='IP_MULTICAST_TTL', OPTION NAME   X
  OPTVAL=OPTVAL4,   OPTION VALUE   X
  RETCODE=RETCODE,   (SPECIFY RETCODE FIELD)   X
  ERROR=ERROR   ABEND IF MACRO ERROR
BAL   R14,RCHECK   --> CHECK IT
```

*Figure 38. IP_MULTICAST_TTL*
IPv6 multicast options

To enable your application to support the IPv6 version of multicast support, the following socket options will be discussed:

- IPV6_JOIN_GROUP
- IPV6_LEAVE_GROUP
- IPV6_MULTICAST_IF
- IPV6_MULTICAST_LOOP
- IPV6_MULTICAST_HOPS

Use the Macro, Callable, and REXX Sockets API SETSOCKOPT call to set these options. Use the Macro, Callable, or REXX Sockets API GETSOCKOPT call to get the current settings. The status of the IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP are exceptions as they are SETSOCKOPT options only.

If you want to enable your application to support the IPv6 multicast source filter, see "Protocol-independent multicast options" on page 93.

IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP

IPV6_JOIN_GROUP is used to join a multicast group. This is accomplished by using the SETSOCKOPT API and specifying the address of the IPV6_MREQ structure containing the IPv6 multicast address and the local IPv6 multicast interface index. The stack chooses a default multicast interface if an interface index of 0 is passed. The values specified in the IPV6_MREQ structure used by IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP must be symmetrical. The format of the IPV6_MREQ structure can be found in the BPXYSOCK macro.

The assembler program example in [Figure 39] illustrates this socket option in EZASMI Macro form:
* Issue INITAPI to connect to interface

```
POST ECB,1
EZASMI TYPE=INITAPI, ISSUE INITAPI MACRO X
   SUBTASK=SUBTASK, SPECIFY SUBTASK IDENTIFIER X
   MAXSOC=MAXSOC, SPECIFY MAXIMUM NUMBER OF SOCKETS X
   MAXSNO=MAXSNO, (HIGHEST SOCKET NUMBER ASSIGNED) X
   ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
   RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
   APITYPE=APITYPE, (SPECIFY APITYPE FIELD) X
   ERROR=ERROR ABEND IF ERROR ON MACRO
   BAL R14,RCHECK --> DID IT WORK?
```

* Issue SOCKET Macro to obtain a socket descriptor

```
EZASMI TYPE=SOCKET, ISSUE SOCKET MACRO X
   AF='INET6', INET OR IUCV X
   SCOTYPE='DATAGRAM', DATAGRAM(UDP) X
   PROTO=ZERO, PROTOCOL X
   ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
   RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
   ERROR=ERROR ABEND IF MACRO ERROR
   BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
```

* Get socket descriptor number

```
STH R8,S SAVE RETCODE (=SOCKET DESCRIPTOR)
```

* ISSUE GETHOSTID CALL

```
EZASMI TYPE=GETHOSTID, ISSUE GETHOSTID MACRO X
   RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
   ERROR=ERROR ABEND IF MACRO ERROR
   BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
ST R8,ADDR SAVE OUR ID
```

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part of 3)
**Issue SETSOCKOPT to allow multiple application on the same stack to bind to the same multicast address and port.**

```
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN4, OPTION LENGTH X
OPTNAME='SO_REUSEADDR', OPTION NAME X
OPTVAL=OPTVALON, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT
```

**Issue BIND socket**

```
MVC PORT(2),PORTS Load port 
MVC ADDRESS(16),ADDR Load IPv6 internet address 
EZASMI TYPE=BIND, ISSUE BIND MACRO X
S=S, DATAGRAM X
NAME=NAME, SOCKET ADDRESS STRUCTURE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
```

* Here you will add code to set the multicast interface, hops, or determine if outgoing datagrams are copied to loopback. See the next sections for the details.

**Issue SETSOCKOPT - IPV6_JOIN_GROUP**

```
MVC IV6MR_MULTIADD,MY_MULTICAST_ADDRESS
MVC IV6MR_INTERFAC,MY_MULTICAST_INTERFACE
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN20, OPTION LENGTH X
OPTNAME='IPV6_JOIN_GROUP', OPTION NAME X
OPTVAL=IPV6_MREQ, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT
```

* Either hard code a multicast address and index or use the SIOCIFNAMEINDEX IOCTL to obtain the interface index from the stack.

* Here your program will perform normal processing such as sending or receiving messages.

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part 2 of 3)
Either hard code a multicast address and index or use the
SIOCGIFNAMEINDEX IOCTL to obtain the interface index from the stack.

```
MVC  IPv6MR_MULTIADD,MY_MULTICAST_ADDRESS
MVC  IPv6MR_INTERFAC,MY_MULTICAST_INTERFACE
EZASMI TYPE=SETSOCKOPT,  ISSUE SETSOCKOPT
   X
S=S,  SOCKET DESCRIPTOR  X
OPLN=OPTLEN20,  OPTION LENGTH  X
OPTNAME='IPV6_LEAVE_GROUP',  OPTION NAME  X
OPTVAL=IPv6 MREQ,  OPTION VALUE  X
RETCODE=RETCODE,  (SPECIFY RETCODE FIELD)  X
ERROR=ERROR  ABEND IF MACRO ERROR
BAL  R14,RCHECK  --> CHECK IT
```

Terminate Connection to API

```
POST  ECB,1  FOLLOWING IS ALWAYS SYNCH
EZASMI TYPE=TERMAPI  ISSUE EZASMI MACRO FOR TERMAPI
```

GETSOCKOPT and SETSOCKOPT parms

```
OPTLEN1  DC  F'1'
OPTLEN4  DC  F'4'
OPTLEN8  DC  F'8'
OPTLEN20  DC  F'20'
OPTVAL4  DC  CL4'
SAMEINTERFACE  DC  F'0'
SAME_SUBNET  DC  F'1'
SAME_SITE  DC  F'32'
SAME_REGION  DC  F'64'
OPTVALON  DC  F'1'
OPTVALOFF  DC  F'0'
```

BIND PARMS

```
NAME  DC  OCL16' '  SOCKET NAME STRUCTURE
DC  AL2(2)  FAMILY
PORT  DC  H'0'  PORT
FLOWINFO  DC  F'0'  FLOWINFO
ADDRESS  DC  F'0'  IP ADDRESS
SCOPEID  DC  F'0'  SCOPEID
ADDR  DC  XL16'FF020101010101010505050505050505'  IP ADDR TO BIND
PORTS  DC  H'11007'  PORT TO BIND
```

My Multicast address and interface

```
MY_MULTICAST_ADDRESS  DC  XL16'FF020101010101010505050505050505'  X
Multicast Address
MY_MULTICAST_INTERFACE  DC  XL4'0000000E'  Interface Index
```

```
MULTIFO  DC  CL4' '  SOCKET MULTICAST INTERFACE OUTPUT  *
```

```
BPXYSOCK  DSECT=NO,LIST=YES
IPV6 MREQ  DS  OF  01-BPXYS
IPV6MR_MULTIADDR  DS  CL16  IPv6 Addr  01-BPXYS
IPV6MR_INTERFACE  DS  F  Interface Index  01-BPXYS
```

Figure 39. IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP (Part 3 of 3)
IPV6_LEAVE_GROUP is used to remove a host from the multicast group. You must issue a SETSOCKOPT API and specify the address of the IPV6_MREQ structure containing the IPv6 multicast address and the local IPv6 multicast interface index. See also Figure 39 on page 88.

While the application is a member of the multicast host group, datagrams may be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEvl Links/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

**IPV6_MULTICAST_IF**

In order to control which interface multicast datagrams will be sent on, the API provides the IPV6_MULTICAST_IF socket option. This option can be used to set the interface for sending outbound multicast datagrams from the sockets application. Multicast datagrams can be transmitted on only one interface at a time. You can determine the interface being used by the way of the GETSOCKOPT API with IPV6_MULTICAST_IF as the OPTNAME. The IPV6_MULTICAST_IF socket option requires that the option value be the value of the IPv6 interface index.

Figure 40 illustrates the use of IPV6_MULTICAST_IF by the use of the SETSOCKOPT and GETSOCKOPT APIs.

```
***********************************************************************
|                                                                 |
| Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_IF                                          |
|                                                                 |
***********************************************************************
```

EZASMI

```
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN4, OPTION LENGTH X
OPTNAME='IPV6_MULTICAST_IF', OPTION NAME X
OPTVAL=MY_MULTICAST_INTERFACE, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
R14, RCCHECK --> CHECK IT
```

```
EZASMI TYPE=GETSOCKOPT, ISSUE GETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN4, OPTION LENGTH X
OPTNAME='IPV6_MULTICAST_IF', OPTION NAME X
OPTVAL=MULTIFO, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
R14, RCCHECK --> CHECK IT
```
**IPV6_MULTICAST_LOOP**

The API uses IPV6_MULTICAST_LOOP socket option to enable or disable the loopback of outgoing multicast datagrams. The default is enabled. This option is used to enable an application with multiple senders and receivers on a system to loop datagrams back so that each process receives the transmissions of the other senders on the system. Figure 41 illustrates the use of IPV6_MULTICAST_LOOP by the use of the SETSOCKOPT and GETSOCKOPT APIs.

---

**Figure 41. IPV6_MULTICAST_LOOP (Part 1 of 2)**

---

**Figure 41. IPV6_MULTICAST_LOOP (Part 2 of 2)**
The IPV6_MULTICAST_HOPS socket option allows the application to primarily limit the lifetime of the packet in the Internet and prevent it from circulating indefinitely. The default value is 1, meaning multicast is available only to the local subnet.

Figure 42 illustrates the use of IPV6_MULTICAST_HOPS by the use of the SETSOCKOPT and GETSOCKOPT APIs.

***
* Issue SETSOCKOPT/GETSOCKOPT - IPV6_MULTICAST_HOPS *
*
***
* SET TTL TO SAME SITE *
* 
EZASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IPV6_MULTICAST_HOPS', OPTION NAME X
OPTVAL=SAMESITE, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR BAL R14,RCHECK -- CHECK IT
*
* DISPLAY HOPS, SHOULD BE 32 *
* 
XC OPTVAL4,OPTVAL4
EZASMI TYPE=GETSOCKOPT, ISSUE GETSOCKOPT X
S=S, SOCKET DESCRIPTOR X
OPTLEN=OPTLEN1, OPTION LENGTH X
OPTNAME='IPV6_MULTICAST_HOPS', OPTION NAME X
OPTVAL=OPTVAL4, OPTION VALUE X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR BAL R14,RCHECK -- CHECK IT
*

Figure 42. IPV6_MULTICAST_HOPS

Protocol-independent multicast options

The following socket options enable your application to support IPv4 and IPv6 multicast:

- MCAST_BLOCK_SOURCE
- MCAST_JOIN_GROUP
- MCAST_JOIN_SOURCE_GROUP
- MCAST_LEAVE_GROUP
- MCAST_LEAVE_SOURCE_GROUP
- MCAST_UNBLOCK_SOURCE

Use the Macro, Callable, and REXX Sockets API SETSOCKOPT call to set these options.

MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP

Use the MCAST_JOIN_GROUP socket option to join a multicast group and set the IPv4 or IPv6 multicast address and the local interface index. Use the SETSOCKOPT API and specify the address of the GROUP_REQ structure that contains the address and the interface index. The application can join multiple multicast groups.
on a single socket and can also join the same group on multiple interfaces on the
same socket. However, there is a maximum limit of 20 groups per single UDP
socket and there is a maximum limit of 256 groups per single RAW socket. The
stack chooses a default multicast interface if the interface index 0 is passed. The
format of the GROUP_REQ structure is in the BPXYSOCK macro. The assembler
program example in Figure 43 on page 95 shows this socket option using the
EZASMI macro:
**Issue SETSOCKOPT - MCAST_JOIN_GROUP**

EASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET_DESCRIPTOR X
OPTLEN=OPTL136, OPTION LENGTH X
OPTNAME='MCAST_JOIN_GROUP', OPTION NAME X
OPTVAL=GROUP_REQ1, OPTION VALUE X
ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT

* Here your program will perform normal processing such as sending or receiving message.
*

**Issue SETSOCKOPT - MCAST_LEAVE_GROUP**

EASMI TYPE=SETSOCKOPT, ISSUE SETSOCKOPT X
S=S, SOCKET_DESCRIPTOR X
OPTLEN=OPTL136, OPTION LENGTH X
OPTNAME='MCAST_LEAVE_GROUP', OPTION NAME X
OPTVAL=GROUP_REQ1, OPTION VALUE X
ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR
BAL R14,RCCHECK --> CHECK IT

* GETSOCKOPT and SETSOCKOPT parms
*
OPTLEN1 DC 'F'1'
OPTLEN4 DC 'F'4'
OPTLEN8 DC 'F'8'
OPTL136 DC 'F'136'
OPTL264 DC 'F'264'

**Group_Req Structure**

GROUP_REQ1 DS OCL136
GR_INTF1 DC XL4'00010005' Interface Index
DS CL4 Padding
GR_GROUP1 DS OCL128 Group Address
DC XL16'10020000E011111110000000000000000'
DC XL112'00'

**Group_Source_Req Structure**

GSR_REQ1 DS OCL264
GSR_INTF1 DC XL4'00010005' Interface Index
DS CL4 Padding
GSR_GROUP1 DS OCL128 Group Address
DC XL16'10020000E011111110000000000000000'
DC XL112'00'
GSR_SRCAD1 DS OCL128 Source Address
DC XL16'10020000424242420000000000000000'
DC XL112'00'

Figure 43. MCAST_JOIN_GROUP and MCAST_LEAVE_GROUP
To remove the host from the multicast host group you must issue a SETSOCKOPT call with the MCAST_LEAVE_GROUP option. Using this call is similar to using the MCAST_JOIN_GROUP option because it also uses the GROUP_REQ structure to declare the multicast address and the local interface index. You can also use MCAST_LEAVE_GROUP option to remove all sources for a given multicast group.

While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEnlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

**MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP**

Use the MCAST_JOIN_SOURCE_GROUP option to set the IPv4 or IPv6 multicast address, source address, and the local interface index. Use the SETSOCKOPT API and specify the address of the GROUP_SOURCE_REQ structure that contains these addresses and the interface index. The application can join multiple source multicast groups on a single socket and can also join the same group on multiple interfaces on the same socket. However, there is a maximum limit of 20 groups per single UDP socket and there is a maximum limit of 256 groups per single RAW socket. The stack chooses a default multicast interface if the interface index 0 is passed. The format of the GROUP_SOURCE_REQ structure is in the BPXYSOCK macro. The assembler program example in Figure 44 on page 97 shows this socket option using the EZASMI macro:
Figure 44. MCAST_JOIN_SOURCE_GROUP and MCAST_LEAVE_SOURCE_GROUP

To remove the host from the source multicast host group you must issue a
SETSOCKOPT call with the MCAST_LEAVE_SOURCE_GROUP option. This call is
similar to the MCAST_JOIN_SOURCE_GROUP option because it also uses the
GROUP_SOURCE_REQ structure to declare the IPv4 or IPv6 multicast address,
source address, and the local interface index (see Figure 44). You can also use the
MCAST_LEAVE_GROUP option to remove all sources for a given multicast group.

While the application is a member of the source multicast host group, datagrams
can be sent or received as required. To see the multicast groups that are joined on
an interface, use the Netstat DEvlinks/-d command. To see the multicast groups
that are joined on a socket, use the Netstat ALL/-A command.

MCAST_BLOCK_SOURCE and MCAST_UNBLOCK_SOURCE

The MCAST_BLOCK_SOURCE socket option enables the application to block IPv4
or IPv6 multicast packets that have a source address that matches the given source
address. The specified multicast group must have been joined previously. The
MCAST_UNBLOCK_SOURCE socket option enables the application to unblock a
previously blocked source for a given source multicast group. Use the
SETSOCKOPT API and specify the GROUP_SOURCE_REQ structure that contains
the multicast address, the source address, and the local interface address. The
format of the GROUP_SOURCE_REQ structure is in the BPXYSOCK macro. The
assembler program example in Figure 45 on page 98 shows the socket option using
the EZASMI macro:
While the application is a member of the multicast host group, datagrams can be sent or received as required. To see the multicast groups that are joined on an interface, use the Netstat DEVlinks/-d command. To see the multicast groups that are joined on a socket, use the Netstat ALL/-A command.

**IOCTL multicast commands**

The following IOCTL commands enable applications to support the advanced (full-state) multicast API for IPv4 and IPv6 addresses:

- SIOCGIPMSFILTER
- SIOCGMSFILTER
- SIOCSIPMSFILTER
- SIOCSMSFILTER

Use the Macro, Callable, and REXX Sockets API IOCTL call for these options.

**SIOCGIPMSFILTER**

An SIOCGIPMSFILTER IOCTL enables an application to retrieve a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or
exclude the set of source addresses, depending on the filter mode
(MCAST_INCLUDE or MCAST_EXCLUDE), which is defined in the IP_MSFILTER
structure of the BPXYIOCC macro.

**SIOCGMSFILTER**
An SIOCGMSFILTER IOCTL enables an application to retrieve a list of the IPv4 or
IPv6 source addresses that comprise the source filter along with the current mode
on a given interface index and a multicast group for a socket. The source filter may
either include or exclude the set of source address, depending on the filter mode
(MCAST_INCLUDE or MCAST_EXCLUDE), which is defined in the
GROUP_FILTER structure of the BPXYIOCC macro.

**SIOCSIPMSFILTER**
An SIOCSIPMSFILTER IOCTL enables an application to specify or modify a list of
IPv4 source addresses on a given interface and to specify or modify a multicast
group for a socket. The source filter can include or exclude the set of source
addresses, depending on the filter mode (MCAST_INCLUDE or MCAST_
EXCLUDE), which is defined in the IP_MSFILTER structure of the BPXYIOCC
macro. The application can join multiple source multicast groups on a single
socket; it also can join the same group on multiple interfaces on the same socket.
However, there is a maximum limit of 20 groups per single UDP socket and there
is a maximum limit of 256 groups per single RAW socket.

**SIOCSMSFILTER**
An SIOCSMSFILTER IOCTL enables an application to specify or modify a list of
IPv4 or IPv6 source addresses on a given interface index and to specify or modify
a multicast group for a socket. The source filter can include or exclude the set of
source address, depending on the filter mode (MCAST_INCLUDE or
MCAST_EXCLUDE), which is defined in the GROUP_FILTER structure of the
BPXYIOCC macro. The application can join multiple source multicast groups on a
single socket; it also can join the same group on multiple interfaces on the same
socket. However, there is a maximum limit of 20 groups per single UDP socket and
there is a maximum limit of 256 groups per single RAW socket.
Part 3. Application program interfaces
Chapter 10. C Socket application programming interface

Note: The TCP/IP C socket API is not being enhanced for IPv6. The use of the UNIX C socket library is encouraged for IPv4 application development and is required for IPv6 application development. For more information, refer to the z/OS XL C/C++ Run-Time Library Reference.

This section describes the C IPv4 socket application program interface (API) provided with TCP/IP. Use the socket routines to interface with the TCP, UDP, and IP protocols. The socket routines allow you to communicate with other programs across networks. You can, for example, use socket routines when you write a client program that must communicate with a server program running on another computer.

Topics include:
- Compiler restrictions
- Compiling and linking C applications
- Compiler messages
- Program abends
- C socket implementation
- C socket header files
- C structures
- Error messages and return codes
- C socket calls
- Sample C socket programs

To use the C socket API, you must know C language programming. For more information about C language programming, refer to the z/OS XL C/C++ Programming Guide.

Compiler restrictions

This section tells you how to move your application to the z/OS Communications Server system.
- When you need to recompile, use the compiler shipped with this product.
- All applications linked to the TCP/IP C sockets library must run on the LE run-time library shipped with z/OS Communications Server.
- To access system return values, you need only use include statement errno.h supplied with the compiler. To access network return values, you must add the following include statement:
  #include <tcperrno.h>
- To print system errors only, use perror(), a procedure available from the C compiler run-time library. To print both system and network errors, use tcperror(), a procedure provided by IBM and included with z/OS Communications Server.

Note to CICS users:
Do not use tcperror(). Add statement #include &lt;ezacichd.h&gt; and compile the statement as non-reentant. For more information, refer to the section on C Language Programming in the z/OS Communications Server: IP CICS Sockets Guide.

- If your C language statements contain information, such as sequence numbers, that are not part of the input for the C/C" compiler, you must exclude that information during compilation. The C/C" compiler provides several ways to do this, one of which is:
  
  **#pragma margins (1,72)**

In this example, we are assuming you have sequence numbers in columns 73 through 80.

- By default, prototype C socket functions and their parameters for the current release are defined. If you need to access the TCP/IP V3R1 definitions, specify the following during a compile:
  
  **#define_TCP31_PROTOS**

- Use of C socket functions by routines that are a part of fetched modules or DLLs might not yield the desired results. Applications that use these C language features need to be designed so that only one copy of the API code is used within the execution environment. Also note that proper cleanup of the supporting data structures relies on the termination logic defined with the atexit() function and has all of the corresponding restrictions listed for it (refer to the z/OS XL C/C++ Run-Time Library Reference for details). Improper use will likely cause new copies of the associated data structures to be allocated in the application’s address space each time the fetched module or DLL is loaded.

### Compiling and linking C applications

There are several ways to compile, link-edit, and execute z/OS Communications Server C source program in MVS. To run a C source program under MVS batch using IBM supplied cataloged procedures, you must include data sets. This section contains information about the data sets that you must include.

The following data set name is used as an example in the sample Job Control Language (JCL) statements.

**USER.MYPROG.H**

Contains user #include files.

### Compatibility considerations

Unless noted in z/OS Communications Server: New Function Summary, an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

### Non-reentrant modules

You must make additions to the compile step of your cataloged procedure to compile a non-reentrant module. The following lines describe these additions. Cataloged procedures are included in the IBM-supplied samples for your MVS system.
Note: Compile all C code source using the def(MVS) preprocessor symbol.

- Add the following line as the first //SYSLIB DD statement:

```bash
//SYSLIB DD DSN=SEZACMAC,DISP=SHR
```

- Add the following //USERLIB DD statement:

```bash
//USERLIB DD DSN=USER.MYPROG.H,DISP=SHR
```

The following lines describe the additions that you must make to the link-edit step of your cataloged procedure to link-edit a non-reentrant module.

- To link-edit programs that use C sockets library functions, add the following statement as the first //SYSLIB DD statement:

```bash
//SYSLIB DD DSN=SEZACMTX,DISP=SHR
```

Figure 46 on page 106 shows a sample JCL to be used when compiling non-reentrant modules. Modify the lines to conform to the naming conventions of your site:
Figure 46. Sample JCL for compiling non-reentrant modules.

Figure 47 on page 107 shows a sample JCL to be used when linking non-reentrant modules. Modify the lines to conform to the naming conventions of your site:
Figure 48 shows JCL to be used when running non-reentrant modules. Modify the lines to conform to the naming conventions of your site:

```plaintext
//LINKIT  JOB ,LINK,MSGLEVEL=(1,1)
//******************************************************************************
/**  SAMPLE JCL THAT LINKS A NON_REENTRANT TEST PROGRAM  */
/**  USING THE C/C++ COMPILER C/MVS  */
/**  INPUT LIBRARY: USER71.TEST.OBJ(&MEM)  */
/**  OUTPUT LIBRARY: USER71.TEST.LMOD(&MEM)  */
/** ******************************************************************************
//EDCL PROC USER=USER71
//TCPPIP EXEC PGM=IEWL,
//   PARM=',MAP,RMODE(ANY),SIZE=(320K,64K)
//SYSPRINT DD SYSOUT=*  
//SYSUT1  DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSLMOD  DD DSN=&USER..TEST.LMOD(&MEM),DISP=SHR
//SYSLIN  DD DSN=&USER..TEST.OBJ(&MEM),DISP=SHR
//SYSLIB  DD DSN=TCP.SEZACMTX,DISP=SHR
  // DD DSN=CEE.OSV2R7.SCEEKED,DISP=SHR
// PEND
// EXEC EDCL,MEM=CTEST
```

Figure 48. Sample JCL for running non-reentrant modules.

Reentrant modules

The following lines describe the additions that you must make to the compile step of your cataloged procedure to compile a reentrant module. Cataloged procedures are included in the IBM-supplied samples for your MVS system.

Note: Compile all C source code using the def(MVS) preprocessor symbol.

Be sure to use the RENT compiler option if your code is reentrant.

- Add the following line as the first //SYSLIB DD statement:

  ```plaintext
  //SYSLIB DD DSN=SEZACMAC,DISP=SHR
  ```

- Add the following //USERLIB DD statement:

  ```plaintext
  //USERLIB DD DSN=USER.MYPREG.H,DISP=SHR
  ```

The following lines describe the additions that you must make to the prelink-edit and link-edit steps of your cataloged procedure to create a reentrant module.

To prelink programs that use the C sockets library function, put the following statement first in the SYSLIB concatenation:

```plaintext
//SYSLIB DD DSN=SEZARNT1,DISP=SHR
```
Guideline: The system administrator should have followed the instructions for program reentrancy in the section of the z/OS XL C/C++ Programming Guide that contains information related to restrictions for using MVS TCP/IP API with z/OS UNIX.

To link-edit programs that have the C sockets library function, the following statement must be first in the SYSLIB concatenation:

```
//SYSLIB DD DSN=SEZACMTX,DISP=SHR
```

Notes:
1. If Language Environment libraries are concatenated ahead of SEZACMTX, socket errors can occur because the link-edit uses the Language Environment z/OS UNIX socket library, not the TCP/IP library.
2. For more information about compiling and linking, refer to the z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer.

Figure 49 on page 109 shows sample JCL to be used when compiling a test program with reentrancy. Modify the lines to conform to the naming conventions of your site:
Figure 49. Sample JCL for compiling reentrant modules

Figure 50 on page 110 shows sample JCL to be used when prelinking and linking a reentrant program using the C socket library. Modify the lines to conform to the naming conventions of your site:
Figure 51 on page 111 shows sample JCL to be used when running the reentrant program prelinked and linked in the previous JCL sample. Modify the lines to
conform to the naming conventions of your site:

```c
//RUNST  JOB RUN,MSGLEVEL=(1,1),CLASS=A,REGION=4096K
//********************************************************************************
//**       SAMPLE JCL THAT RUNS A TEST PROGRAM, CTESTRNT
//********************************************************************************
//S1 EXEC PGM=CTESTRNT
//STPLIB DD DSN=CEEL.DSV2R7.SCEERUN,DISP=SHR
// DD DSN=USER71.TEST.LMOD,DISP=SHR
//SYSPRINT DD SYSOUT**
```

_Figure 51. Sample JCL for running the reentrant program_

### Compiler messages

/z/OS Communications Server uses the C/C++/390 compiler. For C programs, migrating from AD/Cycle® to the C/C++/390 compiler can pose a few minor problems. See z/OS XL C/C++ Messages or z/OS XL C/C++ Compiler and Run-Time Migration Guide for the Application Programmer for more information.

### Program abends

A C program might compile and link correctly, but at run-time it might abend or behave peculiarly. The following lists some reasons for unexpected behavior, and suggests some fixes.

#### Errno values

Code depends on specific errno values. This might be a problem, as errno values can change from release to release. Do the following:

1. Check for any error conditions.
2. Make sure your logic has a default section that can be used if the specific errno has changed or is no longer available.

**Printing errno values**: The tcperror() function converts errno values to strings, which you can then print using printf() or a similar command. This procedure is provided by IBM and included with z/OS Communications Server, and is similar to the strerror() function in the standard C library.

#### Return values

Code depends on a specific return value. Some RTL functions, such as remove(), specify that the return code be nonzero on failure. In earlier releases, checking for -1 was sufficient; with release V1R4, the correct check is for nonzero.

Unfortunately, there is no checklist of functions that might generate this problem. If you get an abend, work backwards from the failure and examine prior RTL function return-code checking.

#### Built-in RTL functions

If RTL functions were built-in during your compile, ensure that they perform the same way as the non-built-in functions from the RTL.

Functions that might have this problem include abs, cds, cs, decabs, decchk, decfix, fabs, fortc, memchr, memcpy, memcmp, memset, strcat, strlen, strncat, strncmp, strncpy, strnchr, and tsched.
**SCEERUN missing**

Ensure that SCEERUN is the first library in STEPLIB encountered by your compile procedure.

**Uninitialized storage**

Check for uninitialized storage. Storage for automatic variables is guaranteed to be garbage.

---

**C socket implementation**

The IBM socket implementation differs from the Berkeley socket implementation. The following list summarizes the differences in the two methods:

- The IBM implementation does not support AF_INET6 sockets.
- Under IBM implementation, you must make reference to the additional header file, TCPERRNO.H, if you want to refer to the networking errors other than those described in the compiler-supplied ERRNO.H file.
- Under IBM implementation, you must use the tcerror() routine to print the networking error messages. tcerror() should be used only after socket calls, and perror() should be used only after C library calls.
- Under IBM implementation, you must include MANIFEST.H to remap the socket function long names to eight-character names.
- The IBM ioctl() call implementation might differ from the current Berkeley ioctl() call implementation. See [“ioctl()” on page 168](#) for a description of the functions supported by the IBM implementation.
- The IBM getsockopt() and setsockopt() calls support only a subset of the options available. See [“getsockopt()” on page 152](#) and [“setsockopt()” on page 204](#) for details about the supported options.
- The IBM fcntl() call supports only a subset of the options available. See [“fcntl()” on page 129](#) for details about the supported commands.
- The IBM implementation supports an increased maximum number (2000) of simultaneous sockets through the use of the maxdesc() call. (Only 1997 simultaneous sockets can be used, however.) The default maximum number of sockets is 47, any or all of which can be AF_INET sockets.

Keep the following in mind while creating your C socket application:

- Compile all C source using the def(MVS) preprocessor symbol.
- During debugging, set sock_do_teststor (1) to on to validate all storage addresses. After debugging, use sock_do_teststor (0) set to off.

---

**C socket header files**

To use the socket routines described in this section, you must have the following header files available to your compiler. They can be found in the SEZACMAC data set:

- bsdtime.h
- bsdtooms.h
- bsdtypes.h
- fcntl.h
- if.h
- in.h
- inet.h
- ioctl.h
- manifest.h
- netdb.h
Note: The C socket header files have been enhanced to allow the user to specify the coded character set to be used. When including the header files in an application, the bsdtypes.h file must precede the socket.h file.

Manifest.h
Under IBM implementation, MANIFEST.H is used to remap socket function long names to eight-character names. To refer to the names, you must include the following statement as the first #include at the beginning of each program:

```
#include <manifest.h>
```

Prototyping
Under TCP/IP z/OS Communications Server, the prototyping of C socket functions and their parameters is the default. If you are migrating your applications, you can bypass the new prototyping by specifying #define_TCP31_PROTOS during a C compile.

C structures
The parameter lists for some C language socket calls include a pointer to a data structure defined by a C structure. Table 6 shows the C structures used, and the corresponding assembler language syntax.

<table>
<thead>
<tr>
<th>C structure</th>
<th>Assembler language equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>struct sockaddr_in</td>
<td></td>
</tr>
<tr>
<td>{</td>
<td></td>
</tr>
<tr>
<td>short sin_family;</td>
<td>FAMILY DS H</td>
</tr>
<tr>
<td>ushort sin_port;</td>
<td>PORT DS H</td>
</tr>
<tr>
<td>struct in_addr sin_addr;</td>
<td>ADDR DS F</td>
</tr>
<tr>
<td>char sin_zero[8];</td>
<td>ZERO DC XL8'00'</td>
</tr>
<tr>
<td>}</td>
<td></td>
</tr>
<tr>
<td>struct timeval</td>
<td></td>
</tr>
<tr>
<td>{</td>
<td></td>
</tr>
<tr>
<td>long tv_sec;</td>
<td>TVSEC DS F</td>
</tr>
<tr>
<td>long tv_usec;</td>
<td>TVUSEC DS F</td>
</tr>
<tr>
<td>}</td>
<td></td>
</tr>
<tr>
<td>struct linger</td>
<td></td>
</tr>
<tr>
<td>{</td>
<td></td>
</tr>
<tr>
<td>int l_onoff;</td>
<td>ONOFF DS F</td>
</tr>
<tr>
<td>int l_linger;</td>
<td>LINGER DS F</td>
</tr>
<tr>
<td>}</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6. C structures in assembler language format (continued)

<table>
<thead>
<tr>
<th>C structure</th>
<th>Assembler language equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>struct ifreq {</td>
<td>NAME DS 0CL16</td>
</tr>
<tr>
<td>#define IFNAMSIZ 16</td>
<td></td>
</tr>
<tr>
<td>char ifr_name[IFNAMSIZ];</td>
<td></td>
</tr>
<tr>
<td>union {</td>
<td></td>
</tr>
<tr>
<td>struct sockaddr ifru_addr;</td>
<td></td>
</tr>
<tr>
<td>struct sockaddr ifru_dstaddr;</td>
<td></td>
</tr>
<tr>
<td>struct sockaddr ifru_broadaddr;</td>
<td></td>
</tr>
<tr>
<td>short ifru_flags;</td>
<td></td>
</tr>
<tr>
<td>int ifru_metric;</td>
<td></td>
</tr>
<tr>
<td>caddr_t ifru_data;</td>
<td></td>
</tr>
<tr>
<td>} ifr_ifru;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>struct ifconf {</td>
<td>IFCLEN DS F</td>
</tr>
<tr>
<td>int ifc_len;</td>
<td>IGNORED DS F</td>
</tr>
<tr>
<td>union {</td>
<td></td>
</tr>
<tr>
<td>caddr_t ifcu_buf;</td>
<td></td>
</tr>
<tr>
<td>struct ifreq *ifcu_req;</td>
<td></td>
</tr>
<tr>
<td>} ifc_ifcu;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>struct clientid {</td>
<td>DOMAIN DS F</td>
</tr>
<tr>
<td>int domain;</td>
<td>NAME DS CL8</td>
</tr>
<tr>
<td>char name[8];</td>
<td>SUBTASK DS CL8</td>
</tr>
<tr>
<td>char subtaskname[8];</td>
<td>RESERVED DC XL20'00'</td>
</tr>
<tr>
<td>char reserved[20];</td>
<td></td>
</tr>
<tr>
<td>}</td>
<td></td>
</tr>
</tbody>
</table>

**Error messages and return codes**

For information about error messages, refer to [z/OS Communications Server: IP Messages Volume 1 (EZA)].

The most common return codes (ERRNOs) returned by TCP/IP are listed following each socket call.

For information about all return codes see Appendix B, “Return codes,” on page 835.

**C socket calls**

This section lists the syntax, parameters, and other information appropriate to each C socket call supported by TCP/IP.
accept()

The accept() call is used by a server to accept a connection request from a client. The call accepts the first connection on its queue of pending connections. The accept() call creates a new socket descriptor with the same properties as s and returns it to the caller. If the queue has no pending connection requests, accept() blocks the caller unless s is in nonblocking mode. If no connection requests are queued and s is in nonblocking mode, accept() returns -1 and sets errno to EWOULDBLOCK. The new socket descriptor cannot be used to accept new connections. The original socket, s, remains available to accept additional connection requests.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>

int accept(int s, struct sockaddr *addr, int *addrlen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>The socket descriptor.</td>
</tr>
<tr>
<td>addr</td>
<td>The socket address of the connecting client that is filled by accept() before it returns. The format of addr is determined by the domain in which the client resides. addr is only filled in by accept() when both addr and addrlen are nonzero values.</td>
</tr>
<tr>
<td>addrlen</td>
<td>Must initially point to an integer that contains the size in bytes of the storage pointed to by addr. If addr is NULL, then addrlen is ignored and can be NULL.</td>
</tr>
</tbody>
</table>

The s parameter is a stream socket descriptor created using the socket() call. It is usually bound to an address using the bind() call. The listen() call marks the socket as one that accepts connections and allocates a queue to hold pending connection requests. The listen() call allows the caller to place an upper boundary on the size of the queue.

The addr parameter points to a buffer into which the connection requester address is placed. The addr parameter is optional and can be set to NULL. If addr or addrlen is null or 0, addr is not filled in. The exact format of addr depends on the addressing domain from which the communication request originated. For example, if the connection request originated in the AF_INET domain, addr points to a sockaddr_in structure as defined in the header file IN.H. The addrlen parameter is used only when name is not NULL. Before calling accept(), you must set the integer pointed to by addrlen to the size of the buffer, in bytes, pointed to by addr. If the buffer is not large enough to hold the address, only the addrlen number of bytes of the requester address is copied.

**Note:** This call is used only with SOCK_STREAM sockets. There is no way to screen requesters without calling accept(). The application cannot determine which system from which requesters connections will be accepted. However, the caller can choose to close a connection immediately after discovering the identity of the requester.

A socket can be checked for incoming connection requests using the select() call.
**Return values**
A nonnegative socket descriptor indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>Indicates insufficient buffer space available to create the new socket.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The s parameter is not of type SOCK_STREAM.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using addr and addrlen would result in an attempt to copy the address into a portion of the caller address space to which information cannot be written.</td>
</tr>
<tr>
<td>EWOULDBLOCK</td>
<td>The socket descriptor s is in nonblocking mode, and no connections are in the queue.</td>
</tr>
</tbody>
</table>

**Example**
Following are two examples of the accept() call. In the first, the caller wishes to have the requester's address returned. In the second, the caller does not want the requester address returned.

```c
int clientsocket;
int s;
struct sockaddr clientaddress;
int addrlen;
int accept(int s, struct sockaddr *addr, int *addrlen);
/* socket(), bind(), and listen() have been called */
/* EXAMPLE 1: I want the address now */
addrlen = sizeof(clientaddress);
clientsocket = accept(s, &clientaddress, &addrlen)
/* EXAMPLE 2: I can get the address later using getpeername() */
addrlen = 0;
clientsocket = accept(s, (struct sockaddr *) 0, (int *) 0);
```

**Related calls**
bind(), connect(), getpeername(), listen(), socket()
bind()

The bind() call binds a unique local name to the socket using descriptors. After calling socket(), the descriptor does not have a name associated with it. However, it does belong to a particular addressing family, as specified when socket() is called. The exact format of a name depends on the addressing family. The bind() call also allows servers to specify the network interfaces from which they want to receive UDP packets and TCP connection requests.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
int bind(int s, struct sockaddr *name, int namelen)

Parameter | Description
------- | -------
s | Socket descriptor returned by a previous socket() call
name | Points to a sockaddr structure containing the name to be bound to s
namelen | Size of name in bytes

The s parameter is a socket descriptor of any type created by calling socket().

The name parameter points to a buffer containing the name to be bound to s. The namelen parameter is the size, in bytes, of the buffer pointed to by name.

Related information

Socket descriptor created in the AF_INET domain

If the socket descriptor s was created in the AF_INET domain, then the format of the name buffer is expected to be sockaddr_in, as defined in the header file IN.H.

struct in_addr
{
    u_long s_addr;
};
struct sockaddr_in
{
    short sin_family;
    u_short sin_port;
    struct in_addr sin_addr;
    char sin_zero[8];
};

The sin_family field must be set to AF_INET.

The sin_port field identifies the port to which the application must bind. It must be specified in network byte order. If sin_port is set to 0, the caller expects the system to assign an available port. The application can call getsockname() to discover the port number assigned.

The in_addr sin_addr field is set to the internet address and must be specified in network byte order. On hosts with more than one network interface (called multihomed hosts), a caller can select the interface to which it should bind. Subsequently, only UDP packets and TCP connection requests from this interface (the one value matching the bound name) are routed to the application. If this field is set to the constant INADDR_ANY, as defined in IN.H, the caller is requesting that the socket be bound to all network interfaces on the host. Subsequently, UDP
packets and TCP connections from all interfaces matching the bound name are routed to the application. This becomes important when a server offers a service to multiple networks. By leaving the address unspecified, the server can accept all UDP packets and TCP connection requests made of its port, regardless of the network interface on which the requests arrived.

The sin_zero field is not used and should be set to all zeros.

**Socket descriptor created in the AF_IUCV domain**

If the socket descriptor $s$ is created in the AF_IUCV domain, the format of the name buffer is expected to be sockaddr_iucv, as defined in the header file SAIUCV.H.

```c
struct sockaddr_iucv
{
    short    siucv_family;  /* addressing family */
    unsigned short    siucv_port;  /* port number */
    unsigned long    siucv_addr;    /* address */
    unsigned char    siucv_nodeid[8]; /* nodeid to connect to */
    unsigned char    siucv_userid[8]; /* userid to connect to */
    unsigned char    siucv_name[8];  /* iucvname for connect */
};
```

- The *siucv_family* field must be set to AF_IUCV.
- The *siucv_port*, *siucv_addr*, and *siucv_nodeid* fields are reserved for future use.
- The *siucv_port* and *siucv_addr* fields must be set to zero.
- The *siucv_nodeid* field must be set to exactly eight blank characters.
- The *siucv_userid* field is set to the MVS user ID of the application making the bind call. This field must be eight characters long, padded with blanks to the right. It cannot contain the NULL character.
- The *siucv_name* field is set to the application name by which the socket is to be known. It must be unique, because only one socket can be bound to a given name. The recommended form of the name contains eight characters, padded with blanks to the right. The eight characters for a connect() call executed by a client must exactly match the eight characters passed in the bind() call executed by the server.

**Note:** Internally, dynamic names are built using hexadecimal character strings representing the internal storage address of the socket. You should choose names that contain at least one non-hexadecimal character to prevent potential conflict. Hexadecimal characters include 0–9, and a–f. Uppercase A–F are considered non-hexadecimal and can be used by the user to build dynamic names.

**Return values**

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The $s$ parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EADDRNOTAVAIL</td>
<td>The address specified is not valid on this host. For example, the internet address does not specify a valid network interface.</td>
</tr>
</tbody>
</table>
EFAULT
   The name or namelen parameter specified an address outside of the caller
   address space.

EAFNOSUPPORT
   The address family is not supported (it is not AF_INET).

EADDRINUSE
   The address is already in use. See the SO_REUSEADDR option described
   under "getsockopt()" on page 152 and the SO_REUSEADDR option
   described under the "setsockopt()" on page 204 for more information. This
   Errno might also be returned if the port is configured as RESERVED on a
   port reservation statement in the TCP/IP profile. For more information,
   refer to the TCP/IP profile (PROFILE.TCPIP) and configuration statement
   information in the z/OS Communications Server: IP Configuration Reference

EINVAL
   The socket is already bound to an address. For example, an attempt to
   bind a name to a socket that is in the connected state.

Example
   Following are examples of the bind() call. The internet address and port must be in
   network byte order. To put the port into network byte order, the htons() utility
   routine is called to convert a short integer from host byte order to network byte
   order. The address field is set using another utility routine, inet_addr(), which takes
   a character string representing the dotted decimal address of an interface and
   returns the binary internet address representation in network byte order. Finally, it
   is a good idea to clear the structure before using it to ensure that the name
   requested does not set any reserved fields. See "connect()" on page 122 for
   examples how a client might connect to servers.

   This example illustrates the bind() call binding to interfaces in the AF_INET
   domain.
   int rc;
   int s;
   struct sockaddr_in myname;
   struct sockaddr_in mymynames;
   int bind(int s, struct sockaddr *name, int namelen);
   /* Bind to a specific interface in the internet domain */
   /* make sure the sin_zero field is cleared */
   memset(&myname, 0, sizeof(myname));
   myname.sin_family = AF_INET;
   myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
   myname.sin_port = htons(1024);
   ...
   rc = bind(s, (struct sockaddr *) &myname, sizeof(mymynames));
   /* Bind to all network interfaces in the internet domain */
   /* make sure the sin_zero field is cleared */
   memset(&myname, 0, sizeof(myname));
   myname.sin_family = AF_INET;
   myname.sin_addr.s_addr = INADDR_ANY; /* specific interface */
   myname.sin_port = htons(1024);
   ...
   rc = bind(s, (struct sockaddr *) &myname, sizeof(mynames));
   /* Bind to a specific interface in the internet domain. */
   Let the system choose a port
   /* make sure the sin_zero field is cleared */
   memset(&myname, 0, sizeof(myname));
   myname.sin_family = AF_INET;
   myname.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
   myname.sin_port = 0;
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));

This example illustrates the bind() call binding to interfaces in the AF_IUCV domain.

/* Bind to a name in the IUCV domain */
/* make sure the siucv_addr, siucv_port fields are zeroed and the
  siucv_nodeid fields is set to blanks */
memset(&mymvsname, 0, sizeof(mymvsname));
strncpy(mymvsname.siucv_nodeid, "", 8);
strncpy(mymvsname.siucv_userid, "", 8);
strncpy(mymvsname.siucv_name, "", 8);
mymvsname.siucv_family = AF_IUCV;
strncpy(mymvsname.siucv_userid, "MVSUSER1", 8);
strncpy(mymvsname.siucv_name, "APPL", 4);
rc = bind(s, (struct sockaddr *) &myname, sizeof(myname));

The binding of a stream socket is not complete until a successful call to bind(),
listen(), or connect() is made. Applications using stream sockets should check the
return values of bind(), listen(), and connect() before using any function that
requires a bound stream socket.

**Related calls**
gethostbyname(), getsockname(), htonl(), inet_addr(), listen(), socket()
close()

The close() call shuts down the socket associated with the socket descriptor s and frees resources allocated to the socket. If s refers to an open TCP connection, the connection is closed. If a stream socket is closed when there is input data queued, the TCP connection is reset, not cleanly closed.

If you specify 0 on SO_LINGER on the setsockopt() call, the data is canceled and the CLOSE is immediately returned. If you do not specify a value for SO_LINGER on the setsockopt() call, the CLOSE returns and TCP/IP tries to immediately resend the data.

Note: Issue a shutdown() call before issuing a close() call for any socket.

```
#include <manifest.h>
#include <socket.h>
int close(int s)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Descriptor of the socket to be closed</td>
</tr>
</tbody>
</table>

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
</tbody>
</table>

**Related calls**
accept(), getsockopt(), setsockopt(), socket()
connect()

For stream sockets, the connect() call attempts to establish a connection between two sockets. For UDP sockets, the connect() call specifies the peer for a socket. The s parameter is the socket used to originate the connection request. The connect() call performs two tasks when called for a stream socket. First, it completes the binding necessary for a stream socket [in case it has not been previously bound using the bind() call]. Second, it attempts to connect to another socket.

The connect() call on a stream socket is used by the client application to connect to a server. The server must have a passive open pending. If the server is using sockets, this means the server must successfully call bind() and listen() before a connection can be accepted by the server using accept(). Otherwise, connect() returns -1 and errno is set to ECONNREFUSED.

If s is in blocking mode, the connect() call blocks the caller until the connection is set up, or until an error is received. If the socket is in nonblocking mode, then connect() returns -1 with errno set to EINPROGRESS if the connection can be initiated (no other errors occurred). The caller can test completion of the connection setup by calling select() and testing ability to write to the socket.

When called for a datagram or raw socket, connect() specifies the peer with which this socket is associated. This gives the application the ability to use data transfer calls reserved for sockets that are in the connected state. In this case, read(), write(), readv(), writev(), send(), and recv() calls are available in addition to sendto(), recvfrom(), sendmsg(), and recvmsg() calls. Stream sockets can call connect() only once, but datagram sockets can call connect() multiple times to change their association. Datagram sockets can dissolve their association by connecting to an incorrect address, such as a null address (all fields cleared).

```
#include <manifest.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

int connect(int s, struct sockaddr *name, int namelen)
```

**Parameter**  
**Description**

s  
Socket descriptor

name  
Points to a socket address structure containing the address of the socket to which connection will be attempted

namelen  
Size of the socket address, in bytes, pointed to by name

The name parameter points to a buffer containing the name of the peer to which the application needs to connect. The namelen parameter is the size, in bytes, of the buffer pointed to by name.

**Related information**

Servers in the AF_INET domain

If the server is in the AF_INET domain, the format of the name buffer is expected to be sockaddr_in as defined in the header file IN.H.

```
struct in_addr
{
    u_long s_addr;
```
struct sockaddr_in {
    short sin_family;
    u_short sin_port;
    struct in_addr sin_addr;
    char sin_zero[8];
};

The `sin_family` field must be set to AF_INET. The `sin_port` field identifies the port to which the server is bound; it must be specified in network byte order. The `sin_addr` field specifies a 32-bit Internet address. The `sin_zero` field is not used, and must be set to all zeros.

**Servers in the AF_IUCV domain**

If the server is in the AF_IUCV domain, the format of the name buffer is expected to be `sockaddr_iucv` as defined in the header file SAIUCV.H.

```c
struct sockaddr_iucv {
    short siucv_family; /* addressing family */
    unsigned short siucv_port; /* port number */
    unsigned long siucv_addr; /* address */
    unsigned char siucv_nodeid[8]; /* nodeid to connect to */
    unsigned char siucv_userid[8]; /* userid to connect to */
    unsigned char siucv_name[8]; /* iucvname for connect */
};
```

The `siucv_family` field must be set to AF_IUCV.

**Note:** The `siucv_port`, `siucv_addr`, and `siucv_nodeid` fields are reserved for future use. The `siucv_port` and `siucv_addr` fields must be set to 0. Set the `siucv_nodeid` field to exactly eight blank characters. The `siucv_userid` field is set to the MVS user ID of the application to which the application is requesting a connection. This field must be eight characters long, padded with blanks to the right. It cannot contain the null character. The `siucv_name` field is set to the application name by which the server socket is known. The name should exactly match the eight characters passed in the `bind()` call executed by the server.

**Return values**

The value 0 indicates success; the value -1 indicates an error. `Errno` identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EADDRNOTAVAIL</td>
<td>Calling host cannot reach the specified destination.</td>
</tr>
<tr>
<td>EAFNOSUPPORT</td>
<td>Address family is not supported.</td>
</tr>
<tr>
<td>EALREADY</td>
<td>Socket descriptor s is marked nonblocking, and a previous connection attempt is incomplete.</td>
</tr>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>ECONNREFUSED</td>
<td>The connection request was rejected by the destination host.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>The name or <code>namelen</code> parameter specified an address outside of the caller address space.</td>
</tr>
</tbody>
</table>
EINPROGRESS
The socket descriptor \( s \) is marked nonblocking, and the connection cannot be completed immediately. The EINPROGRESS value does not indicate an error.

EISCONN  Socket descriptor \( s \) is already connected.

ENETUNREACH  Network cannot be reached from this host.

ETIMEDOUT  Connection attempt timed out before the connection was made.

**Example**
Following is a connect() call example. The internet address and port must be in network byte order. To put the port into network byte order, the htons() utility is called to convert a short integer from host byte order to network byte order. The address field is set using another utility, inet_addr(), which takes a character string representing the dotted decimal address of an interface and returns the binary internet address in network byte order. Set the structure to 0 before using it to ensure that the name requested does not set any reserved fields.

These examples could be used to connect to the servers shown in the examples listed with the call `bind()` on page 117:

```c
int s;
struct sockaddr_in servername;
struct sockaddr_iucv mvsservername;
int rc;
int connect(int s, struct sockaddr *name, int namelen);
/* Connect to server bound to a specific interface in the internet domain */
/* make sure the sin_zero field is cleared */
memset(&servername, 0, sizeof(servername));
servername.sin_family = AF_INET;
servername.sin_addr = inet_addr("129.5.24.1"); /* specific interface */
servername.sin_port = htons(1024);
... rc = connect(s, (struct sockaddr *) &servername, sizeof(servername));
/* Connect to a server bound to a name in the IUCV domain */
/* make sure the siucv_addr, siucv_port, siucv_nodeid fields are cleared */
memset(&mvsservername, 0, sizeof(mvsservername));
mvsservername.siucv_family = AF_IUCV;
strncpy(mvsservername.siucv_userid, "MVSUSER1", 8); /* The field is 8 positions padded to the right with blanks */
strncpy(mvsservername.siucv_name, "APPL", 8);
... rc = connect(s, (struct sockaddr *) &mvsservername, sizeof(mvsservername));
```

**Related calls**
bind(), htons(), inet_addr(), listen(), select(), selectex(), socket()
endhostent()

When indicated by sethostent(), the endhostent() call frees the cached information for the local host tables. The endhostent() call is available only where RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>
void endhostent()
```

**Parameters**

None

**Related calls**

gethostbyname(), gethostent(), sethostent()
endnetent()

When indicated by setnetent(), the endnetent() call frees the cached information for the local host tables. The endnetent() call is available only where RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information on using local host tables.

#include <manifest.h>
#include <socket.h>
void endnetent()

Parameters
None

Related calls
getnetbyname(), getnetent(), setnetent()
The endprotoent() call closes the hlq.ETC.PROTO data set.

The hlq.ETC.PROTO data set contains information about networking protocols IP, ICMP, TCP, and UDP.

```
#include <manifest.h>
#include <socket.h>
void endprotoent()
```

**Parameters**
None

**Related calls**
getprotoent(), setprotoent()
endservent()

The endservent() call closes the hlq.ETC.SERVICES data set.

The hlq.ETC.SERVICES data set contains information about the networking services running on the host. Example services are domain name server, FTP, and Telnet.

```
#include <manifest.h>
#include <socket.h>
void endservent()
```

Parameters
None

Related calls
getservbyport(), getservent(), setservent()
fcntl()

The operating characteristics of sockets can be controlled with the fcntl() call.

Note: COMMAND values that are supported by the UNIX Systems Services fcntl() callable service are also supported.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <fcntl.h>
int fcntl(int s, int cmd, int arg)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor</td>
</tr>
<tr>
<td>cmd</td>
<td>Command to perform</td>
</tr>
<tr>
<td>arg</td>
<td>Data associated with cmd</td>
</tr>
</tbody>
</table>

The operations to be controlled are determined by cmd. The arg parameter is a variable, the meaning of which depends on the value of the cmd parameter. The following are valid fcntl() commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F_SETFL</td>
<td>Sets the status flags of socket descriptor s. (One flag, FNDELAY, can be set.)</td>
</tr>
<tr>
<td>F_GETFL</td>
<td>Returns the status flags of socket descriptor s. (One flag, FNDELAY, can be queried.)</td>
</tr>
</tbody>
</table>

The FNDELAY flag marks s as being in nonblocking mode. If data is not present on calls that can block [read(), readv(), and recv()] the call returns with -1, and errno is set to EWOULDBLOCK.

Note: This function does not reject other values that might be rejected downstream.

**Return values**

For the F_GETFL command, the return value is the flags, set as a bit mask. For the F_SETFL command, the value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The arg parameter is not a valid flag, or the command is not a valid command.</td>
</tr>
</tbody>
</table>

**Example**

```
int s;
int rc;
int flags;
;
/* Place the socket into nonblocking mode */
rc = fcntl(s, F_SETFL, FNDELAY);
/* See if asynchronous notification is set */
flags = fcntl(s, F_GETFL, 0);
if (flags & FNDELAY)
  /* it is set */
else
  /* it is not */
```
Related calls
ioctl(), getsockopt(), setsockopt(), socket()
getclientid()

The getclientid() call returns the identifier by which the calling application is known to the TCP/IP address space. The *clientid* is used in givesocket() and takesocket() calls.

```c
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
int getclientid(int domain, struct clientid *clientid)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>domain</td>
<td>The value in <em>domain</em> must be AF_INET.</td>
</tr>
<tr>
<td>clientid</td>
<td>Points to a <em>clientid</em> structure to be provided.</td>
</tr>
</tbody>
</table>

**Return values**

The value 0 indicates success. The value -1 indicates an error. *Errno* identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFAULT</td>
<td>The <em>clientid</em> parameter as specified would result in an attempt to access storage outside the caller address space, or storage that cannot be modified by the caller.</td>
</tr>
<tr>
<td>EAFNOSUPPORT</td>
<td>The domain is not AF_INET.</td>
</tr>
</tbody>
</table>

**Related calls**
takesocket()
getdtablesizex()

The TCPII address space reserves a fixed-size table for each address space using sockets. The size of this table equals the number of sockets an address space can allocate simultaneously. The getdtablesizex() call returns the maximum number of sockets that can fit in the table.

To increase the table size, use maxdescx(). After calling maxdescx(), always use getdtablesizex() to verify the change.

```
#include <manifest.h>
#include <socket.h>
int getdtablesizex()
```

**Parameters**
None

**Related calls**
maxdescx()
gethostbyaddr()

The gethostbyaddr() call tries to resolve the IP address to a host name. The resolution attempted depends on how the resolver is configured and if any local host tables exist. If the symbol RESOLVE_VIA_LOOKUP is defined before including MANIFEST.H, gethostbyaddr() only uses local host tables and name servers are not used. Refer to the z/OS Communications Server: IP Configuration Guide for information on configuring the resolver and using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostbyaddr(char *addr, int addrlen, int domain)
```

Parameter Description
addr Points to an unsigned long value containing the address of the host
addrlen Size of addr in bytes
domain Address domain supported (AF_INET)

The gethostbyaddr() call points to hostent structure for the host address specified on the call.

The NETDB.H header file defines the hostent structure, and contains the following elements:

Element Description
h_name The address of the official name of the host
h_aliases A pointer to a zero-terminated list of addresses pointing to alternate names for the host
h_addrtype The type of host address returned; currently, always set to AF_INET
h_length The length of the host address, in bytes
h_addr A pointer to a zero-terminated list of addresses pointing to the internet host addresses returned by the call

Return values
The return value points to static data that is overwritten by subsequent calls. A pointer to a hostent structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate: the output from a tcperror() call cannot be validated. The global variable h_errno identifies the specific error.

h_errno Description
HOST_NOT_FOUND The name specified is unknown, the address domain specified is not supported, or the address length specified is not valid.
TRY_AGAIN Temporary error; information not currently accessible.
NO_RECOVERY Fatal error occurred.

Related calls
gethostent(), sethostent(), endhostent()
The gethostbyname() call tries to resolve the host address to an IP address. The resolution attempted depends on how the resolver is configured and if any local host tables exist. If the symbol RESOLVE_VIA_LOOKUP is defined before including MANIFEST.H, gethostbyname() only uses local host tables and name servers are not used. Refer to the [z/OS Communications Server: IP Configuration Guide](https://www.ibm.com) for information about configuring the resolver and using local host tables.

```c
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostbyname(char *name)
```

### Parameter Description

**name**
The name of the host being queried. Any trailing blanks will be removed from the specified name prior to trying to resolve it to an IP address. The maximum host name length is 255 characters.

The gethostbyname() call returns a pointer to a `hostent` structure for the host name specified on the call.

The NETDB.H header file defines the `hostent` structure and contains the following elements:

### Element Description

- **h_name**
The address of the official name of the host
- **h_aliases**
  A pointer to a zero-terminated list of addresses pointing to alternate names for the host
- **h_addrtype**
The type of host address returned; currently, set to AF_INET
- **h_length**
The length of the host address in bytes
- **h_addr**
  A pointer to the network address of the host

### Return values
The return value points to static data that is overwritten by subsequent calls. A pointer to a `hostent` structure indicates success. A NULL pointer indicates an error or EOF. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid. Global variable h_errno identifies the specific error.

```c
h_errno Value Description
HOST_NOT_FOUND The name specified is unknown.
TRY_AGAIN Temporary error; information not currently accessible.
NO_RECOVERY Fatal error occurred.
```

### Related calls
`gethostent()`, `sethostent()`, `endhostent()`
gethostent()

The gethostent() call returns the next line in the local host table for a host name and points to the next host entry in the local host table. The gethostent() call also returns any aliases. The gethostent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information on using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct hostent *gethostent()
```

The NETDB.H header file defines the hostent structure and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>h_name</td>
<td>The address of the official name of the host</td>
</tr>
<tr>
<td>h_aliases</td>
<td>A pointer to a zero-terminated list of addresses pointing to alternate names for the host</td>
</tr>
<tr>
<td>h_addrtype</td>
<td>The type of host address returned; currently set to AF_INET</td>
</tr>
<tr>
<td>h_length</td>
<td>The length of the host address, in bytes</td>
</tr>
<tr>
<td>h_addr</td>
<td>A pointer to the network address of the host</td>
</tr>
</tbody>
</table>

Return values
The return value points to static data that is overwritten by subsequent calls. A pointer to a hostent structure indicates success. A NULL pointer indicates an error or EOF. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid.

Related calls
gethostbyname(), sethostent()
gethostid()

The gethostid() call returns the 32-bit identifier unique to the current host. This value is the default home internet address.

This call can be used only in the AF_INET domain.

```c
#include <manifest.h>
#include <socket.h>
unsigned long gethostid()
```

**Return values**
The gethostid() call returns the 32-bit identifier of the current host, which should be unique across all hosts. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and, therefore, the output from a tcperror() call is also not valid.

**Related calls**
gethostname()
gethostname()

The gethostname() call returns the name of the host processor on which the program is running. Characters to the limit of namelen are copied into the name array. The value returned for host name is limited to 24 characters. The returned name is NULL-terminated unless truncated to the size of the name array.

Note: The host name returned is the host name the TCPIP stack learned at startup from the TCPIP:DATA file that was found.

This call can be used only in the AF_INET domain.

Errno EINVAL is returned when namelen is 0, or greater than 255 characters.

```
#include <manifest.h>
#include <socket.h>
int gethostname(char *name, int namelen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>Character array to be filled with the host name</td>
</tr>
<tr>
<td>namelen</td>
<td>Length of name; restricted to 255 characters</td>
</tr>
</tbody>
</table>

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFAULT</td>
<td>The name parameter specified an address outside the caller address space.</td>
</tr>
</tbody>
</table>

**Related calls**
gethostbyname(), gethostid()
getibmopt()

The getibmopt() call returns the number of TCP/IP images installed on a given MVS system, and their status, version, and name.

**Note:** Images from pre-V3R2 releases of TCP/IP for MVS are excluded. The getibmopt() call is not meaningful to pre-V3R2 releases.

Using this information, the caller can dynamically choose the TCP/IP image with which to connect through the setibmopt() call. The getibmopt() call is optional. If it is not used, determine the connecting TCP/IP image as follows:

- Connect to the TCP/IP specified TCPIPJOBNAME in the active TCPIP:DATA file.

For detailed information about this method, refer to [z/OS Communications Server: New Function Summary](https://www.ibm.com/support/docview.wss?uid=swg21278588).

```c
#include <manifest.h>
#include <socket.h>

int getibmopt(int cmd, struct ibm_gettcpinfo *buf)
{
    struct ibm_tcpiimage {
        unsigned short status;
        unsigned short version;
        char name[8];
    }
    struct ibm_gettcpinfo {
        int tcpcnt;
        struct ibm_tcpiimage image[8];
    }

    Parameter          Description
    ------------        ---------
    cmd                The command to perform. For TCP/IP V3R2 for MVS, IBMTCP_IMAGE is supported.
    buf                Points to the structure filled in by the call.

    The `buf` parameter is a pointer to the (struct ibm_gettcpinfo) buffer into which the TCP/IP image status, version, and name are placed.

    On successful return, the struct ibm_tcpiimage buffer contains the status, version, and name of up to eight active TCP/IP images.

    The status field can contain the following information:

    **Status Field**      **Meaning**
    ----------------------
    X'8xxx'                Active
    X'4xxx'                Terminating
    X'2xxx'                Down
    X'1xxx'                Stopped or stopping

    **Note:** In the above status fields, xxx is reserved for IBM use and can contain any value.
```
When this field returns with a combination of Down and Stopped, TCP/IP was abended. Value stopped, when returned alone, indicates that TCP/IP has been stopped only.

The version field for z/OS V1R7 is X'0617'.

The TCP/IP character name field is the PROC name, left-justified, and padded with blanks.

The tcpcnt field of struct ibm_gettcpinfo is a count field into which the TCP/IP image count is placed. The caller uses this value to determine how many entries in the ibm_tcpimage structure of buf have been filled. If the tcpcnt returned is 0, there are no TCP/IP images present.

**Return values**

Zero indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOPNOTSUPP</td>
<td>This is returned for command that is not valid.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>The name parameter specified an address outside of the caller address space.</td>
</tr>
</tbody>
</table>
**getibmsockopt()**

Like `getsockopt()` call, the `getibmsockopt()` call gets the options associated with a socket in the AF_INET domain. This call is for options specific to the IBM implementation of sockets. Currently, only the SOL_SOCKET level is supported.

This call can be used only in the AF_INET domain.

```c
#include <manifest.h>
#include <socket.h>
int getibmsockopt(int s, int level, int optname, char *optval, int *optlen)
```

**Parameter**
- `s`: The socket descriptor
- `level`: The level for which the option is set
- `optname`: The name of a specified socket option
- `optval`: Points to option data
- `optlen`: Points to the length of the option data

**Return values**
The value 0 indicates success; the value -1 indicates an error. `Errno` identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using optval and optlen parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>This is returned when optlen points to a length of 0.</td>
</tr>
</tbody>
</table>

**Example**

```c
#include <manifest.h>
#include <socket.h>
#include <tcperror.h>
{ struct ibm_bulkmode_struct bulkstr;
  int optlen, rc;
  optlen = sizeof(bulkstr);
  rc = getibmsockopt(s, SOL_SOCKET, (char *), &bulkstr, &optlen);
  if (rc < 0)
    { tcperror("on getibmsockopt()");
      exit(1);
    }
  fprintf(stream, "%d byte buffer available for outbound queue.\n",
            bulkstr.b_max_send_queue_size_avail);
} 
```

**Related calls**
- `ibmsflush()`, `setibmsockopt()`, `getsockopt()`
getnetbyaddr()

The getnetbyaddr() call searches the local host tables for the specified network address. This call can be used only in the AF_INET domain. Refer to the Communications Server: IP Configuration Guide for information on using local host tables.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <netdb.h>
struct netent *getnetbyaddr(unsigned long net, int type)
```

Parameter | Description
---|---
net | The network address
type | The address domain supported (AF_INET)

The `netent` structure is defined in the NETDB.H header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n_name</td>
<td>The official name of the network.</td>
</tr>
<tr>
<td>n_aliases</td>
<td>An array, terminated with a NULL pointer, of alternative names for the network.</td>
</tr>
<tr>
<td>n_addrtype</td>
<td>The type of network address returned. The call always sets this value to AF_INET.</td>
</tr>
<tr>
<td>n_net</td>
<td>The network number, returned in host byte order.</td>
</tr>
</tbody>
</table>

**Return values**

The return value points to static data that is overwritten by subsequent calls. A pointer to a `netent` structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

**Related calls**

endnetent(), getnetbyname(), getnetent(), setnetent(), endhostent()
getnetbyname()

The getnetbyname() call searches the local host tables for the specified network
name. This call can be used only in the AF_INET domain. Refer to the z/OS
Communications Server: IP Configuration Guide for information about using local host
tables.

```c
#include <manifest.h>
#include <netdb.h>
struct netent *getnetbyname(char *name)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>Points to a network name.</td>
</tr>
</tbody>
</table>

The getnetbyname() call returns a pointer to a netent structure for the network
name specified on the call.

The netent structure is defined in the NETDB.H header file and contains the
following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n_name</td>
<td>The official name of the network.</td>
</tr>
<tr>
<td>n_aliases</td>
<td>An array, terminated with a NULL pointer, of alternative names for the network.</td>
</tr>
<tr>
<td>n_addrtype</td>
<td>The type of network address returned. The call always sets this value to AF_INET.</td>
</tr>
<tr>
<td>n_net</td>
<td>The network number, returned in host byte order.</td>
</tr>
</tbody>
</table>

**Return values**
The return value points to static data that is overwritten by subsequent calls. A
pointer to a netent structure indicates success. A NULL pointer indicates an error or
end-of-file. When a NULL pointer or 0 is returned, the value of errno is
indeterminate, and therefore, the output from a tcperror() call cannot be validated.

**Related calls**
endnetent(), getbyaddr(), getent(), setnetent(), endhostent()
getnetent()

The getnetent() call returns the next line in the local host table for a network name and points to the next network entry in the local host table. The getnetent() call also returns any aliases. The getnetent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information on using local host tables.

```
#include <manifest.h>
#include <netdb.h>
struct netent *getnetent()
```

The netent structure is defined in the NETDB.H header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n_name</td>
<td>The official name of the network.</td>
</tr>
<tr>
<td>n_aliases</td>
<td>An array, terminated with a NULL pointer, of alternative names for the network.</td>
</tr>
<tr>
<td>n_addrtype</td>
<td>The type of network address returned. The call always sets this value to AF_INET.</td>
</tr>
<tr>
<td>n_net</td>
<td>The network number, returned in host byte order.</td>
</tr>
</tbody>
</table>

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a netent structure indicates success. A NULL pointer indicates an error or end-of-file.

Related calls

endnetent(), getnetbyaddr(), getnetbyname(), setnetent(), endhostent()
getpeernam()  

The getpeernam() call returns the name of the peer connected to socket descriptor s. For AF_IUCV, namelen must be initialized to reflect the size of the space pointed to by name; it is set to the number of bytes copied into the space before the call returns. For AF_INET, the input value in the contents of namelen are ignored, but are set before the call returns. The size of the peer name is returned in bytes. If the buffer of the local host is too small to receive the entire peer name, the name is truncated.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
int getpeername(int s, struct sockaddr *name, int *namelen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>The socket descriptor.</td>
</tr>
<tr>
<td>name</td>
<td>Points to a structure containing the internet address of the connected socket that is filled in by getpeername() before it returns. The exact format of name is determined by the domain in which communication occurs.</td>
</tr>
<tr>
<td>namelen</td>
<td>Points to a fullword containing the size of the address structure pointed to by name in bytes.</td>
</tr>
</tbody>
</table>

**Return values**

The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the name and namelen parameters as specified would result in an attempt to access storage outside of the caller address space.</td>
</tr>
<tr>
<td>ENOTCONN</td>
<td>The socket is not in the connected state.</td>
</tr>
</tbody>
</table>

**Related calls**

accept(), connect(), getsockname(), socket()
getprotobynumber()

The getprotobynumber() call searches the hlq.ETC.PROTO data set for the specified protocol name.

The getprotobynumber() call returns a pointer to a protoent structure for the network protocol specified on the call.

#include <manifest.h>
#include <netdb.h>
struct protoent *getprotobynumber(char *name)

Parameter Description
name Points to the specified protocol.

The protoent structure is defined in the NETDB.H header file and contains the following elements:

Element Description
p_name The official name of the protocol
p_aliases An array, terminated with a NULL pointer, of alternative names for the protocol
p_proto The protocol number

Return values
The return value points to static data that is overwritten by subsequent calls. A pointer to a protoent structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls
deprotoent(), getprotobynumber(), getprotoent(), setprotoent()
getprotobynumber()

The getprotobynumber() call searches the hlq.ETC.PROTO data set for the specified protocol number.

The getprotobynumber() call returns a pointer to a protoent structure for the network protocol specified on the call.

```
#include <manifest.h>
#include <netdb.h>
struct protoent *getprotobynumber(int proto)
```

Parameter | Description  
---|---
proto     | Protocol number

The protoent structure is defined in the NETDB.H header file and contains the following elements:

Element | Description  
---|---
p_name | The official name of the protocol
p_aliases | An array, terminated with a NULL pointer, of alternative names for the protocol
p_proto | The protocol number

Return values
The return value points to static data that is overwritten by subsequent calls. A pointer to a protoent structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls
endprotoent(), getprotobyname(), getprotoent(), setprotoent()
getprotoent()

The getprotoent() call reads the hlq.ETC.PROTO data set, and the getprotoent() call returns a pointer to the next entry in the hlq.ETC.PROTO data set.

```c
#include <manifest.h>
#include <netdb.h>
struct protoent *getprotoent()
```

The `protoent` structure is defined in the NETDB.H header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>p_name</code></td>
<td>The official name of the protocol</td>
</tr>
<tr>
<td><code>p_aliases</code></td>
<td>An array, terminated with a NULL pointer, of alternative names for the protocol</td>
</tr>
<tr>
<td><code>p_proto</code></td>
<td>The protocol number</td>
</tr>
</tbody>
</table>

Return values

The return value points to static data that is overwritten by subsequent calls. A pointer to a `protoent` structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

`endprotoent(), getprotobyname(), getprotobynumber(), setprotoent()`
getservbyname()

The getservbyname() call searches the hlq.ETC.SERVICES data set for the specified service name. Service name searches must match the protocol, if a protocol is stated.

The getservbyname() call returns a pointer to a servent structure for the network service specified on the call.

```c
#include <manifest.h>
#include <netdb.h>
struct servent *getservbyname(char *name, char *proto)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>Points to the specified service name</td>
</tr>
<tr>
<td>proto</td>
<td>Points to the specified protocol</td>
</tr>
</tbody>
</table>

The servent structure is defined in the NETDB.H header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s_name</td>
<td>The official name of the service</td>
</tr>
<tr>
<td>s_aliases</td>
<td>An array, terminated with a NULL pointer, of alternative names for the service</td>
</tr>
<tr>
<td>s_port</td>
<td>The port number of the service</td>
</tr>
<tr>
<td>s_proto</td>
<td>The protocol required to contact the service</td>
</tr>
</tbody>
</table>

**Return values**
The return value points to static data that is overwritten by subsequent calls. Points to a servent structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

**Related calls**
endservant(), getsvbyport(), getservent(), setservent()
getservbyport()

The `getservbyport()` call searches the `hlq.ETC.SERVICES` data set for the specified port number. Searches for a port number must match the protocol, if a protocol is stated.

The `getservbyport()` call returns a pointer to a `servent` structure for the port number specified on the call.

```c
#include <manifest.h>
#include <netdb.h>
struct servent *getservbyport(int port, char *proto)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>port</code></td>
<td>Port number</td>
</tr>
<tr>
<td><code>proto</code></td>
<td>Points to the specified protocol</td>
</tr>
</tbody>
</table>

The `servent` structure is defined in the `NETDB.H` header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>s_name</code></td>
<td>The official name of the service</td>
</tr>
<tr>
<td><code>s_aliases</code></td>
<td>An array, terminated with a NULL pointer, of alternative names for the service</td>
</tr>
<tr>
<td><code>s_port</code></td>
<td>The port number of the service</td>
</tr>
<tr>
<td><code>s_proto</code></td>
<td>The protocol required to contact the service</td>
</tr>
</tbody>
</table>

**Return values**

The return value points to static data that is overwritten by subsequent calls. Points to a `servent` structure indicates success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of `errno` is indeterminate, and therefore, the output from a `tcperror()` call cannot be validated.

**Related calls**

`endservant()`, `getservbyname()`, `getservent()`, `setservent()`
getservent()

The getservent() call reads the next line of the hlq.ETC.SERVICES data set and returns a pointer to the next entry in the hlq.ETC.SERVICES data set.

```c
#include <manifest.h>
#include <netdb.h>
struct servent *getservent()
```

The `servent` structure is defined in the NETDB.H header file and contains the following elements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>s_name</code></td>
<td>The official name of the service</td>
</tr>
<tr>
<td><code>s_aliases</code></td>
<td>An array, terminated with a NULL pointer, of alternative names for the service</td>
</tr>
<tr>
<td><code>s_port</code></td>
<td>The port number of the service</td>
</tr>
<tr>
<td><code>s_proto</code></td>
<td>The required protocol to contact the service</td>
</tr>
</tbody>
</table>

Return values

The return value points to static data that is overwritten by subsequent calls. Points to a `servent` structure indicate success. A NULL pointer indicates an error or end-of-file. When a NULL pointer or 0 is returned, the value of errno is indeterminate, and therefore, the output from a tcperror() call cannot be validated.

Related calls

dendservant(), getservbyname(), getservbyport(), setservent()
getsockname()

The getsockname() call stores the current name for the socket specified by the s parameter into the structure pointed to by the name parameter. It returns the address to the socket that has been bound. If the socket is not bound to an address, the call returns with the family set and sets the rest of the structure to 0. For example, an inbound socket in the internet domain would cause the name to point to a sockaddr_in structure with the sin_family field set to AF_INET, and all other fields cleared.

Stream sockets are not assigned a name until a call is successful: bind(), connect(), or accept().

The getsockname() call is often used to discover the port assigned to a socket after the socket has been implicitly bound to a port. For example, an application can call connect() without previously calling bind(). In this case, the connect() call completes the binding necessary by assigning a port to the socket. This assignment can be detected using a call to getsockname().

For AF_IUCV, namelen must be initialized to indicate the size of the space pointed to by name, and is set to the number of bytes copied into the space before the call returns. For AF_INET, the input value in the contents of namelen is ignored, but set before the call returns.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
int getsockname(int s, struct sockaddr *name, int *namelen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>The socket descriptor.</td>
</tr>
<tr>
<td>name</td>
<td>The address of the buffer into which getsockname() copies the name of s.</td>
</tr>
<tr>
<td>namelen</td>
<td>Points to a fullword containing the size of the address structure pointed to by name in bytes.</td>
</tr>
</tbody>
</table>

Return values
A value of 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the name and namelen parameters as specified would result in an attempt to access storage outside of the caller address space.</td>
</tr>
</tbody>
</table>

Related calls
accept(), bind(), connect(), getpeername(), socket()
**getsockopt()**

The getsockopt() call gets options associated with a socket. It can be called only for sockets in the AF_INET domain. This call is not supported in the AF_IUCV domain. While options can exist at multiple protocol levels, they are always present at the highest socket level.

When manipulating socket options, you must specify the level at which the option resides and the name of that option. To manipulate options at the socket level, the level parameter must be set to SOL_SOCKET as defined in SOCKET.H. To manipulate options at the TCP level, the level parameter must be set to IPPROTO_TCP as defined in SOCKET.H. To manipulate options at any other level, such as the IP level, supply the appropriate protocol number for the protocol controlling the option. Currently, the SOL_SOCKET, IPPROTO_TCP, and IPPROTO_IP levels are supported. The getprotobynum() call can be used to return the protocol number for a named protocol.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int getsockopt(int s, int level, char *optname, char *optval, int *optlen)

Parameter   Description
s           The socket descriptor.
level        The level to which the option is set.
optname      The name of a specified socket option. See [Appendix D] for the numeric values of optname.
optval       Points to option data.
optlen       Points to the length of the option data.
```

The `optval` and `optlen` parameters are used to return data used by the particular get command. The `optval` parameter points to a buffer that is to receive the data requested by the get command. The `optlen` parameter points to the size of the buffer pointed to by the `optval` parameter. Initially, this size must be set to the size of that buffer before calling getsockopt(). On return it is set to the size of the data actually returned.

All of the socket level options except SO_LINGER expect `optval` to point to an integer and `optlen` to be set to the size of an integer. When the integer is nonzero, the option is enabled. When it is 0, the option is disabled. The SO_LINGER option expects `optval` to point to a linger structure as defined in SOCKET.H. This structure is defined in the following example:

```c
#include <manifest.h>
struct linger
{   int l_onoff;    /* option on/off */
    int l linger;   /* linger time */
};
```

The `l_onoff` field is set to 0 if the SO_LINGER option is being disabled. A nonzero value enables the option. The `l linger` field specifies the amount of time to linger on close.
The following option is recognized at the TCP level (IPPROTO_TCP):

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP_NODELAY</td>
<td>Returns the status of Nagle algorithm (RFC 896). This option is not</td>
</tr>
<tr>
<td></td>
<td>supported for AF_IUCV sockets.</td>
</tr>
<tr>
<td></td>
<td>When optval is 0, Nagle algorithm is enabled and TCP will wait to</td>
</tr>
<tr>
<td></td>
<td>send small packets of data until the acknowledgment for the previous data is</td>
</tr>
<tr>
<td></td>
<td>received.</td>
</tr>
<tr>
<td></td>
<td>When optval is nonzero, Nagle algorithm is disabled and TCP will</td>
</tr>
<tr>
<td></td>
<td>send small packets of data even before the acknowledgment for previous data</td>
</tr>
</tbody>
</table>
An internal indicator means that for this side of the connection, the link/interface type is one of the following:

- CTC
- HiperSockets™ (iQDIO)
- MPCPTP (including XCF and IUTSAMEH connections)
- Loopback
- Or both partners are owned by the same multi-homed stack

On return, one or more of the following bits are set:

```
00000000 00000000 00000000 00000001'-'SO_CLUSTERCONNTYPE_NONE
00000000 00000000 00000000 00000100'-'SO_CLUSTERCONNTYPE_SAME_CLUSTER
00000000 00000000 00000000 00010000'-'SO_CLUSTERCONNTYPE_SAME_IMAGE
00000000 00000000 00000000 00000100'-'SO_CLUSTERCONNTYPE_INTERNAL
00000000 00000000 00000000 00000001'-'SO_CLUSTERCONNTYPE_NOCONN
```

**Note:** A value of all zeros means that there is no active connection on the socket. This is usually the case for a listening socket. This is also true for a client socket before the client issues connect(). The caller should first check for a returned value of SO_CLUSTERCONNTYPE_NOCONN before checking for any of the other returned indicators.

If getsockopt() (SO_CLUSTERCONNTYPE) is issued before the connection has been established, it results in a return value of 0.

If the application issues getsockopt() (SO_CLUSTERCONNTYPE) on a connected socket, and has received an indication of SO_CLUSTERCONNTYPE_INTERNAL, any subsequent rerouting decisions due to current route failure will either select an alternate route, which is also SO_CLUSTERCONNTYPE_INTERNAL, or fail the connection with no route available indications. This means that when an application has received an indication of SO_CLUSTERCONNTYPE_INTERNAL on a connection, any subsequent rerouting preserves that indication on the new route, or will fail the connection. This ensures that a connection that an application relies on as being internal does not transparently become non-internal due to a routing change.

If the application never issues the new getsockopt() or if the connection was previously reported as not SO_CLUSTERCONNTYPE_INTERNAL, rerouting decisions are made as at present, and the rerouting is transparent to the application as long as any alternate route exists.

**SO_DEBUG**  The sock_debug() call provides the socket library tracing facility. The onoff parameter can have a value of 0 or nonzero. When onoff=0 (the default), no socket library tracing is done; when onoff=nonzero, the system traces for socket library calls and interrupts.

**SO_ERROR**  Returns any error pending on the socket and clears the error status. It can be used to check for asynchronous errors on connected datagram sockets and for other asynchronous errors (errors returned explicitly by one of the socket calls).

**SO_KEEPALIVE**  Toggles the TCP keep alive mechanism for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet along an otherwise idle connection. If
the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.

**SO_LINGER**  
Lingers on close if data is present. The default is *disabled*. When this option is enabled and there is unsent data present when close() is called, the calling application is blocked during the close() call until the data is transmitted, or the connection has timed out. If this option is disabled, the close() call returns without blocking the caller and the TCP/IP address space still waits before trying to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits only a finite amount of time while trying to send the data. This option has meaning only for stream sockets.

**SO_OOBINLINE**  
Toggles reception of out-of-band data. The default is *disabled*. When this option is enabled, it causes out-of-band data to be placed in the normal data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() without specifying the MSG_OOB flag in those calls. When this option is disabled, it causes out-of-band data to be placed in the priority data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() only by specifying the MSG_OOB flag in those calls. This option has meaning only for stream sockets.

**SO_RCVBUF**  
Returns the size of the data portion of the TCP/IP send buffer in *optval*. The size of the data portion of the receive buffer is protocol-specific.

**SO_REUSEADDR**  
Toggles local address reuse. The default is *disabled*. This alters the normal algorithm used in the bind() call.

The normal bind() call algorithm allows each internet address and port combination to be bound only once. If the address and port have been bound already, a subsequent bind() will fail and return error EADDRINUSE.

After the SO_REUSEADDR option is active, the following situations are supported:

- A server can bind() the same port multiple times as long as every invocation uses a different local IP address, and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.

**SO_SNDBUF**  
Returns the size of the data portion of the TCP/IP send buffer in *optval*. The size of the data portion of the send buffer is protocol-specific.

**SO_TYPE**  
Returns the type of the socket. On return, the integer pointed to by *optval* is set to SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW.

The following options are recognized at the IP level (IPPROTO_IP):
Option | Description
--- | ---
**IP_MULTICAST_TTL** | Gets the IP time to live of outgoing multicast datagrams. The default value is 1 (multicast is available only to the local subnet).

**IP_MULTICAST_LOOP** | Used to determine whether outgoing multicast datagrams are looped back.

**IP_MULTICAST_IF** | Gets the interface for sending outbound multicast datagrams from the socket application.

**Note:** Multicast datagrams can be transmitted only on one interface at a time.

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

**Errno** | Description
--- | ---
EBADF | The s parameter is not a valid socket descriptor.
EFAULT | Using optval and optlen parameters would result in an attempt to access storage outside the caller address space.
EINVAL | The optname parameter is unrecognized, or the level parameter is not SOL_SOCKET.

**Example**
The following are examples of the getsockopt() call. See "setsockopt()" on page 204 to see how the setsockopt() call options are set.

**Example 1**
#include <manifest.h>

int rc;
int s;
int optval;
int optlen;
struct linger l;

int getsockopt(int s, int level, int optname, char *optval, int *optlen);

/* Is out of band data in the normal input queue? */
optlen = sizeof(int);
rc = getsockopt(
    s, SOL_SOCKET, SO_OOBINLINE, (char *) &optval, &optlen);
if (rc == 0)
    
    /* yes it is in the normal queue */
    else
        /* no it is not */
Example 2

/* Do I linger on close? */
optlen = sizeof(l);
rc = getsockopt(
    s, SOL_SOCKET, SO_LINGER, (char *)&l, &optlen);
if (rc == 0)
{
    if (optlen == sizeof(l))
    {
        if (l.l_onoff)
            /* yes I linger */
        else
            /* no I do not */
    }
    /* no I do not */
}

Related calls
bind(), close(), getprotobynamc(), setsockopt(), socket()
**givesocket()**

The `givesocket()` call tells TCP/IP to make the specified socket available to a `takesocket()` call issued by another program. Any connected stream socket can be given. Typically, `givesocket()` is used by a master program that obtains sockets by means of `accept()` and gives them to slave programs that handle one socket at a time.

This call can be used only in the AF_INET domain.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int givesocket(int d, struct clientid *clientid)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>d</code></td>
<td>The descriptor of a socket to be given to another application.</td>
</tr>
<tr>
<td><code>clientid</code></td>
<td>Points to a client ID structure specifying the target program to which the socket is to be given.</td>
</tr>
</tbody>
</table>

To pass a socket, the master program first calls `givesocket()` with the client ID structure filled in as follows:

**Field** | **Description** |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>domain</code></td>
<td>This call is supported only in the AF_INET domain.</td>
</tr>
<tr>
<td><code>name</code></td>
<td>The slave program address space name, left-justified and padded with blanks. The slave program can run in the same address space as the master program, in which case this field is set to the master program address space. If this field is set to blanks, any MVS address space can take the socket.</td>
</tr>
<tr>
<td><code>subtaskname</code></td>
<td>Specifies blanks.</td>
</tr>
<tr>
<td><code>reserved</code></td>
<td>Specifies binary zeros.</td>
</tr>
</tbody>
</table>

The master program then calls `getclientid()` to obtain its client ID, and passes its client ID, along with the descriptor of the socket to be given, to the slave program. One way to pass a socket is by passing the slave program startup parameter list.

The slave program calls `takesocket()`, specifying the master program client ID and socket descriptor.

Waiting for the slave program to take the socket, the master program uses `select()` to test the given socket for an exception condition. When `select()` reports that an exception condition is pending, the master program calls `close()` to free the given socket.

If your program closes the socket before a pending exception condition is indicated, the TCP connection is immediately reset, and the target program call to `takesocket()` call is unsuccessful. Calls other than the `close()` call issued on a given socket return a value of -1, with `errno` set to EBADF.
Sockets that have been given and not taken for a period of four days will be closed and become unavailable. If a `select` for the socket is outstanding, it is posted.

**Return values**
The value 0 indicates success. The value -1 indicates an error. Errno identifies a specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The $d$ parameter is not a valid socket descriptor. The socket has already been given. The socket domain is not AF_INET.</td>
</tr>
<tr>
<td>EBUSY</td>
<td><code>Listen()</code> has been called for the socket.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the <code>clientid</code> parameter as specified would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The <code>clientid</code> parameter does not specify a valid client identifier.</td>
</tr>
<tr>
<td>ENOTCONN</td>
<td>The socket is not connected.</td>
</tr>
<tr>
<td>EOPNOTSUPP</td>
<td>The socket type is not SOCK_STREAM.</td>
</tr>
</tbody>
</table>

**Related calls**
`accept()`, `close()`, `getclientid()`, `listen()`, `select()`, `takesocket()`
htonl()

The htonl() call translates a long integer from host byte order to network byte order.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned long htonl(unsigned long a)
```

**Parameter**  **Description**

- **a**  The unsigned long integer to be put into network byte order.

**Return values**

Returns the translated long integer.

**Related calls**

htons(), ntohs(), ntohl()
htons()

The htons() call translates a short integer from host byte order to network byte order.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned short htons(unsigned short a)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>The unsigned short integer to be put into network byte order.</td>
</tr>
</tbody>
</table>

**Return values**

Returns the translated short integer.

**Related calls**

ntohs(), htonl(), ntohl()
**inet_addr()**

The inet_addr() call interprets character strings representing host addresses expressed in standard dotted decimal notation and returns host addresses suitable for use as internet addresses.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_addr(char *cp)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cp</td>
<td>A character string in standard dotted decimal (.) notation</td>
</tr>
</tbody>
</table>

Values specified in standard dotted decimal notation take one of the following forms:
- a.b.c.d
- a.b.c
- a.b
- a

When a four-part address is specified, each part is interpreted as a byte of data and assigned, from left to right, to one of the four bytes of an internet address.

When a three-part address is specified, the last part is interpreted as a 16-bit quantity and placed in the two rightmost bytes of the network address. This makes the three-part address a good format for specifying Class B network addresses as 128.net.host.

When a two-part address is specified, the last part is interpreted as a 24-bit quantity and placed in the three rightmost bytes of the network address. This makes the two-part address a good format for specifying Class A network addresses as net.host.

When a one-part address is specified, the value is stored directly in the network address space without any rearrangement of its bytes.

Numbers supplied as address parts in standard dotted decimal notation can be decimal, hexadecimal, or octal. Numbers are interpreted using C language syntax. A leading 0x implies hexadecimal; a leading 0 implies octal. A number without a leading 0 implies decimal.

**Return values**
The internet address is returned in network byte order.

A value of -1 is returned as an error.

**Related calls**
inet_lnaof(), inet_makeaddr(), inet_netof(), inet_network(), inet_ntoa()
inet_lnaof()

The inet_lnaof() call breaks apart the existing internet host address, and returns the local network address portion.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_lnaof(struct in_addr in)

Parameter Description
in The host internet address

Return values
The local network address is returned in host byte order.

Related calls
inet_addr(), inet_makeaddr(), inet_netof(), inet_network(), inet_ntoa()
**inet_makeaddr()**

The `inet_makeaddr()` call combines an existing network number and a local network address to construct an internet address.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

struct in_addr inet_makeaddr(unsigned long net, unsigned long lna)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>net</td>
<td>The network number</td>
</tr>
<tr>
<td>lna</td>
<td>The local network address</td>
</tr>
</tbody>
</table>

**Return values**
The internet address is returned in network byte order.

**Related calls**
`inet_addr()`, `inet_lnaof()`, `inet_netof()`, `inet_network()`, `inet_ntoa()`
**inet_netof()**

The *inet_netof()* call breaks apart the existing internet host address and returns the network number portion.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>
unsigned long inet_netof(struct in_addr in)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>in</em></td>
<td>The internet address in network byte order</td>
</tr>
</tbody>
</table>

**Return values**

The network number is returned in host byte order.

**Related calls**

*inet_addr()*; *inet_lnaof()*; *inet_makeaddr()*; *inet_ntoa()*
inet_network()

The inet_network() call interprets character strings representing addresses expressed in standard dotted decimal notation and returns numbers suitable for use as a network number.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

unsigned long inet_network(char *cp)

Parameter        Description
-----------------------------------
cp                A character string in standard, dotted decimal (.) notation

Return values
The network number is returned in host byte order.

Related calls
inet_addr(), inet_lnaof(), inet_makeaddr(), inet_ntoa()
**inet_ntoa()**

The *inet_ntoa()* call returns a pointer to a string expressed in dotted decimal notation. The *inet_ntoa()* call accepts an internet address expressed as a 32-bit quantity in network byte order and returns a string expressed in dotted decimal notation.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <inet.h>

char *inet_ntoa(struct in_addr in)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>in</em></td>
<td>The host internet address</td>
</tr>
</tbody>
</table>

**Return values**

Returns a pointer to the internet address expressed in dotted decimal notation

**Related calls**

*inet_addr(), inet_lnaof(), inet_makeaddr(), inet_network(), inet_ntoa()*
ioctl()

The operating characteristics of sockets can be controlled using the ioctl() call.

Rules:
- This call can be used only in the AF_INET domain.
- Only the ioctl() commands that are documented in this section are supported by this API.

```c
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <ioctl.h>
#include <rtroute.h>
#include <if.h>
#include <ezbcmonc.h>

int ioctl(int s, unsigned long cmd, char *arg)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>The socket descriptor.</td>
</tr>
<tr>
<td>cmd</td>
<td>The command to perform.</td>
</tr>
<tr>
<td>arg</td>
<td>Points to the data associated with cmd.</td>
</tr>
</tbody>
</table>

The operations to be controlled are determined by cmd. The arg parameter points to data associated with the particular command, and its format depends on the command being requested. The following are valid ioctl() keywords:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIONBIO</td>
<td>Sets or clears nonblocking I/O for a socket. The variable arg points to an integer. If the integer is 0, nonblocking I/O on the socket is cleared; otherwise, the socket is set for nonblocking I/O.</td>
</tr>
<tr>
<td>FIONREAD</td>
<td>Gets for the socket the number of immediately readable bytes. The variable arg points to an integer.</td>
</tr>
<tr>
<td>SIOCADDRT</td>
<td>Adds a routing table entry. The variable arg points to a rtentry structure, as defined in RTROUTE.H. The routing table entry, passed as an argument, is added to the routing tables.</td>
</tr>
<tr>
<td>SIOCATMARK</td>
<td>Queries whether the current location in the data input is pointing to out-of-band data. The variable arg points to an integer of 1 when the socket points to a mark in the data stream for out-of-band data; otherwise, it points to 0.</td>
</tr>
<tr>
<td>SIOCDELRT</td>
<td>Deletes a routing table entry. The variable arg points to a rtentry structure, as defined in RTROUTE.H. If the structure exists, the routing table entry passed as an argument is deleted from the routing tables.</td>
</tr>
<tr>
<td>SIOCGIFADDR</td>
<td>Gets the network interface address. The variable arg points to an ifreq structure, as defined in IF.H. The interface address is returned in the argument.</td>
</tr>
<tr>
<td>SIOCGIFBRDADDR</td>
<td>Gets the network interface broadcast address. The variable arg points to an ifreq structure, as defined in IF.H. The interface broadcast address is returned in the argument.</td>
</tr>
</tbody>
</table>
SIOCGIFCONF
Gets the network interface configuration. The variable arg points to an ifconf structure, as defined in IF.H. The interface configuration is returned in the argument.

SIOCGIFDSTADDR
Gets the network interface destination address. The variable arg points to an ifreq structure, as defined in IF.H. The interface destination (point-to-point) address is returned in the argument.

SIOCGIFFLAGS
Gets the network interface flags. The variable arg points to an ifreq structure, as defined in IF.H. The interface flags are returned in the argument.

SIOCGIFMETRIC
Gets the network interface routing metric. The variable arg points to an ifreq structure, as defined in IF.H. The interface routing metric is returned in the argument.

SIOCGIFNETMASK
Gets the network interface network mask. The variable arg points to an ifreq structure, as defined in IF.H. The interface network mask is returned in the argument.

SIOCSIFMETRIC
Sets the network interface routing metric. The variable arg points to an ifreq structure, as defined in IF.H. The interface routing metric is set to the value passed in the argument.

SIOCGMONDATA
Returns TCP/IP stack statistical counters. The variable arg points to a MonDataIn structure. The counters are returned in a MonDataOut structure. Both of these structures are defined in EZBZMONC in SEZANMAC.

Note: The ARP counter data provided differs depending on the type of device. Refer to the z/OS Communications Server: IP Configuration Guide for information about devices that support ARP Offload and what is supported for each device.

Return values
The value 0 indicates success; the value -1 indicates an error._errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The request is not valid, or not supported.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>The arg is a bad pointer.</td>
</tr>
</tbody>
</table>

Example
```c
int s;
int dontblock;
int rc;
...
/* Place the socket into nonblocking mode */
dontblock = 1;
rc = ioctl(s, FIONBIO, (int *)&dontblock);
...```
listen()

The listen() call applies only to stream sockets. It performs two tasks: it completes the binding necessary for a socket s, if bind() has not been called for s, and it creates a connection request queue of length backlog to queue incoming connection requests. When the queue is full, additional connection requests are ignored.

The listen() call indicates a readiness to accept client connection requests. It transforms an active socket into a passive socket. Once called, s can never again be used as an active socket to initiate connection requests. Calling listen() is the third of four steps that a server performs when it accepts a connection. It is called after allocating a stream socket using socket(), and after binding a name to s using bind(). It must be called before calling accept().

```
#include <manifest.h>
#include <socket.h>
int listen(int s, int backlog)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor</td>
</tr>
<tr>
<td>backlog</td>
<td>Maximum queue length for pending connections</td>
</tr>
</tbody>
</table>

If the backlog is less than 0, backlog is set to 0. If the backlog is greater than SOMAXCONN, as defined in the TCPIP.PROFILE file, backlog is set to SOMAXCONN. There is a SOMAXCONN variable in the SOCKET.H file that is hardcoded at 10. If your C socket programs use this variable to determine the maximum listen() backlog queue length, remember to change the header file to reflect the value you specified for TCP/IP in TCPIP.PROFILE.

Return values
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EOPNOTSUPP</td>
<td>The s parameter is not a socket descriptor that supports the listen() call.</td>
</tr>
</tbody>
</table>

Related calls
accept(), bind(), connect(), socket()
maxdesc()

The maxdesc() call reserves additional space in the TCP/IP address space to allow socket numbers to extend beyond the default range of 0 through 49. Socket numbers 0, 1, and 2 are never assigned, so the default maximum number of sockets is 47.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>

int maxdesc(int *totdesc, int *inetdesc)

Parameter Description

totdesc Points to an integer containing a value one greater than the largest socket number desired. The maximum allowed value is 2000.

Note: If a totdesc value greater than 2000 is specified, the internal value is set to 2000. In all cases, use getdtablesiz() to verify the value set by maxdesc().

inetdesc Points to an integer containing a value one greater than the largest socket number desired. The maximum value, usable for AF_INET sockets, allowed is 2000.

Set the integer pointed to by totdesc to one more than the maximum socket number desired. If your program does not use AF_INET sockets, set the integer pointed to by inetdesc to 0. If your program uses AF_INET sockets, set the integer pointed to by inetdesc to the same value as totdesc; maxdesc() must be called before your program creates its first socket. Your program should use getdtablesiz() to verify that the number of sockets has been changed.

Note: Increasing the size of the bit sets for the select() call must be done at compile time. To increase the size of the bit sets, before including BSDTYPES.H, define FD_SETSIZE to be the largest value of any socket. The default size of FD_SETSIZE is 255 sockets.

Return values
The value 0 indicates success. (Your application should check the integer pointed to by inetdesc. It might contain less than the original value, if there was insufficient storage available in the TCP/IP address space. In this case, the desired number of AF_INET sockets are not available.) The value -1 indicates an error. Erno identifies the specific error.

Erno Description

EFAULT Using the totdesc or inetdesc parameters as specified results in an attempt to access storage outside of the caller address space, or storage not able to be modified by the caller.

EALREADY Your program called maxdesc() after creating a socket, or after a previous call to maxdesc().

EINVAL Indicates that *totdesc is less than *inetdesc; *totdesc is less than or equal to 0; or *inetdesc is less than 0.

ENOMEM Your address space lacks sufficient storage.
Example

```c
int totdesc, inetdesc;
totdesc = 100;
inetdesc = 0;
rc = maxdesc(&totdesc, &inetdesc)
```

If successful, your application can create 97 sockets, all of type AF_IUCV. Socket numbers run from 3–99.

```c
int totdesc, inetdesc;
totdesc = 100;
inetdesc = 100;
rc = maxdesc(&totdesc, &inetdesc)
```

If successful, your application can create 97 sockets, each of which can be of type AF_INET or AF_IUCV. The socket numbers run from 3–99.

Related calls

select(), socket(), getdtablesze()
ntohl()

The ntohl() call translates a long integer from network byte order to host byte order.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned long ntohl(unsigned long a)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>The unsigned long integer to be put into host byte order</td>
</tr>
</tbody>
</table>

**Return values**

Returns the translated long integer

**Related calls**

htonl(), htons(), ntohs()
ntohs()

The `ntohs()` call translates a short integer from network byte order to host byte order.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>

unsigned short ntohs(unsigned short a)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>a</code></td>
<td>The unsigned short integer to be put into host byte order</td>
</tr>
</tbody>
</table>

**Return values**

Returns the translated short integer

**Related calls**

`ntohl()`, `htons()`, `htonl()`
**read()**

The `read()` call reads data on a socket with descriptor `s` and stores it in a buffer. The `read()` call applies only to connected sockets. This call returns as many as `len` bytes of data. If fewer than the number of bytes requested is available, the call returns the number currently available. If data is not available for the socket `s`, and `s` is in blocking mode, the `read()` call blocks the caller until data arrives. If data is not available, and `s` is in nonblocking mode, `read()` returns a -1 and sets `errno` to `EWOULDBLOCK`. See ["ioctl()" on page 168](#) or ["fcntl()" on page 129](#) for a description of how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

```c
#include <manifest.h>
#include <socket.h>
int read(int s, char *buf, int len)
```

**Parameter | Description**
---|---
`s` | Socket descriptor.
`buf` | Points to the buffer that receives the data.
`len` | Length in bytes of the buffer pointed to by `buf`.

**Return values**
If successful, the number of bytes copied into the buffer is returned. The value 0 indicates that the connection is closed. The value -1 indicates an error. `errno` identifies the specific error.

**Errno | Description**
---|---
EBADF | Indicates that `s` is not a valid socket descriptor.
EFAULT | Using the `buf` and `len` parameters would result in an attempt to access storage outside the caller address space.
EWOULDBLOCK | Indicates an unconnected socket (RAW).

**Note:** ENOTCONN is returned for TCP, and EINVAL is returned for UDP.

EMSGSIZE | For non-TCP sockets, this indicates that the length exceeds the maximum data size. This is determined by `getsockopt()` using `SO_SNDBUF` for the socket type (TCP, UDP, or RAW).

**Related calls**
`connect()`, `fcntl()`, `getsockopt()`, `ioctl()`, `readv()`, `recv()`, `recvmsg()`, `recvfrom()`, `select()`, `selectex()`, `send()`, `sendmsg()`, `sendto()`, `setsockopt()`, `socket()`, `write()`, `writev()`
readv()

The readv() call reads data on a socket with descriptor s and stores it in a set of buffers. The readv() call applies to connected sockets only.

```c
#include <manifest.h>
#include <socket.h>
#include <socket.h>
#include <bsdtypes.h>

int readv(int s, struct iov *iov, int iovcnt)
```

**Parameter**  
- **s**: The socket descriptor.  
- **iov**: Points to an iovec structure.  
- **iovcnt**: The number of buffers pointed to by the iov parameter.

The data is scattered into the buffers specified by iov[0]...iov[iovcnt–1]. The iovec structure is defined in UIO.H and contains the following variables:

**Variable**  
- **iov_base**: Points to the buffer.  
- **iov_len**: The length of the buffer.

The readv() call applies only to connected sockets.

This call returns up to len bytes of data. If less than the number of bytes requested is available, the call returns the number currently available. If data is not available for the socket s, and s is in blocking mode, the readv() call blocks the caller until data arrives. If data is not available and s is in nonblocking mode, readv() returns a -1 and sets errno to EWOULDBLOCK. See “fcntl()” on page 129 or “ioctl()” on page 168 for a description of how to set nonblocking mode. When a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been received.

**Return values**

If successful, the number of bytes read into the buffers is returned. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

**Errno**  
- **EBADF**: Indicates that s is not a valid socket descriptor.  
- **EFAULT**: Using iov and iovcnt would result in an attempt to access storage outside the caller address space.  
- **EINVAL**: iovcnt was not valid, or one of the fields in the iov array was not valid. Also returned for a NULL iov pointer.  
- **EWOULDBLOCK**: Indicates that s is in nonblocking mode and data is not available to read.
Related calls
connect(), fcntl(), getsockopt(), ioctl(), read(), recv(), recvmsg(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()
recv()

The recv() call receives data on a socket with descriptor s and stores it in a buffer. The recv() call applies only to connected sockets.

This call returns the length of the incoming message or data. If data is not available for socket s, and s is in blocking mode, the recv() call blocks the caller until data arrives. If data is not available and s is in nonblocking mode, recv() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 129 or "ioctl()" on page 168 for a description of how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been received.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recv(int s, char *buf, int len, int flags)

Parameter Description
s Socket descriptor.
buf Points to the buffer that receives the data.
len Length in bytes of the buffer pointed to by buf.
flags Set the flags parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain.

MSG_OOB Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only.

MSG_PEEK Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.

Return values
If successful, the byte length of the message or datagram is returned. The value -1 indicates an error. The value 0 indicates connection closed. Errno identifies the specific error.

Errno Description
EBADF Indicates that s is not a valid socket descriptor.
EFAULT Using the buf and len parameters would result in an attempt to access storage outside the caller address space.
**EWOULD_BLOCK**
Indicates that s is in nonblocking mode and data is not available to read.

**ENOTCONN** Indicates an unconnected TCP socket.

**EMSGSIZE** For non-TCP sockets, this indicates that length exceeds the maximum data size as determined by getsockopt() using SO_SNDBUF for the socket type, either TCP, UDP, or RAW.

**Related calls**
connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()
recvfrom()

The recvfrom() call receives data on a socket by name with descriptor s and stores
it in a buffer. The recvfrom() call applies to any datagram socket, whether
connected or unconnected. For a datagram socket, when name is nonzero, the
source address of the message is filled. Parameter namelen must first be initialized
to the size of the buffer associated with name; then it is modified on return to
indicate the actual size of the address stored there.

This call returns the length of the incoming message or data. If a datagram packet
is too long to fit in the supplied buffer, datagram sockets discard extra bytes. If
data is not available for the socket s, and s is in blocking mode, the recvfrom() call
blocks the caller until data arrives. If data is not available, and s is in nonblocking
mode, recvfrom() returns -1 and sets errno to EWOULDBLOCK. See “fcntl()” on
page 129 or “ioctl()” on page 168 to set nonblocking mode.

For datagram sockets, this call returns the entire datagram sent, providing the
datagram can fit into the specified buffer. Stream sockets act like streams of
information with no boundaries separating data. For example, if applications A
and B are connected with a stream socket, and Application A sends 1000 bytes,
each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes.
Therefore, applications using stream sockets should place this call in a loop, calling
this function until all data has been received.

For datagram protocols, recvfrom() returns the source address associated with each
incoming datagram. For connection-oriented protocols like TCP, getpeername()
returns the address associated with the remote end of the connection.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recvfrom(int s, char *buf, int len, int flags,
             struct sockaddr *name, int *namelen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor.</td>
</tr>
<tr>
<td>buf</td>
<td>Pointer to the buffer to receive the data.</td>
</tr>
<tr>
<td>len</td>
<td>Length in bytes of the buffer pointed to by buf.</td>
</tr>
<tr>
<td>flags</td>
<td>A parameter that can be set to 0 or MSG_PEEK, or MSG_OOB. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain.</td>
</tr>
</tbody>
</table>

**MSG_OOB**
Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only.

**MSG_PEEK**
Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.
name  Points to a socket address structure from which data is received. If name is a nonzero value, the source address is returned (datagram sockets).

namelen  Points to the size of name in bytes.

**Return values**
If successful, the length of the message or datagram is returned in bytes. The value 0 indicates that the connection is closed. The value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the buf and len parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>EWOULD_BLOCK</td>
<td>Indicates that s is in nonblocking mode and data is not available to read.</td>
</tr>
<tr>
<td>ENOTCONN</td>
<td>Indicates an unconnected TCP socket.</td>
</tr>
<tr>
<td>EMSGSIZE</td>
<td>For non-TCP sockets, this indicates that length exceeds the maximum data size as determined by getsockopt() using SO_SNDBUF for the socket type, either TCP, UDP, or RAW.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>Parameter namelen is not valid.</td>
</tr>
</tbody>
</table>

**Related calls**
fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()
recvmsg()

The recvmsg() call receives messages on the socket with descriptor s and stores the messages in an array of message headers.

For datagram protocols, recvmsg() returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, getpeername() returns the address associated with the remote end of the connection.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int recvmsg(int s, struct msghdr *msg, int flags)
```

**Parameter** | **Description**
---|---
 s | Socket descriptor.
 msg | Points to an msghdr structure.
 flags | Set the flags parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator ( | ) must be used to separate them. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported for sockets in the AF_IUCV domain.

**MSG_OOB**
Reads any out-of-band data on the socket. This is valid for stream (TCP) sockets only.

**MSG_PEEK**
Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation will see the same data.

A message header is defined by structure msghdr. The definition of this structure can be found in the SOCKET.H header file and contains the following elements:

**Variable** | **Description**
---|---
 msg_name | An optional pointer to a buffer where the sender address is stored for datagram sockets.
 msg_name_len | The size of the address buffer.
 msg_iov | An array of iovec buffers into which the message is placed. An iovec buffer contains the following variables:
 | `iov_base` | Points to the buffer.
 | `iov_len` | The length of the buffer.
 msg_iovlen | The number of elements in the msg_iov array.
 msg_accrights | The access rights received. This field is ignored.
 msg_accrights_len | The length of access rights received. This field is ignored.

A message header is defined by structure msghdr. The definition of this structure can be found in the SOCKET.H header file and contains the following elements:

**Variable** | **Description**
---|---
 msg_name | An optional pointer to a buffer where the sender address is stored for datagram sockets.
 msg_name_len | The size of the address buffer.
 msg_iov | An array of iovec buffers into which the message is placed. An iovec buffer contains the following variables:
 | `iov_base` | Points to the buffer.
 | `iov_len` | The length of the buffer.
 msg_iovlen | The number of elements in the msg_iov array.
 msg_accrights | The access rights received. This field is ignored.
 msg_accrights_len | The length of access rights received. This field is ignored.

The recvmsg() call applies to sockets, regardless of whether they are in the connected state, except for TCP sockets, which must be connected.
This call returns the length of the data received. If data is not available for socket s,
and s is in blocking mode, the recvmsg() call blocks the caller until data arrives. If
data is not available, and s is in nonblocking mode, recvmsg() returns a -1 and sets
errno to EWOULDBLOCK. See “fcntl()” on page 129 or “ioctl()” on page 168 to see
how to set nonblocking mode.

If a datagram packet is too long to fit in the supplied buffer, datagram sockets
discard extra bytes. Stream sockets act like streams of information with no
boundaries separating data. For example, if applications A and B are connected
with a stream socket, and Application A sends 1000 bytes, each call to this function
can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications
using stream sockets should place this call in a loop, and call this function until all
data has been received.

Return values
If successful, the length of the message in bytes is returned. The value 0 indicates
that the connection is closed. The value -1 indicates an error. Errno identifies the
specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using msg would result in an attempt to access storage outside the</td>
</tr>
<tr>
<td></td>
<td>caller address space. Also returned when msg_namelen is not valid.</td>
</tr>
<tr>
<td>EWOULDBLOCK</td>
<td>Indicates that s is in nonblocking mode and data is not available to</td>
</tr>
<tr>
<td></td>
<td>read.</td>
</tr>
<tr>
<td>ENOTCONN</td>
<td>Returned for an unconnected TCP socket.</td>
</tr>
<tr>
<td>EMSGSIZE</td>
<td>For non-TCP sockets, this indicates that length exceeds the</td>
</tr>
<tr>
<td></td>
<td>maximum data size determined by getsockopt() using SO_SNDBUF for the socket</td>
</tr>
<tr>
<td></td>
<td>type (TCP, UDP, or RAW).</td>
</tr>
</tbody>
</table>

Related calls
connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), select(),
selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write(), writev()
**select()**

The select() call monitors activity on a set of sockets looking for sockets ready for reading, writing, or with an exception condition pending.

```c
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <bsdtime.h>

int select(int nfds, fd_set *readfds, fd_set *writefds, fd_set *exceptfds,
            struct timeval *timeout)
```

**Parameter**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>nfds</strong></td>
<td>The number of socket descriptors to be checked. This value should be one greater than the greatest number of sockets to be checked. You can use the select() call to pass a bit set containing the socket descriptors for the sockets you want checked. The bit set is fixed in size using one bit for every possible socket. Use the nfds parameter to force select() to check only a subset of the allocated socket bit set. If your application allocates sockets 3, 4, 5, 6, and 7, and you want to check all of your allocations, nfds should be set to 8, the highest socket descriptor you specified, plus 1. If your application checks sockets 3 and 4, nfds should be set to 5. Socket numbers are assigned starting with number 3 because numbers 0, 1, and 2 are used by the C socket interface.</td>
</tr>
<tr>
<td><strong>readfds</strong></td>
<td>Points to a bit set of descriptors to check for reading.</td>
</tr>
<tr>
<td><strong>writefds</strong></td>
<td>Points to a bit set of descriptors to check for writing.</td>
</tr>
<tr>
<td><strong>exceptfds</strong></td>
<td>Points to a bit set of descriptors to check for exception conditions pending.</td>
</tr>
<tr>
<td><strong>timeout</strong></td>
<td>Points to the time to wait for select() to complete.</td>
</tr>
</tbody>
</table>

If `timeout` is not a NULL pointer, it specifies a maximum time to wait for the selection to complete. If `timeout` is a NULL pointer, the select() call blocks until a socket becomes ready. To poll the sockets and return immediately, `timeout` should be a non-NULL pointer to a `timeval` structure with a value of 0.

If you are using both AF_INET and AF_IUCV sockets in the socket descriptor sets, the timer value is ignored and processed as if `timeout` were a non-NULL pointer to a `timeval` structure with a value of 0.

To use select() as a timer in your program, do either of the following:
- Set the read, write, and except arrays to 0.
- Set nfds to be a NULL pointer.

To completely understand the implementation of the select() call, you must understand the difference between a socket and a port. TCP/IP defines ports to represent a certain process on a certain machine. A port represents the location of one process; it does not represent a connection between processes. In the MVS programming interface for TCP/IP, a socket describes an endpoint of
communication. Therefore, a socket describes both a port and a machine. Like file descriptors, a socket is a small integer representing an index into a table of communication endpoints in a TCP/IP address space.

To test more than one socket at a time, place the sockets to be tested into a bit set of type FD_SET. A bit set is a string of bits that when X is an element of the set, the bit representing X is set to 1. If X is not an element of the set, the bit representing X is set to 0. For example, if Socket 33 is an element of a bit set, then bit 33 is set to 1. If Socket 33 is not an element of a bit set, then bit 33 is set to 0.

Because the bit sets contain a bit for every socket that a process can allocate, the size of the bit sets is constant. The function getdtablesize() returns the number of sockets that your program can allocate. If your program needs to allocate a large number of sockets, use getdtablesize() and maxdesc() to increase the number of sockets that can be allocated. Increasing the size of the bit sets must be done when you compile the program. To increase the size of the bit sets, define FD_SETSIZE before including BSDTYPES.H. The largest value of any socket is FD_SETSIZE, defined to be 255 in BSDTYPES.H.

The following macros can manipulate bit sets.

<table>
<thead>
<tr>
<th>Macro</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD_ZERO(fdset)</td>
<td>Sets all bits in bit set fdset to 0. After this operation, the bit set does not contain sockets as elements. This macro should be called to initialize the bit set before calling FD_SET() to set a socket as a member.</td>
</tr>
<tr>
<td>FD_SET(sock, &amp;fdset)</td>
<td>Sets the bit for the socket sock to 1, making sock a member of bit set fdset.</td>
</tr>
<tr>
<td>FD_CLR(sock, &amp;fdset)</td>
<td>Clears the bit for the socket sock in bit set fdset. This operation sets the appropriate bit to 0.</td>
</tr>
<tr>
<td>FD_ISSET(sock, &amp;fdset)</td>
<td>Returns nonzero if sock is a member of the bit set fdset. Returns 0 if sock is not a member of fdset. (This operation returns the bit representing sock.)</td>
</tr>
</tbody>
</table>

A socket is ready to be read when incoming data is buffered for it, or when a connection request is pending. A call to accept(), read(), recv(), or recvfrom() does not block. To test whether any sockets are ready to be read, use FD_ZERO() to initialize the readfds bit set and invoke FD_SET() for each socket to be tested.

A socket is ready to be written if there is buffer space for outgoing data. A socket is ready for reading if there is data on the socket to be received. For a nonblocking stream socket in the process of connecting the connect() will return with a -1. The program needs to check the errno. If the errno is EINPROGRESS the socket is selected for write when the connect() completes. In the situation where the errno is not EINPROGRESS, the socket will still be selected for write which indicates that there is a pending error on the socket. A call to write(), send(), or sendto() does not block providing that the amount of data is less than the amount of buffer space. If a socket is selected for write, the amount of available buffer space is guaranteed to be at least as large as the size returned from using SO_SNDBUF with getsockopt().
To test whether any sockets are ready for writing, initialize writefds using FD_ZERO(), and use FD_SET() for each socket to be tested.

The select() call checks for a pending exception condition on the given socket to indicate that the target program has successfully called takesocket(). When select() indicates a pending exception condition, your program calls close() to close the given socket. A socket has exception conditions pending if it has received out-of-band data. A stream socket that was given using givesocket() is selected for exception when another application successfully takes the socket using takesocket().

The programmer can pass NULL for any bit sets without sockets to test. For example, if a program need only check a socket for reading, it can pass NULL for both writefds and exceptfds.

Because the sets of sockets passed to select() are bit sets, the select() call must test each bit in each bit set before polling the socket for status. For efficiency, the nbsd parameter specifies the largest socket passed in any of the bit sets. The select() call then tests only sockets in the range 0 to nbsd-1. Variable nbsd can be the result of gettablesizes(), but if the application has only two sockets and nbsd is the result of gettablesizes(), select() tests every bit in each bit set.

**Return values**
The total number of ready sockets in all bit sets is returned. The value -1 indicates an error; check errno. The value 0 indicates an expired time limit. If the return value is greater than 0, the sockets that are ready in each bit set are set to 1. Sockets in each bit set that are not ready are set to 0. Use macro FD_ISSET() with each socket to test its status.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>One of the bit sets specified an incorrect socket. [FD_ZERO() was probably not called before the sockets were set.]</td>
</tr>
<tr>
<td>EFAULT</td>
<td>One of the bit sets pointed to a value outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>One of the fields in the timeval structure is not valid.</td>
</tr>
</tbody>
</table>

**Note:** If the number of ready sockets is greater than 65 535, only 65 535 is reported.

**Example**
In the following example, select() is used to poll sockets for reading (socket r), writing (socket w), and exception (socket e) conditions.

```c
int sock_stats(r, w, e) int r, w, e; 
{ 
    struct timeval timeout; 
    int rc, max_sock; 
    /* initialize the bit sets */ 
    FD_ZERO( &reading ); 
    FD_ZERO( &writing ); 
    FD_ZERO( &except ); 
    /* add r, w, and e to the appropriate bit set */ 
    FD_SET( r, &reading ); 
```
FD_SET(w, &writing);
FD_SET(e, &except);

/* for efficiency, what's the maximum socket number? */
max_sock = MAX(r, w);
max_sock = MAX(max_sock, e);
max_sock ++;

/* make select poll by sending a 0 timeval */
memset(&timeout, 0, sizeof(timeout));

/* poll */
rc = select(max_sock, &reading, &writing, &except, &timeout);

if (rc < 0 ) {
    /* an error occurred during the select() */
    tcperror("select");
}
else if (rc == 0 ) {
    /* none of the sockets were ready in our little poll */
    printf("nobody is home.\n");
} else {
    /* at least one of the sockets is ready */
    printf("r is %s\n", FD_ISSET(r,&reading) ? "READY" : "NOT READY");
    printf("w is %s\n", FD_ISSET(w,&writing) ? "READY" : "NOT READY");
    printf("e is %s\n", FD_ISSET(e,&except) ? "READY" : "NOT READY");
}

Related calls
getdtablesize(), maxdesc(), selectex()
selectex()

The selectex() call provides an extension to the select() call by allowing you to use an ECB or ECB list that defines an event not described by readfs, writefs, or exceptfs.

The selectex() call monitors activity on a set of different sockets until a timeout expires to see whether any sockets are ready for reading or writing, or if any exception conditions are pending. See "select()" on page 184 for more information about selectex().

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <socket.h>

int selectex(int nfds, fd_set *readfs, fd_set *writefs, fd_set *exceptfs,
struct timeval *timeout, int *ecbptr)
```

**Parameter**  **Description**

`nfds` The number of socket descriptors to be checked.
`readfs` Points to a bit set of descriptors to be checked for reading.
`writefs` Points to a bit set of descriptors to be checked for writing.
`exceptfs` Points to a bit set of descriptors to be checked for exception pending conditions.
`timeout` Points to the time to wait for selectex() to complete.
`ecbptr` Points to the event control block (ECB) or ECB list. For an ECB list, the high-order bit must be turned on in `ecbptr`. The last entry in the ECB list must also have its high-order bit set to 1, signifying list end. The maximum ECBs allowed is 63.

**Note:** ECB list is only supported for AF_INET sockets.

**Return values**
The total number of ready sockets (in all bit sets) is returned. The returned value -1 indicates an error. The returned value of 0 indicates either an expired time limit or that the caller ECB has been posted. To determine which of these two conditions occurred, check the ECB value. If the value of the ECB is nonzero, then the ECB has been POSTed; otherwise, the time limit has expired. The caller must initialize the ECB value to 0 before issuing selectex(). If the caller’s ECB has been POSTed, the caller descriptor sets are also set to 0. If the return value is greater than 0, the socket descriptors in each bit set that are ready are set to 1. All others are set to 0.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>One of the descriptor sets specified an incorrect descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>One of the parameters pointed to a value outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>One of the fields in the <code>timeval</code> structure is not valid.</td>
</tr>
</tbody>
</table>

**Note:** If the number of ready sockets is greater than 65 535, only 65 535 is reported.
Related calls
accept(), connect(), getdtablesiz(), recv(), send(), select()
send()

The send() call sends datagrams on the socket with descriptor s. The send() call applies to all connected sockets.

If buffer space is not available to hold the socket data to be transmitted, and the socket is in blocking mode, send() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, send() returns -1 and sets errno to EWOULDBLOCK. See "fcntl() on page 129 or "ioctl() on page 168 to set nonblocking mode. See "select() on page 184 for additional information.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop and call this function until all data has been sent.

```
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int send(int s, char *msg, int len, int flags)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor.</td>
</tr>
<tr>
<td>msg</td>
<td>Points to the buffer containing the message to transmit.</td>
</tr>
<tr>
<td>len</td>
<td>Length of the message pointed to by msg.</td>
</tr>
<tr>
<td>flags</td>
<td>Set the flags parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (</td>
</tr>
</tbody>
</table>

- **MSG_OOB**: Sends out-of-band data on sockets that support this function. Only SOCK_STREAM sockets created in the AF_INET address family support out-of-band data.

- **MSG_DONTROUTE**: The MSG_DONTROUTE option is turned on for the duration of the operation. This is usually used only by diagnostic or routing programs.

**Return values**

No indication of failure to deliver is implicit in a send() routine. The value -1 indicates locally detected errors. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the msg and len parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>Buffer space is not available to send the message.</td>
</tr>
</tbody>
</table>
EWOULD阻塞

表明 s 处于非阻塞模式并且 TCP/IP 中没有足够的空间来接受数据。

**Related calls**

connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), recvmsg(), 
select(), selectex(), sendmsg(), sendto(), socket(), write(), writev()
sendmsg()

The sendmsg() call sends messages on a socket with descriptor s passed in an array of message headers.

```
#include <manifest.h>
#include <bsdtyes.h>
#include <socket.h>

int sendmsg(int s, struct msghdr *msg, int flags)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor.</td>
</tr>
<tr>
<td>msg</td>
<td>Points to an msghdr structure.</td>
</tr>
<tr>
<td>flags</td>
<td>Set the flags parameter by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (</td>
</tr>
<tr>
<td>MSG_OOB</td>
<td>Sends out-of-band data on the socket.</td>
</tr>
<tr>
<td>MSG_DONTROUTE</td>
<td>The SO_DONTROUTE option is turned on for the duration of the operation; it is usually used by diagnostic or routing programs only.</td>
</tr>
</tbody>
</table>

A message header is defined by a msghdr. The definition of this structure can be found in the SOCKET.H header file and contains the following parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>msg_name</td>
<td>The pointer to the buffer containing the recipient address. This is required for datagram sockets where an explicit connect() has not been done.</td>
</tr>
<tr>
<td>msg_namelen</td>
<td>The size of the address buffer. This is required for datagram sockets where an explicit connect() has not been done.</td>
</tr>
<tr>
<td>msg_iov</td>
<td>An array of iovec buffers containing the message. The iovec buffer contains the following:</td>
</tr>
<tr>
<td></td>
<td>iov_base</td>
</tr>
<tr>
<td></td>
<td>iov_len</td>
</tr>
<tr>
<td>msg_iovlen</td>
<td>The number of elements in the msg_iov array.</td>
</tr>
<tr>
<td>msg_accrights</td>
<td>The access rights sent. This field is ignored.</td>
</tr>
<tr>
<td>msg_accrightslen</td>
<td>The length of the access rights sent. This field is ignored.</td>
</tr>
</tbody>
</table>

The sendmsg() call applies to sockets regardless of whether they are in the connected state and returns the length of the data sent.
If there is not enough buffer space available to hold the socket data to be transmitted, and the socket is in blocking mode, sendmsg() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, sendmsg() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 129 or "ioctl()" on page 168 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

**Return values**
If successful, the length of the message in bytes is returned. The value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using msg would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>Indicates that msg_namelen is not the size of a valid address for the specified address family.</td>
</tr>
<tr>
<td>EMSGSIZE</td>
<td>The message was too big to be sent as a single datagram.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>Buffer space is not available to send the message.</td>
</tr>
<tr>
<td>EWOULDBLOCK</td>
<td>Indicates that s is in nonblocking mode and there is not enough space in TCP/IP to accept the data.</td>
</tr>
</tbody>
</table>

**Related calls**
connect(), fcntl(), getsockopt(), ioctl(), read(), readv(), recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendto(), socketopt(), socket(), write(), writev()
sendto() call sends datagrams on the socket with descriptor \( s \). The sendto() call applies to any datagram socket, whether connected or unconnected.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, sendto() blocks the caller until more buffer space becomes available. If the socket is in nonblocking mode, sendto() returns a -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 129 or "ioctl()" on page 168 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int sendto(int s, char *msg, int len, int flags, struct sockaddr *to,
            int tolen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( s )</td>
<td>Socket descriptor.</td>
</tr>
<tr>
<td>( msg )</td>
<td>Points to the buffer containing the message to be transmitted.</td>
</tr>
<tr>
<td>( len )</td>
<td>Length of the message in the buffer pointed to by ( msg ).</td>
</tr>
<tr>
<td>( flags )</td>
<td>A parameter that can be set to 0 or MSG_DONTROUTE. Setting this parameter is supported only for sockets in the AF_INET domain. Setting these flags is not supported in the AF_IUCV domain.</td>
</tr>
<tr>
<td>( to )</td>
<td>Address of the target.</td>
</tr>
<tr>
<td>( tolen )</td>
<td>Size of the structure pointed to by ( to ).</td>
</tr>
</tbody>
</table>

**Return values**

If successful, the number of characters sent is returned. The value -1 indicates an error. Errno identifies the specific error.

No indication of failure to deliver is implied in the return value of this call when used with datagram sockets.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that ( s ) is not a valid socket descriptor.</td>
</tr>
</tbody>
</table>
EFAULT
Using the msg and len parameters would result in an attempt to access storage outside the caller address space.

EINVAL
Tolen is not the size of a valid address for the specified address family.

EMSGSIZE
The message was too big to be sent as a single datagram. The default is large-envelope-size.

ENOBUFS
Buffer space is not available to send the message.

EWOULDBLOCK
Indicates that s is in nonblocking mode and there is not enough space in TCP/IP to accept the data.

Related calls
read(), readv(), recv(), recvfrom(), recvmsg(), send(), select(), selectex(), sendmsg(), socket() write(), writev()
sethostent()

The sethostent() call opens and caches the local host table contents for gethostent() calls. The sethostent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information about using local host tables.

```c
#include <manifest.h>
#include <socket.h>

int sethostent(int stayopen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>stayopen</td>
<td>A nonzero flag value prevents the cached local host table contents from being freed after an endhostent().</td>
</tr>
</tbody>
</table>

Return values
The value 0 indicates success. The value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls
endhostent(), endnetent(), gethostbyaddr(), gethostbyname(), gethostent()
setibmopt()

The setibmopt() call chooses the TCP/IP image with which to connect. It is used in conjunction with getibmopt(), which returns the number of TCP/IP images installed on a given MVS system and their names, versions, and states. With this information, the caller can dynamically choose the TCP/IP image with which to connect through the setibmopt() call.

**Note:** Images from pre-V3R2 releases of TCP/IP for MVS are excluded. The setibmopt() call is not meaningful for pre-V3R2 releases.

The setibmopt() call is optional. If setibmopt is not used, the standard method for determining the connecting TCP/IP image is followed. If setibmopt is used, it must be issued before any other socket calls that establish the connection to TCP/IP.

```c
#include <manifest.h>
#include <socket.h>

int setibmopt(int cmd, struct ibm_tcpimage *buf)

struct ibm_tcpimage {
    unsigned short status;
    unsigned short version;
    char name[8];
}
```

**Parameter** | **Description**
--- | ---
`cmd` | The command to perform. For TCP/IP V3R2 for MVS, IBMTCP_IMAGE is supported.
`buf` | The address of the buffer to be used.

Parameter `buf` is the address of the struct `ibm_tcpimage` buffer containing the name and version of the TCP/IP image to which the caller wishes to connect. The name must be left-justified and padded with blanks. The TCP/IP name is always the PROC name, left-justified and padded with blanks. The TCP/IP version and status are ignored. The caller is responsible to fill in `name` before issuing the call. If `setibmopt` is not one of the active TCP/IP supported images on the system, subsequent socket calls will fail. This call checks the validity of the contents of the `name` field in the structure pointed to by `buf`. It checks the validity by verifying that the TCP/IP name is in the list generated by a `getibmopt()` call. It does not check the `status` or `version` fields. This call sets the image of the connection to be created on another call.

Typically, the caller issues `getibmopt()` to verify the choice for the TCP/IP image. On successful return, the caller’s choice will be honored when attempting the connection to TCP/IP.

**Return values**
A 0 indicates success; the value -1 indicates an error. `Errno` identifies the specific error.

**Errno** | **Description**
--- | ---
**EOPNOTSUPP** | This is not supported in this release of TCP/IP.
**EALREADY** | Your program is already connected to a TCP/IP image.
EFAULT Using *buf* would result in an attempt to copy the address into a portion of the caller address space into which information cannot be written.
setibmsockopt()

Like setsockopt() call, the setibmsockopt() call sets the options associated with a socket in the AF_INET domain. This call is for options specific to the IBM implementation of sockets.

```
#include <manifest.h>
#include <socket.h>

int setibmsockopt(int s, int level, int optname, char *optval, int optlen)
```

Parameter  Description
---  ---
s  Socket descriptor.
level  Level for which the option is being set. Only SOL_SOCKET is supported.
optname  The name of a specified socket option.
optval  Points to option data.
optlen  The length of the option data.

SO_IGNOREINCOMINGPUSH is another option to consider. This option is meaningful only for stream sockets. This option is effective only for connections established through an offload box. If optval points to 1, the option is set. If optval points to 0, the option is off.

The SO_IGNOREINCOMINGPUSH option causes a receive call to return when one of the following occurs:

- The requested length is reached.
- The internal TCP/IP length is reached.
- The peer application closes the connection.

The amount of data returned for each call is maximized and the amount of CPU time consumed by your program and TCP/IP is reduced.

This option is not appropriate to your operation if your program depends on receiving data before the connection is closed. For example, this option is appropriate for an FTP data connection, but not for a Telnet connection.

Return values
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using optval and optlen parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>ENOPROTOOPT</td>
<td>The optname parameter is unrecognized, or the level parameter is not SOL_SOCKET.</td>
</tr>
</tbody>
</table>

Example
```
#include <manifest.h>
#include <socket.h>
#include <tcperror.h>
```
struct ibm_bulkmode_struct bulkstr;
int optlen, rc;

optlen = sizeof(bulkstr);
rc = getibmsockopt(s, SOL_SOCKET, , (char *), &bulkstr, &optlen);
if (rc < 0) {
    tcperror("on getibmsockopt()");
    exit(1);
}
fprintf(stream,"%d byte buffer available for outbound queue.\n",
        bulkstr.b_max_send_queue_size_avail);

bulkstr.b_max_send_queue_size=bulkstr.b_max_send_queue_size_avail;
bulkstr.b_onoff = 1;
bulkstr.b_teststor = 0;
bulkstr.b_move_data = 1;
bulkstr.b_max_receive_queue_size = 65536;
rc = setibmsockopt(s, SOL_SOCKET, , (char *), &bulkstr, optlen);
if (rc < 0) {
    tcperror("on setibmsockopt()");
    exit(1);
}

**Related calls**
getibmsockopt(), getsockopt(), ibmsflush(), setsockopt()
setnetent()

The setnetent() call opens and caches the local host table contents for getnetent() call. The setnetent() call is available only when RESOLVE_VIA_LOOKUP is defined before MANIFEST.H is included. Refer to the z/OS Communications Server: IP Configuration Guide for information about using local host tables.

```
#include <manifest.h>
#include <socket.h>

int setnetent(int stayopen)
```

**Parameter Description**

- **stayopen** A nonzero flag value prevents the cached local host table contents from being freed after an endnetent().

**Return values**

The value 0 indicates success; the value -1 indicates an error._errno identifies the specific error, returning the errno value of the fopen() call.

**Related calls**

endnetent(), endhostent(), getbyaddr(), getbyname(), getnetent()
setprotoent()

The setprotoent() call opens the hlq.ETC.PROTO data set and sets it to the data set starting point. If the stayopen flag is nonzero, the hlq.ETC.PROTO data set remains open after every call.

Note: The hlq.ETC.PROTO data set is described in the [z/OS Communications Server: IP Configuration Reference](#).

```c
#include <manifest.h>
#include <socket.h>

int setprotoent(int stayopen)
```

Parameter | Description
---|---
stayopen | A flag that can be set to prevent data set hlq.ETC.PROTO closing after every call to setprotoent().

Return values
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

Related calls
endprotoent(), getprotobyname(), getprotobynumber(), getprotoent()
setservent()

The setservent() call opens the hlq.ETC.SERVICES data set and resets it to its starting point. If the stayopen flag is nonzero, the hlq.ETC.SERVICES data set remains open after every call.

Note: The hlq.ETC.SERVICES data set is described in the z/OS Communications Server: IP Configuration Reference.

```c
#include <manifest.h>
#include <socket.h>

int setservent(int stayopen)
```

**Parameter** | **Description**
---|---
**stayopen** | A flag that can be set to prevent data set hlq.ETC.SERVICES closing after each call to setservent().

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error, returning the errno value of the fopen() call.

**Related calls**
endservent(), getservbyname(), getservent()
### setsockopt()

The `setsockopt()` call sets options associated with a socket. It can be called only for sockets in the AF_INET domain. Options can exist at multiple protocol levels; they are always present at the highest socket level.

When manipulating socket options, you must specify the level at which the option resides and the name of the option. To manipulate options at the socket level, the `level` parameter must be set to `SOL_SOCKET`, as defined in `SOCKET.H`. To manipulate options at the TCP level, the `level` parameter must be set to `IPPROTO_TCP`, as defined in `SOCKET.H`. To manipulate options at any other level, such as the IP level, supply the appropriate protocol number for the protocol controlling the option. Currently, the `SOL_SOCKET`, `IPPROTO_TCP`, and `IPPROTO_IP` levels are supported. The `getprotobyname()` call can be used to return the protocol number for a named protocol.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int setsockopt(int s, int level, int optname, char *optval, int optlen)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>s</code></td>
<td>The socket descriptor</td>
</tr>
<tr>
<td><code>level</code></td>
<td>The level for which the option is being set</td>
</tr>
<tr>
<td><code>optname</code></td>
<td>The name of a specified socket option. See <a href="#">Appendix D</a> for the numeric values of <code>optname</code>.</td>
</tr>
<tr>
<td><code>optval</code></td>
<td>The pointer to option data</td>
</tr>
<tr>
<td><code>optlen</code></td>
<td>The length of the option data</td>
</tr>
</tbody>
</table>

The `optval` and `optlen` parameters are used to pass data used by the particular set command. The `optval` parameter points to a buffer containing the data needed by the set command. The `optlen` parameter must be set to the size of the data pointed to by `optval`.

All of the socket level options except SO_LINGER expect `optval` to point to an integer and `optlen` to be set to the size of an integer. When the integer is nonzero, the option is enabled. For toggle type options, if the integer is nonzero, the option is enabled. If it is 0, the option is disabled. The SO_LINGER option expects `optval` to point to a `linger` structure, as defined in `SOCKET.H`. This structure is defined in the following example:

```c
define linger
{
    int l_onoff; /* option on/off */
    int l_linger; /* linger time */
};
```

The `l_onoff` field is set to 0 if the SO_LINGER option is begin disabled. A nonzero value enables the option. The `l_linger` field specifies the amount of time to wait on close. The units of `l_linger` are seconds.

The following option is recognized at the TCP level:
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCP_NODELAY</strong></td>
<td>Toggles the use of Nagle algorithm (RFC 896) for all data sent over the socket. This option is not supported for AF_IUCV sockets. Under most circumstances, TCP sends data when it is presented from the application. However, when outstanding data has not yet been acknowledged, TCP will defer the transmission of any new data from the application until all of the outstanding data has been acknowledged. The Nagle algorithm enforces this deferral, even in cases where the receiver’s window is sufficiently open to accept the new data. For interactive applications, such as ones that send a stream of mouse events which receive no replies, this deferral of transmission might result in significant delays. For these types of applications, disabling Nagle algorithm would improve response time.</td>
</tr>
</tbody>
</table>
| **Notes:** | 1. When Nagle algorithm is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data is received.  
2. When Nagle algorithm is disabled, TCP will send small amounts of data even before the acknowledgment for previous data sent is received. |

The following keywords are recognized at the socket level:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
</table>
| **SO_RCVBUF** | Sets the size of the data portion of the TCP/IP receive buffer in OPTVAL. The size of the data portion of the receive buffer is protocol-specific. If the requested size exceeds the allowed size, the following occurs:  
  - If the protocol is TCP, a return value of -1 and errno of ENOBUFS is set. The receive buffer size is unchanged.  
    For maximum values for the TCP protocol, see the TCPCONFIG TCPRCVBUFSIZE and TCPMAXRCVBUFSIZE parameters in the [z/OS Communications Server: IP Configuration Guide](https://www.ibm.com/support/manuals/zoscommserver-ix86-64-communications-server-ips-configuration-guide).  
  - If the protocol is UDP or RAW, a return value of 0 is returned and the buffer size is set to 65 535. |
| **SO_SNDBUF** | Sets the size of the data portion of the TCP/IP send buffer in OPTVAL. The size of the data portion of the send buffer is protocol-specific. If the requested size exceeds the allowed size, the following occurs:  
  - If the protocol is TCP, a return value of -1 and errno of ENOBUFS is set. The send buffer size is unchanged.  
    For maximum values for the TCP protocol, see the TCPCONFIG TCPSENDBUFSIZE parameters in the [z/OS Communications Server: IP Configuration Guide](https://www.ibm.com/support/manuals/zoscommserver-ix86-64-communications-server-ips-configuration-guide).  
  - If the protocol is UDP or RAW, a return value of 0 is returned and the buffer size is set to 65 535. |
| **SO_BROADCAST** | Toggles the ability to broadcast messages. The default is disabled. If |
this option is enabled, it allows the application to send broadcast messages over s when the interface specified in the destination supports broadcasting of packets. This option has no meaning for stream sockets.

**SO_KEEPALIVE**
Toggles the TCP keep alive mechanism for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet, or to retransmissions of the packet, the connection is ended with the error ETIMEDOUT.

**SO_LINGER**
Lingers on close if data is present. The default is disabled. When this option is enabled and there is unsent data present when close() is called, the calling application is blocked during the close() call until the data is transmitted, or the connection has timed out. If this option is disabled, the close() call returns without blocking the caller, and the TCP/IP address space still waits to try to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits a finite amount of time while trying to send the data. This option has meaning for stream sockets only.

**SO_OOBINLINE**
Toggles the reception of out-of-band data. The default is disabled. When this option is enabled, it causes out-of-band data to be placed in the normal data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() without having to specify the MSG_OOB flag in those calls. When this option is disabled, it causes out-of-band data to be placed in the priority data input queue as it is received, making it available to recv(), recvfrom(), and recvmsg() only by specifying the MSG_OOB flag in those calls. This option has meaning for stream sockets only.

**SO_REUSEADDR**
Toggles local address reuse. The default is disabled. This alters the normal algorithm used in the bind() call.

The normal bind() call algorithm allows each internet address and port combination to be bound only once. If the address and port have been bound already, a subsequent bind() will fail and return error EADDRINUSE.

After the ‘SO_REUSEADDR’ option is active, the following situations are supported:
- A server can bind() the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.

The following options are recognized at the IP level (IPPROTO_IP):

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**IP_MULTICAST_TTL**
Sets the IP time to live of outgoing multicast datagrams. The default value is 1 (multicast is available only to the local subnet).

**IP_MULTICAST_LOOP**
Enables or disables the loopback of outgoing multicast datagrams. The default value is enable.

**IP_MULTICAST_IF**
Sets the interface for sending outbound multicast datagrams from the socket application.

Note: Multicast datagrams can be transmitted only on one interface at a time.

**IP_ADD_MEMBERSHIP**
Joins a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups.

**IP_DROP_MEMBERSHIP**
Exits a multicast group.

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>The s parameter is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using optval and optlen parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>No buffer space is available.</td>
</tr>
<tr>
<td>ENOPROTOOPT</td>
<td>The optname parameter is unrecognized, or the level parameter is not SOL_SOCKET.</td>
</tr>
</tbody>
</table>

**Example**
See "getsockopt()" on page 152 to see how the getsockopt() options set is queried.

```c
int rc;
int s;
int optval;
struct linger l;
int setsockopt(int s, int level, int optname,char *optval, int optlen);
...
/* I want out of band data in the normal inputqueue */
optval = 1;
rc = setsockopt(s, SOL_SOCKET, SO_OOBINLINE, (char *) &optval, sizeof(int));
...
/* I want to linger on close */
l.l_onoff = 1;
l.l linger = 100;
rc = setsockopt(s, SOL_SOCKET, SO_LINGER, (char *) &l, sizeof(l));
```

**Related calls**
fcntl(), getprotobyname(), getsockopt(), ioctl(), socket()
**shutdown()**

The shutdown() call shuts down all or part of a duplex connection. Parameter how sets the condition for shutdown to the socket's connection.

If you issue a shutdown() for a socket that currently has outstanding socket calls pending, see [Table 3 on page 35](#) to determine the effects of this operation on the outstanding socket calls.

**Note:** Issue a shutdown() call before issuing a close() call for a socket.

```c
#include <manifest.h>
#include <socket.h>

int shutdown(int s, int how)
```

**Parameter** | **Description**
---|---
`s` | The socket descriptor.
`how` | The how condition can have a value of 0, 1, or 2, where:
- Zero ends further receive operations.
- One ends further send operations.
- Two ends further send and receive operations.

**Return values**
The value 0 indicates success; the value -1 indicates an error. Errno identifies the specific error.

**Errno** | **Description**
---|---
EBADF | Indicates that `s` is not a valid socket descriptor.
EINVAL | The how parameter was not set to a valid value: 0, 1, or 2.
sock_debug()

The sock_debug() call provides the socket library tracing facility. The onoff parameter can have a value of 0 or nonzero. If onoff=0 (the default), no socket library tracing is done. If onoff=nonzero, the system traces for socket library calls and interrupts.

Note: You can include the statement SOCKDEBUG in data set TCPIP.DATA as an alternative to calling sock_debug() with onoff not equal to 0.

#include <manifest.h>
#include <socket.h>

void sock_debug(int onoff)

Parameter  Description
----------  ----------------
onoff       A parameter that can be set to 0 or nonzero

Related calls
accept(), close(), connect(), socket()
sock_do_teststor()

The sock_do_teststor() call is used to check for calls that attempt to access storage outside the caller address space.

```c
#include <manifest.h>
#include <socket.h>

void sock_do_teststor(int onoff)
```

**Parameter**  

**Description**

- `onoff` A parameter that can be set to 0 or nonzero

If `onoff` is not 0 for either inbound or outbound sockets, both the address of the message buffer and the message buffer itself are checked for addressability at every socket call. The error condition, EFAULT, is set if there is an addressing problem. If `onoff` is set to 0, address checking is not done by the socket library program. If an error occurs when `onoff` is 0, normal runtime error handling reports the exception condition.

The default for `onoff` is 0. Addresses are not checked for addressability for parameters of C socket calls. While you are testing your program, you might find it useful to set `onoff` to a nonzero value.

**Notes:**

1. You can include the statement SOCKNOTESTSTOR in data set TCPIP.DATA, as an alternative to calling sock_do_teststor() with `onoff` equal to 0.
2. You can include the statement SOCKTESTSTOR in the data set TCPIP.DATA which is in the client’s catalog when the socket program is started, as an alternative to calling sock_do_teststor() with `onoff` not equal to 0.

**Restrictions**

None
socket()

The socket() call creates an endpoint for communication and returns a socket descriptor representing that endpoint. Different types of sockets provide different communication services.

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int socket(int domain, int type, int protocol)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>domain</td>
<td>The address domain requested. It is either AF_INET or AF_IUCV.</td>
</tr>
<tr>
<td>type</td>
<td>The type of socket created, either SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol requested. Possible values are 0, IPPROTO_UDP, or IPPROTO_TCP.</td>
</tr>
</tbody>
</table>

The domain parameter specifies the communication domain within which communication is to take place. This parameter specifies the address family (format of addresses within a domain) to be used. The families supported are AF_INET, which is the internet domain, and AF_IUCV, which is the IUCV domain. These constants are defined in the SOCKET.H header file.

The type parameter specifies the type of socket created. The type is analogous to the communication requested. These socket type constants are defined in the SOCKET.H header file. The types supported are:

<table>
<thead>
<tr>
<th>Socket Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCK_STREAM</td>
<td>Provides sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data. This type is supported in both the AF_INET and AF_IUCV domains.</td>
</tr>
<tr>
<td>SOCK_DGRAM</td>
<td>Provides datagrams, which are connectionless messages, of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered repeatedly. This type is supported in the AF_INET domain only.</td>
</tr>
<tr>
<td>SOCK_RAW</td>
<td>Provides the interface to internal protocols (such as IP and ICMP). This type is supported in the AF_INET domain only.</td>
</tr>
</tbody>
</table>

Note: To use raw sockets, the application must be APF-authorized.

The protocol parameter specifies the particular protocol to be used with the socket. In most cases, a single protocol exists to support a particular type of socket within a particular addressing family (not true with raw sockets). If the protocol parameter is set to 0, the system selects the default protocol number for the domain and socket type requested. Protocol numbers are found in the hlq.ETC.PROTO data set. Alternatively, the getprotobyname() call can be used to get the protocol number for a protocol with a known name. The protocol field must be set to 0 if the domain
parameter is set to AF_IUCV. The protocol defaults are TCP for stream sockets and UDP for datagram sockets. There is no default for raw sockets.

SOCK_STREAM sockets model duplex byte streams. They provide reliable, flow-controlled connections between peer applications. Stream sockets are either active or passive. Active sockets are used by clients who initiate connection requests using connect(). By default, socket() creates active sockets. Passive sockets are used by servers to accept connection requests from the connect() call. An active socket is transformed into a passive socket by binding a name to the socket using the bind() call, and by indicating a willingness to accept connections with the listen() call. Once a socket is passive, it cannot be used to initiate connection requests.

In the AF_INET domain, the bind() call applied to a stream socket lets the application specify the networks from which it will accept connection requests. The application can fully specify the network interface by setting the internet address field in the address structure to the internet address of a network interface. Alternatively, the application can use a wildcard to specify that it wants to receive connection requests from any network. This is done by setting the internet address field within the address structure to the constant INADDR_ANY, as defined in the SOCKET.H header file.

Once a connection has been established between stream sockets, any of the data transfer calls can be used: (read(), write(), send(), recv(), readv(), writev(), sendto(), recvfrom(), sendmsg(), and recvmsg()). Usually, the read-write or send-recv pairs are used to send data on stream sockets. If out-of-band data is to be exchanged, the send-recv pair is normally used.

SOCK_DGRAM sockets model datagrams. They provide connectionless message-exchange without guarantee of reliability. Messages sent are limited in size. Datagram sockets are not supported in the AF_IUCV domain.

There is no active or passive analogy to stream sockets with datagram sockets. Servers must still call bind() to name a socket and to specify the network interface from which it wants to receive packets. Wildcard addressing, as described for stream sockets, applies to datagram sockets also. Because datagram sockets are connectionless, the listen() call has no meaning for them and must not be used with them.

After an application has received a datagram socket, it can exchange datagrams using the sendto() and recvfrom(), or sendmsg() and recvmsg() calls. If the application goes one step further by calling connect() and fully specifying the name of the peer with which all messages are to be exchanged, then the other data transfer calls of read(), write(), readv(), writev(), send(), and recv() can be used also. See "connect()" on page 122 for more information about placing a socket into the connected state.

Datagram sockets allow messages to be broadcast to multiple recipients. Setting the destination address to a broadcast address depends on the class of address, and whether subnets are used. The constant INADDR_BROADCAST, defined in socket.h, can be used to broadcast to the primary network when the primary network configured supports broadcast.

SOCK_RAW sockets give the application an interface to lower layer protocols, such as IP and ICMP. This interface is often used to bypass the transport layer when
direct access to lower layer protocols is needed. Raw sockets are also used to test new protocols. Raw sockets are not supported in the AF_IUCV domain.

Raw sockets are connectionless and data transfer semantics are the same as those described previously for datagram sockets. The connect() call can be used similarly to specify the peer.

Outgoing packets have an IP header prefixed to them. IP options can be set and inspected using the setsockopt() and getsockopt() calls respectively. Incoming packets are received with the IP header and options intact.

Notes:
1. Sockets are deallocated using the close() call.
2. Only SOCK_STREAM sockets are supported in the AF_IUCV domain.
3. The setsockopt() and getsockopt() calls are not supported for sockets in the AF_IUCV domain.
4. The flags field in the send(), recv(), sendto(), recvfrom(), sendmsg(), and recvmsg() calls is not supported in the AF_IUCV domain.

Return values
A nonnegative socket descriptor indicates success. The value -1 indicates an error. Errno identifies the specific error.

Errno  Description
EPROTONOSUPPORT  The protocol is not supported in this domain or this socket type.
EACCES  Access denied. The application is not an APF-authorized application.
EAFNOSUPPORT  The specified address family is not supported by this protocol family.

Example
int s;
struct protoent *p;
struct protoent *getprotobyname(char *name);
int socket(int domain, int type, int protocol);
...  /* Get stream socket in internetdomain with default protocol */
s = socket(AF_INET, SOCK_STREAM, 0);
...  /* Get stream socket in iucvdomain with default protocol */
s = socket(AF_IUCV, SOCK_STREAM, 0);
...  /* Get raw socket in internetdomain for ICMP protocol */
p = getprotobyname("iucv");
s = socket(AF_INET, SOCK_RAW, p->p_proto);

Related calls
accept(), bind(), close() connect(), fcntl(), getprotobyname(), getsockname(), getsockopt(), ioctl(), maxdesc(), read(), readv(), recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), shutdown(), write(), writev()
takesocket()\

The takesocket() call acquires a socket from another program. Typically, the other program passes its client ID and socket descriptor to your program through your program startup parameter list.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>

int takesocket(struct clientid *clientid, int hisdesc)
```

### Parameter Description

- **clientid**: Points to the `clientid` of the application from which you are taking a socket.
- **hisdesc**: Describes the socket to be taken.

The takesocket() call acquires a socket from another program. Typically, the other program passes its client ID and socket descriptor to your program through your program startup parameter list.

### Return values

A nonnegative socket descriptor indicates success. The value -1 indicates an error. `Errno` identifies a specific error.

<table>
<thead>
<tr>
<th>Error</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EACCES</td>
<td>The other application did not give the socket to your application.</td>
</tr>
<tr>
<td>EBADF</td>
<td>The <code>hisdesc</code> parameter does not specify a valid socket descriptor owned by the other application. The socket has already been taken.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the <code>clientid</code> parameter as specified would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>EINVAL</td>
<td>The <code>clientid</code> parameter does not specify a valid client identifier.</td>
</tr>
<tr>
<td>EMFILE</td>
<td>The socket descriptor table is already full.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>The operation cannot be performed because of a shortage of control blocks (SCB or SKCB) in the TCP/IP address space.</td>
</tr>
<tr>
<td>EPFNOSUPPORT</td>
<td>The domain field of the <code>clientid</code> parameter is not AF_INET.</td>
</tr>
</tbody>
</table>

### Related calls

`getclientid()`, `givesocket()`
tcperror()

When a socket call produces an error, the call returns a negative value and the variable errno is set to an error value found in TCPERRNO.H. The tcperror() call prints a short error message describing the last error that occurred. If s is non-NULL, tcperror() prints the string s followed by a colon, followed by a space, followed by the error message, and terminating with a new-line character. If s is NULL or points to a NULL string, only the error message and the new-line character are output.

The tcperror() function is equivalent to the UNIX perror() function.

```
#include <manifest.h>
#include <socket.h>
#include <tcperrno.h>

void tcperror(char *s)
```

**Parameter Description**

- s A NULL or NULL-terminated character string

**Example**

**Example 1**

```
if ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
    tcperror("socket()");
    exit(2);
}
```

If the socket() call produces error ENOMEM, socket() returns a negative value and errno is set to ENOMEM. When tcperror() is called, it prints the string:

- socket(): Not enough storage (ENOMEM)

**Example 2**

```
if ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0) tcperror(NULL);
```

If the socket() call produces error ENOMEM, socket() returns a negative value and errno is set to ENOMEM. When tcperror() is called, it prints the string:

- Not enough storage (ENOMEM)
write()

The write() call writes data from a buffer on a socket with descriptor s. The write() call applies only to connected sockets.

This call writes up to len bytes of data.

If there is not enough available buffer space to hold the socket data to be transmitted and the socket is in blocking mode, write() blocks the caller until more buffer space is available. If the socket is in nonblocking mode, write() returns -1 and sets errno to EWOULDBLOCK. See "fcntl()" on page 129 or "ioctl()" on page 168 to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, and call this function until all data has been sent.

```
#include <manifest.h>
#include <socket.h>

int write(int s, char *buf, int len)
```

Parameter | Description
---|---
s | Socket descriptor.
buf | Points to the buffer holding the data to be written.
len | Length in bytes of buf.

Return values

If successful, the number of bytes written is returned. The value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the buf and len parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>Buffer space is not available to send the message.</td>
</tr>
<tr>
<td>EWOULDBLOCK</td>
<td>Indicates that s is in nonblocking mode and there is not enough space in TCP/IP to accept the data.</td>
</tr>
</tbody>
</table>

Related calls

connect(), fcntl(), getsockopt(), ioctl(), read(), recv(), recvfrom(), recvmsg(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), writev()
writev()

The writev() call writes data from a set of buffers on a socket using descriptor s.

The writev() call applies only to connected sockets.

```
#include <manifest.h>
#include <socket.h>
#include <bsdtypes.h>
#include <uio.h>

int writev(int s, struct iovec *iov, int iovcnt)
```

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>s</td>
<td>Socket descriptor.</td>
</tr>
<tr>
<td>iov</td>
<td>Points to an array of iovec buffers.</td>
</tr>
<tr>
<td>iovcnt</td>
<td>Number of buffers in the array.</td>
</tr>
</tbody>
</table>

The data is gathered from the buffers specified by iov[0]...iov[iovcnt-1]. The iovec structure is defined in UIO.H and contains the following fields:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>iov_base</td>
<td>Points to the buffer.</td>
</tr>
<tr>
<td>iov_len</td>
<td>The length of the buffer.</td>
</tr>
</tbody>
</table>

This call writes the sum of the iov_len bytes of data.

If buffer space is not available to hold the socket data to be transmitted and the socket is in blocking mode, writev() blocks the caller until additional buffer space becomes available. If the socket is in a nonblocking mode, writev() returns a -1 and sets errno to EWOULDBLOCK. For a description of how to set nonblocking mode, see "fcntl()" on page 129 or "ioctl()" on page 168.

For datagram sockets, this call sends the entire datagram, providing the datagram can fit into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been sent.

**Return values**

If successful, the number of bytes written from the buffers is returned. The value -1 indicates an error. Errno identifies the specific error.

<table>
<thead>
<tr>
<th>Errno</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBADF</td>
<td>Indicates that s is not a valid socket descriptor.</td>
</tr>
<tr>
<td>EFAULT</td>
<td>Using the iov and iovcnt parameters would result in an attempt to access storage outside the caller address space.</td>
</tr>
<tr>
<td>ENOBUFS</td>
<td>Buffer space is not available to send the message.</td>
</tr>
<tr>
<td>EWOULDBLOCK</td>
<td>Indicates that s is in nonblocking mode and there is not enough space in TCP/IP to accept the data.</td>
</tr>
</tbody>
</table>
Related calls
connect(), fcntl(), getsockopt(), ioctl(), write(), read(), readv(), recv(), recvmsg(), recvfrom(), select(), selectex(), send(), sendmsg(), sendto(), setsockopt(), socket(), write()
Sample C socket programs

This section contains sample C socket programs. The C source code can be found in the SEZAINST data set.

Following are the sample socket programs available:

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCPC</td>
<td>C socket TCP client</td>
</tr>
<tr>
<td>TCPS</td>
<td>C socket TCP server</td>
</tr>
<tr>
<td>UDPC</td>
<td>C socket UDP client</td>
</tr>
<tr>
<td>UDPS</td>
<td>C socket UDP server</td>
</tr>
</tbody>
</table>

For samples of the multitasking C programs in the following table, see Appendix A, “Multitasking C socket sample program,” on page 819.

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTCLNT</td>
<td>C socket MTC client</td>
</tr>
<tr>
<td>MTCSRVR</td>
<td>C socket MTC server</td>
</tr>
<tr>
<td>MTCCSUB</td>
<td>C socket subtask MTCCSUB</td>
</tr>
</tbody>
</table>

Executing TCPS and TCPC modules

To start the TCPS server, execute TCPS 9999 on the other MVS address space (server).

To run the TCPC client, execute TCPC MVS13 9999. (MVS13 is the host name where the TCPS server is running, and 9999 is the port you have assigned.)

After executing the TCPC client, the following output is displayed on the server session:

Server Ended Successfully

Executing UDPS and UDPC modules

To start the UDPS server, execute UDPS on the other MVS address space (server). The following message is displayed:

Port assigned is 1028

To run the UDPC client, execute UDPC 9.67.60.10 1028. (Address 9.67.60.10 is the IP machine address where the UDPS server is running, and 1028 is the port assigned by the UDPS server.)

After executing the UDPC client, the following message is displayed:

Received Message Hello....

C socket TCP client

Following is an example of a C socket TCP client (TCPC) program. The source code can be found in the TCPC member of the SEZAINST data set.
static char ibmcopyr[] =
  "TCPC - Licensed Materials - Property of IBM."
  "This module is "Restricted Materials of IBM" *
  "5647-A01 (C) Copyright IBM Corp. 1977, 1998 *
  "US Government Users Restricted Rights - *
  "Use, duplication or disclosure restricted by *
  "GSA ADP Schedule Contract with IBM Corp. *
  "*
  "Status: CSV2R6 *
  "*
  "SMP/E Distribution Name: EZAEC01V *
  "*
  /* ***/

Figure 52. C socket TCP client sample (Part 1 of 3)
* Check Arguments Passed. Should be hostname and port. */
if (argc != 3)
{
    fprintf(stderr, "Usage: %s hostname port\n", argv[0]);
    exit(1);
}

/* The host name is the first argument. Get the server address. */
hostnm = gethostbyname(argv[1]);
if (hostnm == (struct hostent *) 0)
{
    fprintf(stderr, "Gethostbyname failed\n");
    exit(2);
}

/* The port is the second argument. */
port = (unsigned short) atoi(argv[2]);

/* Put a message into the buffer. */
strcpy(buf, "the message");

/* Put the server information into the server structure. */
The port must be put into network byte order.
server.sin_family = AF_INET;
server.sin_port = htons(port);
server.sin_addr.s_addr = *((unsigned long *)hostnm->h_addr);

/* Get a stream socket. */
if ((s = socket(AF_INET, SOCK_STREAM, 0)) < 0)
{
    tcperror("Socket()");
    exit(3);
}

/* Connect to the server. */
if (connect(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("Connect()");
    exit(4);
}

if (send(s, buf, sizeof(buf), 0) < 0)

Figure 52. C socket TCP client sample (Part 2 of 3)
The following is an example of a C socket TCP server (TCPS) program. The source code can be found in the TCPS member of the SEZAINST data set.

```c
{  tcperror("Send()" jean;
    exit(5);  
}

/* The server sends back the same message. Receive it into the
 * buffer.
 */
if (recv(s, buf, sizeof(buf), 0) < 0)
{  tcperror("Recv()");
    exit(6);
}

/* Close the socket.
 */
close(s);
printf("Client Ended Successfully\n");
exit(0);
}
```

Figure 52. C socket TCP client sample (Part 3 of 3)

**C socket TCP server**

The following is an example of a C socket TCP server (TCPS) program. The source code can be found in the TCPS member of the SEZAINST data set.
static char ibmcopyr[] =
    "TCPS - Licensed Materials - Property of IBM."
    "This module is "Restricted Materials of IBM"
    "5647-A01 (C) Copyright IBM Corp. 1996."
    "See IBM Copyright Instructions."
};

#include <manifest.h>
#include <bsdtypes.h>
#include <socket.h>
#include <in.h>
#include <netdb.h>
#include <stdio.h>

/* Server Main. */
main(argc, argv)
    int argc;
    char **argv;
{
    unsigned short port; /* port server binds to */
    char buf[12]; /* buffer for sending & receiving data */
    struct sockaddr_in client; /* client address information */
    struct sockaddr_in server; /* server address information */
    int s; /* socket for accepting connections */
    int ns; /* socket connected to client */
    int namelen; /* length of client name */

    /*
    Figure 53. C socket TCP server sample (Part 1 of 3)
    */
* Check arguments. Should be only one: the port number to bind to.
* /

if (argc != 2)
{
    fprintf(stderr, "Usage: %s port\n", argv[0]);
    exit(1);
}

* First argument should be the port.
* /
port = (unsigned short) atoi(argv[1]);

* Get a socket for accepting connections.
* /
if ((s = socket(AF_INET, SOCK_STREAM, 0)) < 0)
{
    tcperror("Socket()");
    exit(2);
}

* Bind the socket to the server address.
* /
server.sin_family = AF_INET;
server.sin_port = htons(port);
server.sin_addr.s_addr = INADDR_ANY;
if (bind(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("Bind()");
    exit(3);
}

* Listen for connections. Specify the backlog as 1.
* /
if (listen(s, 1) != 0)
{
    tcperror("Listen()");
    exit(4);
}

* Accept a connection.
* /
namelen = sizeof(client);
if ((ns = accept(s, (struct sockaddr *)&client, &namelen)) == -1)
{
    tcperror("Accept()");
    exit(5);
}

Figure 53. C socket TCP server sample (Part 2 of 3)
C socket UDP server

The following is an example of a C socket UDP server (UDPS) program. The source code can be found in the UDPS member of the SEZAINST data set.
static char ibmcopyr[] =
"UDPS - Licensed Materials - Property of IBM."
"This module is "Restricted Materials of IBM"
"5647-A01 (C) Copyright IBM Corp. 1977, 1998"
"US Government Users Restricted Rights -
Use, duplication or disclosure restricted by
GSA ADP Schedule Contract with IBM Corp.
"Status: CSV2R6"
"SMP/E Distribution Name: EZAEC021"

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <socket.h>
#include <netdb.h>
#include <stdio.h>

int s, namelen, client_address_size;
struct sockaddr_in client, server;
char buf[32];

/*
 * Create a datagram socket in the internet domain and use the
 * default protocol (UDP).
 */
if ((s = socket(AF_INET, SOCK_DGRAM, 0)) < 0)
{  tcperror("socket()");
   exit(1);
}
/*
Figure 54. C socket UDP server sample (Part 1 of 3)
* Bind my name to this socket so that clients on the network can
* send me messages. (This allows the operating system to demultiplex
* messages and get them to the correct server)
* * Set up the server name. The internet address is specified as the
* wildcard INADDR_ANY so that the server can get messages from any
* of the physical internet connections on this host. (Otherwise we
* would limit the server to messages from only one network
* * interface.)
*/
server.sin_family = AF_INET; /* Server is in Internet Domain */
server.sin_port = 0; /* Use any available port */
server.sin_addr.s_addr = INADDR_ANY; /* Server's Internet Address */

if (bind(s, (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("bind()");
    exit(2);
}

/* Find out what port was really assigned and print it */
namelen = sizeof(server);
if (getsockname(s, (struct sockaddr *)&server, &namelen) < 0)
{
    tcperror("getsockname()");
    exit(3);
}

printf("Port assigned is %d\n", ntohs(server.sin_port));

/*
* Receive a message on socket s in buf of maximum size 32
* from a client. Because the last two parameters
* are not null, the name of the client will be placed into the
* client data structure and the size of the client address will
* be placed into client_address_size.
*/
client_address_size = sizeof(client);

if (recvfrom(s, buf, sizeof(buf), 0, (struct sockaddr *)&client,
            &client_address_size) < 0)
{
    tcperror("recvfrom()");
    exit(4);
}

/*
* Print the message and the name of the client.
* The domain should be the internet domain (AF_INET).
* The port is received in network byte order, so we translate it to
* host byte order before printing it.
* The internet address is received as 32 bits in network byte order
* so we use a utility that converts it to a string printed in
* dotted decimal format for readability.
*/
printf("Received message %s from domain %s port %d internet\n", buf, client.sin_addr.s_addr, ntohs(server.sin_port));

Figure 54. C socket UDP server sample (Part 2 of 3)
The following is an example of a C socket UDP (UDPC) client program. The source code can be found in the UDPC member of the SEZAINST data set.

C socket UDP client

Figure 54. C socket UDP server sample (Part 3 of 3)
static char ibmcopyr[] =
  "UPDC - Licensed Materials - Property of IBM. "
  "This module is "Restricted Materials of IBM"
  "5647-A01 (C) Copyright IBM Corp. 1992, 1996. "
  "See IBM Copyright Instructions.";

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <socket.h>
#include <netdb.h>
#include <stdio.h>

main(argc, argv)
int argc;
char **argv;
{

  int s;
  unsigned short port;
  struct sockaddr_in server;
  char buf[32];

     * Convert the port from ascii to integer and then from host byte
     * order to network byte order.
     */
  if(argc != 3)
    {
      
      Figure 55. C socket UDP client sample (Part 1 of 2)
printf("Usage: \%s <host address> <port> \n",argv[0]);
exit(1);
}
port = htons(atoi(argv[2]));

/* Create a datagram socket in the internet domain and use the *
 * default protocol (UDP).
 */
if ((s = socket(AF_INET, SOCK_DGRAM, 0)) < 0)
{
    tcperror("socket()");
    exit(1);
}

/* Set up the server name */
server.sin_family = AF_INET;  /* Internet Domain    */
server.sin_port = port;      /* Server Port      */
server.sin_addr.s_addr = inet_addr(argv[1]); /* Server's Address */

strcpy(buf, "Hello");

/* Send the message in buf to the server */
if (sendto(s, buf, (strlen(buf)+1), 0,
            (struct sockaddr *)&server, sizeof(server)) < 0)
{
    tcperror("sendto()");
    exit(2);
}

/* Deallocate the socket */
close(s);

Figure 55. C socket UDP client sample (Part 2 of 2)
Chapter 11. X/Open Transport Interface

This section describes the X/Open Transport Interface (XTI) IPv4 socket application program interface (API) and contains the following topics:

- Software requirements
- What is provided
- How XTI works in the z/OS environment
- Creating an application
- Coding XTI calls
- Compiling and linking XTI applications using cataloged procedures
- Understanding XTI sample programs

The XTI allows you to write applications in the z/OS environment to access the open transport interface.

Note: The XTI calls in this section apply only to unconnected sessions.

For more information on the XTI protocol, refer to CAE Specification: X/Open Transport Interface (XTI).

Software requirements

Application programs using the X/Open Transport Interface (XTI) require the following:

- SEZACMAC (macro library routines)
- SEZACMTX (executable modules)
- SEZALOAD (executable modules)
- SEZAINST (sample programs)
- Current z/OS Language Environment run-time library

What is provided

The XTI support provided with TCP/IP includes the following:

- The XTI library containing the XTI calls for C language programmers
- The XTI management services that allow you to include additional protocol mappers
- The RFC 1006 protocol mapping component that creates the protocol expected by the XTI interface

For more information about RFC1006, see Appendix E, “Related protocol specifications,” on page 871.

How XTI works in the z/OS environment

The XTI is a network-transparent protocol. In the z/OS environment, XTI system support is a set of application calls to create the XTI protocol, as requested by your application. The services request is communicated to the XTI transport system using the RFC 1006 protocol mapper. RFC 1006 translates messages to transport class 0 service requests before passing them to the XTI.
Figure 56 is a high-level diagram to show how the XTI interface works in an z/OS environment.

In the z/OS environment, external names must be eight characters or fewer. If the XTI application program interface names exceed this limit, those names longer than eight characters are remapped to new names using the C compiler preprocessor. This name remapping is found in a file called XI1GLUE.H, which is automatically included in your program when you include the header file called XLIB.H. When debugging your application, you can refer to the XI1GLUE.H file to find the remapped names of the XTI programs.

Creating an application

To create an application that uses the XTI protocol, you should study the XTI application program interface in CAE Specification: X/Open Transport Interface (XTI). In addition, both “XTI socket client sample program” on page 239 and “XTI socket server sample program” on page 248 illustrate programs that use the XTI interface. These programs are distributed with TCP/IP.

Coding XTI calls

The following tables list the call instructions supported by the XTI for TCP/IP. These call instructions are for unconnected sessions only, and are listed by type of service.

Initializing a transport endpoint

Table 7 on page 233 lists the routines needed to initialize a transport endpoint. For more information refer to CAE Specification: X/Open Transport Interface (XTI).
Table 7. Initializing a call

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_bind()</td>
<td>Finds the endpoint for an address, and activates the endpoint.</td>
</tr>
<tr>
<td>t_open()</td>
<td>Creates a transport endpoint, and identifies the transport provided.</td>
</tr>
</tbody>
</table>

Establishing a connection

Table 8 lists the routines needed to establish a connection. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

Table 8. Establishing a connection

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_accept()</td>
<td>Accepts a connection after a connect indication is received.</td>
</tr>
<tr>
<td>t_connect()</td>
<td>Requests connection to a transport user at a known destination.</td>
</tr>
<tr>
<td>t_listen()</td>
<td>Listens for connect information from other transport users.</td>
</tr>
<tr>
<td>t_rcvconnect()</td>
<td>Checks the status of a completed connect.</td>
</tr>
</tbody>
</table>

Transferring data

Table 9 lists the routines needed to transfer data. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

Table 9. Transferring data

<table>
<thead>
<tr>
<th>Routine</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_rcv()</td>
<td>Receives normal or expedited data over a transport connection.</td>
</tr>
<tr>
<td>t_snd()</td>
<td>Sends normal or expedited data over a transport connection.</td>
</tr>
</tbody>
</table>

Releasing a connection

Table 10 lists the routines needed to release a connection. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

Table 10. Releasing a connection

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_rcvdis()</td>
<td>Determines the reason for an abortive release or connection reject.</td>
</tr>
<tr>
<td>t_snddis()</td>
<td>Sends an abortive release or a connection reject.</td>
</tr>
</tbody>
</table>

Disabling a connection

Table 11 lists the routines needed to disable a connection. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

Table 11. Disabling a connection

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_close()</td>
<td>Informs the XTI manager that you have finished with the endpoint, and frees any locally allocated resources assigned to endpoint.</td>
</tr>
<tr>
<td>t_unbind()</td>
<td>Resets the path to the transport endpoint. The connection is removed from the transport system, and requests for this path are denied.</td>
</tr>
</tbody>
</table>
Managing events

Table 12 lists the routines needed to manage events. Each XTI call handles one event at a time. Events are processed one at a time, and you can wait on only one event at a time. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_look()</td>
<td>Returns the events current for a transport endpoint and notifies the calling program of an asynchronous event when the calling program is in synchronous mode.</td>
</tr>
</tbody>
</table>

Using utility calls

Table 13 lists utility routines that you can use to solve problems and monitor connections. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_error()</td>
<td>Returns the last error that occurred on a call to a transport function. You can add an identifying prefix to this call to aid in problem solving.</td>
</tr>
<tr>
<td>t_getinfo()</td>
<td>Returns information about the underlying transport protocol for the connection associated with file descriptor fd.</td>
</tr>
<tr>
<td>t_getstate()</td>
<td>Returns information about the state of the transport provider associated with file descriptor fd.</td>
</tr>
</tbody>
</table>

Using system calls

Table 14 lists system routines that you can use to manage your program. For more information refer to CAE Specification: X/Open Transport Interface (XTI).

<table>
<thead>
<tr>
<th>Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fcntl()</td>
<td>Controls the operating characteristics of sockets. For more information, see “selectex()” on page 188.</td>
</tr>
<tr>
<td>select()</td>
<td>Checks descriptor sets to see if information is available for a read or a write. Select() also checks for pending exception conditions. For more information, see “select()” on page 184.</td>
</tr>
<tr>
<td>selectex()</td>
<td>Extends the select() calls by allowing you to add an ECB to define extra events. For more information, see “selectex()” on page 188.</td>
</tr>
</tbody>
</table>

Compiling and linking XTI applications using cataloged procedures

Several methods are available to compile, link-edit, and run your XTI program. This section contains information about the data sets that you must include to run your XTI source program, using IBM-supplied cataloged procedures.

The following compile and link-edit sample procedures are supplied by IBM:
- XTICL is a sample compile and link-edit procedure.
- XTC is a sample client execute procedure.
XTIS is a sample server execute procedure.

Note: For more information about compiling and linking, refer to the IBM C/370 Programming Guide.

Figure 57. Sample compile and link-edit job control procedure (Part 1 of 2)
Figure 57. Sample compile and link-edit job control procedure (Part 2 of 2)
XTIS

Figure 58. Sample client execution job control procedure
Understanding XTI sample programs

This section contains sample XTI socket programs. The XTI source code can be found in the SEZAINST data set.

Note: As with all TCP/IP applications, dynamic data set allocations are used unless explicitly overridden.
The following sample XTI socket programs are available:

<table>
<thead>
<tr>
<th>Name when shipped</th>
<th>Alias name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XTICC</td>
<td>EZAEC0YL</td>
<td>XTI socket client sample program</td>
</tr>
<tr>
<td>XTISC</td>
<td>EZAEC0YM</td>
<td>XTI socket server sample program</td>
</tr>
</tbody>
</table>

**XTI socket client sample program**

The following is an example of an XTI socket client program:
static char ibmcopyr[] =
 "XTICC - Licensed Materials - Property of IBM.
 "This module is "Restricted Materials of IBM" *
 "5647-A01 (C) Copyright IBM Corp. 1994.
 "See IBM Copyright Instructions."

;*/

Figure 60. Sample client code for XTI (Part 1 of 9)
/*
 * bind request structure for t_bind()
 */

struct t_bind req, ret;

/*
 * for client to make calls to server
 */

struct t_call scall, rcall;

/*
 * store fd returned on open()
 */

int fd;
int tot_received;
char *hostname;

/*
 * data buffer
 */

char buf[25];
int looking;

/*
 * flags returned from t_rcv()
 */

int rflags, sflags;

/*
 * transport provider for t_open()
 */

char tprov[1][8] =
   { "RFC1006" };

/*
 * args that are optional
 */

int args;

int pnum = 102;
char *port = "102";
char *ctsel = "client";
char *stsel = "server";
unsigned int rqlen = 0;

Figure 60. Sample client code for XTI (Part 2 of 9)
struct xti1006tsap tsap, tsapret;
void cleanup(int);
void form_addr_1006(struct xti1006tsap *, int, char *, char *, int, int);

/*
* MAIN line program starts here !!!
*/

main(argc,argv)
int argc;
char *argv[];
{


/* Check arguments. The host name is required. Host name is the
* last parameter passed. Port can be changed by passing it as the
* first parameter.
*/

if ((argc > 3) | (argc < 2)) {
    fprintf(stderr,"Usage XTI <port> <host>\n");
    exit(1);
}

if(argc==2)
    hostname = argv[1];
else
    {
    hostname = argv[2];
    port = argv[1];
    pnum = (unsigned short) atoi(argv[1]);
}

/* assume normal data
*/
sflags = 0;

/* establish endpoint to t_listen() on
*/

if ((fd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
{
    t_error("Error on t_open for FD");
    exit(t_errno);
}

/* compose req structure for t_bind() calls
*/

/* length of tsap

Figure 60. Sample client code for XTI (Part 3 of 9)
```c
/*
 req.qlen = 0;
 req.addr.len = sizeof(tsap);

/*
 * allocate the buffer to contain the
 * port and tsel to bind server to
 */
 req.addr.buf = (char *)malloc(sizeof(tsap));

/*
 * fill address buffer with the address information
 */
 form_addr_1006((struct xti1006tsap *)req.addr.buf,pnum,NULL,
     ctsel,fd,-1);

/*
 * now that we're done composing the req,
 * do the bind of fd to addr in req
 */
 if (t_bind(fd,&req,NULL) != 0)
 {
   t_error("ERROR ON BIND FOR FD");
   exit(t_errno);
 }

/*
 * compose call structure for t_connect() call
 */
 scall.addr.len = sizeof(tsap);
 scall.addr.buf = (char *)malloc(sizeof(tsap));

/*
 * fill address buffer with the address information
 */
 form_addr_1006((struct xti1006tsap *)scall.addr.buf,-1,hostname,
     stsel,fd,-1);

scall.opt.maxlen = 0;
scall.opt.len = 0;
scall.opt.buf = NULL;
scall.udata.len = 0;
scall.udata.buf = NULL;

rcall.addr.maxlen = sizeof(tsapret);
rcall.addr.buf = (char *)malloc(sizeof(tsapret));
rcall.opt.maxlen = 0;
rcall.udata.maxlen = 0;
rcall.udata.buf = NULL;

Figure 60. Sample client code for XTI (Part 4 of 9)
```
/* *
 * issue connect request
 */

looking = t_connect(fd,&scall,&rcall);
if (looking < 0 & t_errno != TNODATA)
{
    t_error("ERROR ON CONNECT");
    cleanup(fd);
    exit(t_errno);
}

looking = 1;
while (looking)
{
    looking = t_look(fd);
    if (looking == T_CONNECT & looking > 0)
        looking = 0;
    else
        if (looking != 0)
            {t_error("ERROR ON LOOK");
             cleanup(fd);
             exit(t_errno);
            }
        else
            looking = 1;
}

/* *
 * establish connection 
 */

looking = 1;
while (looking)
{
    if (t_rcvconnect(fd,&rcall) == 0)
        looking = 0;
    else
        if (t_errno != TNODATA)
            {t_error("ERROR ON RCVCCONNECT");
             cleanup(fd);
             exit(t_errno);
            }

/* *
 * place message in buffer 
 */

memset(buf,'B',25);

/* *
 * send message to server 
 */

Figure 60. Sample client code for XTI (Part 5 of 9)
looking = 1;
while (looking)
    if (looking = t_snd(fd,buf,sizeof(buf),sflags)) < 0)
        t_error("ERROR SENDING MESSAGE TO SERVER");
        cleanup(fd);
        exit(t_errno);
    else
        if (looking == 0)
            looking = 1;
        else
            looking = 0;
/
* receive data back from the server
*
looking = 1;
while (looking)
    { if (looking = t_rcv(fd,buf,sizeof(buf),&rflags)) > 0)
        looking = 0;
    else
        { if (looking < 0 & t_errno != TNODATA)
            t_error("ERROR RECEIVING DATA FROM SERVER");
            cleanup(fd);
            exit(t_errno);
        else
            looking = 1;
    }
/
* disconnect from server
*
looking = 1;
while (looking)
    if ((t_snddis(fd,NULL) == 0)
        looking = 0;
    else
        t_error("ERROR DISCONNECTING FROM SERVER");
        cleanup(fd);
        exit(t_errno);
    }
/
* if fd is an endpoint, try to close it
*
Figure 60. Sample client code for XTI (Part 6 of 9)
if (t_unbind(fd) != 0)
{
    t_error("ERROR ON BIND FOR FD");
    exit(t_errno);
}
cleanup(fd);
printf("Client ended successfully\n");
exit(0);
}

/*
 * formats the provided address information
 * into the buffer for RFC1006
 */

/*
 * address buffer to be filled in
 */
struct xti1006tsap *addrbuf1006;

int portnum;

/*
 * hostnmstr represented as a string
 */
char *hostnmstr;

/*
 * tsel represented as a string
 */
char *tselstr1006;

/*
 * one possible endpoint to close if
 * an error occurs in forming address
 */
int fd1;

/*
 * other possible endpoint to close
 */
int fd2;

Figure 60. Sample client code for XTI (Part 7 of 9)
if (strlen(hostnmstr) > 64)
{
    fprintf(stderr,"hostname %s too long\n",hostnmstr);
    /*
     * don't want TADDRBUSY when you try to reuse the address
     */
    cleanup(fd1);
    cleanup(fd2);
    exit(TBADADDR);
}

addrbuf1006->xti1006_hostnm_len = strlen(hostnmstr);
strcpy(addrbuf1006->xti1006_hostnm,hostnmstr);

/*
 * check validity of hostname
 * there's no way program can
 * continue without valid addr
 */

if (strlen(tselstr1006) > 64)
{
    fprintf(stderr,"tsel %s too long\n",tselstr1006);
    /*
     * don't want TADDRBUSY when you try to reuse the address
     */
    cleanup(fd1);
    cleanup(fd2);
    exit(TBADADDR);
}

addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
strcpy(addrbuf1006->xti1006_tsel,tselstr1006);

if (tselstr1006 == "Nulltsap")
{
    addrbuf1006->xti1006_tsel_len = 0;
    strcpy(addrbuf1006->xti1006_tsel,NULL);
}
else
{
    addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
    strcpy(addrbuf1006->xti1006_tsel,tselstr1006);
} /* endif */

Figure 60. Sample client code for XTI (Part 8 of 9)
**XTI socket server sample program**

As with all TCP/IP applications, dynamic dataset allocations are used unless explicitly overridden. For example, the TCPIP.DATA file can be specified using the SYSTCPD DD JCL statement. For more information, see Chapter 10, “C Socket application programming interface,” on page 103.

The following is an example of an XTI socket server program.

```c
if (portnum != -1)
   addrbuf1006->xti1006_tset = portnum;

/******************************************************************************/

void cleanup(fd)
int fd;
{
    if (fd >= 0)
        if (t_close(fd) != 0)
            {
                fprintf(stderr,"unable to t_close() endpoint while");
                fprintf(stderr," cleaning up from error\n");
            }
}

Figure 60. Sample client code for XTI (Part 9 of 9)
```
static char ibmcopyr[]="XTISC - Licensed Materials - Property of IBM. "
    "This module is \"Restricted Materials of IBM\" "
    "5647-A01 (C) Copyright IBM Corp. 1994. "
    "See IBM Copyright Instructions.;

#include "xti.h"
#include "xti1006.h"
#include "stdio.h"

/* XTIS Sample: Server */
/* Function: */
/* 1. Establishes an XTI endpoint (Asynchronous mode) */
/* 2. Listens for a connection request from an XTI client */
/* 3. Accepts the connection request */
/* 4. Receives a block of data from the client */
/* 5. Echos the data back to the client */
/* 6. Waits for the disconnect request from the XTI client */
/* 7. Server stops */
/* */
/* Command line: */
/* */
/* XTIS  H */
/* */

Figure 61. Sample server code for XTI (Part 1 of 9)
/* bind request structure for t_bind() */
struct t_bind req, ret;

/* for server to listen for calls with */
struct t_call call;

/* descriptor to t_listen() on */
int fd;

/* descriptor to t_accept() on */
int resfd;

int tot_received;

/* data buffer */
char buf[25];

int looking;

/* flags returned from t_rcv() */
int rflags, sflags;

/* transport provider for t_open() */
char tprov[1][8] =
{ "RFC1006" };

/* args that are optional */
int args;

int tot_sent;
int pnum = 102;
char *port = "102";

Figure 61. Sample server code for XTI (Part 2 of 9)
char *hostnm;
char *stsel = "server";
unsigned int rqlen = 0;
struct xti1006tsap tsap, tsapret;
void cleanup(int);
void form_addr_1006(struct xti1006tsap *, int, char *, char *, int, int);

/**
 * MAIN line program starts here !!!
 */

main(argc,argv)
int argc;
char *argv[];
{
    /**************************************************************************/
    * Check arguments. No arguments should be passed to the server
    /**************************************************************************/
    if (argc > 2) {
        fprintf(stderr,"Usage : XTIS <port>\n");
        exit(1);
    }

    if(argc == 2)
    {
        pnum = (unsigned short) atoi(argv[1]);
        port = argv[1];
    }
    /**************************************************************************/
    * assume normal data
    /**************************************************************************/
    sflags = 0;

    /**************************************************************************/
    * establish endpoint to t_listen() on
    /**************************************************************************/
    if ((fd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
    {
        t_error("Error on t_open");
        exit(t_errno);
    }

    /**************************************************************************/
    * establish endpoint to t_accept() on
    /**************************************************************************/
    if ((resfd = t_open(tprov[0],O_NONBLOCK,NULL)) < 0)
    {
        t_error("Error on t_open");
        cleanup(fd);
        exit(t_errno);
    }

Figure 61. Sample server code for XTI (Part 3 of 9)
/* compose req structure for t_bind() calls */

/* length of tsap */
req.addr.len = sizeof(tsap);

/* allocate the buffer to contain the */
/* port and tsel to bind server to */
req.addr.buf = (char *)malloc(sizeof(tsap));

/* fill address buffer with the address information */
form_addr_1006((struct xti1006tsap *)req.addr.buf, 
    pnum, 
    NULL, 
    stsel, 
    fd, 
    resfd);

/* length of tsap */
ret.addr.maxlen = sizeof(tsapret);
ret.addr.buf = (char *)malloc(sizeof(tsapret));

/* listening endpoint needs qlen > 0, */
/* ability to queue 10 requests */
req.qlen = 10;
ret.qlen = rqlen;

/* now that we're done composing the req, */
/* do the bind of fd to addr in req */
if (t_bind(fd,&req,&ret) != 0)
{
    t_error("Error on t_bind");
    cleanup(fd);
    cleanup(resfd);
}

Figure 61. Sample server code for XTI (Part 4 of 9)
exit(t_errno);
}
/*
 * accepting endpoint with same addr needs qlen == 0
 */
req.qlen = 0;
/*
 * now that we're done composing the req,
 * do the bind of resfd to addr in req
 */
if (t_bind(resfd,&req,&ret) != 0)
{
    t_error("Error on t_bind");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
}
/*
 * initialize call receipt structure for t_listen()
 */
call.opt.maxlen = 0;
call.addr.len = 0;
call.opt.len = 0;
call.udata.len = 0;
call.opt.buf = NULL;
call.addr.maxlen = sizeof(tsapret); /* listen for return*/
call.addr.buf = (char *)malloc(sizeof(tsapret));
call.udata.maxlen = 0;
call.udata.buf = NULL;
/*
 * wait for connect req & get seq num in the call variable
 */
looking = 1;
while (looking)
    if (t_listen(fd,&call) == 0)
        looking = 0;
    else
        if (t_errno != TNODATA)
        {
            t_error("Error on t_accept");
            cleanup(fd);
            cleanup(resfd);
            exit(t_errno);
        }

Figure 61. Sample server code for XTI (Part 5 of 9)
/* 
* accept the connection on the accepting endpoint 
*/

if (t_accept(fd, resfd, &call) != 0)
{
    t_error("Error on t_accept");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
}

/* 
* receive data from the client 
*/

looking = 1;
while (looking)
    if (t_rcv(resfd, buf, sizeof(buf), &rflags) > 0)
        looking = 0;
    else
        if (t_errno != TNODATA)
            {
            t_error("Error on t_rcv");
            cleanup(fd);
            cleanup(resfd);
            exit(t_errno);
        }

/* 
* sent data back to the client 
*/

strcpy(buf,"DATA FROM SERVER");

looking = 1;
while (looking)
    if (t_snd(resfd, buf, sizeof(buf), sflags) > 0)
        looking = 0;

/* 
* wait for disconnect from the client 
*/

looking = 1;
while (looking)
    if (t_look(resfd) == T_DISCONNECT)
        looking = 0;

/* 
* receive the disconnect request 
*/

looking = 1;
while (looking)

Figure 61. Sample server code for XTI (Part 6 of 9)
if (t_rcvdis(resfd, NULL) == 0)
    looking = 0;

/*
 * unbind the endpoints
 */

if (t_unbind(resfd) != 0)
{
    t_error("Error on t_unbind for resfd");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
}

if (t_unbind(fd) != 0)
{
    t_error("Error on t_unbind for fd");
    cleanup(fd);
    cleanup(resfd);
    exit(t_errno);
}

/*
 * if fd is an endpoint, try to close it
 */
cleanup(fd);

/*
 * if resfd is an endpoint, try to close it
 */
cleanup(resfd);

printf("Server ended successfully\n");
exit(0);

}
int portnum;

/*
 * hostnmstr represented as a string
 */
char *hostnmstr;

/*
 * tsel represented as a string
 */
char *tselstr1006;

/*
 * one possible endpoint to close if
 * an error occurs in forming address
 */
int fd1;

/*
 * other possible endpoint to close
 */
int fd2;
{

/*
 * check validity of hostname
 * there's no way program can
 * continue without valid addr
 */
if (strlen(hostnmstr) > 64)
{
    fprintf(stderr,"hostname %s too long\n",hostnmstr);
    /*
     * don't want TADDRBUSY when you try to reuse the address
     */
    cleanup(fd1);
    cleanup(fd2);
    exit(TBADADDR);
}

daddrbuf1006->xti1006_hostnm_len = strlen(hostnmstr);
strncpy(daddrbuf1006->xti1006_hostnm,hostnmstr);

/*
 * check validity of hostname
 * there's no way program can
 * continue without valid addr
 */

Figure 61. Sample server code for XTI (Part 8 of 9)
if (strlen(tselstr1006) > 64)
{
    fprintf(stderr,"tsel too long\n",tselstr1006);
    /*
     * don't want TADDRBUSY when you try to reuse the address
     */
    cleanup(fd1);
    cleanup(fd2);
    exit(TBADADDR);
}

addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
strcpy(addrbuf1006->xti1006_tsel,tselstr1006);

if (tselstr1006 == "Nulltsap")
{
    addrbuf1006->xti1006_tsel_len = 0;
    strcpy(addrbuf1006->xti1006_tsel,NULL);
}
else
{
    addrbuf1006->xti1006_tsel_len = strlen(tselstr1006);
    strcpy(addrbuf1006->xti1006_tsel,tselstr1006);
} /* endif */

if (portnum != -1)
    addrbuf1006->xti1006_tset = portnum;

******************************************************************************

Figure 61. Sample server code for XTI (Part 9 of 9)
Chapter 12. Macro application programming interface

This section describes the macro API for IPv4 or IPv6 socket application programs written in z/OS assembler language. The macro interface can be used to produce reentrant modules and can be used in a multithread environment.

The following topics are included:
- Environmental restrictions and programming requirements
- Defining storage for the API macro
- Understanding common parameter descriptions
- Error messages and return codes
- Characteristics of sockets
- Task management and asynchronous function processing
- Using an unsolicited event exit routine
- Diagnosing problems in applications using the macro API
- Macros for assembler programs
- Macro interface assembler language sample programs

Environmental restrictions and programming requirements

The following restrictions apply to both the Macro Socket API and the Callable Socket API:

<table>
<thead>
<tr>
<th>Function</th>
<th>Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRB mode</td>
<td>These APIs can only be invoked in TCB mode (task mode).</td>
</tr>
<tr>
<td>Cross-memory mode</td>
<td>These APIs can only be invoked in a non-cross-memory environment (PASN=SASN=HASN).</td>
</tr>
<tr>
<td>Functional Recovery Routine (FRR)</td>
<td>Do not invoke these APIs with an FRR set. This will cause system recovery routines to be bypassed and severely damage the system.</td>
</tr>
<tr>
<td>Locks</td>
<td>No locks should be held when issuing these calls.</td>
</tr>
<tr>
<td>INITAPI and TERMAPI socket commands</td>
<td>The INITAPI and TERMAPI socket commands must be issued under the same task.</td>
</tr>
<tr>
<td>Storage</td>
<td>Storage acquired for the purpose of containing data returned from a socket call must be obtained in the same key as the application program status word (PSW) at the time of the socket call. This includes the ECB that is posted upon completion of an asynchronous EZASMI call that is issued after an EZASMI TYPE=INITAPI with the ASYNC=('ECB') option has been issued.</td>
</tr>
<tr>
<td>Nested socket API calls</td>
<td>You cannot issue nested API calls within the same task. That is, if a request block (RB) issues a socket API call and is interrupted by an interrupt request block (IRB) in an STIMER exit, any additional socket API calls that the IRB attempts to issue are detected and flagged as an error.</td>
</tr>
</tbody>
</table>
Function | Restriction
---|---
Addressability mode (Amode) considerations | The EZASMI interface can be invoked while the caller is in either 31-bit or 24-bit Amode. However, if the application is running in 24-bit addressability mode at the time of the call, all addresses of parameters passed by the application must be addressable in 31-bit Amode. This implies that even if the addresses being passed reside in storage below the 16 MB line (and therefore addressable by 24-bit Amode programs) the high-order byte of these addresses needs to be 0.

Use of z/OS UNIX System Services | Address spaces using the EZASMI API should not use any z/OS UNIX System Services socket API facilities such as z/OS UNIX Assembler Callable Services or Language Environment for z/OS C/C++. Doing so can yield unpredictable results.

Dynamic allocation | Socket calls should not be issued during START (initialization) processing for LOGONs, MOUNTs, or started tasks. This is because they require dynamic allocation that can fail during these times.

The EZASMI macro is located in SEZACMAC.

**Input register information**

Before invoking the sockets API, the general purpose registers (GPRs) need to contain the following:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>N/A</td>
</tr>
<tr>
<td>2-12</td>
<td>N/A, unless referenced by a macro parameter</td>
</tr>
<tr>
<td>13</td>
<td>Pointer to a standard save area in the key of the caller</td>
</tr>
<tr>
<td>14-15</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The contents of the access registers (ARs) on entry to the sockets API call are not used.

When control returns to the caller, the access registers (ARs) contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-14</td>
<td>Unchanged</td>
</tr>
<tr>
<td>15</td>
<td>Used as a work register by the system</td>
</tr>
</tbody>
</table>

If a caller depends on register contents to remain the same before and after issuing a service, the caller must save the contents of a register before issuing the service and restore them after the system returns control.

**Output register information**

When control returns to the caller, the general purpose registers (GPRs) contain:
Compatibility considerations

Unless noted in [z/OS Communications Server: New Function Summary] an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

Defining storage for the API macro

The macro API requires both global and task storage areas.

The global storage area must be known and addressable to all socket users within an address space. It should be defined by the primary task within the address space, preferably by the JobStep task. This task can define storage in two ways:

- Enter the instruction EZASMI TYPE=GLOBAL with STORAGE=CSECT as part of your program code. This makes the program nonreentrant, but simplifies the code.
- Enter the instruction EZASMI TYPE=GLOBAL with STORAGE=DSECT as part of your program code. This instruction generates the equate field GWALENTH, which is equal to the length of the storage area. GWALENTH is used to issue an MVS GETMAIN to allocate the required storage.

The defining task must make the address of this storage available to all other tasks within the address space using the interface. Programs running in these tasks must define the storage mapping using the instructions EZASMI TYPE=GLOBAL and STORAGE=DSECT.

The second storage area is a task storage area that must be known to and addressable by all socket users communicating across a specified connection. A connection runs between the application and TCP/IP. The most common way to organize storage is to assign one connection to each MVS subtask. If there are multiple modules using sockets within a single task or connection, you must provide the address of the task storage to every user.
The following describes how to define the address of the task storage:

- Code the instruction EZASMI TYPE=TASK with STORAGE=CSECT as part of the program code. This makes the program nonreentrant, but simplifies the code.
- Code the instruction EZASMI TYPE=TASK with STORAGE=DSECT as part of the program code. The expansion of this instruction generates the equate field, TIELENTH, which is equal to the length of the storage area. This can be used to issue an MVS GETMAIN to allocate the required storage.

The defining program must make the address of this storage available to all other programs using this connection. Programs running in these tasks must define the storage mapping with an EZASMI TYPE=TASK with STORAGE=DSECT.

The EZASMI TYPE=TASK macro generates only one parameter list for a connection. This can lead to overlay problems for programs using APITYPE=3 connections (multiple calls can be issued simultaneously). For more detail on APITYPE=3 connections, see "Task management and asynchronous function processing" on page 265. A program should use the following format to build unique parameter list storage areas if it will be issuing multiple calls simultaneously on one connection:

```
BINDPRML EZASMI MF=L This will generate the storage used for
building the parm list in the following BIND call
EZASMI TYPE=BIND,
    S=SOCKDESC,
    NAME=NAMEID,
    ERRNO=ERRNO,
    RETCODE=RETCODE,
    ECB=ECB1,
    MF=(E,BINDPRML)
```

This example of an asynchronous BIND macro would use the MF=L macro to generate the parameter list. The fields that are common across all macro calls, for example, RETCODE and ERRNO, must be unique for each outstanding call.

You can create multiple connections to TCP/IP from a single task. Each of these connections functions independently of the other and is identified by its own task interface element (TIE). The TASK parameter can be used to explicitly reference a TIE. If you do not include the TASK parameter, the macro uses the TIE generated by the EZASMI TYPE=TASK macro.

```
TIE1 DS XL(TIELENTH) Length of TIE
EZASMI TYPE=INITAPI,
    MAXSOC=MAX75,
    ERRNO=ERRNO,
    RETCODE=RETCODE,
    APITYPE=2,
    MAXSNO=MAXS,
    TASK=TIE1
EZASMI TYPE=SOCKET,
    AF='INET',
    SOCTYPE='STREAM',
    ERRNO=ERRNO,
    RETCODE=RETCODE,
    TASK=TIE1
```

In this example, the TIE TIE1 is used for the connection, not the TIE generated by the EZASMI TYPE=TASK macro.
Understanding common parameter descriptions

This section describes the parameters and concepts common to the macros described in this section.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>address</td>
<td>The name of the field that contains the value of the parameter. The following example illustrates a BIND macro where SOCKNO is set to 2.</td>
</tr>
<tr>
<td></td>
<td>MVC SOCKNO=H’2’</td>
</tr>
<tr>
<td></td>
<td>EZASMI TYPE=BIND, S=SOCKNO</td>
</tr>
<tr>
<td>*indaddr</td>
<td>The name of the address field that contains the address of the field containing the parameter. The following example produces the same result as the example above.</td>
</tr>
<tr>
<td></td>
<td>MVC SOCKNO=H’2’</td>
</tr>
<tr>
<td></td>
<td>LA 0, SOCKNO</td>
</tr>
<tr>
<td></td>
<td>ST 0, SOCKADD</td>
</tr>
<tr>
<td></td>
<td>EZASMI TYPE=BIND, S=SOCKADD</td>
</tr>
<tr>
<td>(reg)</td>
<td>The name (equated to a number) or the number of a general purpose register. Do not use a register 0, 1, 14, or 15. The following example produces the same result as the previous examples.</td>
</tr>
<tr>
<td></td>
<td>MVC SOCKNO=H’2’</td>
</tr>
<tr>
<td></td>
<td>LA 3, SOCKNO</td>
</tr>
<tr>
<td></td>
<td>EZASMI TYPE=BIND, SOCKNO=(3)</td>
</tr>
<tr>
<td>’value’</td>
<td>A literal value for the parameter; for example, AF='INET'</td>
</tr>
</tbody>
</table>

Error messages and return codes

For information about error messages, refer to [z/OS Communications Server: IP Messages Volume 1 (EZA)](https://www.ibm.com/support/knowledgecenter/SSLTBW_2.2.1/com.ibm.zos.v2r1.cis.doc/messages_zos.html)

For information about codes returned by TCP/IP, see Appendix B, “Return codes,” on page 835

Characteristics of sockets

For stream sockets, data is processed as streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to the SEND function can return 1 byte, 10 bytes, or the entire 1000 bytes, with the number of bytes sent returned in the RETCODE call. Therefore, applications using stream sockets should place the READ call and the SEND call in a loop that repeats until all of the data has been sent or received.

PROTO specifies a particular protocol to be used with the socket. In most cases, a single protocol exists to support one type of socket in a domain (not true with raw sockets). If PROTO is set to 0, the system selects the default protocol number for the domain and socket type requested. The PROTO defaults are TCP for stream sockets and UDP for datagram sockets. There is no default for raw sockets.

SOCK_STREAM sockets model duplex byte streams. They provide reliable, flow-controlled connections between peer applications. Stream sockets are either active or passive. Active sockets are used by clients who initiate connection requests with CONNECT. By default, SOCKET creates active sockets. Passive sockets are used by servers to accept connection requests with the CONNECT call.
macro. An active socket is transformed into a passive socket by binding a name to the socket with the BIND macro and by indicating a willingness to accept connections with the LISTEN macro. Once a socket is passive, it cannot be used to initiate connection requests.

In the AF_INET or AF_INET6 domain, the BIND macro, applied to a stream socket, lets the application specify the networks from which it is willing to accept connection requests. The application can fully specify the network interface by setting the Internet address field in the address structure to the Internet address of a network interface. Alternatively, the application can set the address in the name structure to zeros to indicate that it wants to receive connection requests from any network.

Once a connection has been established between stream sockets, the data transfer macros READ, WRITE, SEND, RECV, SENDTO, and RECVFROM can be used. Usually, the READ-WRITE or SEND-RECV pairs are used for sending data on stream sockets.

SOCK_DGRAM sockets are used to model datagrams. They provide connectionless message exchange without guarantees of reliability. Messages sent have a maximum size. Datagram sockets are not supported in the AF_IUCV domain.

The active or passive concepts for stream sockets do not apply to datagram sockets. Servers must still call BIND to name a socket and to specify from which network interfaces it wants to receive datagrams. Wildcard addressing, as described for stream sockets, also applies to datagram sockets. Because datagram sockets are connectionless, the LISTEN macro has no meaning for them and must not be used.

After an application receives a datagram socket, it can exchange datagrams using the SENDTO and RECVFROM macros. If the application goes one step further by calling CONNECT and fully specifying the name of the peer with which all messages are exchanged, then the other data transfer macros READ, WRITE, SEND, and RECV can be used as well. For more information about placing a socket into the connected state, see "CONNECT" on page 464.

Datagram sockets allow message broadcasting to multiple recipients. Setting the destination address to a broadcast address depends on the network interface (address class and whether subnets are used).

SOCK_RAW sockets supply an interface to lower layer protocols, such as IP. You can use this interface to bypass the transport layer when you need direct access to lower layer protocols. Raw sockets are also used to test new protocols. Raw sockets are not supported in the AF_IUCV domain.

Raw sockets are connectionless and data transfer is the same as for datagram sockets. You can also use the CONNECT macro to specify a peer socket in the same way that is previously described for datagram sockets.

Outgoing datagrams have an IP header prefixed to them. Your program receives incoming datagrams with the IP header intact. You can set and inspect IP options by using the SETSOCKOPT and GETSOCKOPT macros.

Use the CLOSE macro to deallocate sockets.
Regardless of the type of socket (SOCK_STREAM, SOCK_DGRAM or SOCK_RAW), all commands that pass a socket address must be consistent with the address family specified when the socket was opened. If the socket was opened with an address family of AF_INET, then any command for that socket that includes a socket address must use an AF_INET socket address. If the socket was opened with an address family of AF_INET6, then any command for that socket that includes a socket address must use an AF_INET6 socket address.

**Task management and asynchronous function processing**

The sockets extended interface allows asynchronous operation, although by default the task issuing a macro request is put into a WAIT state until the requested function completes. At that time, the issuing task resumes and continues execution.

If you do not want the issuing task to be placed into a WAIT while its request is processed, use asynchronous function processing.

**How it works**

The macro API provides for asynchronous function processing in two forms. Both forms cause the system to return control to the application immediately after the function request has been sent to TCP/IP. The difference between the two forms is in how the application is notified when the function is completed:

**ECB method**

Enables you to pass an MVS event control block (ECB) on each socket call. The socket library returns control to the program immediately and posts the ECB when the call has completed.

**EXIT method**

Enables you to specify the entry point of an exit routine using the INITAPI() call. The individual socket calls immediately return control to the program and the socket library drives the specified exit routine when the socket call is complete.

In either case, the function is completed when the notification is delivered. Note that the notification can be delivered at any time, in some cases even before the application has received control back from the EZASMI macro call. It is therefore important that the application is ready to handle a notification as soon as it issues the EZASMI macro call.

Like nonblocking calls, asynchronous calls return control to your program immediately. But in this case, there is no need to reissue the call. When the requested event has taken place, an ECB is posted or an exit routine is driven.

Using the API macro, you can specify APITYPE=2 or APITYPE=3

**APITYPE=2**  Allows an asynchronous macro API program to have only one outstanding socket call per socket descriptor. An APITYPE=2 program can use macro API asynchronous calls, but synchronous calls are equally well supported.

**APITYPE=3**  Allows an asynchronous macro API program to have many outstanding socket calls per socket descriptor. Only the macro API supports APITYPE=3. An APITYPE=3 program must use macro API asynchronous calls with either an ECB or REQAREA parameter.
The REQAREA parameter is used in macros using the EXIT form. This parameter is mutually exclusive with the ECB parameter used with the ECB form.

<table>
<thead>
<tr>
<th>ECB</th>
<th>Storage Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4 bytes)</td>
<td>(100 bytes)</td>
</tr>
</tbody>
</table>

*Figure 62. ECB input parameter*

Like the ECB parameter, the REQAREA parameter points to an area that contains:
- A 4-byte token that is presented to your asynchronous exit routine when the response to this function request is complete
- A 100-byte storage area that is used by the interface to save the state information

**Note:** This storage must not be modified or freed until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

<table>
<thead>
<tr>
<th>User Token</th>
<th>Storage Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4 bytes)</td>
<td>(100 bytes)</td>
</tr>
</tbody>
</table>

*Figure 63. User token setting*

Before you issue the macro, you must set the first word of the 104 bytes to a token of any value. The token is used by your asynchronous exit routine to determine the function completion event for which it is being invoked.

Asynchronous functions are processed in the following sequence:
1. The application must issue the EZASMI TYPE=INITAPI with ASYNC='ECB' or ASYNC=('EXIT', AEEXIT). The ASYNC parameter notifies the API that asynchronous processing is to be used for this connection. The API notes the type of asynchronous processing to be used, ECB or EXIT, and specifies the use of the asynchronous exit routine for this connection.
2. When a function request is issued by the application, the API does one of the following:
   - If the type of asynchronous processing is ECB, and an ECB is supplied in the function request, the API returns control to the application. If Register 15 is 0, the ECB is posted when the function has completed. Note that the ECB might be posted prior to when control is returned to the application.
   - If the type of asynchronous processing is EXIT, and a REQAREA parameter is supplied in the function request, the API returns control to the application. If Register 15 is 0, the exit routine is invoked when the function has completed. Note that the exit can be invoked prior to when control is returned to the application.

   In either case, Register 15 is used to inform the caller whether or not the ECB is posted or asynchronous exit driven. Therefore, you must not use Register 15 for the RETCODE parameter.

When the asynchronous exit routine is invoked, the following linkage conventions are used:

**GPR0**  Register Setting
0 Normal return
1 TCP/IP address space has terminated (TCPEND).

**GPR1** Points to a doubleword field containing the following:

**WORD1**
The token specified by the INITAPI macro

**WORD2**
The token specified by the functional request macro (First 4 bytes of the REQAREA storage)

**GPR13**
Points to standard MVS save area in the same key as the application PSW at the time of the INITAPI command.

**GPR14**
Return address

**GPR15**
Entry point of the exit routine

The following example shows how to code an asynchronous macro function:

```
EZASMI TYPE=READ,
S=SOCKNO,
NBYTES=COUNT,
BUF=DATABUF,
ERRNO=ERROR,
RETCODE=RCODE,
ECB=MYECB,
ERROR=ERRORRTN
```

```
LTR R15,R15 Was macro function passed to TCP/IP?
BNZ BADRCODE If no, ECB will not be posted
WAIT ECB=MYECB TELL MVS TO WAIT UNTIL READ IS DONE
```

**Asynchronous exit environmental and programming considerations**

When utilizing the ASYNC=EXIT option of the EZASMI macro, the following requirements need to be considered:

- **Asynchronous calls can only be issued from a single request block (RB) in a given task (TCB).**
  
The first RB that issues an ASYNC EZASMI call under a given task is deemed as the target RB that is interrupted when an asynchronous exit needs to be driven. This means that after an asynchronous EZASMI macro call is invoked you should not invoke any services that cause the current RB to no longer be the top RB for this task (for example, a LINK call). If the target RB is no longer the top RB at the time that the exit needs to be driven, then the exit is deferred until the target RB becomes the top RB. One exception to this rule is that EZASMI calls can be issued under the asynchronous user exit.

- **EZASMI macro calls within the asynchronous exits.**
  
While running the asynchronous exit notification routine, an application can issue other EZASMI calls. However, the application should avoid issuing any
Using an unsolicited event-exit routine

The unsolicited event-exit routine enables an application to specify an event exit routine that is invoked when an unsolicited event occurs. This exit routine can be a part of the program that specifies it, or it can be a separate module. The exit routine must be resident at the time that the EZASMI TYPE=INITAPI macro is issued, and it must stay resident until the EZASMI TYPE=TERMAPI macro is issued.

The user invokes this facility by the issuing the optional UEEXIT parameter that is used in the EZASMI TYPE=INITAPI macro, as shown in the following syntax fragment:

```
/myuee , UEEXIT = address , indaddr = reg
```

Keyword   Description
----------   ----------
UEEXIT       A double word value that is composed of two positional parameters. The first parameter is the address of the event-exit routine that is invoked when an unsolicited event occurs. The second parameter is the address of the token that is passed to the exit routine. On entry to the unsolicited event-exit routine, the general purpose registers (GPRs) contain the following values:

GPR0       Register setting. The following values are supported:

0        TPC/IP is active

1        TCP/IP is inactive

GPR1       Address of the token that is specified in the INITAPI macro

GPR13      Pointer to a standard MVS save area. This save area is in the same key that the application program status word (PSW) was in when the EZASMI TYPE=INITAPI macro was issued.

GPR14      Return address

The following code example shows how the EZASMI TYPE=INITAPI macro can be used to specify an unsolicited event-exit routine (MYUEE). The MYUEE storage
definition contains the address of the exit routine, MYUEE1, followed by the address of the user exit token, UETOKEN:

```
EZASMI TYPE=INITAPI, Issue INITAPI Macro X
SUBTASK=SUBTASK, SPECIFY SUBTASK IDENTIFIER X
MAXSOC=MAXSOC, SPECIFY MAXIMUM NUMBER OF SOCKETS X
MAXNO=MAXNO, (HIGHEST SOCKET NUMBER ASSIGNED) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
APITYPE=APITYPE, (SPECIFY APITYPE FIELD) X
ERROR=ERROR, ABEND IF ERROR ON MACRO X
UEEXIT=MYUEE, ASYNC=(‘EXIT’,MYEXIT) (SPECIFY AN EXIT)
```

*---------------------------------------------------------------*
*   UNSOLICITED EVENT EXIT                                      *
*---------------------------------------------------------------*
CNOP 0,4
MYUEE DC A(MYUEE1,UETOKEN)
UETOKEN DS F
MYUEE1 SAVE (14,12),T,*
LR R2,R15
USING MYUEE1,R2
UEEXIT WTO ‘UEEXIT BEING DRIVEN’
EZASMI TYPE=TERMAPI Issue EZASMI Macro for Termapi
POST ECB,1
RETURN (14,12),T,RC=0
DROP R2

---

**Diagnosing problems in applications using the macro API**

TCP/IP provides a trace facility that can be helpful in diagnosing problems in applications using the Macro API. The trace is implemented using the TCP/IP Component Trace (CTRACE) SOCAPI trace option. The SOCAPI trace option allows all Macro socket API calls issued by an application to be traced in the TCP/IP CTRACE. The SOCAPI trace records include information such as the type of socket call, input, and output parameters and return codes. This trace can be helpful in isolating failing socket API calls and in determining the nature of the error or the history of socket API calls that might be the cause of an error. For more information on the SOCAPI trace option, refer to [z/OS Communications Server: IP Diagnosis Guide](https://www.ibm.com/support/knowledgecenter/en/SSLTBK_2.2.0/com.ibm.zos.cs22520/zoscs22520_a638596911e98b1fdd85cc51921b7013b93495c0.html).

---

**Macros for assembler programs**

This section contains the description, syntax, parameters, and other related information for every macro included in this API.

The EZASMI macro is located in SEZACMAC.

**ACCEPT**

The ACCEPT macro is issued when the server receives a connection request from a client. ACCEPT points to a socket that was created with a SOCKET macro and marked by a LISTEN macro. If a process waits for the completion of connection requests from several peer processes, a later ACCEPT macro can block until one of the CONNECT macros completes. To avoid this, issue a SELECT macro between the CONNECT and the ACCEPT macros. Concurrent server programs use the ACCEPT macro to pass connection requests to subtasks.

When issued, the ACCEPT macro does the following:

1. Accepts the first connection on a queue of pending connections.
2. Creates a new socket with the same properties as the socket used in the macro and returns the address of the client for use by subsequent server macros. The new socket cannot be used to accept new connections, but can be used by the calling program for its own connection. The original socket remains available to the calling program for more connection requests.

3. Returns the new socket descriptor to the calling program.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

```
---EZASMI---TYPE=ACCEPT---,S---number---,NAME---address---
     address---*indaddr---(reg)
---ERRNO---,RETCODE---address---*indaddr---(reg)
     address---*indaddr---(reg)
---ECB---address---*indaddr---(reg)
     REQAREA---address---*indaddr---(reg)
---TASK---address---*indaddr---(reg)
```

**Keyword**

**Description**

- **S**
  - Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket from which the connection is accepted.

**NAME**
Output parameter. Initially, the IPv4 or IPv6 application provides a pointer to the IPv4 or IPv6 socket address structure, which is filled on completion of the call with the socket address of the connection peer. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is a decimal 2, indicating AF_INET.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary field that is set to the client port number.</td>
</tr>
<tr>
<td>IPv4-ADDRESS</td>
<td>A fullword binary field that is set to the 32-bit IPv4 Internet address, in network byte order, of the client host machine.</td>
</tr>
<tr>
<td>RESERVED</td>
<td>Specifies eight bytes of binary zeros. This field is required, but not used.</td>
</tr>
</tbody>
</table>

The IPv6 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary field that is set to the client port number.</td>
</tr>
<tr>
<td>FLOW-INFO</td>
<td>A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.</td>
</tr>
</tbody>
</table>
ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. If RETCODE is positive, RETCODE is the new socket number.
If RETCODE is negative, check ERRNO for an error number.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

NS
Input parameter. A value or the address of a halfword binary number specifying the descriptor number chosen for the new socket, which is the socket for the client at the time. If NS is not specified, the interface assigns it.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your program.

BIND
In a server program, the BIND macro normally follows a SOCKET macro to complete the new socket creation process.

The BIND macro can specify the port or let the system choose the port. A listener program should always bind to the same well-known port so that clients know the socket address to use when issuing a CONNECT, SENDTO, or SENDMSG request.

In addition to the port, the application also specifies an IP address on the BIND macro. Most applications typically specify a value of 0 for the IP address, which allows these applications to accept new TCP connections or receive UDP
datagrams that arrive over any of the network interfaces of the local host. This enables client applications to contact the application using any of the IP addresses associated with the local host.

Alternatively, an application can indicate that it is only interested in receiving new TCP connections or UDP datagrams that are targeted towards a specific IP address associated with the local host. This can be accomplished by specifying the IP address in the appropriate field of the socket address structure passed on the NAME parameter.

**Note:** Even if an application specifies a value of 0 for the IP address on the BIND, the system administrator can override that value by specifying the BIND parameter on the PORT reservation statement in the TCP/IP profile. This has a similar effect to the application specifying an explicit IP address on the BIND macro. For more information, refer to the z/OS Communications Server: IP Configuration Reference.

Note that even if an application specifies a value of 0 for the IP address on the BIND, the system administrator can override that value by specifying the BIND parameter on the PORT reservation statement in the TCP/IP profile. This has a similar effect to the application specifying an explicit IP address on the BIND macro. For more information, refer to the z/OS Communications Server: IP Configuration Reference.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

```

EZASMI—TYPE=BIND—,S—number—,NAME—address—
   +indaddr—(reg)

,ERRNO—address—,RETCODE—address—
   +indaddr—(reg)
```
Keyword: Description

S: Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

NAME

Input parameter. The IPv4 or IPv6 application provides a pointer to an IPv4 or IPv6 socket address structure. This structure specifies the port number and an IPv4 or IPv6 IP address from which the application can accept connections. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.


The IPv4 socket structure must specify the following fields:

Field: Description

FAMILY
A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is a decimal 2, indicating AF_INET.

PORT: A halfword binary field set to the port number that binds to the socket. The application can call the GETSOCKNAME macro after the BIND macro to discover the assigned port number.

IPv4-ADDRESS
A fullword binary field that is set to the 32-bit IPv4 Internet address, in network byte order, of the host machine.

RESERVED
Specifies eight bytes of binary zeros. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field: Description

NAMELEN
A 1-byte binary field specifying the length of this IPv6
socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

**FAMILY**
A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.

**PORT**
A halfword binary field set to the port number that binds to the socket. The application can call the GETSOCKNAME macro after the BIND macro to discover the assigned port number.

**FLOW-INFO**
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

**IPV6-ADDRESS**
A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the host machine.

**SCOPE-ID**
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPV6-ADDRESS field. A value of 0 indicates that the SCOPE-ID field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope IPV6-ADDRESS, SCOPE-ID can specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

**ERRNO**
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.
Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR** Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK** Input parameter. The location of the task storage area in your program.

### CANCEL

The CANCEL function terminates a call in progress. The call being canceled must have specified **ECB** or **REQAREA**.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td><strong>Note:</strong> See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
//EZASMI--TYPE=CANCEL--CALAREA--
  address
    *indaddr
    (reg)
  ,ECB=address
    *indaddr
    (reg)
  ,REQAREA=address
    *indaddr
    (reg)
  ,ERRNO=address
    *indaddr
    (reg)
  ,RETCODE=address
    *indaddr
    (reg)
  ,ERROR=address
    *indaddr
    (reg)
  ,TASK=address
    *indaddr
    (reg)
```

**Keyword**  **Description**

**CALAREA** Input parameter. The **ECB** or **REQAREA** specified in the call being canceled.

**Note:** To be compatible with TCP/IP for MVS V3R1, **CALAREA** can be specified as **CALLAREA**.
ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, this contains an error number.

RETCODE
Output parameter. A fullword binary field. If RETCODE is 0, the CANCEL was successful.

Value  Description
0      Successful call.
–1     Check ERRNO for an error code.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your program.

CLOSE
The CLOSE macro shuts down the socket and frees the resources that are allocated to the socket. Issue the SHUTDOWN macro before you issue the CLOSE macro.

CLOSE can also be issued by a concurrent server after it gives a socket to a subtask program. After issuing GIVESOCKET and receiving notification that the client child has successfully issued TAKESOCKET, the concurrent server issues the CLOSE macro to complete the transfer of ownership.

Note: If a stream socket is closed while input or output data is queued, the stream connection is reset and data transmission can be incomplete. SETSOCKOPT can be used to set a SO_LINGER condition, in which TCP/IP continues to send data for a specified period of time after the CLOSE macro is issued. For information about SO_LINGER, see “SETSOCKOPT” on page 561.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.
Interrupt status: Enabled for interrupts.
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Keyword Description

S Input parameter. A value or the address of a halfword binary number specifying the socket to be closed.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

Value Description
0 Successful call.
−1 Check ERRNO for an error code.

ECB or REQAREA

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.
For ECB/REQAREA

A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK

Input parameter. The location of the task storage area in your program.

CONNECT

The CONNECT macro is used by a client to establish a connection between a local socket and a remote socket.

For stream sockets, the CONNECT macro:

- Completes the binding process for a stream socket if BIND has not been previously issued.
- Attempts connection to a remote socket. This connection must be completed before data can be transferred.

For datagram sockets, CONNECT is not essential, but you can use it to send messages without specifying the destination.

For both types of sockets, the following CONNECT macro sequence applies:

1. The server issues BIND and LISTEN (stream sockets only) to create a passive open socket.
2. The client issues CONNECT to request a connection.
3. The server creates a new connected socket by accepting the connection on the passive open socket.

If the socket is in blocking mode, CONNECT blocks the calling program until the connection is established or until an error is received.

If the socket is in nonblocking mode, the return code indicates the success of the connection request.

- A 0 RETCODE indicates that the connection was completed.
- A nonzero RETCODE with an ERRNO of 36 (EINPROGRESS) indicates that the connection could not be completed, but since the socket is nonblocking, the CONNECT macro completes its processing.

The caller must test the completion of the connection setup by calling SELECT and testing for the ability to write to the socket. The completion cannot be checked by issuing a second CONNECT.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

---

**Keyword** | **Description**
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

**NAME**

Input parameter. The NAME parameter for CONNECT specifies the IPv4 or IPv6 socket address of the IPv4 or IPv6 IP connection peer. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket structure must specify the following fields:

**Field** | **Description**
--- | ---
FAMILY | A halfword binary field specifying the IPv4 addressing family. For IPv4 the value is always a decimal 2, indicating AF_INET.

PORT | A halfword binary field that is set to the server port
number in network byte order. For example, if the port number is 5000 in decimal, it is set to X'1388'.

IPv4-ADDRESS
A fullword binary field specifying the 32-bit IPv4 Internet address of the server host machine in network byte order. For example, if the Internet address is 129.4.5.12 in dotted decimal notation, it is set to X'8104050C'.

RESERVED
Specifies eight bytes of binary zeros. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary field that is set to the port number in network byte order. For example, if the port number is 5000 in decimal, it is set to X'1388'.</td>
</tr>
<tr>
<td>FLOW-INFO</td>
<td>A fullword binary field specifying the traffic class and flow label. This field must be set to 0.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine. For example, if the IPv6 Internet address is 12ab:0:0:0:cd30:123:4567:89AB:cedf in colon hex notation, it is set to X'12AB00000000CD300123456789ABCF'.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID can specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.</td>
</tr>
</tbody>
</table>

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
</table>

0  Successful call.
−1  Check ERRNO for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your program.

FCNTL
The blocking mode for a socket can be queried or set to nonblocking using the FNDELAY flag. You can query or set the FNDELAY flag even though it is not defined in your program.

See “IOCTL” on page 513 for another way to control socket blocking.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>
Keyword | Description
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor for the socket that you want to unblock or query.

**COMMAND**
Input parameter. A fullword binary field or a literal that sets the FNDELAY flag to one of the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or 'F_GETFL'</td>
<td>Query the blocking mode for the socket.</td>
</tr>
<tr>
<td>4 or 'F_SETFL'</td>
<td>Set the mode to nonblocking for the socket. <strong>REQARG</strong> is set by TCP/IP.</td>
</tr>
</tbody>
</table>

The FNDELAY flag sets the nonblocking mode for the socket. If data is not present on calls that can block (READ, READV, and RECV), the call returns a -1, and **ERRNO** is set to 35 (EWOULDBLOCK).

**Note:** Values for **COMMAND** that are supported by the z/OS UNIX System Services FCNTL callable service are supported also. Refer to the z/OS UNIX System Services Programming: Assembler Callable Services Reference for more information.

**REQARG**
A fullword binary field containing a mask that TCP/IP uses to set the FNDELAY flag.

- If **COMMAND** is set to 3 (query), the **REQARG** field should be set to 0.
- If **COMMAND** is set to 4 (set),
  - Set **REQARG** to 4 to turn the FNDELAY flag on. This places the socket in nonblocking mode.
  - Set **REQARG** to 0 to turn the FNDELAY flag off. This places the socket in blocking mode.
ERRNO  Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE  Output parameter. A fullword binary field that returns one of the following:

   • If COMMAND was set to 3 (query), a bit string is returned.
     - If RETCODE contains X'00000004', the socket is nonblocking. The FNDELAY flag is on.
     - If RETCODE contains X'00000000', the socket is blocking. The FNDELAY flag is off.
   • If the COMMAND field was 4 (set), a successful call returns 0 in RETCODE. For either COMMAND, a RETCODE of -1 indicates an error. Check ERRNO for the error number.

ECB or REQAREA  Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

   For ECB  A 4-byte ECB posted by TCP/IP when the macro completes.

   For REQAREA  A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

   For ECB/REQAREA  A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR  Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK  Input parameter. The location of the task storage area in your program.

FREEADDRINFO

The FREEADDRINFO macro frees all the address information structures returned by GETADDRINFO in the RES parameter.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Keyword</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ADDRINFO</td>
<td>Input parameter. The address of a set of address information structures returned by TYPE=GETADDRINFO RES argument.</td>
</tr>
<tr>
<td>ERRNO</td>
<td>Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.</td>
</tr>
<tr>
<td>RETCODE</td>
<td>Output parameter. A fullword binary field that returns one of the following: Value  Description 0      Successful call. –1     Check ERRNO for an error code. ERROR     Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.</td>
</tr>
</tbody>
</table>

**GETADDRINFO**

The GETADDRINFO macro translates either the name of a service location (for example, a host name), a service name, or both, and returns a set of socket addresses and associated information to be used in creating a socket with which to address the specified service or sending a datagram to the specified service.

The following requirements apply to this call:

Authorization: Supervisor state or problem state, any PSW key.
### Dispatchable unit mode:
Task.

### Cross memory mode:
PASN = HASN.

### Amode:
31-bit or 24-bit.

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

### ASC mode:
Primary address space control (ASC) mode.

### Interrupt status:
Enabled for interrupts.

### Locks:
Unlocked.

### Control parameters:
All parameters must be addressable by the caller and in the primary address space.

---

**Keyword** | **Description**
--- | ---
**NODE** | An input parameter. Storage up to 255 bytes long that contains the host name being queried. If the **AI_NUMERICHOST** flag is specified in the storage pointed to by the **HINTS** operand, then **NODE** should contain the queried host’s IP address in network byte order presentation form. This is an optional field, but if specified you must also code **NODELEN**. The **NODE** name being queried consists of up to **NODELEN** or up to the first binary zero.

You can append scope information to the host name by using the format `node%scope information`. The combined information must be 255 bytes or less. For more information, see [z/OS Communications Server: IPv6 Network and Application Design Guide](https://www.ibm.com/docs/en/zos/v2r10?topic=ipv6-design-guide).

**NODELEN** | An input parameter. A fullword binary field set to the length of the
host name specified in the NODE field and should not include extraneous blanks. This is an optional field, but if specified you must also code NODE.

**SERVICE**

An input parameter. Storage up to 32 bytes long that contains the service name being queried. If the **AI_NUMERICSERV** flag is specified in the storage pointed to by the HINTS operand, then SERVICE should contain the queried port number in presentation form. This is an optional field, but if specified you must also code SERVLEN. The SERVICE name being queried consists of up to SERVLEN or up to the first binary zero.

**SERVLLEN**

An input parameter. A fullword binary field set to the length of the service name specified in the SERVICE field and should not include extraneous blanks. This is an optional field but if specified you must also code SERVICE.

**HINTS**

An input parameter. If the HINTS argument is specified, then it contains the address of an addrinfo structure containing input values that can direct the operation by providing options and limiting the returned information to a specific socket type, address family, or protocol. If the HINTS argument is not specified, then the information returned is as if it referred to a structure containing the value 0 for the **FLAGS**, **SOCTYPE** and **PROTO** fields, and **AF_UNSPEC** for the AF field. Include the **EZBREHST** Resolver macro to enable your program to contain the assembler mappings for the **ADDR_INFO** structure.

This is an optional field.

The address information structure has the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLAGS</strong></td>
<td>A fullword binary field. Must have the value of 0 or the bitwise, OR of one or more of the following: <strong>AI_PASSIVE (X’00000001’)</strong></td>
</tr>
</tbody>
</table>

- Specifies how to fill in the NAME pointed to in the returned RES. If this flag is specified, then the returned address information is suitable for use in binding a socket for accepting incoming connections for the specified service (that is the **TYPE=BIND** call). In this case, if the NODE argument is not specified, then the IP address portion of the socket address structure pointed to by the returned RES is set to **INADDR_ANY** for an IPv4 address or to the IPv6 unspecified address (in6addr_any) for an IPv6 address.

- If this flag is not set, the returned address information is suitable for the **TYPE=CONNECT** call (for a connection-mode protocol) or for a **TYPE=CONNECT, TYPE=SENDTO**, or **TYPE=SENDMSG** call (for a connectionless protocol). In this case, if the NODE argument is not specified, then the IP address portion of the socket address structure pointed to by the returned RES is set to the default loopback address.
address for an IPv4 address (127.0.0.0) or the
default loopback address for an IPv6 address
(:1).

- This flag is ignored if the NODE argument is
  specified.

**AI_CANONNAMEOK** (X'00000002')

- If this flag is specified and the NODE argument
  is specified, then the TYPE=GETADDRINFO
call attempts to determine the canonical name
corresponding to the NODE argument.

**AI_NUMERICHOST** (X'00000004')

- If this flag is specified then the NODE argument
  must be a numeric host address in presentation
  form. Otherwise, an error of host not found
  [EAI_NONAME] is returned.

**AI_NUMERICSERV** (X'00000008')

- If this flag is specified then the SERVICE
  argument must be a numeric port in
  presentation form. Otherwise, an error
  [EAI_NONAME] is returned.

**AI_V4MAPPED** (X'00000010')

- If this flag is specified along with the AF field
  with the value of AF_INET6, or a value of
  AF_UNSPEC when IPv6 is supported on the
  system, then the caller accepts IPv4-mapped
  IPv6 addresses. When the AI_ALL flag is not
  also specified and no IPv6 addresses are found,
  then a query is made for IPv4 addresses. If any
  IPv4 addresses are found, they are returned as
  IPv4-mapped IPv6 addresses.

- If the AF field does not have the value of
  AF_INET6 or the AF field contains AF_UNSPEC
  but IPv6 is not supported on the system, this
  flag is ignored.

**AI_ALL** (X'00000020')

- When the AF field has a value of AF_INET6 and
  AI_ALL is set, the AI_V4MAPPED flag must
  also be set to indicate that the caller accepts all
  addresses (IPv6 and IPv4-mapped IPv6
  addresses). When the AF field has a value of
  AF_UNSPEC when the system supports IPv6
  and AI_ALL is set, the caller accepts IPv6
  addresses and either IPv4 (if AI_V4MAPPED is
  not set) or IPv4-mapped IPv6 (if AI_V4MAPPED
  is set) addresses. A query is first made for IPv6
  addresses and if successful, the IPv6 addresses
  are returned. Another query is then made for
  IPv4 addresses and any found are returned as
  IPv4 addresses (if AI_V4MAPPED was not set)
  or as IPv4-mapped IPv6 addresses (if
  AI_V4MAPPED was set).
If the AF field does not have the value of AF_INET6, or the value of AF_UNSPEC when the system supports IPv6, the flag is ignored.

**AI_ADDRCONFIG (X’00000040’)**
If this flag is specified, then a query for IPv6 on the NODE will occur if the Resolver determines whether either of the following is true:
- If the system is IPv6 enabled and has at least one IPv6 interface, the Resolver makes a query for IPv6 (AAAA or A6 DNS) records.
- If the system is IPv4 enabled and has at least one IPv4 interface, the Resolver makes a query for IPv4 (A DNS) records.

The loopback address is not considered in this case as a valid interface.

**AF** A fullword binary field. Used to limit the returned information to a specific address family. The value of AF_UNSPEC means that the caller accepts any protocol family. The value of a decimal 0 indicates AF_UNSPEC. The value of a decimal 2 indicates AF_INET, and the value of a decimal 19 indicates AF_INET6.

**SOCTYPE**
A fullword binary field. Used to limit the returned information to a specific socket type. A value of 0 means that the caller accepts any socket type. If a specific socket type is not given (for example, a value of 0), then information on all supported socket types is returned.

The following are the acceptable socket types:

<table>
<thead>
<tr>
<th>Type name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCK_STREAM</td>
<td>1</td>
<td>for stream socket</td>
</tr>
<tr>
<td>SOCK_DGRAM</td>
<td>2</td>
<td>for datagram socket</td>
</tr>
<tr>
<td>SOCK_RAW</td>
<td>3</td>
<td>for raw-protocol interface</td>
</tr>
</tbody>
</table>

Anything else will fail with return code EAI_SOCKTYPE. Note that although SOCK_RAW is accepted, it is valid only when SERVICE is numeric (for example, SERVICE=23). A lookup for a SERVICE name will never occur in the appropriate services file (for example, hlq.ETC.SERVICES) using any protocol value other than SOCK_STREAM or SOCK_DGRAM.

If PROTO is not 0 and SOCTYPE is 0, then the only acceptable input values for PROTO are IPPROTO_TCP and IPPROTO_UDP. Otherwise, the TYPE=GETADDRINFO fails with return code EAI_BADFLAGS.

If SOCTYPE and PROTO are both specified as 0 then TYPE=GETADDRINFO proceeds as follows:
If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos defaults to a specification of SOCTYPE as SOCK_STREAM.

If SERVICE is specified as a service name (for example, SERVICE=FTP), then TYPE=GETADDRINFO searches the appropriate services file (such as, hlq.ETC.SERVICES) twice. The first search uses SOCK_STREAM as the protocol, and the second search uses SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both SOCTYPE and PROTO are specified as a value other than 0 then they should be compatible, regardless of the value specified by SERVICE. In this context, compatible means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE=SOCK_RAW and PROTO can be anything

PROTO
A fullword binary field. Used to limit the returned information to a specific protocol. A value of 0 means that the caller accepts any protocol.

The following are the acceptable protocols:

<table>
<thead>
<tr>
<th>Protocol name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPPROTO_TCP</td>
<td>6</td>
<td>TCP</td>
</tr>
<tr>
<td>IPPROTO_UDP</td>
<td>17</td>
<td>user datagram</td>
</tr>
</tbody>
</table>

If SOCKTYPE is 0 and PROTO is not 0, then the only acceptable input values for PROTO are IPPROTO_TCP and IPPROTO_UDP. Otherwise, the TYPE=GETADDRINFO is failed with return code EAI_BADFLAGS.

If PROTO and SOCKTYPE are both specified as 0, then TYPE=GETADDRINFO proceeds as follows:

- If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos default to a specification of SOCKTYPE as SOCK_STREAM.
- If SERVICE is specified as a service name (for example, SERVICE=FTP), then TYPE=GETADDRINFO searches the appropriate services file (such as, hlq.ETC.SERVICES) twice. The first search uses SOCK_STREAM as the protocol, and the second search uses SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both PROTO and SOCKTYPE are specified as nonzero, then they should be compatible, regardless of the value specified by SERVICE. In this context, compatible means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
• SOCTYPE=SOCK_RAW and PROTO can be anything

If the lookup for the value specified in SERVICE fails [that is, the service name does not appear in the appropriate services file (for example, hlq.ETC.SERVICES) using the input protocol], then the TYPE=GETADDRINFO fails with return code EAI_SERVICE.

NAMELEN
A fullword binary field. This field must be 0.

CANONNAME
A fullword binary field. This field must be 0.

NAME
A fullword binary field. This field must be 0.

NEXT A fullword binary field. This field must be 0.

RES
Initially a fullword binary field. On a successful return, this field contains a pointer to a chain of one or more address information structures. Use the EZBREHST macro to establish address information mapping. The structures are allocated in the key of the calling application. Do not use or reference these structures between MVS tasks. When you are finished using the structures, explicitly free their storage by specifying the returned pointer on a TYPE=FREEADDRINFO call; storage that is not explicitly freed is released when the task is ended.

The address information structure contains the following fields. All fields in this structure that are not filled in with an explicit value are set to 0:

Field Description

FLAGS
A fullword binary field that is not used as output.

AF A fullword binary field. The value returned in this field can be used as the AF= argument on the TYPE=SOCKET macro to create a socket suitable for use with the returned address NAME.

SOCTYPE
A fullword binary field. The value returned in this field can be used as the SOCTYPE= argument on the TYPE=SOCKET macro to create a socket suitable for use with the returned address NAME.

PROTO
A fullword binary field. The value returned in this field can be used as the PROTO= argument on the TYPE=SOCKET macro to create a socket suitable for use with the returned address NAME.

NAMELEN
A fullword binary field. The length of the NAME socket address structure. The value returned in this field can be
used as the arguments for the TYPE=CONNECT or TYPE=BIND macros with such a socket, according to the AI_PASSIVE flag.

**CANONNAME**
A fullword binary field. The address of storage containing the canonical name for the value specified by NODE. Initially, this field must be 0. If the NODE argument is specified, and if the AI_CANONNAMEOK flag was specified by the HINTS argument, then the CANONNAME field in the first returned address information structure contains the address of storage containing the canonical name corresponding to the input NODE argument. If the canonical name is not available, then the CANONNAME field refers to the NODE argument or a string with the same contents. The CANNLEN field contains the length of the returned canonical name.

**NAME**
A fullword binary field. The address of the returned socket address structure. The value returned in this field can be used as the arguments for the TYPE=CONNECT or TYPE=BIND macros with such a socket, according to the AI_PASSIVE flag.

**NEXT**
A fullword binary field. Contains the address of the next address information structure on the list, or 0's if it is the last structure on the list.

**CANNLEN**
Initially an input parameter. A fullword binary field used to contain the length of the canonical name returned by the RES CANONNAME field. This is an optional field.

**ERRNO**
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ERROR**
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**GETCLIENTID**
The GETCLIENTID macro returns the identifier by which the calling application is known to the TCP/IP address space. The client ID structure returned is used by the GIVESOCKET and TAKESOCKET macros.

When GETCLIENTID is called by a server or client, the identifier of the calling application is returned.
The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=GETCLIENTID, CLIENT = address
  *indaddr (reg)
```

```
ERRNO = address
  *indaddr (reg)
```

```
RETCODE = address
  *indaddr (reg)
```

```
ECB = address
  *indaddr (reg)
```

```
ERROR = address
  *indaddr (reg)
```

```
REQAREA = address
  *indaddr (reg)
```

```
TASK = address
  *indaddr (reg)
```

**Keyword**  
**Description**

**CLIENT**  
Input/Output parameter. A client ID structure describing the identifier for your application, regardless whether a server or client.

**FIELD**  
**Description**

**DOMAIN**  
A fullword binary number specifying the domain of the client. On input, this is an optional parameter for AF_INET, and a required parameter for AF_INET6 to specify the domain of the client. For TCP/IP, the value is a decimal 2 indicating AF_INET, or decimal 19 indicating AF_INET6. On output, this is the returned domain of the client.

**NAME**  
An 8-byte character field that is filled, on completion of the call, with the client address space identifier.
**TASK** Output parameter. An 8-byte field set to the client task identifier.

**RESERVED** Output parameter. Specifies 20 bytes of binary 0’s. This field is required, but it is not used.

**ERRNO** Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, “Return codes,” on page 835 for information about **ERRNO** return codes.

**RETCODE** Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check <strong>ERRNO</strong> for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA** Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For **ECB**

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For **REQAREA**

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For **ECB/REQAREA**

A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.

**ERROR** Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK** Input parameter. The location of the task storage area in your program.

---

**GETHOSTBYADDR**

The GETHOSTBYADDR macro returns domain and alias names of the host whose IPv4 Internet address is specified by the macro. A TCP/IP host can have multiple alias names and host IPv4 Internet addresses.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td><strong>PASN = HASN.</strong></td>
</tr>
<tr>
<td>Keyword</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>HOSTADR</td>
<td>Input parameter. A fullword unsigned binary field set to the Internet address of the host whose name you want to find.</td>
</tr>
<tr>
<td>HOSTENT</td>
<td>Input parameter. A fullword containing the address of the HOSTENT structure returned by the macro. For information about the HOSTENT structure, see Figure 64 on page 296.</td>
</tr>
<tr>
<td>RETCODE</td>
<td>Output parameter. A fullword binary field that returns one of the following:</td>
</tr>
<tr>
<td></td>
<td><strong>Value</strong></td>
</tr>
<tr>
<td></td>
<td>&gt;0</td>
</tr>
<tr>
<td></td>
<td>-1</td>
</tr>
<tr>
<td>ERROR</td>
<td>Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.</td>
</tr>
<tr>
<td>TASK</td>
<td>Input parameter. The location of the task storage area in your program.</td>
</tr>
</tbody>
</table>
GETHOSTBYADDR returns the HOSTENT structure shown in Figure 64. The HOSTENT structure is a task’s serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name returned by the macro. The name length is variable and is ended by X’00’.
- The address of a list of addresses that point to the alias names returned by the GETHOSTBYADDR. This list is ended by the pointer X’00000000’. Each alias name is a variable length field ended by X’00’.
- The value returned in the FAMILY field is always 2 to signify AF_INET.
- The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 to signify AF_INET.
- The address of a list of addresses that point to the host Internet addresses returned by the macro. The list is ended by the pointer X’00000000’.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses.

GETHOSTBYNAME

The GETHOSTBYNAME macro returns the alias names and the IPv4 Internet addresses of a host whose domain name is specified in the macro.

The name resolution attempted depends on how the resolver is configured and if any local host tables exist. Refer to the z/OS Communications Server: IP Configuration Guide for information about configuring the resolver and using local host tables.
If the host name is not found, the return code is -1.

**Important:** Repeated use of GETHOSTBYNAME before calls which implicitly or explicitly invoke INITAPI can result in the allocation of unreleased storage.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td><strong>Note:</strong> See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI — TYPE = GETHOSTBYNAME — NAMELEN — number
   address — +indaddr — (reg)

EZASMI — NAME — address — +indaddr — (reg)
   HOSTENT — address — +indaddr — (reg)
   RETCODE — address — +indaddr — (reg)

EZASMI — ERROR — address — +indaddr — (reg)
   TASK — address — +indaddr — (reg)
```

**Note:** The storage for the HOSTENT structure returned by this call is released during TERMAPI processing; therefore, the application program must not use the HOSTENT storage after the TERMAPI.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>Input parameter. A value or the address of a fullword binary field specifying the length of the name and alias fields. This length has a maximum value of 255 bytes.</td>
</tr>
<tr>
<td>NAME</td>
<td>A character string, up to 255 characters, set to a host name. This call returns the address of HOSTENT for this name. Any trailing blanks are removed from the specified name prior to trying to resolve it to an IP address.</td>
</tr>
<tr>
<td>HOSTENT</td>
<td>Output parameter. A fullword word containing the address of HOSTENT returned by the macro. For information about the HOSTENT structure, see Figure 65 on page 298.</td>
</tr>
</tbody>
</table>
**RETCODE**  A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

**ERROR**  Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**  Input parameter. The location of the task storage area in your program.

---

**Figure 65. HOSTENT structure returned by the GETHOSTBYNAME macro**

GETHOSTBYNAME returns the HOSTENT structure shown in [Figure 65.](#) The HOSTENT structure is a task's serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name returned by the macro. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by GETHOSTBYNAME. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 to signify AF_INET.
- The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 to signify AF_INET.
- The address of a list of addresses that point to the host Internet addresses returned by the macro. The list is ended by the pointer X'00000000'.
The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses.

**GETHOSTID**

The GETHOSTID macro returns the 32-bit identifier for the current host. This value is the default home Internet address.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=GETHOSTID ,RETCODE=(address) RETCODE=address *indaddr(reg)
```

```
,ECB=address *indaddr(reg),ERROR=address *indaddr(reg),REQAREA=address *indaddr(reg)
```

```
,TASK=address *indaddr(reg)
```

**Keyword** | **Description**
---|---
**RETCODE** | Output parameter. Returns a fullword binary field containing the 32-bit Internet address of the host. A -1 in RETCODE indicates an error. There is no ERRNO parameter for this macro.

**ECB or REQAREA** | Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

**For ECB** | A 4-byte ECB posted by TCP/IP when the macro completes.
For REQAREA
   A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
   A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR
   Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
   Input parameter. The location of the task storage area in your program.

GETHOSTNAME
   The GETHOSTNAME macro returns the name of the host processor on which the program is running. As many as NAMELEN characters are copied into the NAME field.

Note: The host name returned is the host name the TCPIP stack learned at startup from the TCPIP.DATA file that was found.

The following requirements apply to this call:

Authorization:            Supervisor state or problem state, any PSW key.
Dispatchable unit mode:   Task.
Cross memory mode:        PASN = HASN.
Amode:                    31-bit or 24-bit.
   Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
ASC mode:                 Primary address space control (ASC) mode.
Interrupt status:         Enabled for interrupts.
Locks:                    Unlocked.
Control parameters:       All parameters must be addressable by the caller and in the primary address space.

---EZASMI—TYPE=GETHOSTNAME—,NAMELEN—address—indaddr—(reg)---
---,NAME—address—indaddr—(reg)---ERRNO—address—indaddr—(reg)---RETCODE—address—indaddr—(reg)---
Keyword Description

**NAMELEN** Input parameter. A fullword set to a value or the address of a fullword binary field set to the length of the name field. The maximum length that can be specified in the field is 255 characters.

**NAME** Initially, the application provides a pointer to a receiving field for the host name. TCP/IP Services allows a maximum length of 24 characters. This field is filled with a host name with the length returned in **NAMELEN** when the call completes. The name returned is the value from the TCP/IP stack’s TCPIP:DATA HOSTNAME statement.

**ERRNO** Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore **ERRNO**.

See Appendix B, “Return codes,” on page 835 for information about **ERRNO** return codes.

**RETCODE** Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA** Input parameter. This parameter is required if you are using **APITYPE=3**. It points to a 104-byte field containing:

For **ECB**

A 4-byte **ECB** posted by TCP/IP when the macro completes.

For **REQAREA**

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For **ECB/REQAREA**

A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the **ECB** has been posted, or the asynchronous exit has been driven.
**ERROR**  Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**  Input parameter. The location of the task storage area in your program.

**GETIBMOPT**

The GETIBMOPT macro returns the number of TCP/IP images installed on a given MVS system and the status, version, and name of each.

**Note:** Images from pre-V3R2 releases of TCP/IP for MVS are excluded. The GETIBMOPT macro is not meaningful for pre-V3R2 releases. With this information, the caller can dynamically choose the TCP/IP image with which to connect, using the INITAPI macro. The GETIBMOPT macro is optional. If it is not used, follow the standard method to determine the connecting TCP/IP image:

1. Connect to the TCP/IP specified by TCPIPJOBNAME in the active TCPIP.DAT file.
2. Locate TCPIP.DAT using the search order described in the [z/OS Communications Server: IP Configuration Reference](https://publib.boulder.ibm.com/infocenter/pseries/v1r9m0/index.jsp?topic=/com.ibm.zos.v1r9m0.cic58o0.doc/tnm0isp0000123.html).

[z/OS Communications Server: New Function Summary](https://publib.boulder.ibm.com/infocenter/pseries/v1r9m0/index.jsp?topic=/com.ibm.zos.v1r9m0.cic58o0.doc/tnm0isp0000123.html) contains detailed information about the standard method.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>
| Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
| ASC mode:                  | Primary address space control (ASC) mode.                                  |
| Interrupt status:          | Enabled for interrupts.                                                    |
| Locks:                     | Unlocked.                                                                   |
| Control parameters:        | All parameters must be addressable by the caller and in the primary address space. |

```plaintext
//EZASMI TYPE=GETIBMOPT, COMMAND=<number>, BUF=<address>, *indaddr *(reg)

//, ERRNO=<address>, RETCODE=<address>, *indaddr *(reg)
```
Keyword | Description
---|---
**COMMAND** | Input parameter. A value or the address of a fullword binary number specifying the command to be processed. The only valid value is 1.

**BUF** | Output parameter. A 100-byte buffer into which each active TCP/IP image status, version, and name are placed.

On successful return, these buffer entries contain the status, name and version of up to eight active TCP/IP images. The following layout shows BUF upon completion of the call.

<table>
<thead>
<tr>
<th>NUM_IMAGES</th>
<th>(4 bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
<tr>
<td>Status (2 bytes)</td>
<td>Version (2 bytes)</td>
</tr>
</tbody>
</table>

*Figure 66. NUM IMAGES field settings*

The NUM IMAGES field indicates how many entries of TCP_IMAGE are included in the total BUF field. If the NUM IMAGES returned is 0, there are no TCP/IP images present.

The status field can combine the following information:

<table>
<thead>
<tr>
<th>Status Field</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'8xxx'</td>
<td>Active</td>
</tr>
<tr>
<td>X'4xxx'</td>
<td>Terminating</td>
</tr>
<tr>
<td>X'2xxx'</td>
<td>Down</td>
</tr>
<tr>
<td>X'1xxx'</td>
<td>Stopped or stopping</td>
</tr>
</tbody>
</table>
Note: In the above status fields, xxx is reserved for IBM use and can contain any value.

When the status field returns Down and Stopped, TCP/IP abended. Stopped, returned alone, indicates that TCP/IP was stopped. The version field is:

<table>
<thead>
<tr>
<th>Version</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP/IP z/OS Communications Server V1R2</td>
<td>X'0612'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R4</td>
<td>X'0614'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R5</td>
<td>X'0615'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R6</td>
<td>X'0616'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R7</td>
<td>X'0617'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R8</td>
<td>X'0618'</td>
</tr>
<tr>
<td>TCP/IP z/OS Communications Server V1R9</td>
<td>X'0619'</td>
</tr>
</tbody>
</table>

The name field is the PROC name, left-aligned, and padded with blanks.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See [Appendix B, “Return codes,” on page 835](#) for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field with the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>Call returned error. See ERRNO.</td>
</tr>
<tr>
<td>&gt;=0</td>
<td>Successful call.</td>
</tr>
</tbody>
</table>

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your program.

**GETNAMEINFO**

The GETNAMEINFO macro returns the node name and service location of a socket address that is specified in the macro. On successful completion, GETNAMEINFO returns the node and service named, if requested, in the buffers provided.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN</td>
</tr>
</tbody>
</table>
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

```
EZASMI TYPE=GETNAMEINFO, NAME=address
      +indaddr
       (reg)

NAMELEN=number
       +indaddr
       (reg)

HOST=address
      +indaddr
     (reg)

HOSTLEN=number
       +indaddr
       (reg)

SERVICE=address
       +indaddr
      (reg)

SERVLEN=number
       +indaddr
       (reg)

FLAGS='NI_DGRAM'
   'NI_NAMEREQD'
   'NI_NOFQDN'
   'NI_NUMERICHOST'
   'NI_NUMERICSCOPE'
   'NI_NUMERICSERV'

ERRNO=address
       +indaddr
      (reg)

RETCODE=address
       +indaddr
      (reg)

ERROR=address
       +indaddr
      (reg)
```

Keyword Description

NAME
An input parameter. An IPv4 or IPv6 socket address structure to be translated. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label.
The **AF_INET** socket address structure fields start at the `SOCK_SIN` label. The **AF_INET6** socket address structure fields start at the `SOCK_SIN6` label.

The IPv4 socket address structure must specify the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>A halfword binary number specifying the IPv4 addressing family. For TCP/IP the value is a decimal 2, indicating <strong>AF_INET</strong>.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary number specifying the port number.</td>
</tr>
<tr>
<td>IPv4-ADDRESS</td>
<td>A fullword binary number specifying the 32-bit IPv4 Internet address.</td>
</tr>
<tr>
<td>RESERVED</td>
<td>An 8-byte reserved field. This field is required, but is not used.</td>
</tr>
</tbody>
</table>

The IPv6 socket address structure specifies the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>A 1-byte binary field that specifies the length of the IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input. The field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>A 1-byte binary field that specifies the IPv6 addressing family. For TCP/IP the value is a decimal 19, indicating <strong>AF_INET6</strong>.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary number that specifies the port number.</td>
</tr>
<tr>
<td>FLOW-INFO</td>
<td>This field is ignored by the TYPE=GETNAMEINFO macro.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>A 16-byte binary field that specifies the 128-bit IPv6 Internet address, in network byte order.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field that specifies the scope for an IPv6 address as an interface index. The resolver ignores the SCOPE_ID field, unless the address in IPv6-ADDRESS is a link-local address and the HOST parameter also is specified.</td>
</tr>
</tbody>
</table>

### NAMELEN
An input parameter. A fullword binary field. The length of the socket address structure pointed to by the NAME argument.

### HOST
On input, storage capable of holding the returned resolved host name, which can be up to 255 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved host name, then the resolver returns the host name up to the storage specified and truncation might occur. If the host’s name cannot be located, the numeric form of the host’s address is returned instead of its name. However, if the NI_NAMEREQD
option is specified and no host name is located, an error is returned. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs. The HOST name being queried consists of up to HOSTLEN or up to the first binary 0.

If the IPv6-ADDRESS value is a link-local address, and the SCOPE_ID interface index is nonzero, scope information is appended to the resolved host name using the format host%scope. The scope information can be the numeric form of the SCOPE_ID interface index or the interface name that is associated with the SCOPE_ID interface index. Use the NI_NUMERICSCOPE option to select which form is returned. The combined host name and scope information is 255 bytes or less. For more information about scope information and TYPE=GETNAMEINFO processing, see [z/OS Communications Server: IPv6 Network and Application Design Guide].

**HOSTLEN**
Initially an input parameter. A fullword binary field that contains the length of the host storage that is used to contain the returned resolved host name. If HOSTLEN is 0 on input, then the resolved host name is not returned. The HOSTLEN value must be equal to or greater than the length of the longest host name, or host name and scope information combination, to be returned. The TYPE=GETNAMEINFO returns the host name, or host name and scope information combination, up to the length specified by the HOSTLEN value. On output, HOSTLEN contains the length of the returned resolved host name, or host name and scope information combination. This is an optional field, but if you specify this field, you also must code the HOST value. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

**SERVICE**
On input, storage capable of holding the returned resolved service name, which can be up to 32 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved service name, then the resolver returns the service name up to the storage specified and truncation might occur. If the service name cannot be located, or if NI_NUMERICSERV was specified in the FLAGS operand, then the presentation form of the service address is returned instead of its name. This is an optional field, but if you specify this field, you also must code the SERVLEN parameter. The SERVICE name being queried consists of up to SERVLEN or up to the first binary zero. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

**SERVLEN**
Initially an input parameter. A fullword binary field that contains the length of the SERVICE storage used to contain the returned
resolved service name. If SERVLEN is 0 on input, then the service name information is not returned. SERVLEN must be equal to or greater than the length of the longest service name to be returned. The TYPE=GETNAMEINFO returns the service name up to the length specified by SERVLEN. On output, SERVLEN contains the length of the returned resolved service name. This is an optional field, but if you specify it, you also must code the SERVICE parameter. One or both of the following groups of parameters are required:

- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters

Otherwise, an error occurs.

**FLGS**

An input parameter. A fullword binary field. This is an optional field. The FLGS argument can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Decimal Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'NI_NOFQDN'</td>
<td>X'00000001'</td>
<td>1</td>
<td>Return the NAME portion of the fully qualified domain name.</td>
</tr>
<tr>
<td>'NI_NUMERICHOST'</td>
<td>X'00000002'</td>
<td>2</td>
<td>Only return the numeric form of host's address.</td>
</tr>
<tr>
<td>'NI_NAMEREQD'</td>
<td>X'00000004'</td>
<td>4</td>
<td>Return an error if the host's name cannot be located.</td>
</tr>
<tr>
<td>'NI_NUMERICSERV'</td>
<td>X'00000008'</td>
<td>8</td>
<td>Only return the numeric form of the service address.</td>
</tr>
<tr>
<td>'NI_DGRAM'</td>
<td>X'00000010'</td>
<td>16</td>
<td>Indicates that the service is a datagram service. The default behavior is to assume that the service is a stream service.</td>
</tr>
<tr>
<td>'NI_NUMERICSCOPE'</td>
<td>X'00000020'</td>
<td>32</td>
<td>Only return the numeric form of the SCOPE-ID interface index, if applicable.</td>
</tr>
</tbody>
</table>

**ERRNO**

Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**

Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ERROR**

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**GETPEERNAME**

The GETPEERNAME macro returns the name of the remote socket to which the local socket is connected.
The following requirements apply to this call:

Authorization: Supervisor state or problem state, any PSW key.
Dispatchable unit mode: Task.
Cross memory mode: PASN = HASN.
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.
Interrupt status: Enabled for interrupts.
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

```
>>EZASMI TYPE=GETPEERNAME, S = address
  NAME = address
>ERROR = address
, RETCODE = address
, ECB = address
, REQAREA = address
, TASK = address

Keyword | Description
-------|-------------
S | A value or the address of a halfword binary number specifying the local socket connected to the remote peer whose address is required.
NAME | Initially points to the peer name structure. It is filled when the call completes with the IPv4 or IPv6 address structure for the remote socket connected to the local socket, specified by S. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure must specify the following fields:
```
### Field Description

**FAMILY**
A halfword binary field set to the connection peer IPv4 addressing family. The IPv4 value is always a decimal 2, indicating AF_INET.

**PORT**
A halfword binary field set to the connection peer port number.

**IPv4-ADDRESS**
A fullword binary field set to the 32-bit IPv4 Internet address of the connection peer host machine.

**RESERVED**
Input parameter. Specifies an 8-byte reserved field. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAMELEN</strong></td>
<td>A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td><strong>FAMILY</strong></td>
<td>A 1-byte binary field specifying the IPv6 addressing family. For IPv6 the value is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td><strong>PORT</strong></td>
<td>A halfword binary field set to the connection peer port number.</td>
</tr>
<tr>
<td><strong>FLOW-INFO</strong></td>
<td>A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td><strong>IPv6-ADDRESS</strong></td>
<td>A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the connection peer host machine.</td>
</tr>
<tr>
<td><strong>SCOPE-ID</strong></td>
<td>A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.</td>
</tr>
</tbody>
</table>

**ERRNO**
Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
Output parameter. A fullword binary field.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>
**ECB or REQAREA**
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

**For ECB**
A 4-byte ECB posted by TCP/IP when the macro completes.

**For REQAREA**
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

**For ECB/REQAREA**
A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**
Input parameter. The location of the task storage area in your program.

**GETSOCKNAME**
The GETSOCKNAME macro stores the name of the socket into the structure pointed to by NAME and returns the address to the socket that has been bound. If the socket is not bound to an address, the macro returns with the FAMILY field completed and the rest of the structure set to zeros.

Stream sockets are not assigned a name until after a successful call to BIND, CONNECT, or ACCEPT.

Use the GETSOCKNAME macro to determine the port assigned to a socket after that socket has been implicitly bound to a port. If an application calls CONNECT without previously calling BIND, the CONNECT macro completes the binding necessary by assigning a port to the socket. You can determine the port assigned to the socket by issuing GETSOCKNAME.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
</tbody>
</table>
Control parameters: All parameters must be addressable by the caller and in the primary address space.

```
EZASMI TYPE = GETSOCKNAME, S = number
  *indaddr
  (reg) , NAME = address
  *indaddr
  (reg) , ERRNO = address
  *indaddr
  (reg) , RETCODE = address
  *indaddr
  (reg) , ECB = address
  *indaddr
  (reg) , REQAREA = address
  *indaddr
  (reg) , ERROR = address
  *indaddr
  (reg) , TASK = address
  *indaddr
  (reg)
```

Keyword Description
S  Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

NAME

Initially, the application provides a pointer to the IPv4 or IPv6 socket address structure, which is filled in on completion of the call with the socket name. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure must specify the following fields:

Field Description
FAMILY  Output parameter. A halfword binary field containing the IPv4 addressing family. The value for IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.

PORT  Output parameter. A halfword binary field set to the port number bound to this socket. If the socket is not bound, a 0 is returned.

IPv4-ADDRESS  Output parameter. A fullword binary field set to the 32-bit IPv4 Internet address of the local host machine.
RESERVED
Output parameter. Specifies 8 bytes of binary 0s. This field is required, but not used.

The IPv6 socket structure must specify the following fields:

Field Description

NAMELEN
Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY
Output parameter. A 1-byte binary field specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT
Output parameter. A halfword binary field set to the port number bound to this socket. If the socket is not bound, a 0 is returned.

FLOW-INFO
Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IPv6-ADDRESS
Output parameter. A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the local host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field that returns one of the following:

Value Description
0 Successful call.
−1 An error occurred.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.
For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

GETSOCKOPT
The GETSOCKOPT macro gets the options associated with a socket that were set using the SETSOCKOPT macro.

The options for each socket are described by the following parameters. You must specify the option that you want when you issue the GETSOCKOPT macro.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

EZASMI—TYPE=GETSOCKOPT—,S—number—address—*indaddr—(reg)
Keyword | Description
--- | ---
**S** | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket requiring options.

**OPTNAME** | Input parameter. See the table below for a list of the options and their unique requirements. See Appendix D, “GETSOCKOPT/SETSOCKOPT command values,” on page 863 for the numeric values of **OPTNAME**.

**OPTLEN** | Input parameter. A fullword binary field containing the length of the data returned in **OPTVAL**. See the table below for determining on what to base the value of **OPTLEN**.

**OPTVAL** | Output parameter. See the table below for a list of the options and their unique requirements.

**ERRNO** | Output parameter. A fullword binary field. If **RETCODE** is
negative, this field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP_ADD_MEMBERSHIP</td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP_ADD_SOURCE_MEMBERSHIP</td>
<td>Contains the IP_MREQ_SOURCE</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>structure as defined in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYS1.MACLIB(BPXYSOCK). The</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP_MREQ_SOURCE structure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>contains a 4-byte IPv4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>multicast address followed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>by a 4-byte IPv4 source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>address and a 4-byte IPv4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interface address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This is an IPv4-only socket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>option.</td>
<td></td>
</tr>
<tr>
<td>IP_BLOCK_SOURCE</td>
<td>Contains the IP_MREQ_SOURCE</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>structure as defined in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYS1.MACLIB(BPXYSOCK). The</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP_MREQ_SOURCE structure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>contains a 4-byte IPv4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>multicast address followed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>by a 4-byte IPv4 source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>address and a 4-byte IPv4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interface address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This is an IPv4-only socket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>option.</td>
<td></td>
</tr>
<tr>
<td>IP_DROP_MEMBERSHIP</td>
<td>Contains the IP_MREQ</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>structure as defined in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SYS1.MACLIB(BPXYSOCK). The</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IP_MREQ structure contains</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a 4-byte IPv4 multicast</td>
<td></td>
</tr>
<tr>
<td></td>
<td>address followed by a 4-byte</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPv4 source address and a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4-byte IPv4 interface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This is an IPv4-only socket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>option.</td>
<td></td>
</tr>
</tbody>
</table>
### OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
</table>
| **IP_DROP_SOURCE_MEMBERSHIP**  
Use this option to enable an application to exit a source multicast group.  
This is an IPv4-only socket option. | Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.  
See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.  
See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE. | N/A |
| **IP_MULTICAST_IF**  
Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application.  
This is an IPv4-only socket option. | A 4-byte binary field containing an IPv4 interface address. | A 4-byte binary field containing an IPv4 interface address. |
| **IP_MULTICAST_LOOP**  
Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back.  
This is an IPv4-only socket option. | A 1-byte binary field.  
To enable, set to 1.  
To disable, set to 0. | A 1-byte binary field.  
If enabled, will contain a 1.  
If disabled, will contain a 0. |
| **IP_MULTICAST_TTL**  
Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet.  
This is an IPv4-only socket option. | A 1-byte binary field containing the value of '00'x to 'FF'x. | A 1-byte binary field containing the value of '00'x to 'FF'x. |
Table 15. **OPTNAME options for GETSOCKOPT and SETSOCKOPT** (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP_UNBLOCK_SOURCE</strong></td>
<td>Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
</tr>
<tr>
<td><strong>IPV6_JOIN_GROUP</strong></td>
<td>Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.</td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
</tr>
<tr>
<td><strong>IPV6_LEAVE_GROUP</strong></td>
<td>Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.</td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. Note: An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.</td>
</tr>
<tr>
<td>Use to set or obtain the hop limit used for outgoing multicast packets. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_IF</strong></td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
</tr>
<tr>
<td>Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_LOOP</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td>Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_UNICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. Note: APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.</td>
</tr>
<tr>
<td>Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_V6ONLY</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td>Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>MCAST_BLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
</tbody>
</table>
Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCAST_LEAVE_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_LEAVE_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_UNBLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_ASCII</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII. <strong>Note:</strong> This is a REXX-only socket option.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To disable, set to OFF.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td><strong>SO_BROADCAST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled. <strong>Note:</strong> This option has no meaning for stream sockets.</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte field.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To disable, set to 0.</td>
</tr>
<tr>
<td><strong>SO_DEBUG</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use SO_DEBUG to set or determine the status of the debug option. The default is disabled. The debug option controls the recording of debug information. <strong>Notes:</strong> 1. This is a REXX-only socket option. 2. This option has meaning only for stream sockets.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To disable, set to OFF.</td>
</tr>
<tr>
<td><strong>SO_EBCDIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts. <strong>Note:</strong> This is a REXX-only socket option.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To disable, set to OFF.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td><strong>SO_ERROR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.</td>
<td>N/A</td>
<td>A 4-byte binary field containing the most recent ERRNO for the socket.</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>SO_KEEPALIVE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.</td>
<td>A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>SO_LINGER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled. Notes: 1. This option has meaning only for stream sockets. 2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set. When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out. When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer. Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields. Assembler coding: ONOFF DS F LINGER DS F COBOL coding: ONOFF PIC 9(8) BINARY. LINGER PIC 9(8) BINARY. Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields. Assembler coding: ONOFF DS F LINGER DS F COBOL coding: ONOFF PIC 9(8) BINARY. LINGER PIC 9(8) BINARY. A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.</td>
</tr>
</tbody>
</table>
**Table 15.** OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_OOBINLINE</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
</tbody>
</table>

Use this option to control or determine whether out-of-band data is received. **Note:** This option has meaning only for stream sockets.

When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM.

When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.

**SO_RCVBUF**

Use this option to control or determine the size of the data portion of the TCP/IP receive buffer.

The size of the data portion of the receive buffer is protocol-specific; based on the following values prior to any SETSOCKOPT call:

- TCPRCVBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket
- UDPRCVBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket
- The default of 65,535 for a raw socket

A 4-byte binary field.

To enable, set to a positive value indicating the size of the data portion of the TCP/IP receive buffer.

To disable, set to a 0.

A 4-byte binary field.

If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer.

If disabled, contains a 0.
Table 15. **OPTNAME options for GETSOCKOPT and SETSOCKOPT** (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_REUSEADDR</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td>Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported:</td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td><strong>SO_SNDBUFSIZE</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td>Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following:</td>
<td>To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer.</td>
<td>If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>SO_TYPE</strong></td>
<td>N/A</td>
<td>A 4-byte binary field</td>
</tr>
<tr>
<td>Use this option to return the socket type.</td>
<td></td>
<td>indicating the socket type:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'1' indicates SOCK_STREAM.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'2' indicates SOCK_DGRAM.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'3' indicates SOCK_RAW.</td>
</tr>
</tbody>
</table>
Table 15. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP_KEEPALIVE</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a value in the range of 1 – 2 147 460.</td>
<td>If enabled, contains the specific timer value (in seconds) that is in effect for the given socket.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a value of 0.</td>
<td>If disabled, contains a 0 indicating keep alive timing is not active.</td>
</tr>
<tr>
<td>TCP_NODELAY</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a 0.</td>
<td>If enabled, contains a 0.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a 1 or nonzero.</td>
<td>If disabled, contains a 1.</td>
</tr>
</tbody>
</table>

**GIVESOCKET**

The GIVESOCKET macro makes the socket available for a TAKESOCKET macro issued by another program. The GIVESOCKET macro can specify any connected stream socket. Typically, the GIVESOCKET macro is issued by a concurrent server program that creates sockets to be passed to a subtask.

After a program has issued a GIVESOCKET macro for a socket, it can only issue a CLOSE macro for the same socket. Sockets which are given but not taken for a period of four days will be closed and will no longer be available for taking. If a select for the socket is outstanding, it is posted.

**Note:** Both concurrent servers and iterative servers use this interface. An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks that process the client requests. When a subtask is created, the concurrent server gets a new socket,
passes the new socket to the subtask, and dissociates itself from the connection. The TCP/IP Listener program is an example of a concurrent server.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI — TYPE = GIVESOCKET, S = number, CLIENT = address

ERRNO = address, RETCODE = address

ECB = address, ERROR = address

REQAREA = address

TASK = address
```

**Keyword** | **Description**
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket to be given.

**CLIENT** | **Description**
--- | ---
Input parameter. The client ID for this application.

**FIELD** | **Description**
--- | ---
**DOMAIN** | Input parameter. A fullword binary number specifying the domain of the client. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6.
Note: A socket given by GIVESOCKET can only be taken by a TAKESOCKET with the same DOMAIN, address family (AF_INET or AF_INET6).

NAME
An 8-character field, left-aligned, padded to the right with blanks. On completion of the call, this field contains the MVS address space name of the application that is going to take the socket. If the socket-taking application is in the same address space as the socket-giving application, NAME can be obtained using the GETCLIENTID call. If this field is set to blanks, any MVS address space requesting a socket can take this socket.

TASK
Specifies an 8-byte field that is set to the MVS subtask identifier of the socket-taking task (specified on the SUBTASK parameter on its INITAPI macro). If this field is set to blanks, any subtask in the address space specified in the NAME field can take the socket.

RESERVED
Input parameter. A 20-byte reserved field. This field is required, but not used.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field that returns one of the following:

Value  Description
0  Successful call.
-1  Check ERRNO for an error code.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.
**GLOBAL**

The GLOBAL macro allocates a global storage area that is addressable by all socket users in an address space. If more than one module is using sockets, you must supply the address of the global storage area to each user. Each program using the sockets interface should define global storage using the instruction EZASMI TYPE=GLOBAL with STORAGE=DSECT.

If this macro is not named, the default name EZASMGWA is assumed.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 433.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=GLOBAL, STORAGE=DSECT
```

**Keyword** | **Description**
---|---
STORAGE | Input parameter. Defines one of the following storage definitions:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSECT</td>
<td>Generates a DSECT.</td>
</tr>
<tr>
<td>CSECT</td>
<td>Generates an inline storage definition that can be used within a CSECT or as a part of a larger DSECT.</td>
</tr>
</tbody>
</table>

**INITAPI**

The INITAPI macro connects an application to the TCP/IP interface. Almost all sockets programs that are written in COBOL, PL/I, or assembler language must issue the INITAPI macro before they issue other sockets macros.

**Note:** Because the default INITAPI still requires the TERMAPI to be issued, it is recommended that you always code the INITAPI command.

The exceptions to this rule are the following calls, which, when issued first, will generate a default INITAPI call:

- GETCLIENTID
• GETHOSTID
• GETHOSTNAME
• GETIBMOPC
• SELECT
• SELECTEX
• SOCKET
• TAKESOCKET

Note: Only the first INITAPI triggers a read of the TCPIP.DATA and all other
INITAPIs under that address space will use the values read by the first
INITAPI.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

```
 EZASMI  TYPE=INITAPI
   ,MAXSOC = number
   ,address
   ,*indaddr
   *(reg)

 ,SUBTASK = address
   ,*indaddr
   *(reg)

 ,IDENT = address
   ,*indaddr
   *(reg)

 ,MAXTO = address
   ,ERRNO = address
   ,RETCODE = address
   ,*indaddr
   *(reg)

 ,APITYPE = '2'
   ,UEEXIT = address
   ,*indaddr
   *(reg)
```
Keyword          Descriptions
MAXSOC           Optional input parameter. A halfword binary field specifying the maximum number of sockets supported by this application. The maximum number is 65535 and the minimum number is 50. The default value for MAXSOC is 50. If less than 50 are requested, MAXSOC defaults to 50.

SUBTASK          Optional input parameter. An 8-byte field that is used to identify a subtask in an address space that can contain multiple subtasks. It is suggested that you use your own job name as part of your subtask name. This will ensure that, if you issue more than one INITAPI command from the same address space, each SUBTASK parameter will be unique.

IDENT            Optional input parameter. A structure containing the identities of the TCP/IP address space and your address space. Specify IDENT on the INITAPI macro from an address space. The structure is as follows:

Field             Description
TCPNAME           Input parameter. An 8-byte character field set to the name of the TCP/IP address space that you want to connect to. If this is not specified, the system derives a value from the configuration file, as described in the z/OS Communications Server: IP Configuration Reference.

ADSNAME           Input parameter. An 8-byte character field set to the name of the calling program’s address space. If this is not specified, the system will derive a value from the MVS control block structure.

MAXSNO            Output parameter. A fullword binary field containing the greatest descriptor number assigned to this application. The lowest socket number is 0. If you have 50 sockets, they are numbered in the range 0 – 49. If MAXNO is not specified, the value for MAXNO is 49.

ERRNO             Output parameter. A fullword binary field. If RETCODE is negative, ERRNO field contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.
RETCODE Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

API TYPE Optional input parameter. A halfword binary field specifying the APITYPE. For details on usage, see "Task management and asynchronous function processing" on page 265.

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>APITYPE 2. This is the default.</td>
</tr>
<tr>
<td>3</td>
<td>APITYPE 3</td>
</tr>
</tbody>
</table>

For an APITYPE value of 3, the ASYNC parameter must be either 'ECB' or 'EXIT'.

UEEXIT Optional input parameter. A doubleword value as follows:

- A fullword specifying the entry point address of the user unsolicited event exit.
- A fullword specifying the token that will be presented to the unsolicited event exit at invocation.

ASYNC Optional input parameter. One of the following:

- The literal 'NO' indicating no asynchronous support.
- The literal 'ECB' indicating the asynchronous support using ECBs is to be used.
- The combination of the literal 'EXIT' and the address of a doubleword value as follows:
  - A fullword specifying the entry point address of the user’s asynchronous event exit.
  - A fullword specifying the token which will be presented to the asynchronous event exit at invocation.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

IOCTL

The IOCTL macro is used to control certain operating characteristics for a socket.

Before you issue an IOCTL macro, you must load a value representing the characteristic that you want to control in COMMAND.

Note: IOCTL can only be used with programming languages that support address pointers.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
</tbody>
</table>
Cross memory mode: PASN = HASN.

Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Keyword Description
---
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**S**

Input parameter. A value or the address of a halfword binary number specifying the socket to be controlled.

**COMMAND**

Input parameter. To control an operating characteristic, set this field to one of the following symbolic names. A value in a bit mask is associated with each symbolic name. By specifying one of these names, you are turning on a bit in a mask that communicates the requested operating characteristic to TCP/IP.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'FIONBIO'</td>
<td>Sets or clears blocking status.</td>
</tr>
<tr>
<td>'FIONREAD'</td>
<td>Returns the number of immediately readable bytes for the socket.</td>
</tr>
<tr>
<td>'SIOCATMARK'</td>
<td>Determines whether the current location in the data input is pointing to out-of-band data.</td>
</tr>
<tr>
<td>'SIOCGHOMEIF6'</td>
<td>Requests all IPv6 home interfaces.</td>
</tr>
<tr>
<td></td>
<td>• When the SIOCGHOMEIF6 IOCTL is issued, the REQARG must contain a Network Configuration Header. The NETCONFHDR is defined in the SYS1.MACLIB(BPXYIOC6). The following fields are input fields and must be filled out:</td>
</tr>
<tr>
<td></td>
<td>NchEyeCatcher</td>
</tr>
<tr>
<td></td>
<td>Contains Eye Catcher '6NCH'.</td>
</tr>
<tr>
<td></td>
<td>NchIocntl</td>
</tr>
<tr>
<td></td>
<td>Contains the command code.</td>
</tr>
<tr>
<td></td>
<td>NchBufferLength</td>
</tr>
<tr>
<td></td>
<td>Buffer length of storage pointed to by NchBufferPtr. This buffer needs to be large enough to contain all the IPv6 interface records. Each interface record is length of HOMEIFADDRESS. If the buffer is not large enough, then errno will be set to ERANGE and the NchNumEntryRet will be set to number of interfaces. Based on NchNumEntryRet and size of HOMEIFADDRESS, calculate the necessary storage to contain the entire list.</td>
</tr>
<tr>
<td></td>
<td>NchBufferPtr</td>
</tr>
<tr>
<td></td>
<td>This is the pointer to an array of HOMEIF structures returned on a successful call. The size depends on the number of qualifying interfaces returned.</td>
</tr>
<tr>
<td></td>
<td>NchNumEntryRet</td>
</tr>
</tbody>
</table>
|           | If return code is 0, this will be set to number of HOMEIFADDRESS returned. If errno is ERANGE, this will be set to number of qualifying interfaces. No interfaces are returned. Recalculate the
NchBufferLength based on this value times the size of HOMEIFADDRESS.

'SIOCGIFADDR'
Requests the IPv4 network interface address for an interface name. For the address format, see Figure 67.

'SIOCGIFBRDADDR'
Requests the IPv4 network broadcast address for an interface name. For the address format, see Figure 67.

'SIOCGIFCONF'
Requests the IPv4 network interface configuration. The configuration consists of a variable number of 32-byte arrays, formatted as shown in Figure 67.

- When IOCTL is issued, the first word in REQARG must contain the length (in bytes) of the array to be returned, and the second word in REQARG should be set to the number of interfaces requested times 32 (one address structure for each network interface). The maximum number of array elements that TCP/IP Services will return is 100.
- When IOCTL is issued, RETARG must be set to the beginning of the area in your program's storage, which is reserved for the array that is to be returned by IOCTL.
- The COMMAND 'SIOCGIFCONF' returns a variable number of network interface configurations. Figure 68 contains an example of a routine that can be used to work with such a structure.

To get length:
1. Multiply COUNT by 32 to get ARRAY-LENGTH.
2. Set REQARG equal to ARRAY-LENGTH.
3. Issue the macro EZASMI TYPE=, S=, COMMAND=, REQARG=, RETARG=, ERRNO=, RETCODE=, ECB=, ERROR=

4. Set GTABLE to RETARG.

'SIOCGIFDSTADDR'
Requests the IPv4 network interface destination address.

'SIOCGIFNAMEINDEX'
Requests all interface names and indexes including local loopback but excluding VIPAs. Information is returned for both IPv4 and IPv6 interfaces whether they are active or inactive. For IPv6 interfaces, information is only returned to an interface if it has at least one available IP address. See z/OS Communications Server: IPv6 Network and Application Design Guide for more information.

The configuration consists of the IF_NAMEINDEX structure which is defined in SYS1.MACLIB(BPX1IOCC).

- When the SIOCGIFNAMEINDEX IOCTL is issued, REQARG must contain the length of application storage (in bytes) being used to contain the returned IF_NAMEINDEX structure. The formula to compute this length is as follows:
  1. Determine the number of interfaces expected to be returned upon successful completion of this command.
  2. Multiply the number of interfaces by the array element (size of IF_NIINDEX, IF_NINAME, and IF_NIEXT) to determine the size of the array element.
  3. To the size of the array add the size of IF_NITOTALIF and IF_NIENTRIES to determine the total number of bytes needed to accommodate the name and index information returned.

Upon successful completion of this call, the stack returns the number of entries required by the way of the IF_NITOTALIF field in the storage referenced by RETARG.

- When IOCTL is issued, RETARG must be set to the address of the beginning of the area in your program’s storage which is reserved for the IF_NAMEINDEX structure that is to be returned by IOCTL.
- The command 'SIOCGIFNAMEINDEX' returns a variable number of all the qualifying network interfaces.

'SIOCGIPMSFILTER'
Requests a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a
socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCPIPMSFILTER IOCTL is issued, the REQARG parameters must contain an IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC). The IP_MSFILTER option must include an interface address (input), a multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of source addresses (output). On input, the number of source addresses is the number of source addresses that fit in the input array. On output, the number of source addresses contains the total number of source filters in the source filter list for the multicast group. If the application does not know the size of the source list prior to processing, it makes a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, then the IOCTL can be repeated with a larger buffer. On output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size that is passed in as the input number.

Calculate the size of IP_MSFILTER value as follows:

1. Determine the expected number of source addresses.

2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.

3. Add the size of all array elements to the size of the IMSF_Header value to determine the total number of bytes that are needed to accommodate the source addresses information that is returned.

'SIOCGMONDATA'

Returns TCP/IP stack IPv4 and IPv6 statistical counters. REQARG must point to a MonDataIn structure. The counters are returned in a MonDataOut structure. Both of these structures are defined in EZBZMONP in SEZANMAC.

Note: The ARP counter data provided differs depending on the type of device. Refer to the z/OS Communications Server: IP Configuration Guide for information about devices that support ARP Offload and what is supported for each device.

'SIOCGRMSFILTER'

Requests a list of the IPv4 or IPv6 source addresses
that comprise the source filter, with the current mode on a given interface index and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCGMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER structure, which is defined in SYS1.MACLIB(BPXYIOC). The GROUP_FILTER option must include an interface index (input), a sockaddr_storage structure of the multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of the sockaddr_storage structure of source addresses (output). On input, the number of source addresses is the number of source addresses that will fit in the input array. On output, the number of source addresses contains the total number of source filters in the source filter list for the multicast group. If the application does not know the size of the source list prior to processing, it can make a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, the IOCTL can be repeated with a buffer that is large enough. That is, on output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size passed in as the input number.

The application calculates the size of GROUP_FILTER value in the following way:

1. Determines the expected number of source addresses.
2. Multiplies the number of source addresses by the array element (size of the GF_SrcEntry value) to determine the size of all array elements.
3. Adds the size of all array elements to the size of the GF_Header value to determine the total number of bytes that are needed to accommodate the source-address information that is returned.

'SIOCGSPLXFQDN'

Requests the fully qualified domain name for a given server and group name in a sysplex. This is a special purpose command to support applications that have registered with WorkLoad Manager (WLM) for connection optimization services by way of the DNS. When IOCTL is issued, REQARG and RETARG must use the address structure sysplexFqDn, which contains the pointer for sysplexFqDnData structure. The fully qualified
domain name is returned in the domainName field of sysplexFqDnData. The group name and the server name can be passed using the groupName and serverName fields of sysplexFqDnData structure. Their structures are defined in the EZBZSDNP MACRO file.

'SIOCSAPPLDATA'

The SIOCSAPPLDATA IOCTL enables an application to set 40 bytes of user-specified application data against a socket endpoint. You can use this application data to identify socket endpoints in interfaces such as Netstat, SMF, or network management applications. When you issue the SIOCSAPPLDATA IOCTL, the REQARG parameter must contain a SetApplData structure as defined by the EZBYAPPL macro. See z/OS Communications Server: IP Programmer's Guide and Reference for more information about programming the SIOCSAPPLDATA IOCTL.

SetAD_buffer: The user-defined application data is 40 bytes of data that identifies the endpoint with the application. You can obtain this application data from the following sources:

- Netstat reports. The information is displayed in the ALL/-A report. If you use the APPLDATA modifier, then the information also is displayed on the ALLConn/-a and CONn/-c reports.
- The SMF 119 TCP connection termination record. See z/OS Communications Server: IP Configuration Guide for more information.

Consider the following guidelines:

- The application must document the content, format and meaning of the ApplData strings that it associates with the sockets that it owns.
- The application should uniquely identify itself with printable EBCDIC characters at the beginning of the string. Strings beginning with 3-character IBM product identifiers, such as TCP/IP's EZA or EZB, are reserved for IBM use. IBM product identifiers begin with a letter in the range A-I.
- Use printable EBCDIC characters for the entire string to enable searching with Netstat filters.

Tip: Separate application data elements with a blank for easier reading.

'SIOCSIPMSFILTER'

Sets a list of the IPv4 source addresses that comprise the source filter, with the current mode
on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSIPMSFILTER IOCTL is issued, the REQARG value must contain an IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC). The IP_MSFILTER option must include an interface address, a multicast address, filter mode, the number of source addresses in the following array, and an array of source addresses.

Calculate the size of the IP_MSFILTER structure as follows:
1. Determine the expected number of source addresses.
2. Multiply the number of source addresses by the array element (size of IMSF_SrcEntry) to get the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to get the total number of bytes needed to accommodate the source addresses information that is returned.

`SIOCSMSFILTER`

Sets a list of the IPv4 or IPv6 source addresses that comprise the source filter, with the current mode on a given interface index and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSMSFILTER IOCTL is issued, the REQARG parameter must contain a GROUP_FILTER option structure, which is defined in SYS1.MACLIB(BPXYIOCC). The GROUP_FILTER option must include an interface index, a sockaddr_storage structure of the multicast address, filter mode, the number of source addresses in the following array, and an array of the sockaddr_storage structure of source addresses.

Calculate the size of the GROUP_FILTER value as follows:
1. Determine the expected number of source addresses.
2. Multiply the number of source addresses by the array element (size of the GF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the GF_Header value to determine the total number of bytes needed to accommodate the source addresses information that is returned.

`SIOCTTLSCTL`

Controls Application Transparent Transport Layer
Security (AT-TLS) for the connection. REQARG and RETARG must contain a TTLS_IOCTL structure. If a partner certificate is requested, the TTLS_IOCTL must include a pointer to additional buffer space and the length of that buffer. Information is returned in the TTLS_IOCTL structure. If a partner certificate is requested and one is available, it is returned in the additional buffer space. The TTLS_IOCTL structure for assembler programs is defined in EZBZTLSP in SEZANMAC. For more usage information, refer to the Application Transparent TLS information of the z/OS Communications Server: IP Programmer's Guide and Reference.

**Restriction:** Use of this ioctl for functions other than query requires that the AT-TLS policy mapped to the connection be defined with the ApplicationControlled parameter set to On.

### REQARG and RETARG

Point to arguments that are passed between the calling program and IOCTL. The length of the argument is determined by the COMMAND request. REQARG is an input parameter and is used to pass arguments to IOCTL. RETARG is an output parameter and is used for arguments returned by IOCTL.

For the lengths and meanings of REQARG and RETARG for each COMMAND type, see Table 16.

### Table 16. IOCTL macro arguments

<table>
<thead>
<tr>
<th>COMMAND/CODE</th>
<th>SIZE</th>
<th>REQARG</th>
<th>SIZE</th>
<th>RETARG</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIONBIO X'8004A77E'</td>
<td>4</td>
<td>Set socket mode to:</td>
<td>0</td>
<td>Not used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'00'=blocking;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'01'=nonblocking.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIONREAD X'4004A77F'</td>
<td>0</td>
<td>Not used.</td>
<td>4</td>
<td>Number of characters available for read.</td>
</tr>
<tr>
<td>SIOCATMARK X'4004A707'</td>
<td>0</td>
<td>Not used.</td>
<td>4</td>
<td>X'00'= not at OOB data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X'01'= at OOB data.</td>
</tr>
<tr>
<td>SIOCGHOMEIF6 X'C014F608'</td>
<td>20</td>
<td>NetConfHdr</td>
<td></td>
<td>See NETCONFHDR in macro BPXYIOC6.</td>
</tr>
<tr>
<td>SIOCGIFADDR X'C020A70D'</td>
<td>32</td>
<td>First 16-bytes - interface name.</td>
<td>32</td>
<td>Network interface address, see Figure 67 on page 336 for format.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last 16-bytes - not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIOCGIFBRDADDR X'C020A712'</td>
<td>32</td>
<td>First 16-bytes - interface name.</td>
<td>32</td>
<td>Network interface address, see Figure 67 on page 336 for format.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last 16-bytes - not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMAND/CODE</td>
<td>SIZE</td>
<td>REQARG</td>
<td>SIZE</td>
<td>RETARG</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>-----------------</td>
<td>-------</td>
<td>-----------------</td>
</tr>
<tr>
<td>SIOCGIFCONF</td>
<td>X'C008A714'</td>
<td>8</td>
<td>First 4 bytes- size of return buffer.</td>
<td>See note 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Last 4 bytes - address of return buffer.</td>
</tr>
<tr>
<td>SIOCGIFDSTADDR</td>
<td>X'C020A70F'</td>
<td>32</td>
<td>First 16-bytes - interface name.</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Last 16-bytes - not used.</td>
</tr>
<tr>
<td>SIOCGIFNAMEINDEX</td>
<td>X'4000F603'</td>
<td>4</td>
<td>First 4 bytes size of return buffer.</td>
<td>See IF_NAMEINDEX in macro BPXYIIOCC.</td>
</tr>
<tr>
<td>SIOCGIPMSFILTER</td>
<td>X'C000A724'</td>
<td>—</td>
<td>See IP_MSFILTER structure in macro BPXYIIOCC.</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See note 3.</td>
</tr>
<tr>
<td>SIOCGMONTDATA</td>
<td>X'C018D902'</td>
<td>—</td>
<td>See MONDATAIN structure in macro ESBZMONP.</td>
<td>—</td>
</tr>
<tr>
<td>SIOCGMSFILTER</td>
<td>X'C000F610'</td>
<td>—</td>
<td>See GROUP_FILTER structure in macro BPXYIIOCC.</td>
<td>0</td>
</tr>
<tr>
<td>SIOCGSPLXFQDN</td>
<td>X'C018D905'</td>
<td>408^2</td>
<td>See sysplexFqDn and sysplexFqDnData in macro ESBZSDNP.</td>
<td>408^2</td>
</tr>
<tr>
<td>SIOCSAPPLDATA</td>
<td>X'8018D90C'</td>
<td>—</td>
<td>See SETAPPLDATA structure in macro EBYAPPL.</td>
<td>0</td>
</tr>
<tr>
<td>SIOCSIPMSFILTER</td>
<td>X'8000A725'</td>
<td>—</td>
<td>See IP_MSFILTER structure in macro BPXYIOCC.</td>
<td>0</td>
</tr>
<tr>
<td>SIOCSMSFILTER</td>
<td>X'8000F611'</td>
<td>—</td>
<td>See GROUP_FILTER structure in macro BPXYIOCC.</td>
<td>0</td>
</tr>
<tr>
<td>SIOCTTLSCTL</td>
<td>X'C038D90B'</td>
<td>56</td>
<td>For IOCTL structure layout, refer to SEZANMAC (EZBZTLSLSP).</td>
<td>56</td>
</tr>
</tbody>
</table>
Table 16. IOCTL macro arguments (continued)

<table>
<thead>
<tr>
<th>COMMAND/CODE</th>
<th>SIZE</th>
<th>REQARG</th>
<th>SIZE</th>
<th>RETARG</th>
</tr>
</thead>
</table>

Notes:
1. The second 4-bytes in the RETARG is the address of the user buffer containing an array of 32-byte socket name structures (see Figure 68 on page 336 for format). Each interface is assigned a 32-byte array element and REQARG should be set to the number of interfaces times 32. TCP/IP Services can return up to 100 array elements.
2. REQARG and RETARG must contain both sysplexFqDn and sysplexFqDnData.
3. The size of the IP_MSFILTER structure must be equal to or greater than the size of the IMSF_Header.
4. The size of the GROUP_FILTER structure must be equal to or greater than the size of the GF_Header.

<table>
<thead>
<tr>
<th>ERRNO</th>
<th>Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>RETCODE</th>
<th>Output parameter. A fullword binary field that returns one of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECB or REQAREA</th>
<th>Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:</th>
</tr>
</thead>
<tbody>
<tr>
<td>For ECB</td>
<td>A 4-byte ECB posted by TCP/IP when the macro completes.</td>
</tr>
<tr>
<td>For REQAREA</td>
<td>A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.</td>
</tr>
<tr>
<td>For ECB/REQAREA</td>
<td>A 100-byte storage field used by the interface to save the state information. Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.</td>
</tr>
</tbody>
</table>

| ERROR | Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded. |
| TASK  | Input parameter. The location of the task storage area in your program. |

LISTEN

Only servers use the LISTEN macro. The LISTEN macro:
Completes the bind, if BIND has not already been called for the socket. If the
BIND has already been called for in the socket, the LISTEN macro uses what
was specified in the BIND call.

• Creates a connection-request queue of a specified number of entries for incoming
connection requests.

The LISTEN macro is typically used by a concurrent server to receive connection
requests from clients. When a connection request is received, a new socket is
created by a later ACCEPT macro. The original socket continues to listen for
additional connection requests.

**Note:** Concurrent servers and iterative servers use this macro. An iterative server
handles one client at a time. A concurrent server receives connection
requests from multiple clients and creates subtasks that process the client
requests. When a subtask is created, the concurrent server gets a new socket,
passes the new socket to the subtask, and dissociates itself from the
connection. The TCP/IP Listener program is an example of a concurrent
server.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space</td>
</tr>
</tbody>
</table>

```assembler
ezasmi type=listen, s
  number
  address
  *indaddr
  (reg)
  backlog
  'number'
  address
  *indaddr
  (reg)
  ,errno
  address
  *indaddr
  (reg)
  ,retcode
  address
  *indaddr
  (reg)
  ,ecb
  address
  *indaddr
  (reg)
  ,error
  address
  *indaddr
  (reg)
  ,reqarea
  address
  *indaddr
  (reg)
```

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Keyword: Description

S: Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.

BACKLOG: Input parameter. A value (enclosed in single quotation marks) or the address of a fullword binary number specifying the number of messages that can be backlogged.

Rule: The BACKLOG value specified on the LISTEN macro is limited to the value configured by the SOMAXCONN statement in the stack’s TCPIP PROFILE (default=10); no error is returned if a larger backlog is requested. You might need to update SOMAXCONN if a larger backlog is desired. Refer to the SOMAXCONN section of the z/OS Communications Server: IP Configuration Reference for details.

ERRNO: Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE: Output parameter. A fullword binary field that returns one of the following:

Value Description
0 Successful call.
-1 Check ERRNO for an error code.

ECB or REQAREA: Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB: A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA: A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA: A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR: Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK: Input parameter. The location of the task storage area in your program.
NTOP

The NTOP macro converts an IP address from its numeric binary form into a standard text presentation form. On successful completion, NTOP returns the converted IP address in the buffer provided.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note</td>
<td>See “Addressability mode (Amode) considerations” under &quot;Environmental restrictions and programming requirements&quot; on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
>>--EZASMI--TYPE=NTOP--,AF--='INET',SRCADDR--=*indaddr--(reg)

>>--DSTADDR--=*indaddr--(reg),DSTLEN--=*indaddr--(reg)

>>--RETCODE--=*indaddr--(reg),ERROR--=*indaddr--(reg)
```

Keyword  Description
AF  Input parameter. Specify one of the following:

Value  Description

‘INET’ or a decimal ‘2’
Indicates the address being converted is an IPv4 address.

‘INET6’ or a decimal ‘19’
Indicates the address being converted is an IPv6 address.

AF can also indicate a fullword binary number specifying the address family.

SRCADDR  Input parameter. A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address, this field must be a fullword. For an IPv6 address, this field must be 16 bytes. The address must be in network byte order.

DSTADDR  Input parameter. A field used to receive the standard text
presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format. The size of the converted IPv4 address will be a maximum of 15 bytes and the size of the converted IPv6 address will be a maximum of 45 bytes. Consult the value returned in DSTLEN for the actual length of the value in DSTADDR.

**DSTLEN**
Initially, an input parameter. The address of a binary halfword field that is used to specify the length of the DSTADDR field on input and upon a successful return will contain the length of the converted IP address.

**ERRNO**
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ERROR**
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**PTON**
The PTON macro converts an IP address in its standard text presentation form to its numeric binary form. On successful completion, PTON returns the converted IP address in the buffer provided.

The following requirements apply to this call:

**Authorization:** Supervisor state or problem state, any PSW key.

**Dispatchable unit mode:** Task.

**Cross memory mode:** PASN = HASN.

**Amode:** 31-bit or 24-bit.

*Note:* See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

**ASC mode:** Primary address space control (ASC) mode.

**Interrupt status:** Enabled for interrupts.

**Locks:** Unlocked.

**Control parameters:** All parameters must be addressable by the caller and in the primary address space.
Keyword Description

AF Input parameter. Specify one of the following:

Value Description

'INET' or a decimal '2'
Indicates the address being converted is an IPv4 address.

'INET6' or a decimal '19'
Indicates the address being converted is an IPv6 address.

AF can also indicate a fullword binary number specifying the address family.

SRCADDR Input parameter. A field containing the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address must be in dotted-decimal format and for IPv6 the address must be in colon-hex format. The size of the field for an IPv4 address must be 15 bytes and the size for an IPv6 address must be 45 bytes.

SRCLEN Input parameter. A binary halfword field that must contain the length of the IP address to be converted.

DSTADDR A field used to receive the numeric binary form of the IPv4 or IPv6 address being converted in network byte order. For an IPv4 address, this field must be a fullword. For an IPv6 address, this field must be 16 bytes.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE A fullword binary field that returns one of the following:

Value Description

0 Successful call.

-1 Check ERRNO for an error code.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

READ The READ macro reads data on a socket and stores it in a buffer. The READ macro applies only to connected sockets.
For datagram sockets, the READ call returns the entire datagram that was sent. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

- **Authorization:** Supervisor state or problem state, any PSW key.
- **Dispatchable unit mode:** Task.
- **Cross memory mode:** PASN = HASN.
- **Amode:** 31-bit or 24-bit.
  
  **Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
- **ASC mode:** Primary address space control (ASC) mode.
- **Interrupt status:** Enabled for interrupts.
- **Locks:** Unlocked.
- **Control parameters:** All parameters must be addressable by the caller and in the primary address space.

---

**Keyword** | **Description**
---|---
**S** | Input parameter. A value or the address of a halfword binary number specifying the socket that is going to read the data.

**NBYTE** | Input parameter. A fullword binary number set to the size of BUF. READ does not return more than the number of bytes of data in **NBYTE** even if more data is available.

**BUF** | On input, a buffer to be filled by completion of the call. The length of **BUF** must be at least as long as the value of **NBYTE**.

**ALET** | Optional input parameter. A fullword binary field containing the **ALET** or **BUF**. The default is 0 (primary address space).
If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

**ERRNO**  
Output parameter. A fullword binary field. If **RETCODE** is negative, **ERRNO** contains a valid error number. Otherwise, ignore the **ERRNO** field.

See [Appendix B, “Return codes,” on page 835](#) for information about **ERRNO** return codes.

**RETCODE**  
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A 0 return code indicates that the connection is closed and no data is available.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive value indicates the number of bytes copied into the buffer.</td>
</tr>
<tr>
<td>-1</td>
<td>Check <strong>ERRNO</strong> for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**  
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing the following:

For **ECB**  
A 4-byte **ECB** posted by TCP/IP when the macro completes.

For **REQAREA**  
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For **ECB/REQAREA**  
A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the **ECB** has been posted or the asynchronous exit has been driven.

**ERROR**  
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**  
Input parameter. The location of the task storage area in your program.

READ returns up to the number of bytes specified by **NBYTE**. If less than the number of bytes requested is available, the READ macro returns the number currently available.

If data is not available for the socket and the socket is in blocking mode, the READ macro blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, READ returns a -1 and sets **ERRNO** to 35 (EWOULDBLOCK). See [“ioctl” on page 333](#) or [“fcntl” on page 282](#) for a description of how to set the nonblocking mode.
READV

The READV macro reads data on a socket and stores it in a set of buffers. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

```
EZASMI — TYPE=READV, S = number, IOV = address
                        *indaddr (reg)

EZASMI — IOVCNT = address
                     *indaddr (reg)

EZASMI — ERRNO = address
                     *indaddr (reg)

EZASMI — RETCODE = address
                     *indaddr (reg)

EZASMI — ECB = address
                     *indaddr (reg)

EZASMI — ERROR = address
                     *indaddr (reg)

EZASMI — REQAREA = address
                     *indaddr (reg)

EZASMI — TASK = address
                     *indaddr (reg)
```

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket into which the data is to be read.</td>
</tr>
<tr>
<td>IOV</td>
<td>An array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:</td>
</tr>
</tbody>
</table>

**Fullword 1**

Input parameter. A buffer to be filled by the completion of the call.
Fullword 2
Input parameter. The ALET for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referred to in Fullword 1.

IOVCNT Input parameter. A fullword binary field specifying the number of data buffers provided for this call. The limit is 120.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, this contains an error number.

RETCODE A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A 0 return code indicates that the connection is closed and no data is available.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive value indicates the number of bytes copied into the buffer.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

ECB or REQAREA Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in your program.

RECV
The RECV macro receives data on a socket and stores it in a buffer. The RECV macro applies only to connected sockets. RECV can read the next message, but
leaves the data in a buffer, and can read out-of-band data. `RECV` gives you the option of setting `FLAGS` with the `FLAGS` parameter.

**Note:** Out-of-band data (called urgent data in TCP) appears to the application like a separate stream of data from the main data stream.

`RECV` returns the length of the incoming message or data. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, the data is processed like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to `RECV` can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place `RECV` in a loop that repeats the call until all data has been received.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td><strong>Note:</strong> See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 433.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=RECV, S=number, NBYTE=number

BUF=address, ALET=address, ERRNO=address

RETCODE=address, FLAGS='MSG_OOB', 'MSG_PEEK'
```

354  z/OS V1R9.0 Comm Svrs: IP Sockets Application Programming Interface Guide and Reference
Keyword | Description
--|---
S | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
NBYTE | Input parameter. A fullword binary number set to the size of BUF. RECV does not receive more than the number of bytes of data in NBYTE even if more data is available.
BUF | On input, a buffer to be filled by completion of the call. The length of BUF must be at least as long as the value of NBYTE.
ALET | Optional input parameter. A fullword binary field containing the ALET of BUF. The default is 0 (primary address space).
If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.
ERRNO | Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.
RETCODE | A fullword binary field that returns one of the following:
Value | Description
0 | A 0 return code indicates that the connection is closed and no data is available.
>0 | A positive value indicates the number of bytes copied into the buffer.
−1 | Check ERRNO for an error code.
FLAGS | Input parameter. FLAGS can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Receive out-of-band data (stream sockets only).</td>
</tr>
<tr>
<td>'MSG_PEEK'</td>
<td>2</td>
<td>Peek at the data, but do not destroy the data.</td>
</tr>
</tbody>
</table>
**ECB or REQAREA**

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

**For ECB**

A 4-byte ECB posted by TCP/IP when the macro completes.

**For REQAREA**

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

**For ECB/REQAREA**

A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**

Input parameter. The location of the task storage area in your program.

If data is not available for the socket and the socket is in blocking mode, the RECV macro blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, RECV returns a −1 and sets ERRNO to 35 (EWOULDBLOCK). See "FCNTL" on page 282 or "IOCTL" on page 333 for a description of how to set nonblocking mode.

**RECVFROM**

The RECVFROM macro receives data for a socket and stores it in a buffer. RECVFROM returns the length of the incoming message or data stream.

If data is not available for the socket designated by descriptor S, and socket S is in blocking mode, the RECVFROM call blocks the caller until data arrives.

If data is not available and socket S is in nonblocking mode, RECVFROM returns a −1 and sets ERRNO to 35 (EWOULDBLOCK). Because RECVFROM returns the socket address in the NAME structure, it applies to any datagram socket, whether connected or unconnected. See "FCNTL" on page 282 or "IOCTL" on page 333 for a description of how to set nonblocking mode. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, the data is processed as streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and Application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Applications using stream sockets should place RECVFROM in a loop that repeats until all of the data has been received.

The following requirements apply to this call:

**Authorization:** Supervisor state or problem state, any PSW key.
Dispatchable unit mode: Task.
Cross memory mode: PASN = HASN.
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.
Interrupt status: Enabled for interrupts.
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Keyword | Description
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the socket to receive the data.
NBYTE | Input parameter. A value or the address of a fullword binary number specifying the length of the input buffer. NBYTE must first be initialized to the size of the buffer associated with NAME. On return the NBYTE contains the number of bytes of data received.
BUF | On input, a buffer to be filled by completion of the call. The length of BUF must be at least as long as the value of NBYTE.
NAME | Initially, the IPv4 or IPv6 application provides a pointer to a structure that will contain the peer socket name on completion of
the call. If the NAME parameter value is nonzero, the IPv4 or IPv6 source address of the message is filled in with the address of who sent the datagram. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.</td>
</tr>
<tr>
<td>PORT</td>
<td>Output parameter. A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>IPv4-ADDRESS</td>
<td>Output parameter. A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.</td>
</tr>
<tr>
<td>RESERVED</td>
<td>Output parameter. An 8-byte reserved field. This field is required, but is not used.</td>
</tr>
</tbody>
</table>

The IPv6 socket structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>Output parameter. A 1-byte binary field specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>Output parameter. A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>FLOW-INFO</td>
<td>Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>Output parameter. A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the sending socket.</td>
</tr>
</tbody>
</table>
| SCOPE-ID   | A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS,
SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ALET Optional input parameter. A fullword binary field containing the ALET of BUF. The default is 0 (primary address space).

If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETS can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A 0 return code indicates that the connection is closed and no data is available.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive value indicates the number of bytes transferred by the RECVFROM call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

FLAGS Input parameter. FLAGS can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Receive out-of-band data. (Stream sockets only.)</td>
</tr>
<tr>
<td>'MSG_PEEK'</td>
<td>2</td>
<td>Peek at the data, but do not destroy the data.</td>
</tr>
</tbody>
</table>

ECB or REQAREA Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.
TASK  Input parameter. The location of the task storage area in your program.

RECVMSG

The RECVMSG macro receives messages on a socket with descriptor s and stores them in an array of message headers. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |
| **Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453. |
| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

```
```
On input, a pointer to a buffer where the sender's IPv4 or IPv6 address will be stored on completion of the call. The storage being pointed to should be for an IPv4 or IPv6 socket address. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.</td>
</tr>
<tr>
<td>PORT</td>
<td>Output parameter. A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>IPv4-ADDRESS</td>
<td>Output parameter. A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.</td>
</tr>
<tr>
<td>RESERVED</td>
<td>Output parameter. An 8-byte reserved field. This field is required, but is not used.</td>
</tr>
</tbody>
</table>

The IPv6 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>Output parameter. A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>Output parameter. A 1-byte binary field specifying the IPv6 addressing family. The value for the IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>Output parameter. A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>FLOW–INFO</td>
<td>Output parameter. A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>Output parameter. 16-byte binary field specifying</td>
</tr>
</tbody>
</table>
the 128-bit IPv6 Internet address, in network byte order, of the sending socket.

**SCOPE-ID**
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the **IPv6-ADDRESS** field. For a link scope **IPv6-ADDRESS**, **SCOPE-ID** contains the link index for the **IPv6-ADDRESS**. For all other address scopes, **SCOPE-ID** is undefined.

**IOV** On input, a pointer to an array of three fullword structures with the number of structures equal to the value in **IOVCNT** and the format of the structures as follows:

**Fullword 1**
Input parameter. The address of a data buffer.

**Fullword 2**
Input parameter. The **ALET** for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero **ALET** is specified, the **ALET** must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that **ALETs** can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an **ALET** representing a SCOPE=COMMON data space.

**Fullword 3**
Input parameter. The length of the data buffer referenced in Fullword 1.

**IOVCNT**
On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.

**ACCRIGHTS**
On input, a pointer to the access rights received. This field is ignored.

**ACCRLEN**
On input, a pointer to the length of the access rights received. This field is ignored.

**ERRNO**
Output parameter. A fullword binary field. If **RETCODE** is negative, this contains an error number.

**RETCODE**
Output parameter. A fullword binary field with the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>Call returned error. See <strong>ERRNO</strong> field.</td>
</tr>
<tr>
<td>0</td>
<td>Connection partner has closed connection.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>Number of bytes read.</td>
</tr>
</tbody>
</table>

**FLAGS**
Input parameter. **FLAGS** can be a literal value or a fullword binary field:
<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Receive out-of-band data. (Stream sockets only.)</td>
</tr>
<tr>
<td>'MSG_PEEK'</td>
<td>2</td>
<td>Peek at the data, but do not destroy the data.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

- **For ECB**
  
  A 4-byte ECB posted by TCP/IP when the macro completes.

- **For REQAREA**

  A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

- **For ECB/REQAREA**

  A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**

Input parameter. The location of the task storage area in your program.

**SELECT**

In a process where multiple I/O operations can occur it is necessary for the program to be able to wait on one or several of the operations to complete. For example, consider a program that issues a READ to multiple sockets whose blocking mode is set. Because the socket would block on a READ macro, only one socket could be read at a time. Setting the sockets to nonblocking would solve this problem, but would require polling each socket repeatedly until data becomes available. The SELECT macro allows you to test several sockets and to process a later I/O macro only when one of the tested sockets is ready. This ensures that the I/O macro does not block.

To use the SELECT macro as a timer in your program, do either of the following:

- Set the read, write, and except arrays to zeros.
- Do not specify MAXSOC.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
Testing sockets
Read, write, and exception operations can be tested. The select () call monitors activity on selected sockets to determine whether:

- A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket does not block.
- TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a socket, a write operation on the socket does not block.
- An exceptional condition occurs on a socket.
- A timeout occurs on the SELECT macro itself. A TIMEOUT period can be specified when the SELECT macro is issued.

Each socket descriptor is represented by a bit in a bit string.

Read operations
The ACCEPT, READ, READV, RECV, RECVFROM, and RECVMSG macros are read operations. A socket is ready for reading when data is received on it, or when an exception condition occurs.

To determine if a socket is ready for the read operation, set the appropriate bit in RSNDMSK to 1 before issuing the SELECT macro. When the SELECT macro returns, the corresponding bits in the RRETMSK indicate sockets ready for reading.

Write operations
A socket is selected for writing, ready to be written, when:

- TCP/IP can accept additional outgoing data.
- A connection request is received in response to an ACCEPT macro.
- A CONNECT call for a nonblocking socket, which has previously returned ERRNO 36 (EINPROGRESS), completes the connection.

The WRITE, WRITEV, SEND, SENDMSG, or SENDTO macros block when the data to be sent exceeds the amount that TCP/IP can accept. To avoid this, you can precede the write operation with a SELECT macro to ensure that the socket is ready for writing. After a socket is selected for WRITE, your program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT macro with the SO_SNDBUF option.

To determine if a socket is ready for the write operation, set the appropriate bit in WSNDMSK to 1.

Exception operations
For each socket to be tested, the SELECT macro can check for an exception condition. The exception conditions are:

<table>
<thead>
<tr>
<th>Amode:</th>
<th>31-bit or 24-bit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>
The calling program (concurrent server) has issued a GIVESOCKET command and the target subtask has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.

• A socket has received out-of-band data. For this condition, a READ macro returns the out-of-band data before the program data.

To determine if a socket has an exception condition, use the ESNDMSK character string and set the appropriate bits to 1.

**Returning the results**

For each event tested by a x SNDMSK, a bit string records the results of the check. The bit strings are RRETMSK, WRETMSK, and ERETMSK for read, write, and exceptional events. On return from the SELECT macro, each bit set to 1 in the xRETMSK is a read, write, or exceptional event for the associated socket.

**MAXSOC parameter**

The SELECT call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECT call tests only bits in the range 0 through the MAXSOC value minus one.

Example: If MAXSOC value is set to 50, the range would be 0 – 49.

**TIMEOUT parameter**

If the time in the TIMEOUT parameter elapses before an event is detected, the SELECT call returns and RETCODE is set to 0.

```plaintext
EZASMI TYPE=SELECT, MAXSOC=address, ERRNO=address

,RETCODE=address, TIMEOUT=address

,RSNDMSK=address, RRETMSK=address

,WSNDMSK=address, WRETMSK=address

,ESNDMSK=address, ERETMSK=address
```
Keyword  Description

MAXSOC  Input parameter. A fullword binary field specifying the largest socket descriptor number being checked.

ERRNO  Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE  Output parameter. A fullword binary field that returns one of the following:

Value  Description
>0    Indicates the number of ready sockets in the three return masks.

Note: If the number of ready sockets is greater than 65 535, only 65 535 is reported.

=0    Indicates that the SELECT time limit has expired.

−1    Check ERRNO for an error code.

TIMEOUT  Input parameter.

If TIMEOUT is not specified, the SELECT call blocks until a socket becomes ready.

If TIMEOUT is specified, TIMEOUT is the maximum interval for the SELECT call to wait until completion of the call. If you want SELECT to poll the sockets and return immediately, TIMEOUT should be specified to point to a 0-valued TIMEVAL structure.

TIMEOUT is specified in the two-word TIMEOUT as follows:

•  TIMEOUT-SECONDS, word one of TIMEOUT, is the seconds component of the timeout value.

•  TIMEOUT-MICROSEC, word two of TIMEOUT, is the microseconds component of the timeout value (0–999999).

For example, if you want SELECT to timeout after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000.

For APITYPE=3 with an ECB specified, the SELECT call will return immediately because it is asynchronous; the ECB will be POSTed when the timer pops.

RSNDMSK  Input parameter. A bit string sent to request read event status.
• For each socket to be checked for pending read events, the corresponding bit in the string should be set to 1.
• For sockets to be ignored, the value of the corresponding bit should be set to 0.

If this parameter is set to 0, the SELECT will not check for read events. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**RRETMSK** Output parameter. A bit string that returns the status of read events.
• For each socket that is ready to read, the corresponding bit in the string will be set to 1.
• For sockets to be ignored, the corresponding bit in the string will be set to 0.

**WSNDMSK** Input parameter. A bit string sent to request write event status.
• For each socket to be checked for pending write events, the corresponding bit in the string should be set to 1.
• For sockets to be ignored, the value of the corresponding bit should be set to 0.

**WRETMSK** Output parameter. A bit string that returns the status of write events.
• For each socket that is ready to write, the corresponding bit in the string will be set to 1.
• For sockets that are not ready to be written, the corresponding bit in the string will be set to 0.

**ESNDMSK** Input parameter. A bit string sent to request exception event status. The length of the string should be equal to the maximum number of sockets to be checked.
• For each socket to be checked for pending exception events, the corresponding bit in the string should be set to 1.
• For each socket to be ignored, the corresponding bit should be set to 0.

**ERETMSK** Output parameter. A bit string that returns the status of exception events. The length of the string should be equal to the maximum number of sockets to be checked.
• For each socket for which exception status has been set, the corresponding bit will be set to 1.
• For sockets that do not have exception status, the corresponding bit will be set to 0.

**ECB or REQAREA** Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For **ECB**
A 4-byte ECB posted by TCP/IP when the macro completes.

For **REQAREA**
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.
For ECB/REQAREA
A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your program.

SELECTEX
The SELECTEX macro monitors a set of sockets, a time value, and an ECB or list of ECBs. It completes when either one of the sockets has activity, the time value expires, or the ECBs are posted.

To use the SELECTEX call as a timer in your program, do either of the following:
• Set the read, write, and except arrays to zeros.
• Do not specify MAXSOC.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Testing sockets
Read, write, and exception operations can be tested. The SELECTEX macro monitors activity on selected sockets to determine whether:
• A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket does not block.
• TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a socket, a write operation on the socket does not block.
• An exceptional condition occurs on a socket.
• A timeout occurs on the SELECTEX macro itself. A TIMEOUT period can be specified when the SELECTEX macro is issued.

Each socket descriptor is represented by a bit in a bit string.
Read operations
The ACCEPT, READ, READV, RECV, RECVFROM, and RECVMSG macros are read operations. A socket is ready for reading when data is received on it, or when an exception condition occurs.

To determine if a socket is ready for the read operation, set the appropriate bit in RSNDMSK to 1 before issuing the SELECTEX macro. When the SELECTEX macro returns, the corresponding bits in the RRETMSK indicate sockets ready for reading.

Write operations
A socket is selected for writing, ready to be written, when:
• TCP/IP can accept additional outgoing data.
• A connection request is received in response to an ACCEPT macro.
• A CONNECT call for a nonblocking socket, which has previously returned ERRNO 36 (EINPROGRESS), completes the connection.

The WRITE, WRITENV, SEND, SENDMSG, or sendto macros block when the data to be sent exceeds the amount that TCP/IP can accept. To avoid this, you can precede the write operation with a SELECTEX macro to ensure that the socket is ready for writing. After a socket is selected for WRITE, your program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT macro with the SO_SNDBUF option.

To determine if a socket is ready for the write operation, set the appropriate bit in WSNDMSK to 1.

Exception operations
For each socket to be tested, the SELECTEX macro can check for an exception condition. The exception conditions are:
• The calling program (concurrent server) has issued a GIVESOCKET command and the target subtask has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
• A socket has received out-of-band data. For this condition, a READ macro returns the out-of-band data before the program data.

To determine whether a socket has an exception condition, use the ESNDMSK character string and set the appropriate bits to 1.

Returning the results
For each event tested by a x SNDMSK, a bit string records the results of the check. The bit strings are RRETMSK, WRETMSK, and ERETMSK for read, write, and exceptional events. On return from the SELECTEX macro, each bit set to 1 in the xRETMSK is a read, write, or exceptional event for the associated socket.

MAXSOC parameter
The SELECTEX call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECTEX call tests only bits in the range 0 through the MAXSOC value minus one.

Example: If MAXSOC value is set to 50, the range would be 0 – 49.
TIMEOUT parameter
If the time in the TIMEOUT parameter elapses before an event is detected, the
SELECTEX macro returns and RETCODE is set to 0.

Keyword | Description
---|---
MAXSOC | Input parameter. A fullword binary field specifying the largest
| socket descriptor number being checked.
ERRNO | Output parameter. A fullword binary field. If RETCODE is
| negative, this contains an error number.
RETCODE | Output parameter. A fullword binary field.
Value | Meaning
---|---
>0 | The number of ready sockets.
0 | Either the SELECTEX time limit has expired (ECB value is
| 0) or one of the caller's ECBs has been posted (ECB value
| is nonzero and the caller's descriptor sets is be set to 0).
| The caller must initialize the ECB values to zero before
| issuing the SELECTEX socket command.

Note: If the number of ready sockets is greater than 65
535, only 65 535 is reported.
Check ERRNO for an error code.

**TIMEOUT**  
Input parameter.

If TIMEOUT is not specified, the SELECTEX call blocks until a socket becomes ready or until a user ECB is posted.

If a TIMEOUT value is specified, TIMEOUT is the maximum interval for the SELECTEX call to wait until completion of the call. If you want SELECTEX to poll the sockets and return immediately, TIMEOUT should be specified to point to a zero-valued TIMEVAL structure.

**TIMEOUT** is specified in the two-word TIMEOUT as follows:

- TIMEOUT-SECONDS, word one of TIMEOUT, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of TIMEOUT, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECT to timeout after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000. TIMEOUT, SELECTEX returns to the calling program.

**RSNDMSK**  
Input parameter. The bit-mask array to control checking for read interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for read interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**RRETMSK**  
Output parameter. The bit-mask array returned by the SELECT if RSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**WSNDMSK**  
Input parameter. The bit-mask array to control checking for write interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for write interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**WRETMSK**  
Output parameter. The bit-mask array returned by the SELECT if WSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**ESNDMSK**  
Input parameter. The bit-mask array to control checking for exception interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for exception interrupts. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**ERETMSK**  
Output parameter. The bit-mask array returned by the SELECT if ESNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC and must be a multiple of 4 bytes. See “Selecting requests” on page 43 for more information.

**SELECB**  
Input parameter. An ECB or list of ECB addresses which, if posted, causes completion of the SELECTEX.
If the address of an ECB list is specified, you must set the high-order bit of the last entry in the ECB list to 1 and you must also add the LIST keyword. The ECBs must reside in the caller’s home address space.

Note: The maximum number of ECBs that can be specified in a list is 1013.

ERROR  Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK   Input parameter. The location of the task storage area in your program.

SEND

The SEND macro sends datagrams on a specified connected socket.

FLAGS allows you to:

- Send out-of-band data, for example, interrupts, aborts, and data marked urgent. Only stream sockets created in the AF_INET address family support out-of-band data.
- Suppress use of local routing tables. This implies that the caller takes control of routing and writing network software.

For datagram sockets, SEND transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes, with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place this call in a loop and reissue the call until all data has been sent.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |
Keyword  Description
S       Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket that is sending data.
NBYTE   Input parameter. A value or the address of a fullword binary number specifying the number of bytes to transmit.
BUF     The address of the data being transmitted. The length of BUF must be at least as long as the value of NBYTE.
ALET    Optional input parameter. A fullword binary field containing the ALET of BUF. The default is 0 (primary address space).
        If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.
ERRNO   Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See [Appendix B, “Return codes,” on page 835] for information about ERRNO return codes.
RETCODE Output parameter. A fullword binary field.
        Value  Description
0 or >0
A successful call. The value is set to the number of bytes transmitted.

-1  Check ERRNO for an error code.

FLAGS
Input parameter. FLAGS can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.)</td>
</tr>
<tr>
<td>'MSG_DONTROUTE'</td>
<td>4</td>
<td>Do not route. Routing is handled by the calling program.</td>
</tr>
</tbody>
</table>

ECB or REQAREA
Input parameter. This parameter is required if you are using
APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your
exit when the response to this function request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to save the
state information.

Note: This storage must not be modified until the macro function
has completed and the ECB has been posted, or the
asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive control
when the application programming interface (API) processing
module cannot be loaded.

TASK
Input parameter. The location of the task storage area in your
program.

SENDMSG
The SENDMSG macro sends messages on a socket with descriptor s passed in an
array of messages.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

```
EZASMI — TYPE=SENDMSG — S — number
   — address
   — *indaddr
     (reg)
   — MSG — address
     — *indaddr
     (reg)

FLAGS — 'MSG_OOB'
   — 'MSG_PEEK'
   — address
     — *indaddr
     (reg)

RETCODE — address
   — *indaddr
     (reg)
   — ECB — address
     — *indaddr
     (reg)
   — REQAREA — address
     — *indaddr
     (reg)
   — ERROR — address
     — *indaddr
     (reg)
   — TASK — address
     — *indaddr
     (reg)
```

Keyword | Description
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor.
MSG | On input, this is a pointer to a message header into which the message is received on completion of the call.

NAME

On input, a pointer to a buffer where the sender’s IPv4 or IPv6 address will be stored on completion of the call. The storage being pointed should be for an IPv4 or IPv6 socket address. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

The IPv4 socket address structure contains the following fields:

Field | Description
--- | ---
FAMILY | A halfword binary number specifying the IPv4
addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.

**PORT** A halfword binary number specifying the port number of the sending socket.

**IPv4-ADDRESS**
A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.

**RESERVED**
An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAMELEN</td>
<td>A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.</td>
</tr>
<tr>
<td>FAMILY</td>
<td>A 1-byte binary field specifying the IPv6 addressing family. The value for the IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>FLOW-INFO</td>
<td>A fullword binary field specifying the traffic class and flow label. This field must be set to 0.</td>
</tr>
<tr>
<td>IPv6-ADDRESS</td>
<td>16-byte binary field specifying the 128-bit IPv6 Internet address, in network byte order, of the sending socket.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID can specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID can be set to 0.</td>
</tr>
</tbody>
</table>

**IOV**
A pointer to an array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:
Fullword 1
Input parameter. The address of a data buffer.

Fullword 2
Input parameter. The ALET for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

Fullword 3
Input parameter. The length of the data buffer referenced in Fullword 1.

IOVCNT
A pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
A pointer to the access rights sent. This field is ignored.

ACCRLEN
A pointer to the length of the access rights sent. This field is ignored.

FLAGS
Input parameter. FLAGS can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.)</td>
</tr>
<tr>
<td>'MSG_DONTROUTE'</td>
<td>4</td>
<td>Do not route. Routing is handled by the calling program.</td>
</tr>
</tbody>
</table>

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, this contains an error number.

RETCODE
Output parameter. A fullword binary field.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or &gt;0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

ECB or REQAREA
Input parameter. This parameter is required if you are using APIType=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.
For REQAREA
A 4-byte user token (set by you) that is presented
to your exit when the response to this function
request is complete.

For ECB/REQAREA
A 100-byte storage field used by the interface to
save the state information.

Note: This storage must not be modified until the macro
function has completed and the ECB has been
posted, or the asynchronous exit has been driven.

ERROR
Input parameter. The location in your program to receive
control when the application programming interface (API)
processing module cannot be loaded.

TASK Input parameter. The location of the task storage area in
your program.

SENDTO
SENDTO is similar to SEND, except that it includes the destination address
parameter. You can use the destination address on the SENDTO macro to send
datagrams on a UDP socket that is connected or not connected.

Use the FLAGS parameter to:
• Send out-of-band data, such as interrupts, aborts, and data marked as urgent.
• Suppress the local routing tables. This implies that the caller takes control of
  routing, which requires writing network software.

For datagram sockets, the SENDTO macro sends the entire datagram if the
datagram fits into the buffer.

For stream sockets, data is processed as streams of information with no boundaries
separating the data. For example, if a program is required to send 1000 bytes, each
SENDTO macro call can send any number of bytes, up to the entire 1000 bytes,
with the number of bytes sent returned in RETCODE. Therefore, programs using
stream sockets should place SENDTO in a loop that repeats the macro until all
data has been sent.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |
  | **Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming
requirements” on page 453. |
| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
Control parameters: All parameters must be addressable by the caller and in the primary address space.

---

**Keyword** | **Description**
--- | ---

**S** | Output parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket sending the data.

**NBYTE** | Input parameter. A value or the address of a fullword binary number specifying the number of bytes to transmit.

**BUF** | Input parameter. The address of the data being transmitted. The length of **BUF** must be at least as long as the value of **NBYTE**.

**ALET** | Optional input parameter. A fullword binary field containing the ALET of **BUF**. The default is 0 (primary address space).

If a nonzero **ALET** is specified, the **ALET** must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that **ALET**s can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an **ALET** representing a SCOPE=COMMON data space.

**NAME** | Input parameter. The address of the IPv4 or IPv6 target. Include the SYS1.MACLIB(BPXYSOCK) macro to get the assembler mappings for the socket address structure. The socket address structure mappings begin at the SOCKADDR label. The AF_INET socket address structure fields start at the SOCK_SIN label. The AF_INET6 socket address structure fields start at the SOCK_SIN6 label.

---

Chapter 12. Macro application programming interface
The IPv4 socket address structure must specify the following fields:

Field          Description

FAMILY          A halfword binary field containing the IPv4 addressing family. The value for the IPv4 socket descriptor (S parameter) is a decimal 2, indicating AF_INET.

PORT            A halfword binary field containing the port number bound to the socket.

IP-ADDRESS      A fullword binary field containing the 32-bit IPv4 Internet address of the socket.

RESERVED        Specifies an 8-byte reserved field. This field is required, but is not used.

The IPv6 socket structure must specify the following fields:

Field          Description

NAMELEN         A 1-byte binary field specifying the length of this IPv6 socket address structure. Any value specified by the use of this field is ignored when processed as input and the field is set to 0 when processed as output.

FAMILY          A 1-byte binary field specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is a decimal 19, indicating AF_INET6.

PORT            A halfword binary field containing the port number bound to the socket.

FLOW-INFO      A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IPv6-ADDRESS    A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network byte order, of the client host machine. If 0 is specified, the application accepts connections from any network address.

SCOPE-ID        A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and can be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID can specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

ERRNO           Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore ERRNO.
See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE** Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or &gt;0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**FLAGS** Input parameter. FLAGS can be a literal value or a fullword binary field:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MSG_OOB'</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.)</td>
</tr>
<tr>
<td>'MSG_DONTROUTE'</td>
<td>4</td>
<td>Do not route. Routing is handled by the calling program.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA** Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

- **For ECB**
  - A 4-byte ECB posted by TCP/IP when the macro completes.

- **For REQAREA**
  - A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

- **For ECB/REQAREA**
  - A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR** Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK** Input parameter. The location of the task storage area in your program.

**SETSOCKOPT**

The SETSOCKOPT macro sets the options associated with a socket.

The **OPTVAL** and **OPTLEN** parameters are used to pass data used by the particular set command. The **OPTVAL** parameter points to a buffer containing the data needed by the set command. The **OPTLEN** parameter must be set to the size of the data pointed to by **OPTVAL**.
The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=SETSOCKOPT, S=number, OPTLEN=address, *indaddr(reg)
```
Keyword | Description
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket requiring options.

| OPTNAME | Input parameter. See the table below for a list of the options and
their unique requirements. See Appendix D, “GETSOCKOPT/SETSOCKOPT command values,” on page 863 for the numeric values of OPTNAME.

**OPTVAL**  
Input parameter. Contains data about the option specified in OPTNAME. See the table below for a list of the options and their unique requirements.

**OPTLEN**  
Input parameter. A fullword binary field containing the length of the data returned in OPTVAL. See the table below for determining on what to base the value of OPTLEN.

**ERRNO**  
Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**  
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**  
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB  
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA  
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA  
A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**  
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**  
Input parameter. The location of the task storage area in your program.
Table 17. **OPTNAME options for GETSOCKOPT and SETSOCKOPT**

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP_ADD_MEMBERSHIP</strong></td>
<td>Use this option to enable an application to join a multicast group on a specific interface. An interface has to be specified with this option. Only applications that want to receive multicast datagrams need to join multicast groups. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. N/A</td>
</tr>
<tr>
<td><strong>IP_ADD_SOURCE_MEMBERSHIP</strong></td>
<td>Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. N/A</td>
</tr>
<tr>
<td><strong>IP_BLOCK_SOURCE</strong></td>
<td>Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. N/A</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>IP_DROP_MEMBERSHIP</strong></td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ.</td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.</td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IP_DROP_SOURCE_MEMBERSHIP</strong></td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a source multicast group.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.</td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQSOURCE.</td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IP_MULTICAST_IF</strong></td>
<td>A 4-byte binary field containing an IPv4 interface address.</td>
<td>A 4-byte binary field containing an IPv4 interface address.</td>
</tr>
<tr>
<td>Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back.</td>
<td>To enable, set to 1.</td>
<td>If enabled, will contain a 1.</td>
</tr>
<tr>
<td>To disable, set to 0.</td>
<td>If disabled, will contain a 0.</td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IP_MULTICAST_TTL</strong></td>
<td>A 1-byte binary field containing the value of ‘00’x to ‘FF’x.</td>
<td>A 1-byte binary field containing the value of ‘00’x to ‘FF’x.</td>
</tr>
<tr>
<td>Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is ‘01’x meaning that multicast is available only to the local subnet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>IP_UNBLOCK_SOURCE</strong></td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. If the interface index number is 0, then the stack chooses the local interface. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
<td></td>
</tr>
<tr>
<td>Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option. This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_JOIN_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to control the reception of multicast packets and specify that the socket join a multicast group. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_LEAVE_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number. If the interface index number is 0, then the stack chooses the local interface. See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to control the reception of multicast packets and specify that the socket leave a multicast group. This is an IPv6-only socket option.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPV6_MULTICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. <strong>Note:</strong> An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.</td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_IF</strong></td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_LOOP</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>IPV6_UNICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. <strong>Note:</strong> APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.</td>
</tr>
<tr>
<td><strong>IPV6_V6ONLY</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>MCAST_BLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_JOIN_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_JOIN_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCAST_LEAVE_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_LEAVE_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_UNBLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_ASCII</strong></td>
<td>Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This is a REXX-only socket option.</td>
<td><strong>Note:</strong> The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td><strong>SO_BROADCAST</strong></td>
<td>Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This option has no meaning for stream sockets.</td>
<td><strong>Note:</strong> The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td><strong>SO_DEBUG</strong></td>
<td>Use SO_DEBUG to set or determine the status of the debug option. The default is disabled. The debug option controls the recording of debug information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Notes:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. This is a REXX-only socket option.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. This option has meaning only for stream sockets.</td>
<td></td>
</tr>
<tr>
<td><strong>SO_EBCDIC</strong></td>
<td>Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This is a REXX-only socket option.</td>
<td><strong>Note:</strong> The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td><strong>SO_ERROR</strong></td>
<td>Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>N/A</strong></td>
<td><strong>A 4-byte binary field containing the most recent ERRNO for the socket.</strong></td>
</tr>
</tbody>
</table>
Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_KEEPALIVE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket. The default is disabled. When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
<td></td>
</tr>
<tr>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
<td></td>
</tr>
<tr>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
<td></td>
</tr>
</tbody>
</table>

| **SO_LINGER**           |                            |                             |
| Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled. |
| Contains an 8-byte field containing two 4-byte binary fields. | Contains an 8-byte field containing two 4-byte binary fields. |
| Assembler coding: ONOFF DS F LINGER DS F |
| COBOL coding: ONOFF PIC 9(B) BINARY. LINGER PIC 9(B) BINARY. |
| Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued. |
| A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued. |

Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.

When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.

When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.

Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.
### Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO_OOBINLINE</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
</tbody>
</table>

**SO_OOBINLINE**

Use this option to control or determine whether out-of-band data is received.

**Note:** This option has meaning only for stream sockets.

When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM.

When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.

**SO_RCVBUF**

Use this option to control or determine the size of the data portion of the TCP/IP receive buffer.

The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call:

- TCPRCVBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket
- UDPRCVBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket
- The default of 65 535 for a raw socket

A 4-byte binary field.

To enable, set to a positive value indicating the size of the data portion of the TCP/IP receive buffer.

To disable, set to a 0.

A 4-byte binary field.

If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer.

If disabled, contains a 0.
Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_REUSEADDR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE. When this option is enabled, the following situations are supported:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If you require multiple servers to BIND to the same port and listen on INADDR_ANY, refer to the SHAREPORT option on the PORT statement in TCPIP.PROFILE.</td>
<td>A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>SO_SNDBUF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The TCPSENDBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The UDPSENDBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The default of 65 535 for a raw socket</td>
<td>A 4-byte binary field. To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>SO_TYPE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to return the socket type.</td>
<td>N/A</td>
<td>A 4-byte binary field indicating the socket type: X'1' indicates SOCK_STREAM. X'2' indicates SOCK_DGRAM. X'3' indicates SOCK_RAW.</td>
</tr>
</tbody>
</table>
Table 17. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP_KEEPALIVE</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a value in the range of 1 – 2 147 460.</td>
<td>If enabled, contains the specific timer value (in seconds) that is in effect for the given socket.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a value of 0.</td>
<td>If disabled, contains a 0 indicating keep alive timing is not active.</td>
</tr>
</tbody>
</table>

TCP_NODELAY

Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896).

Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received.

Note: Use the following to set TCP_NODELAY OPTNAME value for COBOL programs:

```cobol
01 TCP-NODELAY-VAL PIC 9(10) COMP VALUE 2147483649.
01 TCP-NODELAY-REDEF REDEFINES TCP-NODELAY-VAL.
05 FILLER PIC 9(6) BINARY.
05 TCP-NODELAY PIC 9(8) BINARY.
```

SHUTDOWN

One way to terminate a network connection is to issue a CLOSE macro that attempts to complete all outstanding data transmission requests prior to breaking the connection. The SHUTDOWN macro can be used to close one-way traffic while completing data transfer in the other direction. The HOW parameter determines the direction of the traffic to shutdown.

A client program can use the SHUTDOWN macro to reuse a given socket with a different connection.

If you issue SHUTDOWN for a socket that currently has outstanding socket calls pending, see Table 3 on page 35 to determine the effects of this operation on the outstanding socket calls.
The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>ASC mode:</th>
<th>Primary address space control (ASC) mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=SHUTDOWN, S = number, HOW = number

ERRNO = address, RETCODE = address

ECB = address, ERROR = address, REQAREA = address

TASK = address
```

### Keyword Description

**S**  
Input parameter. A value or the address of a halfword binary number specifying the socket to be shutdown.

**HOW**  
Input parameter. A fullword binary field specifying the shutdown method.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Ends further receive operations.</td>
</tr>
<tr>
<td>1</td>
<td>Ends further send operations.</td>
</tr>
<tr>
<td>2</td>
<td>Ends further send and receive operations.</td>
</tr>
</tbody>
</table>

**ERRNO**  
Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.
RETCODE  Output parameter. A fullword binary field that returns the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**

Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB

A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA

A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA

A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**

Input parameter. The location of the task storage area in your program.

**SOCKET**

The SOCKET macro creates an endpoint for communication and returns a socket descriptor representing the endpoint. Different types of sockets provide different communication services.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

**Note:** See “Addressability mode (Amode) considerations” under "Environmental restrictions and programming requirements" on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |
Keyword | Description
--- | ---
AF | Input parameter. Specify one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'INET' or a decimal 2</td>
<td>Indicates the socket being created will use the IPv4 Internet protocol.</td>
</tr>
<tr>
<td>'INET6' or decimal 19</td>
<td>Indicates the socket being created will use the IPv6 Internet protocol.</td>
</tr>
</tbody>
</table>

Note: AF can also indicate a fullword binary number specifying the address family.

SOCTYPE | Input parameter. A fullword binary field set to the type of socket required. The types are:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 'STREAM'</td>
<td>Stream sockets provide sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data. This is the normal type for TCP/IP.</td>
</tr>
<tr>
<td>2 or 'DATAGRAM'</td>
<td>Datagram sockets provide datagrams, which are connectionless messages of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered multiple times. This type is supported only in the AF_INET domain.</td>
</tr>
</tbody>
</table>
3 or 'RAW'
Raw sockets provide the interface to internal protocols (such as IP and ICMP).

Note: For SOCK_RAW sockets, the application must by APF-authorized.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; or 0</td>
<td>Contains the new socket descriptor.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

NS
Optional input. A value or the address of a halfword binary number specifying the socket number for the new socket. If a socket number is not specified, the interface assigns one.

PROTO
Input parameter. A fullword binary number specifying the protocol supported. PROTO only applies to new sockets and should be set to 0 for TCP/IP. PROTO for IPv6 raw sockets cannot be set to the following:

<table>
<thead>
<tr>
<th>Protocol name</th>
<th>Numeric value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPROTO_HOPOPTS</td>
<td>0</td>
</tr>
<tr>
<td>IPPROTO_TCP</td>
<td>6</td>
</tr>
<tr>
<td>IPPROTO_UDP</td>
<td>17</td>
</tr>
<tr>
<td>IPPROTO_IPV6</td>
<td>41</td>
</tr>
<tr>
<td>IPPROTO_ROUTING</td>
<td>43</td>
</tr>
<tr>
<td>IPPROTO_FRAGMENT</td>
<td>44</td>
</tr>
<tr>
<td>IPPROTO_ESP</td>
<td>50</td>
</tr>
<tr>
<td>IPPROTO_AH</td>
<td>51</td>
</tr>
<tr>
<td>IPPROTO_NONE</td>
<td>59</td>
</tr>
<tr>
<td>IPPROTO_DSTOPTS</td>
<td>60</td>
</tr>
</tbody>
</table>

PROTO numbers are found in the hlq.etc.proto data set.

ECB or REQAREA
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB
A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.
For ECB/REQAREA

A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR

Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK

Input parameter. The location of the task storage area in your program.

TAKESOCKET

The TAKESOCKET macro acquires a socket from another program and creates a new socket. Typically, a subtask issues this macro using client ID and socket descriptor data that it obtained from the concurrent server.

Notes:

1. When TAKESOCKET is issued, a new socket descriptor is returned in RETCODE. You should use this new socket descriptor in later macros such as GETSOCKOPT, which require the S (socket descriptor) parameter.

2. Both concurrent servers and iterative servers use this interface. An iterative server handles one client at a time. A concurrent server receives connection requests from multiple clients and creates subtasks that process the client requests. When a subtask is created, the concurrent server gets a new socket, passes the new socket to the subtask, and dissociates itself from the connection. The TCP/IP Listener program is an example of a concurrent server.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: Addressability mode (Amode)</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI—TYPE=TAKESOCKET—.CLIENT—.address
->indaddr(reg)
```
Keyword | Description
---|---
CLIENT | Input parameter. The client data returned by the GETCLIENTID macro.

Field | Description
---|---
DOMAIN | Input parameter. A fullword binary number set to the domain of the program that is giving the socket. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6.

Note: The TAKESOCKET can only acquire a socket of the same address family from a GIVESOCKET.

NAME | An 8-byte character field set to the MVS address space identifier of the program giving the socket.

TASK | Input parameter. Specifies an 8-byte field. This field must match the value of the SUBTASK parameter on the INITAPI for the MVS task that issued the GIVESOCKET request.

RESERVED | Input parameter. A 20-byte reserved field. This field is required, but not used.

SOCRECV | Input parameter. A halfword binary field containing the socket descriptor number assigned by the application that called GIVESOCKET.

ERRNO | Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE | Output parameter. A fullword binary field.
<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or &gt;0</td>
<td>Contains the new socket descriptor.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**NS**
Input parameter. A value or a halfword binary number specifying the socket descriptor number for the new socket. If a number is not specified, the interface assigns a socket number.

**ECB or REQAREA**
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

**For ECB**
A 4-byte ECB posted by TCP/IP when the macro completes.

**For REQAREA**
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

**For ECB/REQAREA**
A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

**ERROR**
Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

**TASK**
Input parameter. The location of the task storage area in your program.

**TASK**
The TASK macro allocates a task storage area addressable to all socket users communicating across a particular connection. Most commonly this is done by assigning one connection to each MVS subtask. If more than one module is using sockets within a connection or task, it is your responsibility to provide the task storage address to each user. Each program using sockets should define task storage using the instruction EZASMI TYPE=TASK with STORAGE=DSECT.

If this macro is not named, the default name EZASMTIE is assumed.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
</tbody>
</table>
Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Keyword Description

**STORAGE** Input parameter. Defines one of the following storage definitions:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSECT</td>
<td>Generates a DSECT.</td>
</tr>
<tr>
<td>CSECT</td>
<td>Generates an inline storage definition that can be used within a CSECT or as a part of a larger DSECT.</td>
</tr>
</tbody>
</table>

**TERMAPI**

The TERMAPI macro ends the session created by the INITAPI macro.

**Note:** The INITAPI and TERMAPI macros must be issued under the same task.

The following requirements apply to this call:

Authorization: Supervisor state or problem state, any PSW key.

Dispatchable unit mode: Task.

Cross memory mode: PASN = HASN.

Amode: 31-bit or 24-bit.

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.
WRITE

The WRITE macro writes data on a connected socket. The WRITE macro is similar to the SEND macro except that it does not have the control flags that can be used with SEND.

For datagram sockets, this macro writes the entire datagram, if it will fit into one TCP/IP buffer.

For stream sockets, the data is processed as streams of information with no boundaries separating the data. For example, if you want to send 1000 bytes of data, each call to the write macro can send 1 byte, 10 bytes, or the entire 1000 bytes. You should place the WRITE macro in a loop that cycles until all of the data has been sent.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |
| Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453. |
| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

```
EZASMITYPE=WRITE,S=number,NBYTE=number
BUF=address,indaddr=(reg),ALET=address,indaddr=(reg),ERRNO=address
RETCODE=address,indaddr=(reg),ECB=address,indaddr=(reg),REQAREA=address,indaddr=(reg)
ERROR=address,indaddr=(reg),TASK=address,indaddr=(reg)
```
S  Input parameter. A value or the address of a halfword binary number specifying the socket descriptor of the socket to receive the data.

NBYTE  Input parameter. A value or the address of a fullword binary field specifying the number of bytes of data to transmit.

BUF  The address of the data being transmitted. The length of BUF must be at least as long as the value of NBYTE.

ALET  Optional input parameter. A fullword binary field containing the ALET of BUF. The default is 0 (primary address space).

If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETs can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

ERRNO  Output parameter. A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.

RETCODE  Output parameter. A fullword binary field.

Value  Description

>0  A successful call. The value is set to the number of bytes transmitted.

0  Connection partner has closed connection.

−1  Check ERRNO for an error code.

ECB or REQAREA  Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

For ECB  A 4-byte ECB posted by TCP/IP when the macro completes.

For REQAREA  A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

For ECB/REQAREA  A 100-byte storage field used by the interface to save the state information.

Note: This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR  Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.

TASK  Input parameter. The location of the task storage area in your program.
This macro writes up to NBYTE bytes of data. If there is not enough available buffer space for the socket data to be transmitted, and the socket is in blocking mode, WRITE blocks the caller until additional buffer space is available. If the socket is in nonblocking mode, WRITE returns a -1 and sets ERRNO to 35 (EWOULDBLOCK). See “FCNTL” on page 282 or “IOCTL” on page 333 for a description of how to set the nonblocking mode.

**WRITEV**

The WRITEV function writes data on a socket from a set of buffers.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

```
EZASMI TYPE=WRITEV, S=number, IOV=address, (reg)
```

```
,IOVCT=address, ERRNO=address, (reg)
```

```
,ECB=address, ERROR=address, (reg)
```

```
,REQAREA=address, TASK=address, (reg)
```

**Keyword** | **Description**
--- | ---
S | Input parameter. A value or the address of a halfword binary number specifying the descriptor of the socket from which the data is to be written.
IOV Input parameter. An array of three fullword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

**Fullword 1**
Input parameter. The address of a data buffer.

**Fullword 2**
Input parameter. The ALET for this buffer. If the buffer is in the primary address space, this should be zeros.

If a nonzero ALET is specified, the ALET must represent a valid entry in the dispatchable unit access list (DU-AL) for the task issuing this call. Note that ALETS can only be specified for synchronous socket calls (for example, ECB/REQAREA cannot be specified). An exception to this is an ALET representing a SCOPE=COMMON data space.

**Fullword 3**
Input parameter. The length of the data buffer referenced in Fullword 1.

IOVCNT Input parameter. A fullword binary field specifying the number of data buffers provided for this call.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, this contains an error number.

RETCODE Output parameter. A fullword binary field.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>0</td>
<td>Connection partner has closed connection.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**ECB or REQAREA**
Input parameter. This parameter is required if you are using APITYPE=3. It points to a 104-byte field containing:

**For ECB**
A 4-byte ECB posted by TCP/IP when the macro completes.

**For REQAREA**
A 4-byte user token (set by you) that is presented to your exit when the response to this function request is complete.

**For ECB/REQAREA**
A 100-byte storage field used by the interface to save the state information.

**Note:** This storage must not be modified until the macro function has completed and the ECB has been posted, or the asynchronous exit has been driven.

ERROR Input parameter. The location in your program to receive control when the application programming interface (API) processing module cannot be loaded.
### Macro interface assembler language sample programs

This section provides sample programs for the macro interface that you can use for assembler language applications. The source code can be found in the SEZAINST data set.

The following sample programs are included:

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EZASOKAS</td>
<td>Sample IPv4 macro interface server program</td>
</tr>
<tr>
<td>EZASOKAC</td>
<td>Sample IPv4 macro interface client program</td>
</tr>
<tr>
<td>EZASO6AS</td>
<td>Sample IPv6 macro interface server program</td>
</tr>
<tr>
<td>EZASO6AC</td>
<td>Sample IPv6 macro interface client program</td>
</tr>
</tbody>
</table>

#### EZASOKAS sample server program for IPv4

The EZASOKAS program is a server program that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- GETHOSTID
- BIND
- LISTEN
- ACCEPT
- READ
- WRITE
- CLOSE
- TERMAPI
EZASOKAS CSECT
EZASOKAS AMODE ANY
EZASOKAS RMODE ANY
* PRINT NGEN
***********************************************************************
* MODULE NAME: EZASOKAS Sample server program
* Copyright: Licensed Materials - Property of IBM
* "Restricted Materials of IBM"
* 5694-A01
* (C) Copyright IBM Corp. 1977, 2003
* US Government Users Restricted Rights -
* Use, duplication or disclosure restricted by
* GSA ADP Schedule Contract with IBM Corp.
* Status: CSV1R5
* LANGUAGE: Assembler
* ATTRIBUTES: NON-REUSABLE
* REGISTER USAGE:
* R1 =
* R2 =
* R3 = BASE REG 1
* R4 = BASE REG 2 (UNUSED)
* R5 = FUTURE BASE REG?
* R6 = TEMP
* R7 = RETURN REG
* R8 =
* R9 = A(WORK AREA)
* R10 =
* R11 =
* R12 =
* R13 = SAVE AREA
* R14 =
* R15 =
* INPUT: NONE
* OUTPUT: WTO results of each test case
***********************************************************************
GBLB &TRACE ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE SETB 1 1=TRACE ON 0=TRACE OFF
R0 EQU 0
R1 EQU 1
R2 EQU 2
R3 EQU 3

Figure 69. EZASOKAS sample server program for IPv4 (Part 1 of 10)
R4  EQU  4
R5  EQU  5
R6  EQU  6
R7  EQU  7
R8  EQU  8
R9  EQU  9
R10  EQU  10
R11  EQU  11
R12  EQU  12
R13  EQU  13
R14  EQU  14
R15  EQU  15

*---------------------------------------------------------------------*
*                  START OF EXECUTABLE CODE                            *
*---------------------------------------------------------------------*

USING *,R3,R4

TELL ASSEMBLER OF OTHERS
SAVE (14,12),T,*
LR R3,R15
COPY EP REG TO FIRST BASE
LA R5,2048
GET R5 THERE
LA R5,2048(R5)
GET R5 THERE
LA R4,0(R5,R3)
GET R4 THERE
LA R12,12
JUST FOR FUN!
ST R1,PARMADDR
SAVE ADDRESS OF PARAMETER LIST
L R1,0(R1)
GET POINTER
LH R1,0(R1)
GET LENGTH

STC R1,TRACE
USE IT AS FLAG
L R7,=A(SOCSAVE)
GET NEW SAVE AREA
ST R7,8(R13)
SAVE ADDRESS OF NEW SAVE AREA
ST R13,4(R7)
COMPLETE SAVE AREA CHAIN
LR R13,R7
NOW SWAP THEM
L R9,=A(MYCB)
POINT TO THE CONTROL BLOCK
USING MYCB,R9
TELL ASSEMBLER

*---------------------------------------------------------------------*
*                  BUILD MESSAGE FOR CONSOLE                           *
*---------------------------------------------------------------------*

LOOP EQU *

MVC MSGNUM(8),SUBTASK
WHO I AM
MVC TYPE,MSGSTART
MOVE 'STARTED' TO MESSAGE

MVC MSGRSLT1,MSGSUC
...SUCCESSFUL TEXT
MVC MSGRSLT2,BLANK35

STM R14,R12,12(R13)
JUST FOR DEBUGGING
BAL R14,WTOSUB
--DO STARTING WTO

******************************************************************************
*  Issue INITAPI to connect to interface                                  *
******************************************************************************

POST ECB,1
NEXT IS ALWAYS SYNCH
MVI SYNFLAG,1
MOVE A 1 FOR ASYNC
MVC TYPE,MINITAPI
MOVE 'INITAPI' TO MESSAGE

EZASMI TYPE=INITAPI,
Issue INITAPI Macro

Figure 69. EZASOKAS sample server program for IPv4 (Part 2 of 10)
**Issue SOCKET Macro to obtain a socket descriptor**

- Issue SOCKET Macro
- ***** INET and STREAM *****

**Get socket descriptor number**

- **STH R8,S SAVE RETCODE (=SOCKET DESCRIPTOR)**

**Issue GETHOSTID CALL**

- **MVC TYPE,MSOCKET MOVE 'SOCKET' TO MESSAGE**
- **EZASMI TYPE=SOCKET, Issue SOCKET Macro X**
- **AF='INET', INET or IUCV X**
- **SOCTYPE='STREAM', STREAM(TCP) DATAGRAM(UDP) or RAW X**
- **ERRNO=ERRNO, (Specify ERRNO field) X**
- **RETCODE=RETCODE, (Specify RETCODE field) X**
- **REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X**
- **ERROR=ERROR Abend if Macro error**

**Issue BIND socket**

- **MVC TYPE,MBIND MOVE 'BIND' TO MESSAGE**
- **MVC PORT(2),PORTS Load STREAM port #**
- **MVC ADDRESS(4),ADDR Load MVS1 internet address**
- **EZASMI TYPE=BIND, Issue Macro X**
- **S=S, STREAM X**

---

*Figure 69. EZASOKAS sample server program for IPv4 (Part 3 of 10)*
NAME=NAME, (SOCKET NAME STRUCTURE) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
ERROR=ERROR Abend if Macro error

* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL

******************************************************************************
* Issue LISTEN - Backlog = 5 *
******************************************************************************

MVC TYPE,MLISTEN MOVE 'LISTEN' TO MESSAGE

EZASMI TYPE=LISTEN, Issue Macro X
S=S, STREAM X
BACKLOG=BACKLOG, BACKLOG X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
ERROR=ERROR Abend if Macro error

* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL

******************************************************************************
* Issue ACCEPT - Block until connection from peer *
******************************************************************************

MVC TYPE,MACCEPT MOVE 'ACCEPT' TO MESSAGE

MVC PORT(2),PORTS Load STREAM port #
MVC ADDRESS(4),ADDR Load MVS1 internet address

EZASMI TYPE=ACCEPT, Issue Macro X
S=S, STREAM X
NAME=NAME, (SOCKET NAME STRUCTURE) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
ERROR=ERROR Abend if Macro error

* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL

* Message RESULTS text
STH R8,SOCDESCA SAVE RETCODE (SOCKET DESCRIPTOR)

******************************************************************************
* Issue READ - Read data and store in buffer *
******************************************************************************

MVC TYPE,MREAD MOVE 'READ ' TO MESSAGE

EZASMI TYPE=READ, Issue Macro X
S=SOCDESCA, ACCEPT SOCKET X
NBYTE=NBYTE, SIZE OF BUFFER X
BUF=BUF, (BUFFER) X
ERRNO=ERRNO, (Specify ERRNO field) X

Figure 69. EZASOKAS sample server program for IPv4 (Part 4 of 10)
RETCODE=RETCODE,  (Specify RETCODE field)  X
REQAREA=REQAREA,  IN CASE WE ARE DOING EXITS OR ECBS X
ERROR=ERROR     Abend if Macro error

*  BAL R14,RCHECK  CHECK FOR SUCCESSFUL CALL
MVC MSGRSLT1,MSGBUFF
MVC MSGRSLT2,BUF
BAL R14,WTOSUB   --> PRINT IT

******************************************************************************
*  Issue WRITE - Write data from buffer                           *
******************************************************************************
MVC TYPE,MWRITE    MOVE 'WRITE' TO MESSAGE

*  EZASMI TYPE=WRITE, Issue Macro                                 X
  S=SOCDESCA, ACCEPT Socket                                   X
  NBYTE=NBYTE, SIZE OF BUFFER                                X
  BUF=BUF, (BUFFER)                                          X
  ERRNO=ERRNO, (Specify ERRNO field)                         X
  RETCODE=RETCODE, (Specify RETCODE field)                   X
  REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS         X
  ERROR=ERROR     Abend if Macro error

*  BAL R14,RCHECK  CHECK FOR SUCCESSFUL CALL
******************************************************************************
*  Issue CLOSE for ACCEPT socket                                *
******************************************************************************
MVC TYPE,MCLOSE  MOVE 'CLOSE' TO MESSAGE

*  EZASMI TYPE=CLOSE, Issue Macro                                 X
  S=SOCDESCA, ACCEPT                                        X
  ERRNO=ERRNO, (Specify ERRNO field)                        X
  RETCODE=RETCODE, (Specify RETCODE field)                  X
  REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS       X
  ERROR=ERROR     Abend if Macro error

*  MVC MSGRSLT2,BLANK35  CHECK FOR SUCCESSFUL CALL

******************************************************************************
*  Terminate Connection to API                                    *
******************************************************************************
MVC TYPE,MTERMAPI  MOVE 'TERMAPI' TO MESSAGE

*  POST ECB,1          FOLLOWING IS ALWAYS SYNCH
EZASMI TYPE=TERMAPI Issue EZASMI Macro for Termapi

******************************************************************************
* Message RESULTS text                                           *
******************************************************************************

Figure 69. EZASOKAS sample server program for IPv4 (Part 5 of 10)
* MVC MSGRSLT2,BLANK35
  * BAL R14,RCHECK  --> CHECK RC
*---------------------------------------------------------------------*
* Issue console message for task termination
*---------------------------------------------------------------------*
  MVC TYPE,MSGEND  Move 'ENDED' to message
  MVC MSGRSLT1,MSGSUCC  ...SUCCESSFUL text
  MVC MSGRSLT2,BLANK35
*---------------------------------------------------------------------*
  BAL R14,WTOSUB
  LA R14,1  CONSTANT
  AH R14,APITYPE  ADD
  STH R14,APITYPE  STORE
  CH R14,=H'3'  COMPARE
  BE LOOP  --> LETS DO IT AGAIN!
*---------------------------------------------------------------------*
* Return to Caller
*---------------------------------------------------------------------*
  L R13,4(R13)  RETURN (14,12),T,RC=0

WTOSUB EQU *
  LR R7,R14  COPY RETURN REG
  MVC MSGCMD(8),TYPE
  WTO TEXT=MSG  WRITE MESSAGE TO OPERATOR
  BR R7  --> RETURN TO CALLER
  CNOP 2,4
* USES R6,R7,R8  RETCODE RETURNED IN R8

RCHECK EQU *
  LR R7,R14  COPY TO REAL RETURN REG
  MVC MSGRSLT1,MSGSUCC  ...SUCCESS TEXT
  L R6,RETCODE
  LTR R6,R6
  BM NOWAIT
  CLI SYNFLAG,0  PLAIN CASE?
  BE NOWAIT  --> SKIP IT
  MVC Key+14(8).SUBTASK
  MVC Key+23(8).TYPE
  KEY WTO 'WAIT: XXXXXXXX XXXXXXXX'
  WAIT ECB=ECB

NOWAIT EQU *
  * LA R15,ECB
  * ST R15,ECB
  ST R9,ECB  MAKE THIS THE TOKEN AGAIN
  L R6,RETCODE  CHECK FOR SUCCESSFUL CALL
  CLC TYPE,=CL8'GETHOSTI'
  BE HOSTIDRC  HANDLE PRINTING HOST ID
  LTR R8,R6  SAVE A COPY
* BNL CONT00

FAILMSG EQU *
  MVC MSGRSLT1,MSGFAIL  ...FAIL TEXT

CONT00 EQU *

Figure 69. EZASOKAS sample server program for IPv4 (Part 6 of 10)
Figure 69. EZASOKAS sample server program for IPv4 (Part 7 of 10)
MVC EXKEY+23(B),TYPE TELL WHAT
EXKEY WTO 'EXIT: XXXXXXX XXXXXXX'
POST ECB,1
RETURN (14,12),T,RC=0
DROP R2

*---------------------------------------------------------------------*
* ABEND PROGRAM AND GET DUMP
*---------------------------------------------------------------------*
ERROR ABEND 1,DUMP
*---------------------------------------------------------------------*
* CONSTANTS USED TO RUN PROGRAM *
*---------------------------------------------------------------------*
EZASMGW EZASMI TYPE=GLOBAL, STORAGE=CSECT

**---------------------------------------------------------------------**
** INITAPI macro parms **
**---------------------**
SUBTASK DC CLB'EZASOKAS'
MAXSOC DC AL2(50)
APITYPE DC H'2'
MAXSNO DC F'0'
IDENT DC 0CL16'
DC CLB'
DC CLB'SOC401CB'

**---------------------------------------------------------------------**
** SOCKET macro parms **
**---------------------**
S DC H'0'

**---------------------------------------------------------------------**
** BIND MACRO PARMS **
**---------------------**
CNOP 0,4
NAME DC 0CL16'
DC AL2(2)
PORT DC H'0'
ADDRESS DC F'0'
DC XLB'00'
ADDR DC AL1(14),AL1(0),AL1(0),AL1(0) Internet Address
PORTS DC H'11007'

**---------------------------------------------------------------------**
** LISTEN PARMS **
**---------------------**
BACKLOG DC F'5'

**---------------------------------------------------------------------**
** READ MACRO PARMS **
**---------------------**
BYTE DC F'50'
SOCDESCA DC H'0'
BUF DC CLB'SOC401CB'

**---------------------------------------------------------------------**
** WTO FRAGMENTS **
**---------------------**
MINITAPI DC CLB'INITAPI'
MSOCKET DC CLB'SOCKET'
MBIND DC CLB'BIND'

Figure 69. EZASOKAS sample server program for IPv4 (Part 8 of 10)
Figure 69. EZASOKAS sample server program for IPv4 (Part 9 of 10)
EZASOKAC sample client program for IPv4

The EZASOKAC program is a client module that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- CONNECT
- GETPEERNAME
- WRITE
- SHUTDOWN
- WRITE
- READ
- TERMAPI

Figure 69. EZASOKAS sample server program for IPv4 (Part 10 of 10)
EZASOKAC CSECT
EZASOKAC AMODE ANY
EZASOKAC RMODE ANY
PRINT NGEN

***********************************************************************
* MODULE NAME: EZASOKAC - THIS IS A VERY SIMPLE CLIENT *
* Copyright: Licensed Materials - Property of IBM *
* "Restricted Materials of IBM" *
* 5694-A01 *
* (C) Copyright IBM Corp. 1977, 2003 *
* US Government Users Restricted Rights - *
* Use, duplication or disclosure restricted by *
* GSA ADP Schedule Contract with IBM Corp. *
* Status: CSV1R5 *
* *
* LANGUAGE: ASSEMBLER *
* *
* ATTRIBUTES: NON-REUSEABLE *
* *
* REGISTER USAGE: *
* R1 = *
* R2 = *
* R3 = BASE REG 1 *
* R4 = BASE REG 2 (UNUSED) *
* R5 = FUTURE BASE? *
* R6 = TEMP *
* R7 = RETURN REG *
* R8 = *
* R9 = A(WORK AREA) *
* R10 = *
* R11 = *
* R12 = *
* R13 = SAVE AREA *
* R14 = *
* R15 = *
* *
* INPUT: ANY PARM TURNS TRACE OFF, NO PARM IS NOISY MODE *
* OUTPUT: WTO RESULTS OF EACH TEST CASE IF TRACING *
* RETURN CODE IS 0 WHETHER IT CONNECTS OR NOT! *
* *
***********************************************************************

GBLB &TRACE ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION

&TRACE SETB 1 1=TRACE ON 0=TRACE OFF
R0 EQU 0
R1 EQU 1
R2 EQU 2

Figure 70. EZASOKAC sample client program for IPv4 (Part 1 of 10)
R3 EQU 3
R4 EQU 4
R5 EQU 5
R6 EQU 6
R7 EQU 7
R8 EQU 8
R9 EQU 9
R10 EQU 10
R11 EQU 11
R12 EQU 12
R13 EQU 13
R14 EQU 14
R15 EQU 15

*---------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*---------------------------------------------------------------------*
USING *,R3,R4
TELL ASSEMBLER OF OTHERS
SAVE (14,12),T,*
LR R3,R15
COPY EP REG TO FIRST BASE
LA R5,2048
GET R5 HALF WAY THERE
LA R5,2048(R5)
GET R5 THERE
LA R4,0(R5,R3)
GET R4 THERE
LA R12,12
JUST FOR FUN!
ST R1,PARMADDR
SAVE ADDRESS OF PARAMETER LIST
L R1,0(R1)
GET POINTER
LH R1,0(R1)
GET LENGTH
* STC R1,TRACE
USE IT AS FLAG
L R7,=A(SOCSAVE)
GET NEW SAVE AREA
ST R7,8(R13)
SAVE ADDRESS OF NEW SAVE AREA
ST R13,4(R7)
COMPLETE SAVE AREA CHAIN
LR R13,R7
NOW SWAP THEM
L R9,=A(MYCB)
POINT TO THE CONTROL BLOCK
USING MYCB,R9
TELL ASSEMBLER

*---------------------------------------------------------------------*
* BUILD MESSAGE FOR CONSOLE                                          *
*---------------------------------------------------------------------*
* INITIALIZE MESSAGE TEXT FIELDS                                     *
*---------------------------------------------------------------------*
LOOP EQU *
MVC MSGNUM(8),SUBTASK
WHO I AM
MVC TYPE,MSGSTART
MOVE 'STARTED' TO MESSAGE
* MVC MSGRSLT1,MSGSUCC
...SUCCESSFUL TEXT
MVC MSGRSLT2,BLANK35
* STM R14,R12,12(R13)
JUST FOR DEBUGGING
BAL R14,WTOSUB
--> DO STARTING WTO

***********************************************************************
* Issue INITAPI to connect to interface                              *
***********************************************************************
MVC TYPE,MINITAPI
MOVE 'INITAPI' TO MESSAGE
*
POST ECB,1
FOLLOWING IS SYNC ONLY
MVI SYNFLAG,0
MOVE A 1 FOR ASYNCH

Figure 70. EZASOKAC sample client program for IPv4 (Part 2 of 10)
EZASMI TYPE=INITAPI, ISSUE INITAPI MACRO X
SUBTASK=SUBTASK, SPECIFY SUBTASK IDENTIFIER X
MAXSOC=MAXSOC, SPECIFY MAXIMUM NUMBER OF SOCKETS X
MAXSNO=MAXSNO, (HIGHEST SOCKET NUMBER ASSIGNED) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
APITYPE=APITYPE, (Specify API TYPE field) X
ERROR=ERROR Abend if error on macro
IDENT=IDENT, TCP ADDR SPACE AND MY ADDR SPACE

ASYNC=('ECB'), (Specify TO USE ECBS)
ASYNC=('EXIT',MYEXIT) (Specify TO USE EXITS)

BAL R14,RCCHECK --> CHECK RESULTS

*******************************************************************************
* Issue SOCKET Macro to obtain a socket descriptor
* *** INET and STREAM ***
*******************************************************************************
MVC TYPE,MSOCKET move 'SOCKET' TO MESSAGE

EZASMI TYPE=SOCKET, Issue SOCKET Macro X
AF='INET', INET or IUCV X
SOCTYPE='STREAM', STREAM (TCP) DATAGRAM (UDP) or RAW X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

BAL R14,RCCHECK --> CHECK RESULTS
STH R8,S SAVE RETCODE (=SOCKET DESCRIPTOR)
LTR R8,R8 CHECK IT
BM DOSHUTDO --> WE ARE DONE!

*******************************************************************************
* Issue GETHOSTID CALL
*******************************************************************************
MVC TYPE,=CL8'GETHOSTI'

EZASMI TYPE=GETHOSTID,RETCODE=RETCODE,ERRNO=ERRNO
BAL R14,RCCHECK --> CHECK RESULTS
ST R8,ADDR

*******************************************************************************
* Issue CONNECT Socket
*******************************************************************************
MVC TYPE,=MCONNECT move 'CONNECT' TO MESSAGE
MVC PORT(2),PORTS Load STREAM port #

MVC ADDRESS(4),ADDR LOAD OUR INTERNET ADDRESS

EZASMI TYPE=CONNECT, Issue Macro X

Figure 70. EZASOKAC sample client program for IPv4 (Part 3 of 10)
S=S,
STREAM X
NAME=NAME,
SOCKET NAME STRUCTURE X
ERRNO=ERRNO,
(Specify ERRNO field) X
RETCODE=RETCODE,
(Specify RETCODE field) X
REQAREA=REQAREA,
FOR EXITS (AND ECBS) X
ERROR=ERROR
Abend if Macro error

* BAL R14,RCCHECK --> CHECK RC
LTR R8,R8 RECHECK IT
BM DOSHUTO DO --> WE ARE DONE
***********************************************************************
* Issue GETPEERNAME
*
***********************************************************************
MVC TYPE,MGETPEER MOVE 'GTPEERN' TO MESSAGE
*
EZASMI TYPE=GETPEERNAME, Issue Macro X
S=S,
STREAM X
NAME=NAME,
(SOCKET NAME STRUCTURE) X
ERRNO=ERRNO,
(Specify ERRNO field) X
RETCODE=RETCODE,
(Specify RETCODE field) X
REQAREA=REQAREA,
FOR EXITS (AND ECBS) X
ERROR=ERROR
Abend if Macro error
*
BAL R14,RCCHECK --> CHECK RC
***********************************************************************
* Issue WRITE - Write data from buffer
*
***********************************************************************
MVC TYPE,WRITE MOVE 'WRITE' TO MESSAGE
*
EZASMI TYPE=WRITE, Issue Macro X
S=S,
STREAM SOCKET X
NBYTE=NBYTE,
SIZE OF BUFFER X
BUF=BUF,
BUFFER X
ERRNO=ERRNO,
(Specify ERRNO field) X
RETCODE=RETCODE,
(Specify RETCODE field) X
REQAREA=REQAREA,
FOR EXITS (AND ECBS) X
ERROR=ERROR
Abend if Macro error
*
BAL R14,RCCHECK --> CHECK RC
***********************************************************************
* Issue SHUTDOWN - HOW = 1 (end communication TO socket)
*
***********************************************************************
DOSHUTO EQU *
MVC HOW(4),='F'1'
*
BAL R14,SHUTSUB --> SHUTDOWN
*
BAL R14,RCCHECK --> CHECK RC
***********************************************************************

Figure 70. EZASOKAC sample client program for IPv4 (Part 4 of 10)
* Issue READ - Read data and store in buffer
*
* *****************************************************
* MVC TYPE,MREAD MOVE 'READ ' TO MESSAGE
* EZASMI TYPE=READ,
  Issue Macro X
  S=S, STREAM SOCKET X
  NBYTE=NBYTE, SIZE OF BUFFER X
  BUF=BUF2, (BUFFER) X
  ERRNO=ERRNO, (Specify ERRNO field) X
  RETCODE=RETCODE, (Specify RETCODE field) X
  REQAREA=REQAREA, FOR EXITS (AND ECBs) X
  ERROR=ERROR Abend if Macro error
*
* BAL R14,RCCHECK --> CHECK RC
* MVC MSGRSLT1,MSGBUFF TITLE
* MVC MSGRSLT2,BUF2 MOVE THE DATA
* BAL R14,WOTOSUB --> PRINT IT
* *****************************************************
* Issue SHUTDOWN - HOW = 0 (end communication FROM socket)
*
* *****************************************************
* MVC HOW(4),=F'0'
* BAL R14,SHUTSUB --> SHUTDOWN
* BAL R14,RCCHECK --> CHECK RC
* *****************************************************
* Terminate Connection to API
*
* *****************************************************
* MVC TYPE,MTERMAPI MOVE 'TERMAPI' TO MESSAGE
* POST ECB,1 FOLLOWING IS SYNC ONLY
* EZASMI TYPE=TERMAPI Issue EZASMI Macro for Termapi
* BAL R14,RCCHECK --> CHECK RC
* *****************************************************
* Issue console message for task termination
*
* *****************************************************
* MVC TYPE,MSGEND Move 'ENDED' to message
* MVC MSGRSLT1,MSGSUC
  ...SUCCESSFUL text
* MVC MSGRSLT2,BLANK35
* BAL R14,WOTOSUB --> DO WTO
* LA R14,1 CONSTANT
* AH R14,APITYPE ADD
* STH R14,APITYPE STORE
* CH R14,=H'3' COMPARE
* BE LOOP --> LETS DO IT AGAIN!
* *****************************************************

Figure 70. EZASOKAC sample client program for IPv4 (Part 5 of 10)
* Return to Caller

L R13,4(R13)
RETURN (14,12),T,RC=0

WTOSUB EQU *
LR R7,R14 SAVE RETURN REG
MVC MSGCMD,TYPE COPY COMMAND
WTO TEXT=MSG
BR R7 --> RETURN

SHUTSUB EQU *
LR R7,R14 MOVE 'SHUTDOW' TO MESSAGE

EZASMI TYPE=SHUTDOWN, Issue Macro X
S=S, STREAM X
HOW=HOW, End communication in both directions X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

BR R7 --> RETURN TO CALLER

ABEND PROGRAM AND GET DUMP TO DEBUG!
ERROR ABEND 1,DUMP CNOP 2,4
* USES R6,R7,R8 RETCODE RETURNED IN R8
RCCHECK EQU *
LR R7,R14 COPY TO REAL RETURN REG
MVC MSGRSLT1,MSGSUCC ...SUCCESS TEXT
L R6,RETCODE
LTR R6,R6
BM NOWAIT
CLI SYNFLAG,0 PLAIN CASE?
BE NOWAIT --> SKIP IT
MVC KEY+14(8),SUBTASK
MVC KEY+23(8),TYPE
KEY WTO 'WAIT: XXXXXXX XXXXXXX'
WAIT ECB=ECB

NOWAIT EQU *
* LA R15,ECB
* ST R15,ECB
ST R9,ECB MAKE THIS THE TOKEN AGAIN
L R6,RETCODE CHECK FOR SUCCESSFUL CALL
CLC TYPE,=CL8'GETHOSTI'
BE HOSTIDRC HANDLE PRINTING HOST ID
LTR R8,R6 SAVE A COPY

* BNL CONT00

FAILMSG EQU *
MVC MSGRSLT1,MSGFAIL ...FAIL TEXT

CONT00 EQU *

*---------------------------------------------------------------------*
* Figure 70. EZASOKAC sample client program for IPv4 (Part 6 of 10)
* FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXX MSG RESULTS
* **** R6 = RETCODE VALUE ON ENTRY
*---------------------------------------------------------------------*
MVC MSGRTCT,MSGRET ' RETCODE= ' 
MVI MSGRTCS,C'+'
LTR R6,R6
BNM NOTM -->
MVI MSGRTCS,C'-' MOVE SIGN WHICH IS ALWAYS MINUS

NOTM EQU *
MVC MSGERT,MSGERR ' ERRNO= ' *

CVD R6,DWORK CONVERT IT TO DECIMAL
UNPK MSGRTCV,DWORK+4(4) UNPACK IT
OI MSGRTCV+6,X'F0' CORRECT THE SIGN

ERRNOFMT EQU *
L R6,ERRNO GET ERRNO VALUE
CVD R6,DWORK CONVERT IT TO DECIMAL
UNPK MSGERRV,DWORK+4(4) UNPACK IT
OI MSGERRV+6,X'F0' CORRECT THE SIGN

MVC MSGRLT2(35),MSGRTCD *
MVI MSGRTHX,X'40' CLEAR HEX INDICATOR
SR R6,R6 CLEAR OUT...
ST R6,RETCODE RETCODE AND...
ST R6,ERRNO ERRNO *

CLI TRACE,0
BNE NOTRACE
LR R14,R7 GIVE HIM RETURN REG
B WTOSUB --> DO WTO
NOTRACE EQU *
BR R7 --> RETURN TO CALLER *

HOSTIDRC EQU * VALID HOSTID MAY LOOK LIKE NEG. RC
C R6,-F'-1' ONLY -1 RC INDICATES FAILURE
BE FAILMSG ...BAD RC, USE STANDARD MSG
LR R8,R6 ...NEXT CALL EXPECTS ADDR IN R8
MVC MSGRLT1,MSGSUCC ...SUCCESS TEXT
UNPK HEXR(9),RETCODE(5) PLUS ONE FOR FAKE SIGN
TR HEXR(8),HEXTAB ...CONVERT UNPK TO PRINTABLE HEX
MVI HEXR+8,X'40' ...SPACE OUT FAKED SIGN BYTE
MVI MSGRTHX,C'X' ...INDICATE INFO IS HEX
B ERRNOFMT *

SYNFLAG DC H'0' DEFAULT TO SYN
TRACE DC H'0' DEFAULT TO TRACE
MYEXIT DC A(MYEXIT1,SUBTASK)
MYEXIT1 SAVE (14,12),T,*
LR R2,R15 USING MYEXIT1,R2
LM R8,R9,0(R1) GET TWO TOKENS
MVC EXKEY+14(8),0(R8) TELL WHO

* Figure 70. EZASOKAC sample client program for IPv4 (Part 7 of 10)
MVC EXKEY+23(B),TYPE TELL WHAT
EXKEY WTO 'EXIT: XXXXXXXX XXXXXXXX'
POST ECB,1
RETURN (14,12),T,RC=0
DROP R2

* ELEMENTS USED TO RUN PROGRAM *
EZASGW EZASMI TYPE=GLOBAL,X STORAGE=CSECT
* INITAPI macro parms *
SUBTASK DC CL8'EZASOKAC' SUBTASK PARM VALUE
IDENT DC OCL16' ' SUBTASK PARM VALUE
DC CL8'TCPV32' DEFAULT TO FIRST ONE AVAILABLE
DC CL8'EZASOKAC' MY ADDR SPACE NAME OR JOBNAME
MAXSNO DC F'0' (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
MAXSOC DC AL2(50) MAXSOC PARM VALUE
APITYPE DC H'2' OR PUT A 3 HERE

* SOCKET macro parms *
S DC H'0' SOCKET DESCRIPTOR FOR STREAM
* CONNECT MACRO PRRMS *
CNOP 0,4
NAME DC OCL16' ' SOCKET NAME STRUCTURE
DC AL2(2) FAMILY
PORT DC H'0'
ADDRESS DC F'0' RESERVED
DC XLB'0'
ADDR DC AL1(14),AL1(0),AL1(0),AL1(0) Internet Address
PORTS DC H'11007'
* ORTS DC H'43'

* WRITE MACRO PARM *
NBYTE DC F'50' SIZE OF BUFFER
BUF DC CL50' THIS IS FROM EZASOKAC! BUFFER FOR WRITE

* SHUTDOWN MACRO PARM *
HOW DC F'2' END COMMUNICATION TO- AND FROM-SOCKET

* READ MACRO PARM *
BUF2 DC CL50'BUF2' BUFFER FOR READ

MINITAPI DC CL8'INITAPI'
MCONNECT DC CL8'SOCKET'
MGETPEER DC CL8'GETPEERN'

Figure 70. EZASOKAC sample client program for IPv4 (Part 8 of 10)
MREAD DC CL8'READ'
MWRITE DC CL8'WRITE'
MSHUTDOW DC CL8'SHUTDOWN'
MTERMDC DC CL8'TERMDI'
MSGSTART DC CL8'STARTED'
MSGEND DC CL8'ENDED'
MSGSUC DC CL10'SUCCESS' Command results...
MSGFALL DC CL10'FAIL: ' ...
MSGRETC DC CL10'RETCODE=' ...
MSGERRN DC CL10'ERRNO=' ...
MSGBUFF DC CL10'BUFFER: ' ...
BLANK35 DC CL35'
*---------------------------------------------------------------------*
* MESSAGE AREA *
*--------------*
MSG DC 0F'0' MESSAGE AREA
DC AL2(MSGE-MSGNUM) LENGTH OF MESSAGE
MSGNUM DC CL10'EZASOKAC:' 'EZASOKAC: ' COMMAND ISSUED
MSGCMD DC CL8'COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT1 DC CL10'RETURNED VALUES' 'End of message
MSG EQU *
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*------------------------------------------------------*
* MSGRTCD DC 0CL35' ' GENERAL RETURNED VALUE
MSGRCTY DC CL9'RETCODE=' 'RETCODE='
MSGRTXH DC CL1'X' X FOR GETHOSTID
MSGRCTS DC CL1' ' ' 'NEGATIVE SIGN'
HEXRC EQU MSGRTCS HEX RC WILL START AT SIGN LOCATION
MSGRCTYV DC CL7'RETURNED VALUE (RETCODE)
MSGERRT DC CL10'ERRNO=' 'ERRNO='
MSGERRV DC CL7'RETURNED VALUE (ERRNO)
DWORK DC D'0' WORK AREA
HEXTAB EQU -240 TAB TO CONVERT TO PRINTABLE HEX
* FIRST 240BYTES NOT REFERENCED
DC CL16'0123456789ABCDEF'
PARMADDR DC A(0) PARM ADDRESS SAVE AREA
LTORG
*---------------------------------------------------------------------*
* REG/SAVEAREA *
*--------------*
SOCSAVE DC 9D'0' SAVE AREA
*---------------------------------------------------------------------*
* CNOP 0,8 MYCB EQU * MY CONTROL BLOCK
REQAREA EQU *
ECB DC A(ECB) SELF POINTER
DC CL100 'WORK AREA'
MYTIE EZASMI TYPE=Task, STORAGE=CSECT TIE
TYPE DC CL8'TYPE'
ERRNO DC F'0'
RETCODE DC F'0'
MYNEXT DC A(MYCB) NEXT IN CHAIN FOR MULTIPLES

Figure 70. EZASOKAC sample client program for IPv4 (Part 9 of 10)
EZASO6AS sample server program for IPv6

The EZASO6AS program is a server program that shows you how to use the following calls provided by the macro socket interface:

- ACCEPT
- BIND
- CLOSE
- GETADDRINFO
- GETHOSTNAME
- FREEADDRINFO
- INITAPI
- LISTEN
- PTON
- READ
- SOCKET
- TERMAPI
- WRITE
EZASO6AS CSECT
EZASO6AS AMODE ANY
EZASO6AS RMODE ANY
* PRINT NOGEN

***********************************************************************
* MODULE NAME: EZASO6AS Sample IPv6 server program
* Copyright: Licensed Materials - Property of IBM
* "Restricted Materials of IBM"
* 5694-A01
* (C) Copyright IBM Corp. 2002, 2003
* US Government Users Restricted Rights -
* Use, duplication or disclosure restricted by
* GSA ADP Schedule Contract with IBM Corp.
* Status: CSV1R5
* LANGUAGE: Assembler
* ATTRIBUTES: NON-REUSABLE
* REGISTER USAGE:
*   R1 =
*   R2 =
*   R3 = BASE REG 1
*   R4 = BASE REG 2 (UNUSED)
*   R5 = FUTURE BASE REG?
*   R6 = TEMP
*   R7 = RETURN REG
*   R8 =
*   R9 = A(WORK AREA)
*   R10 =
*   R11 =
*   R12 =
*   R13 = SAVE AREA
*   R14 =
*   R15 =
* INPUT: NONE
* OUTPUT: WTO results of each test case
************************************************************************
GBLB &TRACE ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION
&TRACE SETB 1 1=TRACE ON 0=TRACE OFF
R0 EQU 0
R1 EQU 1
R2 EQU 2
R3 EQU 3

Figure 71. EZASO6AS sample server program for IPv6 (Part 1 of 13)
R4 EQU 4
R5 EQU 5
R6 EQU 6
R7 EQU 7
R8 EQU 8
R9 EQU 9
R10 EQU 10
R11 EQU 11
R12 EQU 12
R13 EQU 13
R14 EQU 14
R15 EQU 15

*---------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*---------------------------------------------------------------------*

USING *,R3,R4
TELL ASSEMBLER OF OTHERS
SAVE (14,12),T,*
LR R3,R15
COPY EP REG TO FIRST BASE
LA R5,2048
GET R5 HALFWAY THERE
LA R5,2048(R5) GET R5 THERE
LA R4,0(R5,R3) GET R4 THERE
LA R12,12 JUST FOR FUN!
ST R1,PARMADDR
SAVE ADDRESS OF PARAMETER LIST
L R1,0(R1) GET POINTER
LH R1,0(R1) GET LENGTH
STC R1,TRACE
USE IT AS FLAG
L R7,=A(SOCSAVE) GET NEW SAVE AREA
ST R7,8(R13) SAVE ADDRESS OF NEW SAVE AREA
ST R13,4(R7) COMPLETE SAVE AREA CHAIN
LR R13,R7
NOW SWAP THEM
L R9,=A(MYCB)
POINT TO THE CONTROL BLOCK
USING MYCB,R9
TELL ASSEMBLER

*---------------------------------------------------------------------*
* BUILD MESSAGE FOR CONSOLE                                          *
*---------------------------------------------------------------------*

INITIALIZE MESSAGE TEXT FIELDS

LOOP EQU *
MVC MSGNUM(8),SUBTASK WHO I AM
MVC TYPE,MSGSTART MOVE 'STARTED' TO MESSAGE

MVC MSGSRSLT1,MSGSUCC ...SUCCESSFUL TEXT
MVC MSGSRSLT2,BLANK35

STM R14,R12,12(R13) JUST FOR DEBUGGING
BAL R14,WTOSUB --> DO STARTING WTO

**************************************************************************
* Issue INITAPI to connect to interface                                *
**************************************************************************

POST ECB,1 NEXT IS ALWAYS SYCH
MVI SYNFLAG,0 MOVE A 1 FOR ASYNC
MVC TYPE,MINITAPI MOVE 'INITAPI' TO MESSAGE

EZASMI TYPE=INITAPI, Issue INITAPI Macro X

Figure 71. EZASO6AS sample server program for IPv6 (Part 2 of 13)
Figure 71. EZASO6AS sample server program for IPv6 (Part 3 of 13)
MVC ADDRESS,NUMERIC_ADDR
***********************************************************************
* ISSUE GETHOSTNAME CALL *
***********************************************************************
MVC TYPE,MHOSTN 'GETHOSTN' TO MESSAGE
EZASMI TYPE=GETHOSTNAME,
   NAMELEN=HOSTNAMEL, LENGTH OF HOST NAME FIELD
   NAME=HOSTNAME, HOST NAME
   ERRNO=ERRNO, (Specify ERRNO field)
   RETCODE=RETCODE, (Specify RETCODE field)
   ERROR=ERROR Abend if Macro error
   REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS
*
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
MVC MSGRSLT1,=C'HOST NAME ' INDICATE WHAT WE'RE PROCESSING
XC MSGRSLT2,MSGRSLT2
MVC MSGRSLT2,HOSTNAME
STM R14,R12,12(R13) JUST FOR DEBUGGING
BAL R14,WTOSUB SEND TO THE CONSOLE
MVC NODENAME(24),HOSTNAME
***********************************************************************
* ISSUE GETADDRINFO MACRO *
***********************************************************************
MVC TYPE,MGADDRI MOVE 'GETADDRINFO' TO MESSAGE
   ADDR_INFO(addrinfo_len),ADDR_INFO CLEAR OUT ALL HINTS
   ai_CANONNAMEOK REQUEST THE CANONICAL NAME
   ai_flags SAVE THE HINT FLAGS
   ADDR_INFO ai_ADDRINFO POINT TO THE HINTS ADDRINFO
   ai_HINTS SAVE THE ADDRESS OF THE HINTS
   ai_servname LENGTH OF SERVICE NAME
   ai_servnamel SAVE THE SERVICE NAME LENGTH
EZASMI TYPE=GETADDRINFO, ISSUE GETADDRINFO MACRO
   NODE=NODENAME, NODE GETTING INFORMATION FOR
   NODELEN=NODENAMEL, LENGTH OF NODE NAME
   SERVICE=SERVNAME, SERVICE GETTING INFORMATION FOR
   SERVLLEN=SERVNAMEL, LENGTH OF SERVICE NAME
   HINTS=HINTS, HINTS FOR FILTERING
   RESULT_ADDRINFO, RETURNED ADDRESS INFORMATION
   CANNAME=CANNAMEL, LENGTH OF CANONICAL NAME
   ERRNO=ERRNO, (Specify ERRNO field)
   RETCODE=RETCODE, (Specify RETCODE field)
   ERROR=ERROR ABEND IF MACRO ERROR
*
BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL
*
IF RETURNED SUCCESSFULLY, THEN PROCESS THE ADDRINFO STRUCTURE AND
* THEN CHECK TO SEE IF THERE IS ANOTHER TO PROCESS. CONTINUE UNTIL
* AI_NEXT IS NULL.
*
Figure 71. EZASO6AS sample server program for IPv6 (Part 4 of 13)
ICM  R10,8'1111',RESULT_ADDRINFO EXAMINE RETURNED ADDRINFO
BZ  NOAIS  IF NOT RETURNED THEN HOST NOT FOUND?

SEEAI  DS  0H
MVC  ADDR_INFO(addrinfo_len).0(R10) LOAD ADDRINFO STRUCTURE
XC  OPNAMELEN,OPNAMELEN CLEAR NAME LENGTH OUTPUT FIELD
XC  OPCANON,OPCANON CLEAR CANONICAL NAME OUTPUT FIELD
XC  OPNAME,OPNAME CLEAR NAME OUTPUT FIELD
XC  OPNEXT,OPNEXT CLEAR NEXT ADDRINFO OUTPUT FIELD

* CALL EZACICO9,(RESULT_ADDRINFO, X
  OPNAMELEN, OUTPUT NAME LENGTH  X
  OPCANON, OUTPUT CANONICAL NAME X
  OPNAME, OUTPUT NAME X
  OPNEXT, OUTPUT NEXT RESULT ADDRESS INFO X
  RETCODE),VL

* FORMAT CANONNAME.
* MVC  MSGRSLT1,"C'CANON NAME' INDICATE WHAT WE'RE PROCESSING
  XC  MSGRSLT2,MSGRSLT2
MVC  MSGRSLT2(21),"C' NO CANON NAME '  
  XC  MSGRSLT2,MSGRSLT2
MVC  MSGRSLT2,OPCANON

FMTAISNCE  DS  0H
STM  R14,R12,12(R13) JUST FOR DEBUGGING
BAL  R14,WTOSUB SEND TO THE CONSOLE

FMTAISNC  DS  0H
* IF AI_NEXT IS NULL THEN THIS IS THE LAST STRUCTURE ON THE LIST.
* TO PROCESS ALL STRUCTURES:
* 1. GET THE FIRST ONE AND PROCESS THE FIELDS RETURNED.
* 2. USE THE ADDRESS IN AI_NEXT TO GET THE NEXT ADDRESS IF NOT NULL.
* 3. PROCESS THE NEW FIELDS IN THE SUBSEQUENT STRUCTURE.
* 4. GOTO 2.
* ICM  R10,8'1111',ai_next SEE IF NEXT ADDRESS IS NULL...
BP  SEEAI  NOPE...PARSE IT.

**********************************************************************
* ISSUE FREEADDRINFO MACRO. MUST BE DRIVEN AFTER A SUCCESSFUL GETADDRINFO; OTHERWISE, RESOLVER STORAGE WILL BE CONSUMED.
**********************************************************************
MVC  TYPE,MFADDRI MOVE 'FREEADDRINFO' TO MESSAGE

EZASMI TYPE=FREEADDRINFO, ISSUE FREEADDRINFO MACRO  X
ADDRINFO=RESULT_ADDRINFO,  X
ERRNO=ERRNO, (SPECIFY ERRNO FIELD)  X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD)  X
ERROR=ERROR ABEND IF MACRO ERROR
BAL  R14,RCHECK CHECK FOR SUCCESSFUL CALL

Figure 71. EZASO6AS sample server program for IPv6 (Part 5 of 13)
B ENDAIS
NOAIS DS 0H
XC MSGRSLT2,MSGRSLT2
MVC MSGRSLT2(21),=C'Result not returned.'
BAL R14,WTOSUB SEND TO THE CONSOLE
ENDAIS DS 0H
*
***************************************************************************************
* Issue BIND socket *
***************************************************************************************
MVC TYPE,MBIND MOVE 'BIND' TO MESSAGE
MVC PORT(2),PORTS Load STREAM port #
*
EZASMI TYPE=BIND, Issue Macro X
S=S, STREAM X
NAME=NAME, (SOCKET NAME STRUCTURE) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
ERROR=ERROR Abend if Macro error
* REQA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
***************************************************************************************
* Issue LISTEN - Backlog = 5 *
***************************************************************************************
MVC TYPE,MLISTEN MOVE 'LISTEN' TO MESSAGE
*
EZASMI TYPE=LISTEN, Issue Macro X
S=S, STREAM X
BACKLOG=BACKLOG, BACKLOG X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
ERROR=ERROR Abend if Macro error
* REQA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
***************************************************************************************
* Issue ACCEPT - Block until connection from peer *
***************************************************************************************
MVC TYPE,MACCEPT MOVE 'ACCEPT' TO MESSAGE
MVC PORT(2),PORTS Load STREAM port #
*
EZASMI TYPE=ACCEPT, Issue Macro X
S=S, STREAM X
NAME=NAME, (SOCKET NAME STRUCTURE) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
ERROR=ERROR Abend if Macro error
* REQA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X

Figure 71. EZASO6AS sample server program for IPv6 (Part 6 of 13)
* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
* Message RESULTS text
* MVC NUMERIC_ADDR,ADDRESS IP ADDRESS FROM ACCEPT
* MVC TYPE,MNTOP MOVE 'NTOP ' TO MESSAGE
* DISPLAY THE NUMERIC ADDRESS FIRST
* MVC TYPE,MTOP MOVE 'NTOP ' TO MESSAGE
* TRANSLATE IT TO PRESENTABLE FORM
* EZASMI TYPE=NTOP, ISSUE PTON MACRO X
  AF='INET6', X
  SRCADDR=NUMERIC_ADDR, X
  DSTADDR=PRESENTABLE_ADDR, X
  DSTLEN=PRESENTABLE_ADDR_LEN, X
  ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
  RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
  ERROR=ERROR ABEND IF MACRO ERROR
* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
* DISPLAY THE RETURNED ADDRESS IN PRESENTABLE FORMAT
* MVC MSGRSLT1,'C'DSTADDR ' INDICATE WHAT WE'RE PROCESSING
  XC MSGRSLT2,MSGRSLT2
  MVC MSGRSLT2(L'PRESENTABLE_ADDR),PRESENTABLE_ADDR
  STM R14,R12,12(R13) JUST FOR DEBUGGING
  BAL R14,WTOSUB SEND TO THE CONSOLE
* Issue READ - Read data and store in buffer
* MVC TYPE,MREAD MOVE 'READ ' TO MESSAGE
* EZASMI TYPE=READ, Issue Macro X
  S=SOCDESCA, ACCEPT SOCKET X
  NBYTE=NBYTE, SIZE OF BUFFER X
  BUF=BUF, (BUFFER) X
  ERRNO=ERRNO, (Specify ERRNO field) X
  RETCODE=RETCODE, (Specify RETCODE field) X
  ERROR=ERROR Abend if Macro error
  REQAREA=REQAREA, IN CASE WE ARE DOING EXITS OR ECBS X
* BAL R14,RCHECK CHECK FOR SUCCESSFUL CALL
  MVC MSGRSLT1,MSGBUFF
  MVC MSGRSLT2,BUF
  BAL R14,WTOSUB --> PRINT IT

Figure 71. EZASO6AS sample server program for IPv6 (Part 7 of 13)
**Issue WRITE - Write data from buffer**

```
MVC TYPE,MWRITE MOVE 'WRITE' TO MESSAGE
```

```
EZASMI TYPE=WRITE,
  Issue Macro  X
  S=SOCDESCA,  ACCEPT Socket  X
  NBYTE=NBYTE,  SIZE OF BUFFER  X
  BUF=BUF,  (BUFFER)  X
  ERRNO=ERRNO,  (Specify ERRNO field)  X
  RETCODE=RETCODE,  (Specify RETCODE field)  X
  ERROR=ERROR    Abend if Macro error  X
  REQAREA=REQAREA,  IN CASE WE ARE DOING EXITS OR ECBS  X
```

```
BAL R14,RCCHECK  CHECK FOR SUCCESSFUL CALL
```

**Issue CLOSE for ACCEPT socket**

```
MVC TYPE,MCLOSE MOVE 'CLOSE' TO MESSAGE
```

```
EZASMI TYPE=CLOSE,
  Issue Macro  X
  S=SOCDESCA,  ACCEPT  X
 (ERRNO=ERRNO,  (Specify ERRNO field)  X
  RETCODE=RETCODE,  (Specify RETCODE field)  X
  ERROR=ERROR    Abend if Macro error  X
  REQAREA=REQAREA,  IN CASE WE ARE DOING EXITS OR ECBS  X
```

```
MVC MSGRLT2,BLANK35
BAL R14,RCCHECK   CHECK FOR SUCCESSFUL CALL
```

**Terminate Connection to API**

```
MVC TYPE,MTERMAPI MOVE 'TERMAPI' TO MESSAGE
```

```
POST ECB,1 FOLLOWING IS ALWAYS SYNCH
EZASMI TYPE=TERMAPI  Issue EZASMI Macro for Termapi
```

`Message RESULTS text`

```
MVC MSGRLT2,BLANK35
BAL R14,RCCHECK  --> CHECK RC
```

**Issue console message for task termination**

```
MVC TYPE,MSGEND  Move 'ENDED' to message
```

---

Figure 71. EZASO6AS sample server program for IPv6 (Part 8 of 13)
MVC MSGRSLT1,MSGSUCC ...SUCCESSFUL text
MVC MSGRSLT2,BLANK35
*
BAL R14,WTOSUB
LA R14,1  CONSTANT
AH R14,APITYPE  ADD
STH R14,APITYPE  STORE
CH R14,=H'3'  COMPARE
*
BE LOOP  --> LETS DO IT AGAIN!
*---------------------------------------------------------------------*
* Return to Caller  ------------------------------------------------------*
*---------------------------------------------------------------------*
L R13,4(R13)  RETURN (14,12),T,RC=0
WTOSUB EQU *
LR R7,R14  COPY RETURN REG
MVC MSGCMD(8),TYPE
WTO TEXT=MSG  WRITE MESSAGE TO OPERATOR
BR R7  --> RETURN TO CALLER
CNOP 2,4
* USES R6,R7,R8  RETCODE RETURNED IN RB
RCCHECK EQU *
LR R7,R14  COPY TO REAL RETURN REG
MVC MSGRSLT1,MSGSUCC  ...SUCCESS TEXT
L R6,RETCODE
LTR R6,R6
BM NOWAIT
CLI SYNFLAG,0  PLAIN CASE?
BE NOWAIT  --> SKIP IT
MVC KEY+14(8),SUBTASK
MVC KEY+23(8),TYPE
KEY WTO 'WAIT: XXXXXXX XXXXXXX'
WAIT ECB=ECB
NOWAIT EQU *
* LA R15,ECB
* ST R15,ECB
* ST R9,ECB  MAKE THIS THE TOKEN AGAIN
* ST R6,RETCODE  CHECK FOR SUCCESSFUL CALL
* CLC TYPE,=CL8'GETHOSTI'
* BE HOSTIDRC  HANDLE PRINTING HOST ID
* LTR R8,R6  SAVE A COPY
*
BNL CONT00
FAILMSG EQU *
MVC MSGRSLT1,MSGFAIL  ...FAIL TEXT
CONT00 EQU *
*
*---------------------------------------------------------------------*
* FORMAT THE RETCODE= -XXXXXXX ERRNO= XXXXXXX MSG RESULTS
* **** R6 = RETCODE VALUE ON ENTRY
*---------------------------------------------------------------------*
MVC MSGRTCT,MSGRETC ' RETCODE= '
MVI MSGRTCS,C'+'
LTR R6,R6
BNM NOTM  -->

Figure 71. EZASO6AS sample server program for IPv6 (Part 9 of 13)
Figure 71. EZASO6AS sample server program for IPv6 (Part 10 of 13)
Figure 71. EZASO6AS sample server program for IPv6 (Part 11 of 13)
MACCEPT DC CL8'ACCEPT'
MLISTEN DC CL8'LISTEN'
MREAD DC CL8'READ'
MWRITE DC CL8'WRITE'
MCLOSE DC CL8'CLOSE'
MTERMAPI DC CL8'TERMAPI'
MSGSTART DC CL8'STARTED'
MSGEND DC CL8'ENDED'
MSGBUFF DC CL10'BUFFER:...
MSGSUCC DC CL10'SUCCESS: Command results...
MSGFAIL DC CL10'FAIL: (...
MSGERETC DC CL10'RETCODE= '...
MSGERRN DC CL10'ERRNO= '...
BLANK35 DC CL35'
*---------------------------------------------------------------------*
* ERROR NUMBER / RETURN CODE FIELDS *
*---------------------------------------------------------------------*
* MESSAGE AREA *
*---------------------------------------------------------------------*
* MSG      DC OF'0'       MESSAGE AREA
DC AL2(MSGE-MSGNUM) LENGTH OF MESSAGE
MSGNUM DC CL10'EZASO6AS: 'EZASO6ASXX:
MSGCMD DC CL8' ' COMMAND ISSUED
MSGRSLT1 DC CL10' ' COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC CL35' ' RETURNED VALUES
MSGE EQU * End of message
*---------------------------------------------------------------------*
* MESSAGE RESULTS AREAS (fill in and move to MSGRSLT2) *
*---------------------------------------------------------------------*
* MSGRTCD DC OCL35' ' GENERAL RETURNED VALUE
MSGRCTCT DC CL9' RETCODE= ' RETCODE= '
MSGRTHX DC CL1' ' 'X' X FOR GETHOSTID
MSGRTCS DC CL1' ' ' ' (NEGATIVE SIGN)
HEXR EQU MSGRTCS HEX RC WILL START AT SIGN LOCATION
MSGRTCV DC CL7' ' RETURNED VALUE (RETCODE)
MSGERRT DC CL10' ERRNO= ' ERRNO= '
MSGERRRY DC CL7' ' RETURNED VALUE (ERRNO)
*---------------------------------------------------------------------*
PARMADDR DC A(0) PARM ADDRESS SAVE AREA
DWORK DC D'0' WORK AREA
HEXTAB EQU *=240 TAB TO CONVERT TO PRINTABLE HEX
* FIRST 240 BYTES NOT REFERENCED
DC CL16'0123456789ABCDEF'
E2BREHT DSECT=NO,LIST=YES,HOSTENT=NO,ADRINFO=YES
LTORG ,
*---------------------------------------------------------------------*
* REG/SAVEAREA *
*---------------------------------------------------------------------*
SOCSAVE DC 9D'0' SAVE AREA
CNOP 0,8
MYCB EQU * MY CONTROL BLOCK
REQAREA EQU *
ECB DC A(ECB) SELF POINTER

Figure 71. EZASO6AS sample server program for IPv6 (Part 12 of 13)
EZASO6AC sample client program for IPv6

The EZASO6AC program is a client module that shows you how to use the following calls provided by the macro socket interface:

- INITAPI
- SOCKET
- CONNECT
- GETPEERNAME
- GETNAMEINFO
- GLOBAL
- WRITE
- READ
- TASK
**TERMAPI**
**SHUTDOWN**

EZASO6AC CSECT
EZASO6AC AMODE ANY
EZASO6AC RMODE ANY
PRINT NGEN

***********************************************************************

* MODULE NAME: EZASO6AC - THIS IS A VERY SIMPLE IPV6 CLIENT *
* *
* Copyright: Licensed Materials - Property of IBM *
* *"Restricted Materials of IBM"
* *
* 5694-A01 *
* *
* (C) Copyright IBM Corp. 2002, 2003 *
* *
* US Government Users Restricted Rights - *
* Use, duplication or disclosure restricted by *
* GSA ADP Schedule Contract with IBM Corp. *
* *
* Status: CSV1R5 *
* *
* *
* LANGUAGE: ASSEMBLER *
* *
* ATTRIBUTES: NON-REUSEABLE *
* *
* REGISTER USAGE: *
* *
* R1 = *
* R2 = *
* R3 = BASE REG 1 *
* R4 = BASE REG 2 (UNUSED) *
* R5 = FUTURE BASE? *
* R6 = TEMP *
* R7 = RETURN REG *
* R8 = *
* R9 = A(WORK AREA) *
* R10 = *
* R11 = *
* R12 = *
* R13 = SAVE AREA *
* R14 = *
* R15 = *
* *
* INPUT: ANY PARM TURNS TRACE OFF, NO PARM IS NOISY MODE *
* OUTPUT: WTO RESULTS OF EACH TEST CASE IF TRACING *
* RETURN CODE IS 0 WHETHER IT CONNECTS OR NOT! *
* *
******************************************************************************

GBLB &TRACE ASSEMBLER VARIABLE TO CONTROL TRACE GENERATION

&TRACE SETB 1 1=TRACE ON 0=TRACE OFF
R0 EQU 0
R1 EQU 1
R2 EQU 2

*Figure 72. EZASO6AC sample client program for IPv6 (Part 1 of 10)*
R3 EQU 3
R4 EQU 4
R5 EQU 5
R6 EQU 6
R7 EQU 7
R8 EQU 8
R9 EQU 9
R10 EQU 10
R11 EQU 11
R12 EQU 12
R13 EQU 13
R14 EQU 14
R15 EQU 15

*---------------------------------------------------------------------*
* START OF EXECUTABLE CODE                                           *
*---------------------------------------------------------------------*
USING *,R3,R4
TELL ASSEMBLER OF OTHERS
SAVE (14,12),T, *
LR R3,R15
COPY EP REG TO FIRST BASE
LA R5,2048
GET R5 HALF WAY THERE
LA R5,2048(R5)
GET R5 THERE
LA R4,0(R5,R3)
GET R4 THERE
LA R12,12
JUST FOR FUN!
ST R1,PARMADDR
SAVE ADDRESS OF PARAMETER LIST
L R1,0(R1)
GET POINTER
LH R1,0(R1)
GET LENGTH
STC R1,TRACE
USE IT AS FLAG
L R7,=A(SOCSAVE)
GET NEW SAVE AREA
ST R7,8(R13)
SAVE ADDRESS OF NEW SAVE AREA
ST R13,4(R7)
COMPLETE SAVE AREA CHAIN
LR R13,R7
NOW SWAP THEM
L R9,=A(MYCB)
POINT TO THE CONTROL BLOCK
USING MYCB,R9
TELL ASSEMBLER

*---------------------------------------------------------------------*
* BUILD MESSAGE FOR CONSOLE                                          *
*---------------------------------------------------------------------*
INITIALIZE MESSAGE TEXT FIELDS
LOOP EQU *
MVC MSGNUM(B),SUBTASK WHO I AM
MVC TYPE,MSGSTART MOVE 'STARTED' TO MESSAGE
*
MVC MSGRSLT1,MSGSUCCESS  ...SUCCESSFUL TEXT
MVC MSGRSLT2,BLANK35
*
STM R14,R12,12(R13)
JUST FOR DEBUGGING
BAL R14,WTOSUB ---> DO STARTING WTO

**************************************************************************
* Issue INITAPI to connect to interface                                *
***************************************************************************

MVC TYPE,MINITAPI MOVE 'INITAPI' TO MESSAGE
*
POST ECB,1 FOLLOWING IS SYNCH ONLY
MVI SYNFLAG,0 MOVE A 1 FOR ASYNCH

Figure 72. EZASO6AC sample client program for IPv6 (Part 2 of 10)
EZASMI TYPE=INITAPI, ISSUE INITAPI MACRO X

SUBTASK=SUBTASK, SPECIFY SUBTASK IDENTIFIER X

MAXSOC=MAXSOC, SPECIFY MAXIMUM NUMBER OF SOCKETS X
MAXSNO=MAXSNO, (HIGHEST SOCKET NUMBER ASSIGNED) X

ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X

APITYPE=APITYPE, (Specify APITYPE field) X
ERROR=ERROR Abend if error on macro
IDENT=IDENT, TCP ADDR SPACE AND MY ADDR SPACE

ASYNC=('ECB'), (Specify TO USE ECBS)
ASYNC=('EXIT',MYEXIT) (Specify TO USE EXITS)

BAL R14,RCCHECK --> CHECK RESULTS

***********************************************************************

* Issue SOCKET Macro to obtain a socket descriptor *
*** INET and STREAM ***
*

MVC TYPE,MSOCKET MOVE 'SOCKET' TO MESSAGE

EZASMI TYPE=SOCKET, Issue SOCKET Macro X
AF='INET6', INET, IUCV, or INET6 X
SOCTYPE='STREAM', STREAM(TCP) DATAGRAM(UDP) or RAW X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

BAL R14,RCCHECK --> CHECK RESULTS
STH R8S,S SAVE RETCODE (=SOCKET DESCRIPTOR)
LTR R8,R8 CHECK IT
BM DOSHUTDO --> WE ARE DONE!

***********************************************************************

* Issue CONNECT Socket *
*

MVC TYPE,MCONNECT MOVE 'CONNECT' TO MESSAGE

MVC PORT(2),PORTS Load STREAM port #
MVC ADDRESS(16),ADDR LOAD THE INTERNET ADDRESS

EZASMI TYPE=CONNECT, Issue Macro X
S=S, STREAM X
NAME=NAME, SOCKET NAME STRUCTURE X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

BAL R14,RCCHECK --> CHECK RC
LTR R8,R8 RECHECK IT
BM DOSHUTDO --> WE ARE DONE!

***********************************************************************

Figure 72. EZASO6AC sample client program for IPv6 (Part 3 of 10)
* Issue GETPEERNAME

*******************************************************************************
MVC TYPE,MGETPEER MOVE 'GTPEERN' TO MESSAGE

EZASMI TYPE=GETPEERNAME, Issue Macro X
S=S, STREAM X
NAME=NAME, (SOCKET NAME STRUCTURE) X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

* BAL R14,RCCHECK --> CHECK RC
*******************************************************************************

* ISSUE GETNAMEINFO MACRO

*******************************************************************************
MVC TYPE,MGETNAMEI MOVE 'GETNAMEINFO' TO MESSAGE

LA R6,NI_NAMEREQD
ST R6,FLAGS

EZASMI TYPE=GETNAMEINFO, ISSUE GETNAMEINFO MACRO X
NAME=NAME, X
NAMELEN=NAMELEN, X
HOST=HOSTNAME, X
HOSTLEN=HOSTNAMEL, X
SERVICE=SERVNAME, X
SERVLEN=SERVNAMEL, X
FLAGS=FLAGS, X
ERRNO=ERRNO, (SPECIFY ERRNO FIELD) X
RETCODE=RETCODE, (SPECIFY RETCODE FIELD) X
ERROR=ERROR ABEND IF MACRO ERROR

* BAL R14,RCCHECK CHECK FOR SUCCESSFUL CALL

* DISPLAY HOSTNAME

MVC MSGRSLT1,'C'HOST NAME ' INDICATE WHAT WERE PROCESSING
XC MSGRSLT2,MSGRSLT2
MVC MSGRSLT2,HOSTNAME LOAD UP THE DATA
STM R14,R12,12(R13) JUST FOR DEBUGGING
BAL R14,WTOSUB SEND TO THE CONSOLE

* DISPLAY SERVNAME

MVC MSGRSLT1,'C'SERV NAME ' INDICATE WHAT WERE PROCESSING
XC MSGRSLT2,MSGRSLT2
MVC MSGRSLT2,SERVNAME LOAD UP THE DATA
STM R14,R12,12(R13) JUST FOR DEBUGGING
BAL R14,WTOSUB SEND TO THE CONSOLE

*******************************************************************************

* Issue WRITE - Write data from buffer

Figure 72. EZASO6AC sample client program for IPv6 (Part 4 of 10)
EZASMI TYPE=WRITE, Issue Macro
S=S, STREAM SOCKET
NBYTE=NBYTE, SIZE OF BUFFER
BUF=BUF, BUFFER
ERRNO=ERRNO, (Specify ERRNO field)
RETCODE=RETCODE, (Specify RETCODE field)
REQAREA=REQAREA, FOR EXITS (AND ECBS)
ERROR=ERROR Abend if Macro error
*
BAL R14,RCCHECK --> CHECK RC

Issue SHUTDOWN - HOW = 1 (end communication TO socket)
*
*

DOSSHUTO EQU *
MVC HOW(4),='1'
*
BAL R14,SHUTSUB --> SHUTDOWN
*
BAL R14,RCCHECK --> CHECK RC

Issue READ - Read data and store in buffer
*
*

MVC TYPE,MREAD MOVE 'READ ' TO MESSAGE
*
EZASMI TYPE=READ, Issue Macro
S=S, STREAM SOCKET
NBYTE=NBYTE, SIZE OF BUFFER
BUF=BUF2, BUFFER
ERRNO=ERRNO, (Specify ERRNO field)
RETCODE=RETCODE, (Specify RETCODE field)
REQAREA=REQAREA, FOR EXITS (AND ECBS)
ERROR=ERROR Abend if Macro error
*
BAL R14,RCCHECK --> CHECK RC
MVC MSGRSLT1,MSGBUFF TITLE
MVC MSGRSLT2,BUF2 MOVE THE DATA
BAL R14,WTOSUB --> PRINT IT

Issue SHUTDOWN - HOW = 0 (end communication FROM socket)
*
*

MVC HOW(4),='0'
*
BAL R14,SHUTSUB --> SHUTDOWN
*
BAL R14,RCCHECK --> CHECK RC

Figure 72. EZASO6AC sample client program for IPv6 (Part 5 of 10)
Terminate Connection to API

MVC TYPE, MTERMAPI MOVE 'TERMAPI' TO MESSAGE

POST ECB, 1 FOLLOWING IS SYNC ONLY
EZASMI TYPE=TERMAPI Issue EZASMI Macro for Termapi

BAL R14, RCCHECK --> CHECK RC

MVC TYPE, MSGEND Move 'ENDED' to message

MVC MSGRLT1, MSGSUC... SUCCESSFUL text
MVC MSGRLT2, BLANK35
BAL R14, WTOSUB --> DO WTO
LA R14, 1 CONSTANT
AH R14, APITYPE ADD
STH R14, APITYPE STORE
CH R14, 'H'3' COMPARE
BE LOOP --> LETS DO IT AGAIN!

Return to Caller

L R13, 4(R13) RETURN (14, 12), T, RC=0

WTO SUB

LR R7, R14 SAVE RETURN REG
MVC MSGCMD, TYPE COPY COMMAND
WTO TEXT=MSG
BR R7 --> RETURN

SHUT SUB

LR R7, R14
MVC TYPE, MSHUTDOW MOVE 'SHUTDOW' TO MESSAGE

EZASMI TYPE=SHUTDOWN, Issue Macro X
S=S, STREAM X
HOW=HOW, End communication in both directions X
ERRNO=ERRNO, (Specify ERRNO field) X
RETCODE=RETCODE, (Specify RETCODE field) X
REQAREA=REQAREA, FOR EXITS (AND ECBS) X
ERROR=ERROR Abend if Macro error

BR R7 --> RETURN TO CALLER

ABEND PROGRAM AND GET DUMP TO DEBUG!
ERROR ABEND 1, DUMP
CNOP 2, 4
USES R6, R7, R8 RETCODE RETURNED IN RB
RC CHECK EQU *

Figure 72. EZASO6AC sample client program for IPv6 (Part 6 of 10)
COPY TO REAL RETURN REG
MVC MSGRSLT1,MSGSUCC ...SUCCESS TEXT

PLAIN CASE?
BE NOWAIT --> SKIP IT
MVC KEY+14(8),SUBTASK
MVC KEY+23(8),TYPE

MVC MSGRSLT1,MSGSUCC

MVI R8,R6 SAVE A COPY

MVC MSGRTCD

L R6,RETCODE CHECK FOR SUCCESSFUL CALL

MVI MSGRTCS,C'+'

MVC MSGRTCS,C'-' MOVE SIGN WHICH IS ALWAYS MINUS

MVC MSGERRT,MSGERRN ' ERRNO= ' ERRNOFMT

MVC MSGRSLT2(35),MSGRTCD

MVI MSGRTHX,X'40' CLEAR HEX INDICATOR

Figure 72. EZASO6AC sample client program for IPv6 (Part 7 of 10)
CLI  TRACE,0
BNE  NOTRACE
LR  R14,R7    GIVE HIM RETURN REG
B  WTO SUB    --> DO WTO
NOTRACE  EQU  *            --> RETURN TO CALLER

*  HOSTIDRC  EQU  *    VALID HOSTID MAY LOOK LIKE NEG. RC
C  R6,=F'-1'    ONLY -1 RC INDICATES FAILURE
BE  FAILMSG    ...BAD RC, USE STANDARD MSG
LR  R8,R6      ...NEXT CALL EXPECTS ADDR IN R8
MVC  MSGRSLT1,  MSGSUCC  ...SUCCESS TEXT
    HEXR(G9),RETCODE(S)  PLUS ONE FOR FAKE SIGN
    TR  HEXR(B),HEXTAB  ...CONVERT UNPK TO PRINTABLE HEX
    MVC  HEXR+(8),X'40'  ...SPACE OUT FAKED SIGN BYTE
    MVI  HEXRTHX,C'X'  ...INDICATE INFO IS HEX
B  ERRN0FMT

*  SYN Flag  DC  H'0'    DEFAULT TO SYN
TRACE  DC  H'0'    DEFAULT TO TRACE
MYEXIT  DC  A(MYEXIT1,SUBTASK)
MYEXIT1  SAVE (14,12),T,*
LR  R2,R15
USING  MYEXIT1,R2
LM  R8,R9,0(R1)  GET TWO TOKENS
MVC  EXKEY+14(8),0(R8)  TELL WHO
MVC  EXKEY+23(8),TYPE  TELL WHAT
EXKEY  WTO 'EXIT: XXXXXXX XXXXXXX'
POST  ECB,1
RETURN (14,12),T,RC=0
DROP  R2

*---------------------------------------------------------------------*
* ELEMENTS USED TO RUN PROGRAM                                        *
*---------------------------------------------------------------------*
EZASMGW  EZASMI  TYPE=GLOBAL, STORAGE DEFINITION FOR GWA
          X
          STORAGE=CSECT

* INITAPI macro parms *

*---------------------*
SUBTASK  DC  CLB'EZASO6AC'  SUBTASK PARM VALUE
IDENT  DC  0CL16'  '
         DC  CLB'TCPV32'  DEFAULT TO FIRST ONE AVAILABLE
         DC  CLB'EZASO6AC'  MY ADDR SPACE NAME OR JOBNAME
MAXSOC  DC  F'0'  (HIGHEST SOCKET DESCRIPTOR AVAILABLE)
MAXSOC  DC  AL2(50)  MAXSOC PARM VALUE
API TYPE  DC  H'2'  OR PUT A 3 HERE

* SOCKET macro parms *

*---------------------*
S  DC  H'0'  SOCKET DESCRIPTOR FOR STREAM

* CONNECT MACRO PARMS *

*---------------------*
CNOP  0,4
NAME  DC  0CL28'  '  SOCKET IPV6 NAME STRUCTURE

Figure 72. EZASO6AC sample client program for IPv6 (Part 8 of 10)
DC AL1(16) Address Length
DC AL1(19) Family
PORT DC H'0'
FLOWINFO DC XL4'00'
ADDRESS DC XL16'FF'
DC XL4'00' SCOPEID
ADDR DC XL16'00000000000000000000000000000001' Internet Address
PORTS DC H'11007'

*---------------------*
* WRITE MACRO PARMS *
*---------------------*
NBYTE DC F'50' SIZE OF BUFFER
BUF DC CL50' THIS IS FROM EZASO6AC! BUFFER FOR WRITE

*---------------------*
* SHUTDOWN MACRO PARMS *
*---------------------*
HOW DC F'2' END COMMUNICATION TO- AND FROM-SOCKET

*---------------------*
* READ MACRO PARMS *
*---------------------*
BUF2 DC CL50'BUF2' BUFFER FOR READ

*---------------------*
* MNTOP DC CLB'MNTOP '
MPTON DC CLB'MPTON '
MFADDR DC CLB'MFADDR '
MGADDR DC CLB'MGADDR '
MGNAMEI DC CLB'MGNAMEI '
MINITAPI DC CLB'MINITAPI '
MSOCKET DC CLB'MSOCKET '
MCONNECT DC CLB'MCONNECT '
MGETPEER DC CLB'MGETPEERN '
MREAD DC CLB'MREAD '
MWRITE DC CLB'MWRITE '
MSHUTDOW DC CLB'MSHUTDOW '
MTERMAPI DC CLB'MTERMAPI '
MSGSTART DC CLB'MSTART '
MSGEND DC CLB'ENDED '
MSGSUCC DC CL10'SUCCESS ' Command results...
MSGFAIL DC CL10'FAIL:- '...
MSGRETC DC CL10'RETCODE= '...
MSGERRN DC CL10'ERRNO= '...
MSGBUFF DC CL10'BUFFER: '...
BLANK35 DC CL35'

* MESSAGE AREA *
*---------------------*
MSG DC OF'0' MESSAGE AREA
DC AL2(MSGE-MSGNUM) LENGTH OF MESSAGE
MSGNUM DC CL10'EZASO6AC:' 'EZASO6AC: '
MSGCMD DC CLB' ' COMMAND ISSUED
MSGRSLT1 DC CL10' ' COMMAND RESULTS (SUCC, PASS, FAIL)
MSGRSLT2 DC CL35 ' RETURNED VALUES
MSGE EQU * End of message

*---------------------------------------------------------------------*
* MESSAGE AREA *
*---------------------*

Figure 72. EZASO6AC sample client program for IPv6 (Part 9 of 10)
Figure 72. EZASO6AC sample client program for IPv6 (Part 10 of 10)
Chapter 13. CALL instruction application programming interface

This section describes the CALL instruction API for IPv4 or IPv6 socket applications. The following topics are included:

- “Environmental restrictions and programming requirements”
- “CALL instruction application programming interface (API)” on page 454
- “Understanding COBOL, Assembler, and PL/I call formats” on page 455
- “Converting parameter descriptions” on page 456
- “Diagnosing problems in applications using the CALL instruction API” on page 456
- “Error messages and return codes” on page 457
- “Code CALL instructions” on page 457
- “Using data translation programs for socket call interface” on page 583
- “Call interface sample programs” on page 602

Environmental restrictions and programming requirements

The following restrictions apply to both the Macro Socket API and the Callable Socket API:

<table>
<thead>
<tr>
<th>Function</th>
<th>Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRB mode</td>
<td>These APIs can only be invoked in TCB mode (task mode).</td>
</tr>
<tr>
<td>Cross-memory mode</td>
<td>These APIs can only be invoked in a non-cross-memory environment (PASN=SASN=HASN).</td>
</tr>
<tr>
<td>Functional Recovery Routine (FRR)</td>
<td>Do not invoke these APIs with an FRR set. This causes system recovery routines to be bypassed and severely damage the system.</td>
</tr>
<tr>
<td>Locks</td>
<td>No locks should be held when issuing these calls.</td>
</tr>
<tr>
<td>INITAPI and TERMAPI socket commands</td>
<td>The INITAPI and TERMAPI socket commands must be issued under the same task.</td>
</tr>
<tr>
<td>Storage</td>
<td>Storage acquired for the purpose of containing data returned from a socket call must be obtained in the same key as the application program status word (PSW) at the time of the socket call.</td>
</tr>
<tr>
<td>Nested socket API calls</td>
<td>You cannot issue nested API calls within the same task. That is, if a request block (RB) issues a socket API call and is interrupted by an interrupt request block (IRB) in an STIMER exit, any additional socket API calls that the IRB attempts to issue are detected and flagged as errors.</td>
</tr>
</tbody>
</table>
Function | Restriction
--- | ---
Addressability mode (Amode) considerations | The EZASOKET API can be invoked while the caller is in either 31-bit or 24-bit Amode. However, if the application is running in 24-bit addressability mode at the time of the call, all addresses of parameters passed by the application must be addressable in 31-bit Amode. This implies that even if the addresses being passed reside in storage below the 16 MB line (and therefore addressable by 24-bit Amode programs) the high-order byte of these addresses needs to be 0.

Use of z/OS UNIX System Services | Address spaces using the EZASOKET API should not use any z/OS UNIX System Services socket API facilities such as z/OS UNIX Assembler Callable Services or Language Environment for z/OS C/C++. Doing so can yield unpredictable results.

### Output register information

When control returns to the caller, the general purpose registers (GPRs) contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-13</td>
<td>Unchanged</td>
</tr>
<tr>
<td>14</td>
<td>Used as a work register by the system</td>
</tr>
<tr>
<td>15</td>
<td>For synchronous calls, it contains the entry point address of EZBSOH03</td>
</tr>
</tbody>
</table>

When control returns to the caller, the access registers (ARs) contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-14</td>
<td>Unchanged</td>
</tr>
<tr>
<td>15</td>
<td>Used as a work register by the system</td>
</tr>
</tbody>
</table>

If a caller depends on register contents to remain the same before and after issuing a service, the caller must save the contents of a register before issuing the service and restore them after the system returns control.

### Compatibility considerations

Unless noted in [z/OS Communications Server: New Function Summary](https://www.ibm.com), an application program compiled and link edited on a release of z/OS Communications Server IP can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS Communications Server IP cannot be used on older releases. That is, the API is not downward compatible.

### CALL instruction application programming interface (API)

This section describes the CALL instruction API for TCP/IP application programs written in the COBOL, PL/I, or System/370 Assembler language. The format and parameters are described for each socket call.
Notes:
1. Unless your program is running in a CICS environment, reentrant code and multithread applications are not supported by this interface.
2. Only one copy of an interface can exist in a single address space.
3. For a PL/I program, include the following statement before your first call instruction.
```
DCL EZASOKET ENTRY OPTIONS(RETCODE,ASM,INTER) EXT;
```
4. The entry point for the CICS Sockets Extended module (EZASOKET) is within the EZACICAL module. Therefore EZACICAL should be included explicitly in your link-edit JCL. If not included, you could experience problems, such as the CICS region waiting for the socket calls to complete.

Understanding COBOL, Assembler, and PL/I call formats

This API is invoked by calling the EZASOKET program and performs the same functions as the C language calls. The parameters look different because of the differences in the programming languages.

**COBOL language call format**

The following is the ‘EZASOKET’ call format for COBOL language programs:

```
CALL 'EZASOKET' USING SOC-FUNCTION—parm1, parm2, ..—ERRNO,RETCODE.
```

**SOC-FUNCTION**

A 16-byte character field, left-justified and padded on the right with blanks. Set to the name of the call. SOC-FUNCTION is case specific. It must be in uppercase.

**parm**

A variable number of parameters depending on the type call.

**ERRNO**

If RETCODE is negative, there is an error number in ERRNO. This field is used in most, but not all, of the calls. It corresponds to the value returned by the tcerror() function in C.

**RETCODE**

A fullword binary variable containing a code returned by the EZASOKET call. This value corresponds to the normal return value of a C function.

**Assembler language call format**

The following is the EZASOKET call format for assembler language programs.

```
CALL EZASOKET,(SOC-FUNCTION,—parm1, parm2, ..—ERRNO,RETCODE),VL
```

**PL/I language call format**

The following is the EZASOKET call format for PL/I language programs:

```
CALL EZASOKET (SOC-FUNCTION—parm1, parm2, ..—ERRNO,RETCODE);
```

**SOC-FUNCTION**

A 16-byte character field, left-justified and padded on the right with blanks. Set to the name of the call.
**parm**

A variable number of parameters depending on the type call.

**ERRNO**

If RETCODE is negative, there is an error number in ERRNO. This field is used in most, but not all, of the calls. It corresponds to the value returned by the tcperror() function in C.

**RETCODE**

A fullword binary variable containing a code returned by the EZASOKET call. This value corresponds to the normal return value of a C function.

---

**Converting parameter descriptions**

The parameter descriptions in this information are written using the VS COBOL II PIC language syntax and conventions, but you should use the syntax and conventions that are appropriate for the language you want to use.

Figure 73 shows examples of storage definition statements for COBOL, PL/I, and assembler language programs.

**VS COBOL II PIC**

- PIC S9(4) BINARY
- PIC S9(8) BINARY
- PIC X(n)

**COBOL PIC**

- PIC S9(4) COMP
- PIC S9(8) BINARY
- PIC X(n)

**PL/I DECLARE STATEMENT**

- DCL HALF FIXED BIN(15),
- DCL FULL FIXED BIN(31),
- DCL CHARACTER CHAR(n)

**ASSEMBLER DECLARATION**

- DS H
- DS F
- DS Cln

---

**Diagnosing problems in applications using the CALL instruction API**

TCP/IP provides a trace facility that can be helpful in diagnosing problems in applications using the CALL instruction API. The trace is implemented using the TCP/IP Component Trace (CTRACE) SOCKAPI trace option. The SOCKAPI trace option allows all Call instruction socket API calls issued by an application to be traced in the TCP/IP CTRACE. The SOCKAPI trace records include information such as the type of socket call, input, and output parameters and return codes. This trace can be helpful in isolating failing socket API calls and in determining the nature of the error or the history of socket API calls that may be the cause of an error. For more information on the SOCKAPI trace option, refer to Communications Server: IP Diagnosis Guide.
Error messages and return codes


Code CALL instructions

This section contains the description, syntax, parameters, and other related information for each call instruction included in this API.

**ACCEPT**

A server issues the ACCEPT call to accept a connection request from a client. The call points to a socket that was previously created with a SOCKET call and marked by a LISTEN call.

The ACCEPT call is a blocking call. When issued, the ACCEPT call:

1. Accepts the first connection on a queue of pending connections.
2. Creates a new socket with the same properties as s, and returns its descriptor in RETCODE. The original sockets remain available to the calling program to accept more connection requests.
3. The address of the client is returned in NAME for use by subsequent server calls.

Notes:

1. The blocking or nonblocking mode of a socket affects the operation of certain commands. The default is blocking; nonblocking mode can be established by use of the FCNTL and IOCTL calls. When a socket is in blocking mode, an I/O call waits for the completion of certain events. For example, a READ call will block until the buffer contains input data. When an I/O call is issued:
   - If the socket is blocking, program processing is suspended until the event completes.
   - If the socket is nonblocking, program processing continues.
2. If the queue has no pending connection requests, ACCEPT blocks the socket unless the socket is in nonblocking mode. The socket can be set to nonblocking by calling FCNTL or IOCTL.
3. When multiple socket calls are issued, a SELECT call can be issued prior to the ACCEPT to ensure that a connection request is pending. Using this technique ensures that subsequent ACCEPT calls will not block.
4. TCP/IP does not provide a function for screening clients. As a result, it is up to the application program to control which connection requests it accepts, but it can close a connection immediately after discovering the identity of the client.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
### Parameter values set by the application

**SOC-FUNCTION**
A 16-byte character field containing ACCEPT. Left-justify the field and pad it on the right with blanks.

**S**
A halfword binary number specifying the descriptor of a socket that was previously created with a SOCKET call. In a concurrent server, this is the socket upon which the server listens.

### Parameter values returned to the application

**NAME**
An IPv4 socket address structure that contains the client’s socket address.

**FAMILY**
A halfword binary field specifying the IPv4 addressing family. The call returns the value decimal 2 for AF_INET.
PORT  A halfword binary field that is set to the client’s port number.

IP-ADDRESS
    A fullword binary field that is set to the 32-bit IPv4 Internet address, in network byte order, of the client’s host machine.

RESERVED
    Specifies 8 bytes of binary zeros. This field is required, but not used.

An IPv6 socket address structure that contains the client’s socket address.

FAMILY
    A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

PORT  A halfword binary field that is set to the client’s port number.

FLOWINFO
    A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
    A 16-byte binary field that is set to the 128-bit IPv6 Internet address, in network-byte-order, of the client’s host machine.

SCOPE-ID
    A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
    A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
    If the RETCODE value is positive, the RETCODE value is the new socket number.
    If the RETCODE value is negative, check the ERRNO field for an error number.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**BIND**

In a typical server program, the BIND call follows a SOCKET call and completes the process of creating a new socket.

The BIND socket command can specify the port or let the system choose the port.
A listener program should always bind to the same well-known port so that clients know the socket address to use when issuing a CONNECT, SENDTO, or SENDMSG request.

In addition to the port, the application also specifies an IP address on the BIND socket command. Most applications typically specify a value of 0 for the IP address, which allows these applications to accept new TCP connections or receive
UDP datagrams that arrive over any of the network interfaces of the local host.
This enables client applications to contact the application using any of the IP
addresses associated with the local host.

Alternatively, an application can indicate that it is only interested in receiving new
TCP connections or UDP datagrams that are targeted towards a specific IP address
associated with the local host. This can be accomplished by specifying the IP
address in the appropriate field of the socket address structure passed on the
NAME parameter.

**Note:** Even if an application specifies a value of 0 for the IP address on the BIND,
the system administrator can override that value by specifying the BIND
parameter on the PORT reservation statement in the TCP/IP profile. This
has a similar effect to the application specifying an explicit IP address on the
BIND CALL. For more information, refer to the z/OS Communications Server:
IP Configuration Reference

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 463.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 75 on page 461 shows an example of BIND call instructions.
**Parameter values set by the application**

**SOC-FUNCTION**
A 16-byte character field containing BIND. The field is left-justified and padded to the right with blanks.

**S**
A halfword binary number specifying the socket descriptor for the socket to be bound.

**NAME**

Specifies the IPv4 socket address structure for the socket that is to be bound.

**FAMILY**
A halfword binary field specifying the IPv4 addressing family. The value is always set to decimal 2, indicating AF_INET.

**PORT**
A halfword binary field that is set to the port number to which you want the socket to be bound.

*Note:* To determine the assigned port number, call the GETSOCKNAME command after calling the BIND command.

**IP-ADDRESS**
A fullword binary field that is set to the 32-bit IPv4 Internet address (network byte order) of the socket to be bound.

**RESERVED**
Specifies an 8-byte character field that is required but not used.

---

**WORKING-STORAGE SECTION.**

01 SOC-FUNCTION PIC X(16) VALUE IS 'BIND'.
01 S PIC 9(4) BINARY.

* IPv4 socket address structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 RESERVED PIC X(8).

* IPv6 socket address structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 FLOWINFO PIC 9(8) BINARY.
    03 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    03 SCOPE-ID PIC 9(8) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 9(8) BINARY.

**PROCEDURE DIVISION.**

CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.

*IPv4 socket address structure.*

01 NAME.
  03 FAMILY PIC 9(4) BINARY.
  03 PORT PIC 9(4) BINARY.
  03 IP-ADDRESS PIC 9(8) BINARY.

*IPv6 socket address structure.*

01 FAMILY PIC 9(4) BINARY.
01 PORT PIC 9(4) BINARY.
01 FLOWINFO PIC 9(8) BINARY.
01 IP-ADDRESS.
10 FILLER PIC 9(16) BINARY.
10 FILLER PIC 9(16) BINARY.
01 SCOPE-ID PIC 9(8) BINARY.
01 ERRNO PIC 9(8) BINARY.
01 RETCODE PIC 9(8) BINARY.

**Figure 75. BIND call instruction example**

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.
Specifies the IPv6 socket address structure for the socket that is to be bound.

**FAMILY**
A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

**PORT**
A halfword binary field that is set to the port number to which you want the socket to be bound.

*Note:* To determine the assigned port number, call the GETSOCKNAME command after calling the BIND command.

**FLOWINFO**
A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

**IP-ADDRESS**
A 16-byte binary field that is set to the 128-bit IPv6 Internet address (network byte order) of the socket to be bound.

**SCOPE-ID**
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

### Parameter values returned to the application

**ERRNO**
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

### CLOSE
The CLOSE call performs the following functions:

- The CLOSE call shuts down a socket and frees all resources allocated to it. If the socket refers to an open TCP connection, the connection is closed.
- The CLOSE call is also issued by a concurrent server after it gives a socket to a child server program. After issuing the GIVESOCKET and receiving notification that the client child has successfully issued a TAKESOCKET, the concurrent server issues the close command to complete the passing of ownership. In high-performance, transaction-based systems the timeout associated with the CLOSE call can cause performance problems. In such systems you should consider the use of a SHUTDOWN call before you issue the CLOSE call. See “SHUTDOWN” on page 573 for more information.
Notes:

1. If a stream socket is closed while input or output data is queued, the TCP connection is reset and data transmission may be incomplete. The SETSOCKOPT call can be used to set a linger condition, in which TCP/IP will continue to attempt to complete data transmission for a specified period of time after the CLOSE call is issued. See SO-LINGER in the description of SETSOCKOPT on page 561.

2. A concurrent server differs from an iterative server. An iterative server provides services for one client at a time; a concurrent server receives connection requests from multiple clients and creates child servers that actually serve the clients. When a child server is created, the concurrent server obtains a new socket, passes the new socket to the child server, and then dissociates itself from the connection. The CICS Listener is an example of a concurrent server.

3. After an unsuccessful socket call, a close should be issued and a new socket should be opened. An attempt to use the same socket with another call results in a nonzero return code.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 76 shows an example of CLOSE call instructions.

```plaintext
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'CLOSE'.
  01 S PIC 9(4) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 59(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S ERRNO RETCODE.
```

Figure 76. CLOSE call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION

A 16-byte field containing CLOSE. Left-justify the field and pad it on the right with blanks.
**S** A halfword binary field containing the descriptor of the socket to be closed.

**Parameter values returned to the application**

**ERRNO**
A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**CONNECT**
The CONNECT call is issued by a client to establish a connection between a local socket and a remote socket.

**Stream sockets**
For stream sockets, the CONNECT call is issued by a client to establish connection with a server. The call performs two tasks:
- It completes the binding process for a stream socket if a BIND call has not been previously issued.
- It attempts to make a connection to a remote socket. This connection is necessary before data can be transferred.

**UDP sockets**
For UDP sockets, a CONNECT call need not precede an I/O call, but if issued, it allows you to send messages without specifying the destination.

The call sequence issued by the client and server for stream sockets is:
1. The server issues BIND and LISTEN to create a passive open socket.
2. The client issues CONNECT to request the connection.
3. The server accepts the connection on the passive open socket, creating a new connected socket.

The blocking mode of the CONNECT call conditions its operation.
- If the socket is in blocking mode, the CONNECT call blocks the calling program until the connection is established, or until an error is received.
- If the socket is in nonblocking mode, the return code indicates whether the connection request was successful.
  - A 0 RETCODE indicates that the connection was completed.
  - A nonzero RETCODE with an ERRNO of 36 (EINPROGRESS) indicates that the connection is not completed, but since the socket is nonblocking, the CONNECT call returns normally.

The caller must test the completion of the connection setup by calling SELECT and testing for the ability to write to the socket.

The completion cannot be checked by issuing a second CONNECT. For more information, see “SELECT” on page 542.
The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 77 shows an example of CONNECT call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'CONNECT'.
  01 S PIC 9(4) BINARY.

  * IPv4 socket address structure.
    01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 RESERVED PIC X(8).

  * IPv6 socket address structure.
    01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 FLOWINFO PIC 9(8) BINARY.
    03 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    03 SCOPE-ID PIC 9(8) BINARY.
    01 ERRNO PIC 9(8) BINARY.
    01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

Figure 77. CONNECT call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

**Parameter values set by the application**

**SOC-FUNCTION**

A 16-byte field containing CONNECT. Left-justify the field and pad it on the right with blanks.

**S** A halfword binary number specifying the socket descriptor of the socket that is to be used to establish a connection.
NAME

An IPv4 socket address structure that contains the IPv4 socket address of the target to which the local, client socket is to be connected.

FAMILY

A halfword binary field specifying the IPv4 addressing family. The value must be decimal 2 for AF_INET.

PORT

A halfword binary field that is set to the server’s port number in network byte order. For example, if the port number is 5000 in decimal, it is stored as X’1388’ in hex.

IP-ADDRESS

A fullword binary field that is set to the 32-bit IPv4 Internet address of the server’s host machine in network byte order. For example, if the Internet address is 129.4.5.12 in dotted decimal notation, it would be represented as X’8104050C’ in hex.

RESERVED

 Specifies an 8-byte reserved field. This field is required, but is not used.

An IPv6 socket address structure that contains the IPv6 socket address of the target to which the local, client socket is to be connected.

FAMILY

A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is decimal 19 for AF_INET6.

PORT

A halfword binary field that is set to the server’s port number in network byte order. For example, if the port number is 5000 in decimal, it is stored as X’1388’ in hex.

FLOWINFO

A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS

A 16-byte binary field that is set to the 128-bit IPv6 Internet address of the server’s host machine in network byte order. For example, if the IPv6 Internet address is 12ab:0:0:cd30:123:4567:89ab:cedf in colon hex notation, it is set to X’12AB00000000CD30123456789ABCDEF’.

SCOPE-ID

A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, this field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.
RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

FCNTL
The blocking mode of a socket can either be queried or set to nonblocking using the FNDELAY flag described in the FCNTL call. You can query or set the FNDELAY flag even though it is not defined in your program.

See "ioctl" on page 513 for another way to control a socket’s blocking mode.

Values for commands that are supported by the z/OS UNIX Systems Services fcntl callable service will also be accepted. Refer to z/OS UNIX System Services Assembler Callable Services Reference for more information.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 78 shows an example of FCNTL call instructions.

```
WORKING-STORAGE SECTION
  01 SOC-FUNCTION PIC X(16) VALUE IS 'FCNTL'.
  01 S       PIC 9(4) BINARY.
  01 COMMAND PIC 9(8) BINARY.
  01 REQARG  PIC 9(8) BINARY.
  01 ERRNO   PIC 9(8) BINARY.
  01 RETCODE PIC 59(8) BINARY.

PROCEDURE DIVISION
  CALL 'EZASOKET' USING SOC-FUNCTION S COMMAND REQARG
                  ERRNO RETCODE.
```

Figure 78. FCNTL call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.
Parameter values set by the application

**SOC-FUNCTION**
A 16-byte character field containing FCNTL. The field is left-justified and padded on the right with blanks.

**S**
A halfword binary number specifying the socket descriptor for the socket that you want to unblock or query.

**COMMAND**
A fullword binary number with the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Query the blocking mode of the socket.</td>
</tr>
<tr>
<td>4</td>
<td>Set the mode to blocking or nonblocking for the socket.</td>
</tr>
</tbody>
</table>

**REQARG**
A fullword binary field containing a mask that TCP/IP uses to set the FNDELAY flag.

- If COMMAND is set to 3 ('query') the REQARG field should be set to 0.
- If COMMAND is set to 4 ('set')
  - Set REQARG to 4 to turn the FNDELAY flag on. This places the socket in nonblocking mode.
  - Set REQARG to 0 to turn the FNDELAY flag off. This places the socket in blocking mode.

Parameter values returned to the application

**ERRNO**
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following.

- If COMMAND was set to 3 (query), a bit string is returned.
  - If RETCODE contains X'00000004', the socket is nonblocking. (The FNDELAY flag is on.)
  - If RETCODE contains X'00000000', the socket is blocking. (The FNDELAY flag is off.)
- If COMMAND was set to 4 (set), a successful call is indicated by 0 in this field. In both cases, a RETCODE of −1 indicates an error (check the ERRNO field for the error number).

**FREEADDRINFO**
The FREEADDRINFO call frees all the address information structures returned by GETADDRINFO in the RES parameter.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 79 shows an example of FREEADDRINFO call instructions.

WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'FREEADDRINFO'.
  01 ADDRINFO PIC 9(8) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
CALL 'EZASOKET' USING SOC-FUNCTION ADDRINFO ERRNO RETCODE.

Figure 79. FREEADDRINFO call instruction example

Parameter values set by the application

Keyword Description
SOC-FUNCTION A 16-byte character field containing FREEADDRINFO. The field is left-justified and padded on the right with blanks.

ADDRINFO Input parameter. The address of a set of address information structures returned by the GETADDRINFO RES argument.

Parameter values returned to the application

Keyword Description
ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>–1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

GETADDRINFO

The GETADDRINFO call translates either the name of a service location (for example, a host name), a service name, or both, and returns a set of socket
addresses and associated information to be used in creating a socket with which to
address the specified service or sending a datagram to the specified service.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit</td>
<td>Task.</td>
</tr>
<tr>
<td>mode:</td>
<td></td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions</td>
</tr>
<tr>
<td></td>
<td>and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

[Figure 80 on page 471](#) shows an example of GETADDRINFO call instructions.
### Parameter values set by the application

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC-FUNCTION</td>
<td>A 16-byte character field containing GETADDRINFO. The field is left-justified and padded on the right with blanks.</td>
</tr>
<tr>
<td>NODE</td>
<td>An input parameter. Storage up to 255 bytes long that contains the host name being queried. If the AI-NUMERICHOST flag is specified in the storage pointed to by the HINTS field, then NODE should contain the queried host’s IP address in presentation form. This is an optional field but if specified you must also code the AI-ADDRCONFIG flag.</td>
</tr>
</tbody>
</table>
NODELEN. The NODE name being queried will consist of up to NODELEN or up to the first binary 0.

You can append scope information to the host name, using the format node%scope information. The combined information must be 255 bytes or less. For more information, see z/OS Communications Server: IPv6 Network and Application Design Guide.

**NODELEN**

An input parameter. A fullword binary field set to the length of the host name specified in the NODE field and should not include extraneous blanks. This is an optional field but if specified you must also code NODE.

**SERVICE**

An input parameter. Storage up to 32 bytes long that contains the service name being queried. If the AI-NUMERICSERV flag is specified in the storage pointed to by the HINTS field, then SERVICE should contain the queried port number in presentation form. This is an optional field but if specified you must also code SERVLEN. The SERVICE name being queried will consist of up to SERVLEN or up to the first binary 0.

**SERVLEN**

An input parameter. A fullword binary field set to the length of the service name specified in the SERVICE field and should not include extraneous blanks. This is an optional field but if specified you must also code SERVICE.

**HINTS**

An input parameter. If the HINTS argument is specified, it contains the address of an addrinfo structure containing input values that may direct the operation by providing options and limiting the returned information to a specific socket type, address family, or protocol. If the HINTS argument is not specified, then the information returned will be as if it referred to a structure containing the value 0 for the FLAGS, SOCTYPE and PROTO fields, and AF_UNSPEC for the AF field. Include the EZBREHST Resolver macro to enable your assembler program to contain the assembler mappings for the ADDR_INFO structure.

This is an optional field.

The address information structure has the following fields:

**Field**  **Description**

**FLAGS**

A fullword binary field. Must have the value of 0 of the bitwise, OR of one or more of the following:

- **AI-PASSIVE (X'00000001') or a decimal value of 1.**
  - Specifies how to fill in the NAME pointed to by the returned RES.
  - If this flag is specified, then the returned address information will be suitable for use in binding a socket for accepting incoming connections for the specified service (for example, the BIND call). In this case, if the NODE argument is not specified, then the IP address portion of the socket address structure pointed to by the returned RES will be set to INADDR_ANY for an IPv4 address or to the IPv6 unspecified address (in6addr_any) for an IPv6 address.
If this flag is not set, the returned address information will be suitable for the CONNECT call (for a connection-mode protocol) or for a CONNECT, SENDTO, or SENDMSG call (for a connectionless protocol). In this case, if the NODE argument is not specified, then the IP address portion of the socket address structure pointed to by the returned RES will be set to the default loopback address for an IPv4 address (127.0.0.0) or the default loopback address for an IPv6 address (::1).

- This flag is ignored if the NODE argument is specified.

**AI-CANONNAMEOK (X’00000002’) or a decimal value of 2.**

- If this flag is specified and the NODE argument is specified, then the GETADDRINFO call attempts to determine the canonical name corresponding to the NODE argument.

**AI-NUMERICHOST (X’00000004’) or a decimal value of 4.**

- If this flag is specified then the NODE argument must be a numeric host address in presentation form. Otherwise, an error of host not found [EAI_NONAME] is returned.

**AI-NUMERICSERV (X’00000008’) or a decimal value of 8.**

- If this flag is specified, the SERVICE argument must be a numeric port in presentation form. Otherwise, an error [EAI_NONAME] is returned.

**AI-V4MAPPED (X’00000010’) or a decimal value of 16.**

- If this flag is specified along with the AF field with the value of AF_INET6 or a value of AF_UNSPEC when IPv6 is supported, the caller will accept IPv4-mapped IPv6 addresses. When the AI-ALL flag is not also specified, if no IPv6 addresses are found, a query is made for IPv4 addresses. If IPv4 addresses are found, they are returned as IPv4-mapped IPv6 addresses.
- If the AF field does not have the value of AF_INET6 or the AF field contains AF_UNSPEC but IPv6 is not supported on the system, this flag is ignored.

**AI-ALL (X’00000020’) or a decimal value of 32.**

- When the AF field has a value of AF_INET and AI-ALL is set, the AI-V4MAPPED flag must also be set to indicate that the caller will accept all addresses (IPv6 and IPv4-mapped IPv6 addresses). When the AF field has a value of AF_UNSPEC when the system supports IPv6 and AI-ALL is set, the caller accepts IPv6 addresses and either IPv4 address (if AI-V4MAPPED is not set), or IPv4-mapped IPv6
addresses (if AI-V4MAPPED is set). A query is first made for IPv6 addresses and if successful, the IPv6 addresses are returned. Another query is then made for IPv4 addresses, and any IPv4 addresses found are returned as either IPv4-mapped IPv6 addresses (if AI-V4MAPPED is also specified), or as IPv4 addresses (if AI-V4MAPPED is not specified).

- If the AF field does not have the value of AF_INET6 or does not have the value of AF_UNSPEC when the system supports IPv6, this flag is ignored.

**AI-ADDRCONFIG (X'00000040') or a decimal value of 64.**

If this flag is specified, then a query on the name in NODE will occur if the Resolver determines whether either of the following is true:

- If the system is IPv6 enabled and has at least one IPv6 interface, then the Resolver will make a query for IPv6 (AAAA or A6 DNS) records.
- If the system is IPv4 enabled and has at least one IPv4 interface, then the Resolver will make a query for IPv4 (A DNS) records.

The loopback address is not considered in this case as a valid interface.

**Note:** To perform the binary OR'ing of the flags above in a COBOL program, simply add the necessary COBOL statements as in the example below. Note that the value of the FLAGS field after the COBOL ADD is a decimal 80 or a X'00000050', which is the sum of OR'ing AI_V4MAPPED and AI_ADDRCONFIG or X'00000010' and X'00000040':

```cobol
01 AI-V4MAPPED PIC 9(8) BINARY VALUE 16.
01 AI-ADDRCONFIG PIC 9(8) BINARY VALUE 64.

ADD AI-V4MAPPED TO FLAGS.
ADD AI-ADDRCONFIG TO FLAGS.
```

**AF**

A fullword binary field. Used to limit the returned information to a specific address family. The value of AF_UNSPEC means that the caller will accept any protocol family. The value of a decimal 0 indicates AF_UNSPEC. The value of a decimal 2 indicates AF_INET, and the value of a decimal 19 indicates AF_INET6.

**SOCTYPE**

A fullword binary field. Used to limit the returned information to a specific socket type. A value of 0 means that the caller will accept any socket type. If a specific socket type is not given (for example, a value of 0) then information on all supported socket types will be returned.
The following are the acceptable socket types:

<table>
<thead>
<tr>
<th>Type name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCK_STREAM</td>
<td>1</td>
<td>for stream socket</td>
</tr>
<tr>
<td>SOCK_DGRAM</td>
<td>2</td>
<td>for datagram socket</td>
</tr>
<tr>
<td>SOCK_RAW</td>
<td>3</td>
<td>for raw-protocol interface</td>
</tr>
</tbody>
</table>

Anything else will fail with return code EAI_SOCTYPE. Note that although SOCK_RAW will be accepted, it will only be valid when SERVICE is numeric (for example, SERVICE=23). A lookup for a SERVICE name will never occur in the appropriate services file (for example, hlq.ETC.SERVICES) using any protocol value other than SOCK_STREAM or SOCK_DGRAM.

If PROTO is not 0 and SOCTYPE is 0, then the only acceptable input values for PROTO are IPPROTO_TCP and IPPROTO_UDP. Otherwise, the GETADDRINFO call will be failed with return code of EAI_BADFLAGS.

If SOCTYPE and PROTO are both specified as 0, then GETADDRINFO will proceed as follows:

- If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos will default to a specification of SOCTYPE as SOCK_STREAM.
- If SERVICE is specified as a service name (for example, SERVICE=FTP), the GETADDRINFO call will search the appropriate services file (for example, hlq.ETC.SERVICES) twice. The first search will use SOCK_STREAM as the protocol, and the second search will use SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both SOCTYPE and PROTO are specified as nonzero, then they should be compatible, regardless of the value specified by SERVICE. In this context, compatible means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE is specified as SOCK_RAW, in which case PROTO can be anything

PROTO

A fullword binary field. Used to limit the returned information to a specific protocol. A value of 0 means that the caller will accept any protocol.

The following are the acceptable protocols:

<table>
<thead>
<tr>
<th>Protocol name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPPROTO_TCP</td>
<td>6</td>
<td>TCP</td>
</tr>
<tr>
<td>IPPROTO_UDP</td>
<td>17</td>
<td>user datagram</td>
</tr>
</tbody>
</table>

If SOCTYPE is 0 and PROTO is nonzero, the only acceptable input values for PROTO are IPPROTO_TCP and
IPPROTO_UDP. Otherwise, the GETADDRINFO call will be failed with return code of EAI_BADFLAGS.

If PROTO and SOCTYPE are both specified as 0, then GETADDRINFO will proceed as follows:

- If SERVICE is null, or if SERVICE is numeric, then any returned addrinfos will default to a specification of SOCTYPE as SOCK_STREAM.
- If SERVICE is specified as a service name (for example, SERVICE=FTP), the GETADDRINFO will search the appropriate services file (for example, hlq.ETC.SERVICE) twice. The first search will use SOCK_STREAM as the protocol, and the second search will use SOCK_DGRAM as the protocol. No default socket type provision exists in this case.

If both PROTO and SOCTYPE are specified as nonzero, they should be compatible, regardless of the value specified by SERVICE. In this context, compatible means one of the following:

- SOCTYPE=SOCK_STREAM and PROTO=IPPROTO_TCP
- SOCTYPE=SOCK_DGRAM and PROTO=IPPROTO_UDP
- SOCTYPE=SOCK_RAW, in which case PROTO can be anything

If the lookup for the value specified in SERVICE fails [for example, the service name does not appear in an appropriate service file (such as, hlq.ETC.SERVICES) using the input protocol], then the GETADDRINFO call will be failed with return code of EAI_SERVICE.

| NAMELEN | A fullword binary field. On input, this field must be 0. |
| CANONNAME | A fullword binary field. On input, this field must be 0. |
| NAME | A fullword binary field. On input, this field must be 0. |
| NEXT | A fullword binary field. On input, this field must be 0. |
| RES | Initially a fullword binary field. On a successful return, this field contains a pointer to a chain of one or more address information structures. The structures are allocated in the key of the calling application. Do not use or reference these structures between MVS tasks. When you are finished using the structures, explicitly free their storage by specifying the returned pointer on a FREEADDRINFO call; storage that is not explicitly freed is released when the task is ended. |

The address information structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLAGS</td>
<td>A fullword binary field that is not used as output.</td>
</tr>
<tr>
<td>AF</td>
<td>A fullword binary field. The value returned in this field</td>
</tr>
</tbody>
</table>
may be used as the AF argument on the SOCKET call to create a socket suitable for use with the returned address NAME.

SOCTYPE
A fullword binary field. The value returned in this field may be used as the SOCTYPE argument on the SOCKET call to create a socket suitable for use with the returned address NAME.

PROTO
A fullword binary field. The value returned in this field may be used as the PROTO argument on the SOCKET call to create a socket suitable for use with the returned address ADDR.

NAMELEN
A fullword binary field. The length of the NAME socket address structure. The value returned in this field may be used as the arguments for the CONNECT or BIND call with such a socket, according to the AI-PASSIVE flag.

CANONNAME
A fullword binary field. The canonical name for the value specified by NODE. If the NODE argument is specified, and if the AI-CANONNAMEOK flag was specified by the HINTS argument, then the CANONNAME field in the first returned address information structure will contain the address of storage containing the canonical name corresponding to the input NODE argument. If the canonical name is not available, then the CANONNAME field will refer to the NODE argument or a string with the same contents. The CANNLEN field will contain the length of the returned canonical name.

NAME
A fullword binary field. The address of the returned socket address structure. The value returned in this field may be used as the arguments for the CONNECT or BIND call with such a socket, according to the AI-PASSIVE flag.

NEXT
A fullword binary field. Contains the address of the next address information structure on the list, or 0's if it is the last structure on the list.

CANNLEN
Initially an input parameter. A fullword binary field used to contain the length of the canonical name returned by the RES CANONNAME field. This is an optional field.

ERRNO
Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
</tbody>
</table>
Check ERRNO for an error code.

The ADDRINFO structure uses indirect addressing to return a variable number of NAMES. If you are coding in PL/I or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC09 to simplify interpretation of the information returned by the GETADDRINFO calls.

**GETCLIENTID**

GETCLIENTID call returns the identifier by which the calling application is known to the TCP/IP address space in the calling program. The CLIENT parameter is used in the GIVESOCKET and TAKESOCKET calls. See “GIVESOCKET” on page 509 for a discussion of the use of GIVESOCKET and TAKESOCKET calls.

Do not be confused by the terminology; when GETCLIENTID is called by a server, the identifier of the caller (not necessarily the client) is returned.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 81 shows an example of GETCLIENTID call instructions.

```
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'GETCLIENTID'.
   01 CLIENT.
      03 DOMAIN PIC 9(B) BINARY.
      03 NAME PIC X(8).
      03 TASK PIC X(8).
      03 RESERVED PIC X(20).
   01 ERRNO PIC 9(B) BINARY.
   01 RETCODE PIC S9(B) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION CLIENT ERRNO RETCODE.
```

Figure 81. GETCLIENTID call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETCLIENTID. The field is left-justified and padded to the right with blanks.

Parameter values returned to the application

CLIENT
A client-ID structure that describes the application that issued the call.

DOMAIN
This is a fullword binary number specifying the domain of the client. On input this is an optional parameter for AF_INET, and required parameter for AF_INET6 to specify the domain of the client. For TCP/IP the value is a decimal 2, indicating AF_INET, or a decimal 19, indicating AF_INET6. On output, this is the returned domain of the client.

NAME
An 8-byte character field set to the caller’s address space name.

TASK
An 8-byte field set to the task identifier of the caller.

RESERVED
Specifies 20-byte character reserved field. This field is required, but not used.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

GETHOSTBYADDR
The GETHOSTBYADDR call returns the domain name and alias name of a host whose IPv4 Internet address is specified in the call. A given TCP/IP host can have multiple alias names and multiple host IPv4 Internet addresses. The address resolution attempted depends on how the resolver is configured and if any local host tables exist. Refer to the z/OS Communications Server: IP Configuration Guide for information about configuring the resolver and how local host tables can be used.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
ASC mode: Primary address space control (ASC) mode.
Interrupt status: Enabled for interrupts.
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 82 shows an example of GETHOSTBYADDR call instructions.

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTBYADDR. The field is left-justified and padded on the right with blanks.

HOSTADDR
A fullword binary field set to the Internet address (specified in network byte order) of the host whose name is being sought. See “Appendix B, Return codes,” on page 833 for information about ERRNO return codes.

Parameter values returned to the application

HOSTENT
A fullword containing the address of the HOSTENT structure.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

GETHOSTBYADDR returns the HOSTENT structure shown in Figure 83 on page 481.
GETHOSTBYADDR returns the HOSTENT structure shown in Figure 83. The HOSTENT structure is a task’s serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name that is returned by the call. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by the call. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 for AF_INET.
- The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 for AF_INET.
- The address of a list of addresses that point to the host Internet addresses returned by the call. The list is ended by the pointer X'00000000'. If the call cannot be resolved, the HOSTENT structure contains the ERRNO 10214.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses. If you are coding in PL/I or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC08 to simplify interpretation of the information returned by the GETHOSTBYADDR and GETHOSTBYNAME calls. For more information about EZACIC08, see "EZACIC08" on page 590.
GETHOSTBYNAME

The GETHOSTBYNAME call returns the alias name and the IPv4 Internet address of a host whose domain name is specified in the call. A given TCP/IP host can have multiple alias names and multiple host IPv4 Internet addresses.

The name resolution attempted depends on how the resolver is configured and if any local host tables exist. Refer to the z/OS Communications Server: IP Configuration Guide for information about configuring the resolver and how local host tables can be used.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state. The PSW key must match the key in which the MVS application task was attached.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 84 shows an example of GETHOSTBYNAME call instructions.

```assembly
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'GETHOSTBYNAME'.
  01 NAMELEN PIC 9(8) BINARY.
  01 NAME PIC X(255).
  01 HOSTENT PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION NAMELEN NAME HOSTENT RETCODE.
```

Figure 84. GETHOSTBYNAME call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

**Parameter values set by the application**

**SOC-FUNCTION**

A 16-byte character field containing GETHOSTBYNAME. The field is left-justified and padded on the right with blanks.

**NAMELEN**

A value set to the length of the host name. The maximum length is 255.

**NAME**

A character string, up to 255 characters, set to a host name. Any trailing
blanks will be removed from the specified name prior to trying to resolve it to an IP address. This call returns the address of the HOSTENT structure for this name.

**Parameter values returned to the application**

**HOSTENT**

A fullword binary field that contains the address of the HOSTENT structure.

**RETCODE**

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

---

*Figure 85. HOSTENT structure returned by the GETHOSTBYNAME call*

GETHOSTBYNAME returns the HOSTENT structure shown in Figure 85. The HOSTENT structure is a tasks’s serially reusable storage area. It should not be used or referenced between MVS tasks. The storage is freed when the task terminates. The assembler mapping of the structure is defined in macro EZBREHST, which is installed in the data set specified on your SMP/E DDDEF for MACLIB. This structure contains:

- The address of the host name that is returned by the call. The name length is variable and is ended by X'00'.
- The address of a list of addresses that point to the alias names returned by the call. This list is ended by the pointer X'00000000'. Each alias name is a variable length field ended by X'00'.
- The value returned in the FAMILY field is always 2 for AF_INET.
The length of the host Internet address returned in the HOSTADDR_LEN field is always 4 for AF_INET.

The address of a list of addresses that point to the host Internet addresses returned by the call. The list is ended by the pointer X'00000000'. If the call cannot be resolved, the HOSTENT structure contains the ERRNO 10214.

The HOSTENT structure uses indirect addressing to return a variable number of alias names and Internet addresses. If you are coding in PL/1 or assembler language, this structure can be processed in a relatively straight-forward manner. If you are coding in COBOL, this structure may be difficult to interpret. You can use the subroutine EZACIC08 to simplify interpretation of the information returned by the GETHOSTBYADDR and GETHOSTBYNAME calls. For more information about EZACIC08, see “EZACIC08” on page 590.

GETHOSTID

The GETHOSTID call returns the 32-bit Internet address for the current host.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 86 shows an example of GETHOSTID call instructions.

```
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'GETHOSTID'.
   01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION RETCODE.
```

Figure 86. GETHOSTID call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION

A 16-byte character field containing GETHOSTID. The field is left-justified and padded on the right with blanks.

RETCODE

Returns a fullword binary field containing the 32-bit Internet address of the host. There is no ERRNO parameter for this call.
GETHOSTNAME

The GETHOSTNAME call returns the domain name of the local host.

Note: The host name returned is the host name the TCPIP stack learned at startup from the TCP/IP.DAT file that was found.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization: Supervisor state or problem state</td>
<td>Amode: 31-bit or 24-bit.</td>
</tr>
<tr>
<td>Dispatchable unit mode: Task.</td>
<td>ASC mode: Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Cross memory mode: PASN = HASN.</td>
<td>Interrupt status: Enabled for interrupts.</td>
</tr>
<tr>
<td>Amode:</td>
<td>Locks: Unlocked.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under &quot;Environmental restrictions and programming requirements&quot; on page 453.</td>
<td>Control parameters: All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 87 shows an example of GETHOSTNAME call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE 'GETHOSTNAME'.
  01 NAMELEN PIC 9(8) BINARY.
  01 NAME PIC X(24).
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION NAMELEN NAME ERRNO RETCODE.
```

Figure 87. GETHOSTNAME call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETHOSTNAME. The field is left-justified and padded on the right with blanks.

NAMELEN
A fullword binary field set to the length of the NAME field.

Parameter values returned to the application

NAME
Indicates the receiving field for the host name. TCP/IP Services allows a maximum length of 24 characters. The Internet standard is a maximum name length of 255 characters. The actual length of the NAME field is found in NAMELEN.
ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

GETIBMOPT
The GETIBMOPT call returns the number of TCP/IP images installed on a given MVS system and their status, versions, and names.

Note: Images from pre-V3R2 releases of TCP/IP Services are excluded. The GETIBMOPT call is not meaningful for pre-V3R2 releases. With this information, the caller can dynamically choose the TCP/IP image with which to connect by using the INITAPI call. The GETIBMOPT call is optional. If it is not used, follow the standard method to determine the connecting TCP/IP image:

- Connect to the TCP/IP specified by TCPIPJOBNAME in the active TCPIP.DATA file.
- Locate TCPIP.DATA using the search order described in the z/OS Communications Server: IP Configuration Reference.

For detailed information about the standard method, refer to z/OS Communications Server: New Function Summary.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>ASC mode:</th>
<th>Primary address space control (ASC) mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 88 on page 487 shows an example of GETIBMOPT call instructions.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETIBMOPT. The field is left-justified and padded on the right with blanks.

COMMAND
A value or the address of a fullword binary number specifying the command to be processed. The only valid value is 1.

Parameter values returned to the application

BUF
A 100-byte buffer into which each active TCP/IP image status, version, and name are placed.

On successful return, these buffer entries contain the status, names, and versions of up to eight active TCP/IP images. The following layout shows the BUF field upon completion of the call.

The NUM IMAGES field indicates how many entries of TCP_IMAGE are included in the total BUF field. If the NUM IMAGES returned is 0, there are no TCP/IP images present.

The status field can have a combination of the following information:

<table>
<thead>
<tr>
<th>Status field</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>X'8xxx'</td>
<td>Active</td>
</tr>
<tr>
<td>X'4xxx'</td>
<td>Terminating</td>
</tr>
<tr>
<td>X'2xxx'</td>
<td>Down</td>
</tr>
<tr>
<td>X'1xxx'</td>
<td>Stopped or stopping</td>
</tr>
</tbody>
</table>

Note: In the above status fields, xxx is reserved for IBM use and can contain any value.

When the status field is returned with a combination of Down and Stopped, TCP/IP abended. Stopped, when returned alone, indicates that TCP/IP was stopped.

The version field is:

<table>
<thead>
<tr>
<th>Version</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP/IP z/OS Communications Server V1R2</td>
<td>X'0612'</td>
</tr>
</tbody>
</table>
### Version Field

| TCP/IP z/OS Communications Server V1R4 | X'0614' |
| TCP/IP z/OS Communications Server V1R5 | X'0615' |
| TCP/IP z/OS Communications Server V1R6 | X'0616' |
| TCP/IP z/OS Communications Server V1R7 | X'0617' |
| TCP/IP z/OS Communications Server V1R8 | X'0618' |
| TCP/IP z/OS Communications Server V1R9 | X'0619' |

The name field is the PROC name, left-justified, and padded with blanks.

### NUM_IMAGES

<table>
<thead>
<tr>
<th>Status (2 bytes)</th>
<th>Version (2 bytes)</th>
<th>Name (8 bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Figure 89. Example of name field

### ERRNO

A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

### RETCODE

A fullword binary field with the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>Call returned error. See ERRNO field.</td>
</tr>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
</tbody>
</table>

### GETNAMEINFO

The GETNAMEINFO call returns the node name and service location of a socket address that is specified in the call. On successful completion, GETNAMEINFO returns the node and service named, if requested, in the buffers provided.
The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td></td>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>
Parameter values set by the application

Keyword Description

SOC-FUNCTION
A 16-byte character field containing GETNAMEINFO. The field is left-justified and padded on the right with blanks.

NAME
An input parameter. A socket address structure to be translated which has the following fields:

The IPv4 socket address structure must specify the following fields:

Field Description
FAMILY
A halfword binary number specifying the IPv4 addressing family. For TCP/IP the value is a decimal 2, indicating AF_INET.

PORT A halfword binary number specifying the port number.

IP-ADDRESS A fullword binary number specifying the 32-bit IPv4 Internet address.

RESERVED An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure specifies the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>A halfword binary field specifying the IPv6 addressing family. For TCP/IP the value is a decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>A halfword binary number specifying the port number.</td>
</tr>
<tr>
<td>FLOWINFO</td>
<td>A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td>IP-ADDRESS</td>
<td>A 16-byte binary field specifying the 128-bit IPv6 Internet address, in network byte order.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field that identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link-local scope, IPv6-ADDRESS, SCOPE-ID contains the interface index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined and is ignored by the resolver.</td>
</tr>
</tbody>
</table>

NAMELEN An input parameter. A fullword binary field. The length of the socket address structure pointed to by the NAME argument.

HOST On input, storage capable of holding the returned resolved host name, which may be up to 255 bytes long, for the input socket address. If inadequate storage is specified to contain the resolved host name, then the resolver will return the host name up to the storage specified and truncation may occur. If the host's name cannot be located, the numeric form of the host’s address is returned instead of its name. However, if the NI_NAMEREQD option is specified and no host name is located then an error is returned. This is an optional field, but if you specify it, you also must code HOSTLEN. One or both of the following groups of parameters are required:
- The HOST and HOSTLEN parameters
- The SERVICE and SERVLEN parameters
Otherwise, an error occurs.
If the IPv6-ADDRESS value is a link-local address, and the
SCOPE-ID interface index is nonzero, scope information is
appended to the resolved host name using the format host\%scope
information. The scope information can be either the numeric form
of the SCOPE-ID interface index or the interface name associated
with the SCOPE-ID interface index. Use the NI_NUMERICSCOPE
option to select which form should be returned. The combined host
name and scope information will still be at most 255 bytes long.
For more information about scope information and
GETNAMEINFO processing, see z/OS Communications Server: IPv6
Network and Application Design Guide

HOSTLEN An output parameter. A fullword binary field that contains the
length of the host storage used to contain the returned resolved
host name. The HOSTLEN value must be equal to or greater than
the length of the longest host name, or host name and scope
information combination, to be returned. The GETNAMEINFO call
returns the host name, or host name and scope information
combination, up to the length specified by the HOSTLEN value.
On output, the HOSTLEN value contains the length of the
returned resolved host name or host name and scope information
combination. If HOSTLEN is 0 on input, then the resolved host
name is not returned. This is an optional field but if specified you
must also code the HOST value. One or both of the following
groups of parameters are required:
  • The HOST and HOSTLEN parameters
  • The SERVICE and SERVLEN parameters
Otherwise, an error occurs.

SERVICE On input, storage capable of holding the returned resolved service
name, which may be up to 32 bytes long, for the input socket
address. If inadequate storage is specified to contain the resolved
service name, then the resolver will return the service name up to
the storage specified and truncation may occur. If the service name
cannot be located, or if NI_NUMERICSERV was specified in the
FLAGS operand, then the numeric form of the service address is
returned instead of its name. This is an optional field, but if you
specify it, you also must code the SERVLEN value. One or both of
the following groups of parameters are required:
  • The HOST and HOSTLEN parameters
  • The SERVICE and SERVLEN parameters
Otherwise, an error occurs.

SERVLEN An output parameter. A fullword binary field. The length of the
SERVICE storage used to contain the returned resolved service
name. SERVLEN must be equal to or greater than the length of the
longest service name to be returned. GETNAMEINFO will return
the service name up to the length specified by SERVLEN. On
output, SERVLEN will contain the length of the returned resolved
service name. If SERVLEN is 0 on input, then the service name
information will not be returned. This is an optional field, but if
you specify it, you also must code the SERVICE value. One or both
of the following groups of parameters are required:
  • The HOST and HOSTLEN parameters
  • The SERVICE and SERVLEN parameters
Otherwise, an error occurs.

**FLAGS**

An input parameter. A fullword binary field. This is an optional field. The FLAGS field must contain either a binary or decimal value, depending on the programming language used:

<table>
<thead>
<tr>
<th>Flag name</th>
<th>Binary value</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'NI_NOFQDN'</td>
<td>X'00000001'</td>
<td>1</td>
<td>Return the NAME portion of the fully qualified domain name.</td>
</tr>
<tr>
<td>'NI_NUMERICHOST'</td>
<td>X'00000002'</td>
<td>2</td>
<td>Only return the numeric form of host’s address.</td>
</tr>
<tr>
<td>'NI_NAMEREQD'</td>
<td>X'00000004'</td>
<td>4</td>
<td>Return an error if the host’s name cannot be located.</td>
</tr>
<tr>
<td>'NI_NUMERICSERV'</td>
<td>X'00000008'</td>
<td>8</td>
<td>Only return the numeric form of the service address.</td>
</tr>
<tr>
<td>'NI_DGRAM'</td>
<td>X'00000010'</td>
<td>16</td>
<td>Indicates that the service is a datagram service. The default behavior is to assume that the service is a stream service.</td>
</tr>
<tr>
<td>'NI_NUMERICSCOPE'</td>
<td>X'00000020'</td>
<td>32</td>
<td>Only return the numeric form of the scope information, when applicable</td>
</tr>
</tbody>
</table>

**ERRNO**

Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**

Output parameter. A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**GETPEERNAME**

The GETPEERNAME call returns the name of the remote socket to which the local socket is connected.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>
Figure 91 shows an example of GETPEERNAME call instructions.

WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'GETPEERNAME'.
  01 S PIC 9(4) BINARY.

* IPv4 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 RESERVED PIC X(8).

* IPv6 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 FLOWINFO PIC 9(8) BINARY.
    03 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    03 SCOPE-ID PIC 9(8) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.

Figure 91. GETPEERNAME call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETPEERNAME. The field is left-justified and padded on the right with blanks.

S A halfword binary number set to the socket descriptor of the local socket connected to the remote peer whose address is required.

Parameter Values Returned to the Application

NAME
An IPv4 socket address structure to contain the peer name. The structure that is returned is the socket address structure for the remote socket connected to the local socket specified in field S.

FAMILY
A halfword binary field containing the connection peer’s IPv4 addressing family. The call always returns the value decimal 2, indicating AF_INET.

PORT A halfword binary field set to the connection peer’s port number.

IP-ADDRESS
A fullword binary field set to the 32-bit IPv4 Internet address of the connection peer’s host machine.

RESERVED
Specifies an 8-byte reserved field. This field is required, but not used.
An IPv6 socket address structure to contain the peer name. The structure that is returned is the socket address structure for the remote socket that is connected to the local socket specified in field S.

**FAMILY**
A halfword binary field containing the connection peer’s IPv6 addressing family. The call always returns the value decimal 19, indicating AF_INET6.

**PORT**
A halfword binary field set to the connection peer’s port number.

**FLOWINFO**
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

**IP-ADDRESS**
A 16-byte binary field set to the 128-bit IPv6 Internet address of the connection peer’s host machine.

**SCOPE-ID**
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

**ERRNO**
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**GETSOCKNAME**
The GETSOCKNAME call returns the address currently bound to a specified socket. If the socket is not currently bound to an address, the call returns with the FAMILY field set, and the rest of the structure set to 0.

Since a stream socket is not assigned a name until after a successful call to either BIND, CONNECT, or ACCEPT, the GETSOCKNAME call can be used after an implicit bind to discover which port was assigned to the socket.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 92 shows an example of GETSOCKNAME call instructions.

```
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'GETSOCKNAME'.
   01 S PIC 9(4) BINARY.

   * IPv4 socket address structure.
     01 NAME.
     03 FAMILY PIC 9(4) BINARY.
     03 PORT PIC 9(4) BINARY.
     03 IP-ADDRESS PIC 9(8) BINARY.
     03 RESERVED PIC X(8).

   * IPv6 socket address structure.
     01 NAME.
     03 FAMILY PIC 9(4) BINARY.
     03 PORT PIC 9(4) BINARY.
     03 FLOWINFO PIC 9(8) BINARY.
     03 IP-ADDRESS.
     10 FILLER PIC 9(16) BINARY.
     10 FILLER PIC 9(16) BINARY.
     03 SCOPE-ID PIC 9(8) BINARY.
     01 ERRNO PIC 9(8) BINARY.
     01 RETCODE PIC 59(8) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION S NAME ERRNO RETCODE.
```

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
   A 16-byte character field containing GETSOCKNAME. The field is left-justified and padded on the right with blanks.

S
   A halfword binary number set to the descriptor of a local socket whose address is required.

Parameter values returned to the application

NAME
   Specifies the IPv4 socket address structure returned by the call.

FAMILY
   A halfword binary field containing the IPv4 addressing family. The call always returns the value decimal 2, indicating AF_INET.

PORT
   A halfword binary field set to the port number bound to this socket. If the socket is not bound, 0 is returned.

IP-ADDRESS
   A fullword binary field set to the 32-bit Internet address of the local host machine.
RESERVED
Specifies 8 bytes of binary 0s. This field is required but not used.

NAME
Specifies the IPv6 socket address structure returned by the call.

FAMILY
A halfword binary field containing the IPv6 addressing family. The call always returns the value decimal 19, indicating AF_INET6.

PORT
A halfword binary field set to the port number bound to this socket. If the socket is not bound, 0 is returned.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16 byte binary field set to the 128-bit IPv6 Internet address in network byte order, of the local host machine.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See.Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

GETSOCKOPT
The GETSOCKOPT call queries the options that are set by the SETSOCKOPT call.

Several options are associated with each socket. These options are described below. You must specify the option to be queried when you issue the GETSOCKOPT call.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>ASC mode:</th>
<th>Primary address space control (ASC) mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
</tbody>
</table>
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 93 shows an example of GETSOCKOPT call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'GETSOCKOPT'.
  01 S PIC 9(4) BINARY.
  01 OPTNAME PIC 9(8) BINARY.
    01 OPTVAL PIC 9(8) BINARY.
    IF OPNAME = SO-LINGER then
    01 OPTVAL PIC X(16). 
    01 OPTLEN PIC 9(8) BINARY.
    01 ERRNO PIC 9(8) BINARY.
    01 RETCODE PIC 9(8) BINARY.
PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S OPTNAME
        OPTVAL OPTLEN ERRNO RETCODE.
```

Figure 93. GETSOCKOPT call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GETSOCKOPT. The field is left-justified and padded on the right with blanks.

S A halfword binary number specifying the socket descriptor for the socket requiring options.

OPTNAME
Set OPTNAME to the required option before you issue GETSOCKOPT. See the following table for a list of the options and their unique requirements.

See Appendix D, “GETSOCKOPT/SETSOCKOPT command values,” on page 863 for the numeric values of OPTNAME.

Note: COBOL programs cannot contain field names with the underbar character. Fields representing the option name should contain dashes instead.

OPTLEN
Input parameter. A fullword binary field containing the length of the data returned in OPTVAL. See the following table for determining on what to base the value of OPTLEN.

Parameter values returned to the application

OPTVAL
For the GETSOCKOPT API, OPTVAL will be an output parameter. See the following table for a list of the options and their unique requirements.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an
error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT**

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP_ADD_MEMBERSHIP</td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td>IP_ADD_SOURCE_MEMBERSHIP</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
<td>N/A</td>
</tr>
<tr>
<td>IP_BLOCK_SOURCE</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
<td>N/A</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>IP_DROP_MEMBERSHIP</strong></td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group.</td>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ.</td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IP_DROP_SOURCE_MEMBERSHIP</strong></td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a source multicast group.</td>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.</td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IP_MULTICAST_IF</strong></td>
<td>A 4-byte binary field containing an IPv4 interface address.</td>
<td>A 4-byte binary field containing an IPv4 interface address.</td>
</tr>
<tr>
<td>Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td>Note: Multicast datagrams can be transmitted only on one interface at a time.</td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back.</td>
<td>To enable, set to 1.</td>
<td>If enabled, will contain a 1.</td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td>To disable, set to 0.</td>
<td>If disabled, will contain a 0.</td>
</tr>
<tr>
<td><strong>IP_MULTICAST_TTL</strong></td>
<td>A 1-byte binary field containing the value of '00'x to 'FF'x.</td>
<td>A 1-byte binary field containing the value of '00'x to 'FF'x.</td>
</tr>
<tr>
<td>Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01'x meaning that multicast is available only to the local subnet.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP_UNBLOCK_SOURCE</strong></td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.</td>
<td></td>
</tr>
<tr>
<td>Use this option to enable an application to unblock a previously blocked source for a given IPv4 multicast group. You must specify an interface and a source address with this option.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.</td>
<td></td>
</tr>
<tr>
<td>This is an IPv4-only socket option.</td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_JOIN_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to control the reception of multicast packets and specify that the socket join a multicast group.</td>
<td>If the interface index number is 0, then the stack chooses the local interface.</td>
<td></td>
</tr>
<tr>
<td>This is an IPv6-only socket option.</td>
<td>See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td></td>
</tr>
<tr>
<td><strong>IPV6_LEAVE_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to control the reception of multicast packets and specify that the socket leave a multicast group.</td>
<td>If the interface index number is 0, then the stack chooses the local interface.</td>
<td></td>
</tr>
<tr>
<td>This is an IPv6-only socket option.</td>
<td>See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td></td>
</tr>
</tbody>
</table>
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPV6_MULTICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. <strong>Note:</strong> An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of multicast hops.</td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_IF</strong></td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
<td>Contains a 4-byte binary field containing an IPv6 interface index number.</td>
</tr>
<tr>
<td><strong>IPV6_MULTICAST_LOOP</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>IPV6_UNICAST_HOPS</strong></td>
<td>Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. -1 indicates use stack default. 0 – 255 is the valid hop limit range. <strong>Note:</strong> APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized.</td>
<td>Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops.</td>
</tr>
<tr>
<td><strong>IPV6_V6ONLY</strong></td>
<td>A 4-byte binary field. To enable, set to 1. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>MCAST_BLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
</tbody>
</table>
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCAST_LEAVE_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_LEAVE_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>MCAST_UNBLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ. See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_ASCII</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_BROADCAST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled.</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte field.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_DEBUG</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use SO_DEBUG to set or determine the status of the debug option. The default is disabled. The debug option controls the recording of debug information.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_EBCDIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: The optvalue is returned and is optionally followed by the name of the translation table that is used if translation is applied to the data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_ERROR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.</td>
<td>N/A</td>
<td>A 4-byte binary field</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_KEEPALIVE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket.</td>
<td>A 4-byte binary field. To enable, set to 1 or a positive value. To disable, set to 0.</td>
<td>A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0.</td>
</tr>
<tr>
<td>The default is disabled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields. Assembler coding: ONOFF DS F LINGER DS F COBOL coding: ONOFF PIC 9(8) BINARY. LINGER PIC 9(8) BINARY. Set ONOFF to a nonzero value to enable and set to 0 to disable this option. Set LINGER to the number of seconds that TCP/IP lingers after the CLOSE is issued.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields. Assembler coding: ONOFF DS F LINGER DS F COBOL coding: ONOFF PIC 9(8) BINARY. LINGER PIC 9(8) BINARY. A nonzero value returned in ONOFF indicates enabled, a 0 indicates disabled. LINGER indicates the number of seconds that TCP/IP will try to send data after the CLOSE is issued.</td>
</tr>
</tbody>
</table>

Notes:
1. This option has meaning only for stream sockets.
2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.

When **SO_LINGER** is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.

When **SO_LINGER** is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.

Use of the **SO_LINGER** option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for **SO_LINGER**.
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_OOBINLINE</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td>Use this option to control or determine whether out-of-band data is received. Note: This option has meaning only for stream sockets.</td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td>When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM.</td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td>When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_RCVBUF</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td>Use this option to control or determine the size of the data portion of the TCP/IP receive buffer.</td>
<td>To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer.</td>
<td>If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer.</td>
</tr>
<tr>
<td>The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call:</td>
<td>To disable, set to a 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td>• TCPRCVBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• UDPRCVBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The default of 65 535 for a raw socket</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT  (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_REUSEADDR</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
</tbody>
</table>

Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE.

When this option is enabled, the following situations are supported:

- A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.
- If you require multiple servers to BIND to the same port and listen on INADDR_ANY, refer to the SHAREPORT option on the PORT statement in TCPIP.PROFILE.

| **SO_SNDBUF**            | A 4-byte binary field.      | A 4-byte binary field.     |
|                         | To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. | If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. |
|                         | To disable, set to 0.        | If disabled, contains a 0. |

Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following:

- The TCPSENDBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket
- The UDPSENDBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP socket
- The default of 65 535 for a raw socket

| **SO_TYPE**              | N/A                         | A 4-byte binary field      |
|                         |                             | indicating the socket type: |
|                         |                             | X’1’ indicates SOCK_STREAM.|
|                         |                             | X’2’ indicates SOCK_DGRAM.  |
|                         |                             | X’3’ indicates SOCK_RAW.    |

Use this option to return the socket type.
Table 18. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP_KEEPALIVE</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a value in the range of 1 – 2 147 460.</td>
<td>If enabled, contains the specific timer value (in seconds) that is in effect for the given socket.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a value of 0.</td>
<td>If disabled, contains a 0 indicating keep alive timing is not active.</td>
</tr>
<tr>
<td>TCP_NODELAY</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a 0.</td>
<td>If enabled, contains a 0.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a 1 or nonzero.</td>
<td>If disabled, contains a 1.</td>
</tr>
</tbody>
</table>

**GIVESOCKET**

The GIVESOCKET call is used to pass a socket from one process to another.

UNIX-based platforms use a command called FORK to create a new child process that has the same descriptors as the parent process. You can use this new child process in the same way that you used the parent process.

TCP/IP normally uses GETCLIENTID, GIVESOCKET, and TAKESOCKET calls in the following sequence:

1. A process issues a GETCLIENTID call to get the job name of its region and its MVS subtask identifier. This information is used in a GIVESOCKET call.
2. The process issues a GIVESOCKET call to prepare a socket for use by a child process.
3. The child process issues a TAKESOCKET call to get the socket. The socket now belongs to the child process, and can be used by TCP/IP to communicate with another process.
**Note:** The TAKESOCKET call returns a new socket descriptor in RETCODE. The child process must use this new socket descriptor for all calls that use this socket. The socket descriptor that was passed to the TAKESOCKET call must not be used.

4. After issuing the GIVESOCKET command, the parent process issues a SELECT command that waits for the child to get the socket.

5. When the child gets the socket, the parent receives an exception condition that releases the SELECT command.

6. The parent process closes the socket.

The original socket descriptor can now be reused by the parent.

Sockets that have been given, but not taken for a period of four days, will be closed and will no longer be available for taking. If a select for the socket is outstanding, it will be posted.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |
  | **Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453. |
| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

**Figure 94** shows an example of GIVESOCKET call instructions.

```plaintext
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'GIVESOCKET'.
  01 S PIC 9(4) BINARY.
  01 CLIENT.
    03 DOMAIN PIC 9(8) BINARY.
    03 NAME PIC X(8).
    03 TASK PIC X(8).
    03 RESERVED PIC X(20).
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S CLIENT ERRNO RETCODE.

Figure 94. GIVESOCKET call instruction example
```

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing GIVESOCKET. The field is left-justified and padded on the right with blanks.

S
A halfword binary number set to the socket descriptor of the socket to be given.

CLIENT
A structure containing the identifier of the application to which the socket should be given.

DOMAIN
A fullword binary number that must be set to decimal 2, indicating AF_INET, or decimal 19 indicating AF_INET6.

Note: A socket given by GIVESOCKET can only be taken by a TAKE_SOCKET with the same DOMAIN (AF_INET or AF_INET6).

NAME
Specifies an eight-character field, left-justified, padded to the right with blanks, that can be set to the name of the MVS address space that will contain the application that is going to take the socket.

• If the socket-taking application is in the same address space as the socket-giving application (as in CICS), NAME can be specified. The socket-giving application can determine its own address space name by issuing the GET_CLIENT_ID call.

• If the socket-taking application is in a different MVS address space, this field should be set to blanks. When this is done, any MVS address space that requests the socket can have it.

TASK
Specifies an 8-byte field that can be set to blanks, or to the identifier of the socket-taking MVS subtask. If this field is set to blanks, any subtask in the address space specified in the NAME field can take the socket.

• As used by IMS and CICS, the field should be set to blanks.

• If TASK identifier is non-blank, the socket-receiving task should already be in execution when the GIVESOCKET is issued.

RESERVED
A 20-byte reserved field. This field is required, but not used.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>
INITAPI

The INITAPI call connects an application to the TCP/IP interface. Almost all sockets programs that are written in COBOL, PL/1, or assembler language must issue the INITAPI socket command before they issue other socket commands.

The exceptions to this rule are the following calls, which, when issued first, will generate a default INITAPI call.

- GETCLIENTID
- GETHOSTID
- GETHOSTNAME
- GETIBMOPT
- SELECT
- SELECTEX
- SOCKET
- TAKESOCKET

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 95 shows an example of INITAPI call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'INITAPI'.
  01 MAXSOC PIC 9(4) BINARY.
  01 IDENT.
  02 TCPNAME PIC X(8).
  02 ADSNAME PIC X(8).
  01 SUBTASK PIC X(8).
  01 MAXSNO PIC 9(8) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 59(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC IDENT SUBTASK
               MAXSNO ERRNO RETCODE.
```

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing INITAPI. The field is left-justified and padded on the right with blanks.

MAXSOC
A halfword binary field set to the maximum number of sockets this application will ever have open at one time. The maximum number is 65535 and the minimum number is 50. This value is used to determine the amount of memory that will be allocated for socket control blocks and buffers. If less than 50 are requested, MAXSOC defaults to 50.

IDENT
A structure containing the identities of the TCP/IP address space and the calling program’s address space. Specify IDENT on the INITAPI call from an address space.

TCPNAME
An 8-byte character field that should be set to the MVS job name of the TCP/IP address space with which you are connecting.

ADSNAME
An 8-byte character field set to the identity of the calling program’s address space. For explicit-mode IMS server programs, use the TIM$rvAddr$Spce field passed in the TIM. If ADSNAME is not specified, the system derives a value from the MVS control block structure.

SUBTASK
Indicates an 8-byte field, containing a unique subtask identifier which is used to distinguish between multiple subtasks within a single address space. Use your own job name as part of your subtask name. This will ensure that, if you issue more than one INITAPI command from the same address space, each SUBTASK parameter will be unique.

Parameter values returned to the application

MAXSNO
A fullword binary field that contains the highest socket number assigned to this application. The lowest socket number is 0. If you have 50 sockets, they are numbered from 0 to 49. If MAXSNO is not specified, the value for MAXSNO is 49.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

IOCTL
The IOCTL call is used to control certain operating characteristics for a socket.

Before you issue an IOCTL socket command, you must load a value that represents the characteristic that you want to control into the COMMAND field.
The variable length parameters REQARG and RETARG are arguments that are passed to and returned from IOCTL. The length of REQARG and RETARG is determined by the value that you specify in COMMAND. See Table 19 on page 522 for information about REQARG and RETARG.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 96 on page 515 shows an example of IOCTL call instructions.
Parameter values set by the application

**SOC-FUNCTION**

A 16-byte character field containing IOCTL. The field is left-justified and padded to the right with blanks.

**S**

A halfword binary number set to the descriptor of the socket to be controlled.

**COMMAND**

To control an operating characteristic, set this field to one of the following symbolic names. A value in a bit mask is associated with each symbolic name. By specifying one of these names, you are turning on a bit in a mask which communicates the requested operating characteristic to TCP/IP.

**FIONBIO**

Sets or clears blocking status.

**FIONREAD**

Returns the number of immediately readable bytes for the socket.

---

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.
SIOCATMARK
Determines whether the current location in the data input is pointing to out-of-band data.

SIOCGHOMEIF6
Requests all IPv6 home interfaces.

- When the SIOCGHOMEIF6 IOCTL is issued, the REGARQ must contain a Network Configuration Header. The NETCONFHDR is defined in the SYS1.MACLIB(BPXYIOC6) for assembler language. The following fields are input fields and must be filled out:

  NchEyeCatcher
  Contains eye catcher '6NCH'

  NchIoctl
  Contains the command code

  NchBufferLength
  Buffer length large enough to contain all the IPv6 interface records. Each interface record is length of HOME-IF-ADDRESS. If buffer is not large enough, then errno will be set to ERANGE and the NchNumEntryRet will be set to number of interfaces. Based on NchNumEntryRet and size of HOME-IF-ADDRESS, calculate the necessary storage to contain the entire list.

  NchBufferPtr
  This is a pointer to an array of HOME-IF structures returned on a successful call. The size will depend on the number of qualifying interfaces returned.

  NchNumEntryRet
  If return code is 0 this will be set to number of HOME-IF-ADDRESS returned. If errno is ERANGE, then will be set to number of qualifying interfaces. No interfaces are returned. Recalculate The NchBufferLength based on this value times the size of HOME-IF-ADDRESS.

REQARG and RETARG
Point to the arguments that are passed between the calling program and IOCTL. The length of the argument is determined by the COMMAND request. REQARG is an input parameter and is used to pass arguments to IOCTL. RETARG is an output parameter and is used for arguments returned by IOCTL. For the lengths and meanings of REQARG and RETARG for each COMMAND type, see Table 19 on page 522
SIOCGIFADDR
Requests the IPv4 network interface address for a given interface name. See the NAME field in Figure 98 on page 518 for the address format.

SIOCGIFBRDADDR
Requests the IPv4 network interface broadcast address for a given interface name. See the NAME field in Figure 98 on page 518 for the address format.

SIOCGIFCONF
Requests the IPv4 network interface configuration. The configuration is a variable number of 32-byte structures formatted as shown in Figure 98.

* When IOCTL is issued, REQARG must contain the length of the array to be returned. To determine the length of REQARG, multiply the structure length (array element) by the number of interfaces requested. The maximum number of array elements that TCP/IP can return is 100.
* When IOCTL is issued, RETARG must be set to the beginning of the storage area that you have defined in your program for the
array to be returned.

```assembly
03  NAME      PIC X(16).
03  FAMILY    PIC 9(4) BINARY.
03  PORT      PIC 9(4) BINARY.
03  ADDRESS   PIC 9(8) BINARY.
03  RESERVED  PIC X(8).
```

*Figure 98. Interface request structure (IFREQ) for the IOCTL call*

**SIOCGIFDSTADDR**

Requests the network interface destination address for a given interface name. (See IFREQ NAME field, Figure 98 for format.)

**SIOCGIFNAMEINDEX**

Requests all interface names and interface indexes including local loopback but excluding VIPAs. Information is returned for both IPv4 and IPv6 interfaces whether they are active or inactive. For IPv6 interfaces, information is only returned for an interface if it has at least one available IP address.

The configuration consists of IF_NAMEINDEX structure, which is defined in SYS1.MACLIB(BPX1IOCC) for the assembler language.

- When the SIOCGIFNAMEINDEX IOCTL is issued, the first word in REQARG must contain the length (in bytes) to contain an IF-NAME-INDEX structure to return the interfaces. The formula to compute this length is as follows:
  1. Determine the number of interfaces expected to be returned upon successful completion of this command.
  2. Multiply the number of interfaces by the array element (size of IF-NINDEX, IF-NNAME, and IF-NIEXT) to get the size of the array element.
  3. Add the size of the IF-NITOTALIF and IF-NIENTRIES to the size of the array to get the total number of bytes needed to accommodate the name and index information returned.

- When IOCTL is issued, RETARG must be set to the address of the beginning of the area in your program’s storage that is reserved for the IF-NAMEINDEX structure that is to be returned by IOCTL.

- The command ‘SIOCGIFNAMEINDEX’ returns a variable number of all the qualifying network interfaces.
Figure 99. COBOL language example for SIOCGIFNAMEINDEX

**SIOCGIPMSFILTER**

Requests a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCGIPMSFILTER IOCTL is issued, the REQARG parameter must contain a IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXIOCC) for assembler language, in SEZAINST(CBLOCK) for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The IP_MSFILTER must include an interface address (input), a multicast address (input), filter mode (output), the number of source addresses in the following array (input and output), and an array of source addresses (output). On input, the number of source addresses is the number of source addresses that will fit in the input array. On output, the number of source addresses contains the total number of source filters in the output array. If the application does not know the size of the source list prior to processing, it can make a reasonable guess (for example, 0), and if when the call completes the number of source addresses is a greater value, the IOCTL can be repeated with a buffer that is large enough. That is, on output, the number of source addresses is always updated to be the total number of sources in the filter, but the array holds as many source addresses as will fit, up to the minimum of the array size passed in as the input number.

Calculate the size of IF_MSFILTER value as follows:

1. Determine the number of expected source addresses.
2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the
   IMSF_Header value to determine the total number of bytes
   needed to accommodate the source addresses information that
   is returned.

**SIOCGMSFILTER**
Requests a list of the IPv4 or IPv6 source addresses that comprise
the source filter, with the current mode on a given interface index
and a multicast group for a socket. The source filter can include or
exclude the set of source address, depending on the filter mode
(MCAST.Include or MCAST.Exclude). When the
SIOCGMSFILTER IOCTL is issued, the REQARG parameter must
contain a GROUP_FILTER structure, which is defined in
SYS1.MACLIB(BPXYIOCC) for assembler, in SEZAINST(CBLOCK)
for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The
GROUP_FILTER option must include an interface index (input), a
socket address structure of the multicast address (input), filter
mode (output), the number of source addresses in the following
array (output), and an array of the socket address structure of
source addresses (input and output). On input, the number of
source addresses is the number of source addresses that will fit in
the input array. On output, the number of source addresses
contains the total number of source filters in the output array. If
the application does not know the size of the source list prior to
processing, it can make a reasonable guess (for example, 0), and if
when the call completes the number of source addresses is a
greater value, the IOCTL can be repeated with a buffer that is large
enough. That is, on output, the number of source addresses is
always updated to be the total number of sources in the filter, but
the array holds as many source addresses as will fit, up to the
minimum of the array size passed in as the input number.

Calculate the size of the GROUP_FILTER value as follows:
1. Determine the number of source addresses expected.
2. Multiply the number of source addresses by the array element
   (size of the GF_SrcEntry value) to determine the size of all
   array elements.
3. Add the size of all array elements to the size of the GF_Header
   value to determine the total number of bytes needed to
   accommodate the source addresses information returned.

**SIOCSAPPLDATA**
The SIOCSAPPLDATA IOCTL enables an application to set 40
bytes of user-specified application data against a socket endpoint.
You can also use this application data to identify socket endpoints
in interfaces such as Netstat, SMF, or network management
applications. When the SIOCSAPPLDATA IOCTL is issued, the
REQARG parameter must contain a SetApplData structure as
defined by the EZBYAPPL macro. See the CBLOCK and the
EZACOBOL samples for the equivalent SetApplData and
SetADContainer structure definitions for PL/I and COBOL
programming environments. See [z/OS Communications Server: IP
Programmer’s Guide and Reference](https://www.ibm.com) for more information about
programming the SIOCSAPPLDATA IOCTL.
**SetAD_buffer**: The user-defined application data is 40 bytes of data that identifies the endpoint with the application. You can obtain this application data from the following sources:

- Netstat reports. The information is displayed in the ALL/-A report. If you use the APPLDATA modifier, then the information also is displayed on the ALLConn/-a and CONn/-c reports.

Consider the following guidelines:

- The application must document the content, format and meaning of the ApplData strings that it associates with the sockets that it owns.
- The application should uniquely identify itself with printable EBCDIC characters at the beginning of the string. Strings beginning with 3-character IBM product identifiers, such as TCP/IP’s EZA or EZB, are reserved for IBM use. IBM product identifiers begin with a letter in the range A-I.
- Use printable EBCDIC characters for the entire string to enable searching with Netstat filters.

**Tip**: Separate application data elements with a blank for easier reading.

**SIOCSIPMSFILTER**

Sets a list of the IPv4 source addresses that comprise the source filter, with the current mode on a given interface and a multicast group for a socket. The source filter can include or exclude the set of source address, depending on the filter mode (MCAST_INCLUDE or MCAST_EXCLUDE). When the SIOCSIPMSFILTER IOCTL is issued, the REQARG parameter must contain a IP_MSFILTER structure, which is defined in SYS1.MACLIB(BPXYIOCC) for assembler, in SEZAINST(CBLOCK) for PL/I and in SEZAINST(EZACOBOL) for COBOL. The IP_MSFILTER option must include an interface address, a multicast address, filter mode, the number of source addresses in the following array, and an array of source addresses.

Calculate the size of the IP_MSFILTER value as follows:

1. Determine the number of expected source addresses.
2. Multiply the number of source addresses by the array element (size of the IMSF_SrcEntry value) to determine the size of all array elements.
3. Add the size of all array elements to the size of the IMSF_Header value to determine the total number of bytes needed to accommodate the source addresses information that is returned.

**SIOCSMSFILTER**

Sets a list of the IPv4 or IPv6 source addresses that comprise the source filter, along with the current mode on a given interface index and a multicast group for a socket. The source filter can
include or exclude the set of source address, depending on the
filter mode (INCLUDE or EXCLUDE). When the SIOCSMSFILTER
IOCTL is issued, the REQARG parameter must contain a
GROUP_FILTER structure which is defined in
SYS1.MACLIB(BPXYIOCC) for assembler, in SEZAINST(CBLOCK)
for PL/I, and in SEZAINST(EZACOBOL) for COBOL. The
GROUP_FILTER option must include an interface index, a socket
address structure of the multicast address, filter mode, the number
of source addresses in the following array, and an array of the
socket address structure of source addresses.

Calculate the size of GROUP_FILTER as follows:
1. Determine the number of source addresses expected.
2. Multiply the number of source addresses by the array element
   (size of the GF_SrcEntry value) to get the size of all array
   elements.
3. Add the size of all array elements to the size of the GF_Header
   value to get the total number of bytes needed to accommodate
   the source addresses information returned.

SIOCTTLSCTL
Controls Application Transparent Transport Layer Security
(AT-TLS) for the connection. REQARG and RETARG must contain
a TTLS_IOCTL structure. If a partner certificate is requested, the
TTLS_IOCTL must include a pointer to additional buffer space and
the length of that buffer. Information is returned in the
TTLS_IOCTL structure. If a partner certificate is requested and one
is available, it is returned in the additional buffer space. The
TTLS_IOCTL structure is defined in members within SEZANMAC.
EZBZTLSP1 defines the PL/I layout, EZBZTLSI defines the
assembler layout, and EZBZTLSB defines the COBOL layout. For
more usage information, refer to the Application Transparent TLS
(AT-TLS) information of the z/OS Communications Server: IP
Programmer's Guide and Reference

Restriction: Use of this ioctl for functions other than query requires
that the AT-TLS policy mapped to the connection be defined with
the ApplicationControlled parameter set to On.

REQARG and RETARG
Points to arguments that are passed between the calling program and
IOCTL. The length of the argument is determined by the COMMAND
request. REQARG is an input parameter and is used to pass arguments to
IOCTL, and RETARG is an output parameter and receives arguments from
IOCTL. The REQARG and RETARG parameters are described in

<table>
<thead>
<tr>
<th>Command/Code</th>
<th>Size</th>
<th>REQARG</th>
<th>Size</th>
<th>RETARG</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIONBIO X'8004A77E'</td>
<td>4</td>
<td>Set socket mode:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'00'=blocking,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'01'=nonblocking.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIONREAD X'4004A77F'</td>
<td>0</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIOCATMARK X'4004A707'</td>
<td>0</td>
<td>Not used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'00' = not at OOB data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X'01' = at OOB data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIOMICHOME IF6</td>
<td>20</td>
<td>NetConfHdr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X'C014F608'</td>
<td></td>
<td>See Figure 97 on page 517 NetConfHdr.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 19. IOCTL call arguments
Table 19. IOCTL call arguments (continued)

<table>
<thead>
<tr>
<th>COMMAND/CODE</th>
<th>SIZE</th>
<th>REQARG</th>
<th>SIZE</th>
<th>RETARG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIOCGIFADDR X'C020A70D'</td>
<td>32</td>
<td>First 16 bytes - interface name. Last 16 bytes - not used.</td>
<td>32</td>
<td>Network interface address, see Figure 98 on page 518 for format.</td>
</tr>
<tr>
<td>SIOCGIFBRDADDR X'C020A712'</td>
<td>32</td>
<td>First 16 bytes - interface name. Last 16 bytes - not used.</td>
<td>32</td>
<td>Network interface address, see Figure 98 on page 518 for format.</td>
</tr>
<tr>
<td>SIOCGIFCONF X'C008A714'</td>
<td>8</td>
<td>Size of RETARG.</td>
<td>See note 1.</td>
<td></td>
</tr>
<tr>
<td>SIOCGIFDSTADDR X'C020A70F'</td>
<td>32</td>
<td>First 16 bytes - interface name. Last 16 bytes - not used.</td>
<td>32</td>
<td>Destination interface address, see Figure 98 on page 518 for format.</td>
</tr>
<tr>
<td>SIOCGBPNAMEINDEX X'400F603'</td>
<td>4</td>
<td>First 4 bytes size of return buffer.</td>
<td>See Figure 99 on page 518 for IP-NAMEINDEX.</td>
<td></td>
</tr>
<tr>
<td>SIOCGBPMSFILTER X'C00A724'</td>
<td>–</td>
<td>See IP_MSFILTER structure in macro BPXYIOC. See note 2.</td>
<td>0</td>
<td>Not used</td>
</tr>
<tr>
<td>SIOCGBPMSFILTER X'C00F610'</td>
<td>–</td>
<td>See GROUP_FILTER structure in macro BPXYIOC. See note 3</td>
<td>0</td>
<td>Not used</td>
</tr>
<tr>
<td>SIOCSAPPLDATA X'3018D90C'</td>
<td>–</td>
<td>See SETAPPLDATA structure in macro EZBYAPPL</td>
<td>0</td>
<td>Not used</td>
</tr>
<tr>
<td>SIOCSIPMSFILTER X'C00A725'</td>
<td>–</td>
<td>See IP_MSFILTER structure in macro BPXYIOC. See note 2.</td>
<td>0</td>
<td>Not used</td>
</tr>
<tr>
<td>SIOCSMSFILTER X'8000F611'</td>
<td>–</td>
<td>See GROUP_FILTER structure in macro BPXYIOC. See note 3</td>
<td>0</td>
<td>Not used</td>
</tr>
<tr>
<td>SIOCTTLSCTL X'C038D90B'</td>
<td>56</td>
<td>For IOCTL structure layout, refer to SEZANMAC(EZBZTLSI) for PL/I, SEZANMAC(EZBZTLSP) for assembler, and SEZANMAC(EZBZTLSB) for COBOL.</td>
<td>56</td>
<td>For IOCTL structure layout, refer to SEZANMAC(EZBZTLSI) for PL/I, SEZANMAC(EZBZTLSP) for assembler, and SEZANMAC(EZBZTLSB) for COBOL.</td>
</tr>
</tbody>
</table>

Notes:
1. When you call IOCTL with the SIOCGIFCONF command set, REQARG should contain the length in bytes of RETARG. Each interface is assigned a 32-byte array element and REQARG should be set to the number of interfaces times 32. TCP/IP Services can return up to 100 array elements.
2. The size of the IP_MSFILTER structure must be equal to or greater than the size of the IMSF_Header value.
3. The size of the GROUP_FILTER structure must be equal to or greater than the size of GF_Header value.

Parameter values returned to the application

RETARG

Returns an array whose size is based on the value in COMMAND. See Table 19 for information about REQARG and RETARG.

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>
The COMMAND SIOGIFCONF returns a variable number of network interface configurations. Figure 100 contains an example of a COBOL II routine that can be used to work with such a structure.

**Note:** This call can only be programmed in languages that support address pointers. Figure 100 shows a COBOL II example for SIOCGIFCONF.

```cobol
WORKING-STORAGE SECTION.
   77 REQARG PIC 9(8) COMP.
   77 COUNT PIC 9(8) COMP VALUE max number of interfaces.
LINKAGE SECTION.
   01 RETARG.
      05 IOCTL-TABLE OCCURS 1 TO max TIMES DEPENDING ON COUNT.
         10 NAME PIC X(16).
         10 FAMILY PIC 9(4) BINARY.
         10 PORT PIC 9(4) BINARY.
         10 ADDR PIC 9(8) BINARY.
         10 NULLS PIC X(8).
PROCEDURE DIVISION.
   MULTIPLY COUNT BY 32 GIVING REQARQ.
   CALL 'EZASOKET' USING SOC-FUNCTION S COMMAND REQARG RETARG ERRNO RETCODE.
```

**LISTEN**

The LISTEN call:
- Completes the bind, if BIND has not already been called for the socket.
- Creates a connection-request queue of a specified length for incoming connection requests.

**Note:** The LISTEN call is not supported for datagram sockets or raw sockets.

The LISTEN call is typically used by a server to receive connection requests from clients. When a connection request is received, a new socket is created by a subsequent ACCEPT call, and the original socket continues to listen for additional connection requests. The LISTEN call converts an active socket to a passive socket and conditions it to accept connection requests from clients. Once a socket becomes passive it cannot initiate connection requests.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller in the primary address space.</td>
</tr>
</tbody>
</table>
Figure 101 shows an example of LISTEN call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'LISTEN'.
  01 S PIC 9(4) BINARY.
  01 BACKLOG PIC 9(8) BINARY.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S BACKLOG ERRNO RETCODE.
```

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

**Parameter values set by the application**

**SOC-FUNCTION**
A 16-byte character field containing LISTEN. The field is left-justified and padded to the right with blanks.

**S**
A halfword binary number set to the socket descriptor.

**BACKLOG**
A fullword binary number set to the number of communication requests to be queued.

**Rule:** The BACKLOG value specified on the LISTEN call is limited to the value configured by the SOMAXCONN statement in the stack’s TCPIP PROFILE (default=10); no error is returned if a larger backlog is requested. SOMAXCONN might need to be updated if a larger backlog is desired. Refer to the [z/OS Communications Server: IP Configuration Reference](https://www.ibm.com/support/docview.ws/docview/5314) for details.

**Parameter values returned to the application**

**ERRNO**
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**NTOP**

The NTOP call converts an IP address from its numeric binary form into a standard text presentation form. On successful completion, NTOP returns the converted IP address in the buffer provided.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
Amode: 31-bit or 24-bit.

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 102 shows an example of NTOP call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-ACCEPT-FUNCTION PIC X(16) VALUE IS 'ACCEPT'.
  01 SOC-NTOP-FUNCTION PIC X(16) VALUE IS 'NTOP'.
  01 S PIC 9(4) BINARY.

  * IPv4 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 RESERVED PIC X(8).

  * IPv6 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 FLOWINFO PIC 9(8) BINARY.
    03 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    03 SCOPE-ID PIC 9(8) BINARY.
    01 NTOP-FAMILY PIC 9(8) BINARY.
    01 ERRNO PIC 9(8) BINARY.
    01 RETCODE PIC S9(8) BINARY.
    01 PRESENTABLE-ADDRESS PIC X(45).
    01 PRESENTABLE-ADDRESS-LEN PIC 9(4) BINARY.

PROCEDURE DIVISION.

  CALL 'EZASOKET' USING SOC-ACCEPT-FUNCTION $ NAME $ ERRNO RETCODE.
  CALL 'EZASOKET' USING SOC-NTOP-FUNCTION NTOP-FAMILY IP-ADDRESS PRESENTABLE-ADDRESS PRESENTABLE-ADDRESS-LEN ERRNO RETURN-CODE.
```

Figure 102. NTOP call instruction example

**Parameter values set by the application**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>The addressing family for the IP address being converted. The value of decimal 2 must be specified for AF_INET and 19 for AF_INET6.</td>
</tr>
<tr>
<td>IP-ADDRESS</td>
<td>A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address this field must be a</td>
</tr>
</tbody>
</table>
fullword and for an IPv6 address this field must be 16 bytes. The address must be in network byte order.

**Parameter values returned to the application**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRESENTABLE-ADDRESS</strong></td>
<td>A field used to receive the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format. The size of the IPv4 address will be a maximum of 15 bytes and the size of the converted IPv6 address will be a maximum of 45 bytes. Consult the value returned in <strong>PRESENTABLE-ADDRESS-LEN</strong> for the actual length of the value in <strong>PRESENTABLE-ADDRESS</strong>.</td>
</tr>
<tr>
<td><strong>PRESENTABLE-ADDRESS-LEN</strong></td>
<td>Initially, an input parameter. The address of a binary halfword field that is used to specify the length of DSTADDR field on input and upon a successful return will contain the length of converted IP address.</td>
</tr>
<tr>
<td><strong>ERRNO</strong></td>
<td>Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field. See <a href="#">Appendix B, “Return codes,” on page 835</a> for information about ERRNO return codes.</td>
</tr>
<tr>
<td><strong>RETCODE</strong></td>
<td>A fullword binary field that returns one of the following:</td>
</tr>
<tr>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>–1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**PTON**

The PTON call converts an IP address in its standard text presentation form to its numeric binary form. On successful completion, PTON returns the converted IP address in the buffer provided.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td><strong>Note:</strong> See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>
Figure 103 shows an example of PTON call instructions.

WORKING-STORAGE SECTION.
  01 SOC-BIND-FUNCTION PIC X(16) VALUE IS 'BIND'.
  01 SOC-PTON-FUNCTION PIC X(16) VALUE IS 'PTON'.
  01 S PIC 9(4) BINARY.

* IPv4 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 IP-ADDRESS PIC 9(8) BINARY.
    03 RESERVED PIC X(8).

* IPv6 socket structure.
  01 NAME.
    03 FAMILY PIC 9(4) BINARY.
    03 PORT PIC 9(4) BINARY.
    03 FLOWINFO PIC 9(8) BINARY.
    03 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    03 SCOPE-ID PIC 9(8) BINARY.

  01 AF-INET PIC 9(8) BINARY VALUE 2.
  01 AF-INET6 PIC 9(8) BINARY VALUE 19.

* IPv4 address.
  01 PRESENTABLE-ADDRESS PIC X(45).
  01 PRESENTABLE-ADDRESS-IPV4 REDEFINES PRESENTABLE-ADDRESS.
    05 PRESENTABLE-IPV4-ADDRESS PIC X(15) VALUE '192.26.5.19'.
    05 FILLER PIC X(30).
  01 PRESENTABLE-ADDRESS-LEN PIC 9(4) BINARY VALUE 11.

* IPv6 address.
  01 PRESENTABLE-ADDRESS PIC X(45)
    VALUE '12f9:0:0:c30:123:457:9cb:1112'.
  01 PRESENTABLE-ADDRESS-LEN PIC 9(4) BINARY VALUE 29.

* IPv4-mapped IPv6 address.
  01 PRESENTABLE-ADDRESS PIC X(45)
    VALUE '12f9:0:0:c30:123:457:9cb:1112'.
  01 PRESENTABLE-ADDRESS-LEN PIC 9(4) BINARY VALUE 32.

  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.

* IPv4 address.
  CALL 'EZASOKET' USING SOC-PTON-FUNCTION AF-INET PRESENTABLE-ADDRESS
    PRESENTABLE-ADDRESS-LEN IP-ADDRESS ERRNO RETURN-CODE.

* IPv6 address.
  CALL 'EZASOKET' USING SOC-PTON-FUNCTION AF-INET6 PRESENTABLE-ADDRESS
    PRESENTABLE-ADDRESS-LEN IP-ADDRESS ERRNO RETURN-CODE.
  CALL 'EZASOKET' USING SOC-BIND-FUNCTION S NAME ERRNO RETURN-CODE.

Figure 103. PTON call instruction example

Parameter values set by the application

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>The addressing family for the IP address being converted. The value of decimal 2 must be specified for AF_INET and 19 for AF_INET6.</td>
</tr>
</tbody>
</table>
PRESENTABLE-ADDRESS
A field containing the standard text presentation form of the IPv4 or IPv6 address being converted. For IPv4 the address will be in dotted-decimal format and for IPv6 the address will be in colon-hex format.

PRESENTABLE-ADDRESS-LEN
Input parameter. The address of a binary halfword field that must contain the length of the IP address to be converted.

Parameter values returned to the application

Keyword Description

IP-ADDRESS A field containing the numeric binary form of the IPv4 or IPv6 address being converted. For an IPv4 address this field must be a fullword and for an IPv6 address this field must be 16 bytes. The address must be in network byte order.

ERRNO Output parameter. A fullword binary field. If RETCODE is negative, ERRNO contains a valid error number. Otherwise, ignore the ERRNO field.

See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE A fullword binary field that returns one of the following:

Value      Description
0           Successful call.
-1          Check ERRNO for an error code.

READ
The READ call reads the data on socket s. This is the conventional TCP/IP read data operation. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard extra bytes.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be contained in RETCODE. Therefore, programs using stream sockets should place this call in a loop that repeats until all data has been received.

Note: See “EZACIC05” on page 586 for a subroutine that will translate ASCII input data to EBCDIC.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 104 shows an example of READ call instructions.

WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'READ'.
  01 S PIC 9(4) BINARY.
  01 NBYTE PIC 9(8) BINARY.
  01 BUF PIC X(length of buffer).
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S NBYTE BUF ERRNO RETCODE.

Figure 104. READ call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READ. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor of the socket that is going to read the data.

NBYTE
A fullword binary number set to the size of BUF. READ does not return more than the number of bytes of data in NBYTE even if more data is available.

Parameter values returned to the application

BUF On input, a buffer to be filled by completion of the call. The length of BUF must be at least as long as the value of NBYTE.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A 0 return code indicates that the connection is closed and no data is available.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive value indicates the number of bytes copied into the buffer.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READ. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket descriptor of the socket that is going to read the data.

NBYTE
A fullword binary number set to the size of BUF. READ does not return more than the number of bytes of data in NBYTE even if more data is available.

Parameter values returned to the application

BUF On input, a buffer to be filled by completion of the call. The length of BUF must be at least as long as the value of NBYTE.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, "Return codes," on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A 0 return code indicates that the connection is closed and no data is available.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive value indicates the number of bytes copied into the buffer.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>
**READV**

The READV function reads data on a socket and stores it in a set of buffers. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 105 shows an example of READV call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE 'READV'.
  01 S PIC 9(4) BINARY.
  01 IOVCNT PIC 9(8) BINARY.

  01 IOV.
    03 BUFFER-ENTRY OCCURS N TIMES.
      05 BUFFER-POINTER USAGE IS POINTER.
      05 RESERVED PIC X(4).
      05 BUFFER_LENGTH PIC 9(8) BINARY.

  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
  SET BUFFER-POINTER(1) TO ADDRESS OF BUFFER1.
  SET BUFFER-LENGTH(1) TO LENGTH OF BUFFER1.
  SET BUFFER-POINTER(2) TO ADDRESS OF BUFFER2.
  SET BUFFER-LENGTH(2) TO LENGTH OF BUFFER2.
  * * * * * * * * * * * * * * * * * * * *
  SET BUFFER-POINTER(n) TO ADDRESS OF BUFFERn.
  SET BUFFER-LENGTH(n) TO LENGTH OF BUFFERn.
  CALL 'EZASOCKET' USING SOC-FUNCTION S IOV IOVCNT ERRNO RETCODE.
```

*Figure 105. READV call instruction example*

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing READV. The field is left-justified and padded to the right with blanks.

S
A value or the address of a halfword binary number specifying the descriptor of the socket into which the data is to be read.

IOV
An array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

Fullword 1
Pointer to the address of a data buffer, which is filled in on completion of the call

Fullword 2
Reserved

Fullword 3
The length of the data buffer referenced in fullword one

IOVCNT
A fullword binary field specifying the number of data buffers provided for this call.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value    Description
0        A 0 return code indicates that the connection is closed and no data is available.
>0       A positive value indicates the number of bytes copied into the buffer.
-1       Check ERRNO for an error code.

RECV
The RECV call, like READ, receives data on a socket with descriptor S. RECV applies only to connected sockets. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For additional control of the incoming data, RECV can:
• Peek at the incoming message without having it removed from the buffer
• Read out-of-band data

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be contained in RETCODE. Therefore, programs using stream sockets should place RECV in a loop that repeats until all data has been received.
If data is not available for the socket, and the socket is in blocking mode, RECV blocks the caller until data arrives. If data is not available and the socket is in nonblocking mode, RECV returns a −1 and sets ERRNO to 35 (EWOULDBLOCK). See “FCNTL” on page 467 or “IOCTL” on page 513 for a description of how to set nonblocking mode.

For raw sockets, RECV adds a 20-byte header.

Note: See “EZACIC05” on page 586 for a subroutine that will translate ASCII input data to EBCDIC.

The following requirements apply to this call:

Authorization: Supervisor state or problem state, any PSW key.
Dispatchable unit mode: Task.
Cross memory mode: PASN = HASN.
Amode: 31-bit or 24-bit.
   Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.
ASC mode: Primary address space control (ASC) mode.
Interrupt status: Enabled for interrupts.
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 106 shows an example of RECV call instructions.

```
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'RECV'.
   01 S   PIC 9(4) BINARY.
   01 FLAGS PIC 9(8) BINARY.
      88 NO-FLAG VALUE IS 0.
      88 OOB   VALUE IS 1.
      88 PEEK  VALUE IS 2.
   01 NBYTE PIC 9(8) BINARY.
   01 BUF   PIC X(length of buffer).
   01 ERRNO PIC 9(8) BINARY.
   01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE BUF ERRNO RETCODE.
```

Figure 106. RECV call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

**SOC-FUNCTION**

A 16-byte character field containing RECV. The field is left-justified and padded to the right with blanks.

**S** A halfword binary number set to the socket descriptor of the socket to receive the data.
FLAGS

A fullword binary field with values as follows:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>Read data.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>PEEK</td>
<td>2</td>
<td>Peek at the data, but do not destroy data. If the peek flag is set, the next RECV call will read the same data.</td>
</tr>
</tbody>
</table>

NBYTE

A value or the address of a fullword binary number set to the size of BUF. RECV does not receive more than the number of bytes of data in NBYTE even if more data is available.

Parameter values returned to the application

BUF  The input buffer to receive the data.

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The socket is closed.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>A positive return code indicates the number of bytes copied into the buffer.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

RECVFROM

The RECVFROM call receives data on a socket with descriptor S and stores it in a buffer. The RECVFROM call applies to both connected and unconnected sockets. The socket address is returned in the NAME structure. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For datagram protocols, RECVFROM returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, GETPEERNAME returns the address associated with the other end of the connection.

If NAME is nonzero, the call returns the address of the sender. The NBYTE parameter should be set to the size of the buffer.

On return, NBYTE contains the number of data bytes received.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if programs A and B are connected with a stream socket and program A sends 1000 bytes, each call to this function can return any number of bytes, up to the entire 1000 bytes. The number of bytes returned will be
contained in RETCODE. Therefore, programs using stream sockets should place
RECVFROM in a loop that repeats until all data has been received.

For raw sockets, RECVFROM adds a 20-byte header.

If data is not available for the socket, and the socket is in blocking mode,
RECVFROM blocks the caller until data arrives. If data is not available and the
socket is in nonblocking mode, RECVFROM returns a −1 and sets ERRNO to 35
(EWOULDBLOCK). See “FCNTL” on page 467 or “IOCTL” on page 513 for a
description of how to set nonblocking mode.

Note: See “EZACIC05” on page 586 for a subroutine that will translate ASCII
input data to EBCDIC.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 489.</td>
<td></td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 107 on page 536 shows an example of RECVFROM call instructions.
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'RECVFROM'.
   01 S PIC 9(4) BINARY.
   01 FLAGS PIC 9(8) BINARY.
      88 NO-FLAG VALUE IS 0.
      88 OOB VALUE IS 1.
      88 PEEK VALUE IS 2.
   01 NBYTE PIC 9(8) BINARY.
   01 BUF PIC X(length of buffer).

* IPv4 socket address structure.
   01 NAME.
      03 FAMILY PIC 9(4) BINARY.
      03 PORT PIC 9(4) BINARY.
      03 IP-ADDRESS PIC 9(8) BINARY.
      03 RESERVED PIC X(8).

* IPv6 socket address structure.
   01 NAME.
      03 FAMILY PIC 9(4) BINARY.
      03 PORT PIC 9(4) BINARY.
      03 FLOWINFO PIC 9(8) BINARY.
      03 IP-ADDRESS.
         10 FILLER PIC 9(16) BINARY.
         10 FILLER PIC 9(16) BINARY.
      03 SCOPE-ID PIC 9(8) BINARY.
   01 ERRNO PIC 9(8) BINARY.
   01 RETCODE PIC 59(8) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS
          NBYTE BUF NAME ERRNO RETCODE.

Figure 107. RECVFROM call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
   A 16-byte character field containing RECVFROM. The field is left-justified and padded to the right with blanks.

S
   A halfword binary number set to the socket descriptor of the socket to receive the data.

FLAGS
   A fullword binary field containing flag values as follows:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>Read data.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>PEEK</td>
<td>2</td>
<td>Peek at the data, but do not destroy data. If the peek flag is set, the next RECVFROM call will read the same data.</td>
</tr>
</tbody>
</table>

NBYTE
   A fullword binary number specifying the length of the input buffer.
Parameter values returned to the application

BUF
Defines an input buffer to receive the input data.

NAME
An IPv4 socket address structure containing the address of the socket that sent the data. The structure is as follows:

FAMILY
A halfword binary number specifying the IPv4 addressing family. The value is always decimal 2, indicating AF_INET.

PORT
A halfword binary number specifying the port number of the sending socket.

IP-ADDRESS
A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.

RESERVED
An 8-byte reserved field. This field is required, but is not used.

An IPv6 socket address structure containing the address of the socket that sent the data. The structure is as follows:

Field  Description
FAMILY
A halfword binary number specifying the IPv6 addressing family. The value is decimal 19, indicating AF_INET6.

PORT
A halfword binary number specifying the port number of the sending socket.

FLOWINFO
A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.

IP-ADDRESS
A 16-byte binary field set to the 128-bit IPv6 Internet address of the sending socket.

SCOPE-ID
A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

Value  Description
0  The socket is closed.
>0  A positive return code indicates the number of bytes of data transferred by the read call.
-1  Check ERRNO for an error code.
The RECVMSG call receives messages on a socket with descriptor S and stores them in an array of message headers. If a datagram packet is too long to fit in the supplied buffers, datagram sockets discard extra bytes.

For datagram protocols, RECVMSG returns the source address associated with each incoming datagram. For connection-oriented protocols like TCP, GETPEERNAME returns the address associated with the other end of the connection.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |
| Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453. |
| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

Figure 108 on page 539 shows an example of RECVMSG call instructions.
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'RECVMSG'.
  01 S PIC 9(4) BINARY.
  01 MSG-HDR.
    03 MSG-NAME USAGE IS POINTER.
    03 MSG-NAME-LEN PIC 9(8) COMP.
    03 IOV USAGE IS POINTER.
    03 IOVCNT USAGE IS POINTER.
    03 MSG-ACCRIGHTS USAGE IS POINTER.
    03 MSG-ACCRIGHTS-LEN USAGE IS POINTER.
  01 FLAGS PIC 9(8) BINARY.
    88 NO-FLAG VALUE IS 0.
    88 OOB VALUE IS 1.
    88 PEEK VALUE IS 2.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

LINKAGE SECTION.
  01 LI.
    03 RECVMSG-IOVECTOR.
      05 IOV1A USAGE IS POINTER.
      05 IOV1AL PIC 9(8) COMP.
      05 IOV1L PIC 9(8) COMP.
      05 IOV2A USAGE IS POINTER.
      05 IOV2AL PIC 9(8) COMP.
      05 IOV2L PIC 9(8) COMP.
      05 IOV3A USAGE IS POINTER.
      05 IOV3AL PIC 9(8) COMP.
      05 IOV3L PIC 9(8) COMP.
  03 RECVMSG-BUFFER1 PIC X(16).
  03 RECVMSG-BUFFER2 PIC X(16).
  03 RECVMSG-BUFFER3 PIC X(16).
  03 RECVMSG-BUFNO PIC 9(8) COMP.

* IPv4 socket address structure.
  03 NAME.
    05 FAMILY PIC 9(4) BINARY.
    05 PORT PIC 9(4) BINARY.
    05 IP-ADDRESS PIC 9(8) BINARY.
    05 RESERVED PIC X(8).

* IPv6 socket address structure.
  03 NAME.
    05 FAMILY PIC 9(4) BINARY.
    05 PORT PIC 9(4) BINARY.
    53 FLOWINFO PIC 9(8) BINARY.
    05 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    05 SCOPE-ID PIC 9(8) BINARY.

Figure 108. RECVMSG call instruction example (Part 1 of 2)
PROCEDURE DIVISION USING L1.

    SET MSG-NAME TO ADDRESS OF NAME.
    MOVE LENGTH OF NAME TO MSG-NAME-LEN.
    SET IOV TO ADDRESS OF RECVMSG-IOVECTOR.
    MOVE 3 TO RECVMSG-BUFNO.
    SET IOVCNT TO ADDRESS OF RECVMSG-BUFNO.
    SET IOV1A TO ADDRESS OF RECVMSG-BUFFER1.
    MOVE 0 TO IOV1AL.
    MOVE LENGTH OF RECVMSG-BUFFER1 TO IOV1L.
    SET IOV2A TO ADDRESS OF RECVMSG-BUFFER2.
    MOVE 0 TO IOV2AL.
    MOVE LENGTH OF RECVMSG-BUFFER2 TO IOV2L.
    SET IOV3A TO ADDRESS OF RECVMSG-BUFFER3.
    MOVE 0 TO IOV3AL.
    MOVE LENGTH OF RECVMSG-BUFFER3 TO IOV3L.
    SET MSG-ACCRIGHTS TO NULLS.
    SET MSG-ACCRIGHTS-LEN TO NULLS.
    MOVE 0 TO FLAGS.
    MOVE SPACES TO RECVMSG-BUFFER1.
    MOVE SPACES TO RECVMSG-BUFFER2.
    MOVE SPACES TO RECVMSG-BUFFER3.

    CALL 'EZASOKET' USING SOC-FUNCTION S MSG-HDR FLAGS ERRNO RETCODE.

Figure 108. RECVMSG call instruction example (Part 2 of 2)

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

S     A value or the address of a halfword binary number specifying the socket descriptor.

MSG   On input, a pointer to a message header into which the message is received upon completion of the call.

Field   Description

NAME
On input, a pointer to a buffer where the sender address is stored upon completion of the call. The storage being pointed to should be for an IPv4 socket address or an IPv6 socket address. The IPv4 socket address structure contains the following fields:

Field   Description

FAMILY
Output parameter. A halfword binary number specifying the IPv4 addressing family. The value for IPv4 socket descriptor (S parameter) is decimal 2, indicating AF_INET.

PORT
Output parameter. A halfword binary number specifying the port number of the sending socket.

IP-ADDRESS
Output parameter. A fullword binary number specifying the 32-bit IPv4 Internet address of the sending socket.

RESERVED
Output parameter. An 8-byte reserved field. This field is required, but is not used.

The IPv6 socket address structure contains the following fields:
<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY</td>
<td>Output parameter. A halfword binary number specifying the IPv6 addressing family. The value for IPv6 socket descriptor (S parameter) is decimal 19, indicating AF_INET6.</td>
</tr>
<tr>
<td>PORT</td>
<td>Output parameter. A halfword binary number specifying the port number of the sending socket.</td>
</tr>
<tr>
<td>FLOWINFO</td>
<td>A fullword binary field specifying the traffic class and flow label. This value of this field is undefined.</td>
</tr>
<tr>
<td>IP–ADDRESS</td>
<td>Output parameter. A 16 byte binary field specifying the 128–bit IPv6 Internet address, in network byte order, of the sending socket.</td>
</tr>
<tr>
<td>SCOPE-ID</td>
<td>A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. For a link scope IPv6-ADDRESS, SCOPE-ID contains the link index for the IPv6-ADDRESS. For all other address scopes, SCOPE-ID is undefined.</td>
</tr>
<tr>
<td>NAME-LEN</td>
<td>On input, a pointer to the size of the NAME.</td>
</tr>
<tr>
<td>IOV</td>
<td>On input, a pointer to an array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:</td>
</tr>
<tr>
<td></td>
<td><strong>Fullword 1</strong></td>
</tr>
<tr>
<td></td>
<td>A pointer to the address of a data buffer. This data buffer must be in the home address space.</td>
</tr>
<tr>
<td></td>
<td><strong>Fullword 2</strong></td>
</tr>
<tr>
<td></td>
<td>Reserved. This storage will be cleared.</td>
</tr>
<tr>
<td></td>
<td><strong>Fullword 3</strong></td>
</tr>
<tr>
<td></td>
<td>A pointer to the length of the data buffer referenced in fullword 1.</td>
</tr>
<tr>
<td></td>
<td>In COBOL, the IOV structure must be defined separately in the Linkage section, as shown in the example.</td>
</tr>
<tr>
<td>IOVCNT</td>
<td>On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.</td>
</tr>
<tr>
<td>ACCRIGTHS</td>
<td>On input, a pointer to the access rights received. This field is ignored.</td>
</tr>
<tr>
<td>ACCRLEN</td>
<td>On input, a pointer to the length of the access rights received. This field is ignored.</td>
</tr>
</tbody>
</table>
| FLAGS   | A fullword binary field with values as follows:
<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>Read data.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Receive out-of-band data (stream sockets only). Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>PEEK</td>
<td>2</td>
<td>Peek at the data, but do not destroy data. If the peek flag is set, the next RECVMSG call will read the same data.</td>
</tr>
</tbody>
</table>

**Parameter values returned to the application**

**ERRNO**
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field with the following values:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0</td>
<td>Call returned error. See ERRNO field.</td>
</tr>
<tr>
<td>0</td>
<td>Connection partner has closed connection.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>Number of bytes read.</td>
</tr>
</tbody>
</table>

**SELECT**
In a process where multiple I/O operations can occur it is necessary for the program to be able to wait on one or several of the operations to complete.

For example, consider a program that issues a READ to multiple sockets whose blocking mode is set. Because the socket would block on a READ call, only one socket could be read at a time. Setting the sockets nonblocking would solve this problem, but would require polling each socket repeatedly until data became available. The SELECT call allows you to test several sockets and to execute a subsequent I/O call only when one of the tested sockets is ready, thereby ensuring that the I/O call will not block.

To use the SELECT call as a timer in your program, do one of the following:
- Set the read, write, and except arrays to zeros.
- Specify MAXSOC <= 0.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>ASC mode:</th>
<th>Primary address space control (ASC) mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
</tbody>
</table>
Locks: Unlocked.
Control parameters: All parameters must be addressable by the caller and in the primary address space.

Defining which sockets to test
The SELECT call monitors for read operations, write operations, and exception operations:

- When a socket is ready to read, one of the following has occurred:
  - A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket will not block.
  - A connection has been requested on that socket.
- When a socket is ready to write, TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a given socket, a write operation on that socket will not block.
- When an exception condition has occurred on a specified socket it is an indication that a TAKESOCKET has occurred for that socket.

Each socket descriptor is represented by a bit in a bit string. The bit strings are contained in 32-bit fullwords, numbered from right to left. The rightmost bit represents socket descriptor 0, the leftmost bit represents socket descriptor 31, and so on. If your process uses 32 or fewer sockets, the bit string is 1 fullword. If your process uses 33 sockets, the bit string is 2 fullwords. You define the sockets that you want to test by turning on bits in the string.

Note: To simplify string processing in COBOL, you can use the program EZACIC06 to convert each bit in the string to a character. For more information, see “EZACIC06” on page 588.

Read operations
Read operations include ACCEPT, READ, READV, RECV, RECVFROM, or RECVMSG calls. A socket is ready to be read when data has been received for it or when a connection request has occurred.

To test whether any of several sockets is ready for reading, set the appropriate bits in RSNDMSK to one before issuing the SELECT call. When the SELECT call returns, the corresponding bits in the RRETMSK indicate sockets are ready for reading.

Write operations
A socket is selected for writing (ready to be written) when:

- TCP/IP can accept additional outgoing data.
- The socket is marked nonblocking and a previous CONNECT did not complete immediately. In this case, CONNECT returned an ERRNO with a value of 36 (EINPROGRESS). This socket will be selected for write when the CONNECT completes.

A call to WRITE, SEND, or SENDTO blocks when the amount of data to be sent exceeds the amount of data TCP/IP can accept. To avoid this, you can precede the write operation with a SELECT call to ensure that the socket is ready for writing. Once a socket is selected for WRITE, the program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT call with the SO-SNDBUF option.
To test whether any of several sockets is ready for writing, set the WSNDMSK bits representing those sockets to 1 before issuing the SELECT call. When the SELECT call returns, the corresponding bits in the WRETMSK indicate sockets are ready for writing.

**Exception operations**
For each socket to be tested, the SELECT call can check for an existing exception condition. Two exception conditions are supported:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target child server has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
- A socket has received out-of-band data. On this condition, a READ will return the out-of-band data ahead of program data.

To test whether any of several sockets have an exception condition, set the ESNDMSK bits representing those sockets to 1. When the SELECT call returns, the corresponding bits in the ERETMSK indicate sockets with exception conditions.

**MAXSOC parameter**
The SELECT call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECT call tests only bits in the range 0 through the MAXSOC value minus one.

Example: If MAXSOC is set to 50, the range would be 0 through 49.

**TIMEOUT parameter**
If the time specified in the TIMEOUT parameter elapses before any event is detected, the SELECT call returns, and the RETCODE is set to 0.

*The bit mask lengths can be determined from the expression:*

\[
\left(\frac{\text{maximum socket number} + 32}{32}\right) \times 4
\]

*Figure 109 shows an example of SELECT call instructions.*

```assembly
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SELECT'.
  01 MAXSOC   PIC 9(8) BINARY.
  01 TIMEOUT.  
      03 TIMEOUT-SECONDS PIC 9(8) BINARY.
      03 TIMEOUT-MICROSEC PIC 9(8) BINARY.
  01 RSNDMSK   PIC X(*).
  01 WSNDSK   PIC X(*).
  01 ESNDMSK   PIC X(*).
  01 RRETMSK   PIC X(*).
  01 WRETMSK   PIC X(*).
  01 EREMTSK   PIC X(*).
  01 ERNNO    PIC 9(8) BINARY.
  01 RETCODE  PIC S9(8) BINARY.
```

Figure 109. SELECT call instruction example
Bit masks are 32-bit fullwords with one bit for each socket. Up to 32 sockets fit into one 32-bit mask [PIC X(4)]. If you have 33 sockets, you must allocate two 32-bit masks [PIC X(8)].

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SELECT. The field is left-justified and padded on the right with blanks.

MAXSOC
Input parameter; a fullword binary field set to the largest socket descriptor number being checked.

TIMEOUT
If TIMEOUT is a positive value, it specifies the maximum interval to wait for the selection to complete. If TIMEOUT-SECONDS is a negative value, the SELECT call blocks until a socket becomes ready. To poll the sockets and return immediately, specify the TIMEOUT value to be 0.

TIMEOUT is specified in the two-word TIMEOUT as follows:
- TIMEOUT-SECONDS, word one of the TIMEOUT field, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of the TIMEOUT field, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECT to time out after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 50000.

RSNDMSK
A bit string sent to request read event status.
- For each socket to be checked for pending read events, the corresponding bit in the string should be set to 1.
- For sockets to be ignored, the value of the corresponding bit should be set to 0.

If this parameter is set to all zeros, the SELECT will not check for read events.

WSNDMSK
A bit string sent to request write event status.
- For each socket to be checked for pending write events, the corresponding bit in the string should be set to 1.
- For sockets to be ignored, the value of the corresponding bit should be set to 0.

If this parameter is set to all zeros, the SELECT will not check for write events.

ESNDMSK
A bit string sent to request exception event status.
- For each socket to be checked for pending exception events, the corresponding bit in the string should be set to 1.
- For each socket to be ignored, the corresponding bit should be set to 0.
If this parameter is set to all zeros, the SELECT will not check for exception events.

**Parameter values returned to the application**

**RRETMSK**
A bit string returned with the status of read events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that is ready to read, the corresponding bit in the string will be set to 1; bits that represent sockets that are not ready to read will be set to 0.

**WRETMSK**
A bit string returned with the status of write events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that is ready to write, the corresponding bit in the string will be set to 1; bits that represent sockets that are not ready to be written will be set to 0.

**ERETMSK**
A bit string returned with the status of exception events. The length of the string should be equal to the maximum number of sockets to be checked. For each socket that has an exception status, the corresponding bit will be set to 1; bits that represent sockets that do not have exception status will be set to 0.

**ERRNO**
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0</td>
<td>Indicates the sum of all ready sockets in the three masks.</td>
</tr>
<tr>
<td>0</td>
<td>Indicates that the SELECT time limit has expired.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**SELECTEX**
The SELECTEX call monitors a set of sockets, a time value, and an ECB. It completes when either one of the sockets has activity, the time value expires, or one of the ECBS is posted.

To use the SELECTEX call as a timer in your program, do either of the following:
- Set the read, write, and except arrays to zeros.
- Specify MAXSOC <= 0.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
### Amode:
31-bit or 24-bit.

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 553.

<table>
<thead>
<tr>
<th>ASC mode:</th>
<th>Primary address space control (ASC) mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

---

### Defining which sockets to test

The SELECTEX call monitors for read operations, write operations, and exception operations:

- When a socket is ready to read, one of the following has occurred:
  - A buffer for the specified sockets contains input data. If input data is available for a given socket, a read operation on that socket will not block.
  - A connection has been requested on that socket.
- When a socket is ready to write, TCP/IP can accommodate additional output data. If TCP/IP can accept additional output for a given socket, a write operation on that socket will not block.
- When an exception condition has occurred on a specified socket it is an indication that a TAKESOCKET has occurred for that socket.

Each socket descriptor is represented by a bit in a bit string. The bit strings are contained in 32-bit fullwords, numbered from right to left. The rightmost bit represents socket descriptor 0, the leftmost bit represents socket descriptor 31, and so on. If your process uses 32 or fewer sockets, the bit string is 1 fullword. If your process uses 33 sockets, the bit string is 2 fullwords. You define the sockets that you want to test by turning on bits in the string.

**Note:** To simplify string processing in COBOL, you can use the program EZACIC06 to convert each bit in the string to a character. For more information, see “EZACIC06” on page 588.

### Read operations

Read operations include ACCEPT, READ, READV, RECV, RECVFROM, or RECVMSG calls. A socket is ready to be read when data has been received for it or when a connection request has occurred.

To test whether any of several sockets is ready for reading, set the appropriate bits in RSNDMSK to one before issuing the SELECTEX call. When the SELECTEX call returns, the corresponding bits in the RRETMSK indicate sockets are ready for reading.

### Write operations

A socket is selected for writing (ready to be written) when:

- TCP/IP can accept additional outgoing data.
- The socket is marked nonblocking and a previous CONNECT did not complete immediately. In this case, CONNECT returned an ERRNO with a value of 36 (EINPROGRESS). This socket will be selected for write when the CONNECT completes.
A call to WRITE, SEND, or SENDTO blocks when the amount of data to be sent exceeds the amount of data TCP/IP can accept. To avoid this, you can precede the write operation with a SELECTEX call to ensure that the socket is ready for writing. Once a socket is selected for WRITE, the program can determine the amount of TCP/IP buffer space available by issuing the GETSOCKOPT call with the SO-SNDBUF option.

To test whether any of several sockets is ready for writing, set the WSNDMSK bits representing those sockets to 1 before issuing the SELECTEX call. When the SELECTEX call returns, the corresponding bits in the WRETMSK indicate sockets are ready for writing.

**Exception operations**

For each socket to be tested, the SELECTEX call can check for an existing exception condition. Two exception conditions are supported:

- The calling program (concurrent server) has issued a GIVESOCKET command and the target child server has successfully issued the TAKESOCKET call. When this condition is selected, the calling program (concurrent server) should issue CLOSE to dissociate itself from the socket.
- A socket has received out-of-band data. On this condition, a READ will return the out-of-band data ahead of program data.

To test whether any of several sockets have an exception condition, set the ESNDMSK bits representing those sockets to 1. When the SELECTEX call returns, the corresponding bits in the ERETMSK indicate sockets with exception conditions.

**MAXSOC parameter**

The SELECTEX call must test each bit in each string before returning results. For efficiency, the MAXSOC parameter can be used to specify the largest socket descriptor number that needs to be tested for any event type. The SELECTEX call tests only bits in the range 0 through the MAXSOC value minus one.

Example: If MAXSOC is set to 50, the range would be 0 through 49.

**TIMEOUT parameter**

If the time specified in the TIMEOUT parameter elapses before any event is detected, the SELECTEX call returns, and the RETCODE is set to 0.

Figure 110 on page 549 shows an example of SELECTEX call instructions.
If an application intends to pass a single ECB on the SELECTEX call, then the corresponding working storage definitions and CALL instruction should be coded as below:

**WORKING-STORAGE SECTION.**

```assembly
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SELECTEX'.
  01 MAXSOC PIC 9(8) BINARY.
  01 TIMEOUT.
    03 TIMEOUT-SECONDS PIC 9(8) BINARY.
    03 TIMEOUT-MINUTES PIC 9(8) BINARY.
  01 RSNDMSK PIC X(*).
  01 WSNDMASK PIC X(*).
  01 ESNDMSK PIC X(*).
  01 RRETMASK PIC X(*).
  01 WRETMASK PIC X(*).
  01 ERETMASK PIC X(*).
  01 SELECB PIC X(4).
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.
```

Where * is the size of the select mask

**PROCEDURE DIVISION.**

```assembly
  CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
    RSNDMSK WSNDMASK ESNDMSK
    RRETMASK WRETMASK ERETMASK
    SELECB ERRNO RETCODE.
```

However, if the application intends to pass the address of an ECB list on the SELECTEX call, then the application must set the high order bit in the ECB list address and pass that address using the BY VALUE option as documented in the following example. The remaining parameters must be set back to the default by specifying BY REFERENCE before ERRNO:

**WORKING-STORAGE SECTION.**

```assembly
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SELECTEX'.
  01 MAXSOC PIC 9(8) BINARY.
  01 TIMEOUT.
    03 TIMEOUT-SECONDS PIC 9(8) BINARY.
    03 TIMEOUT-MINUTES PIC 9(8) BINARY.
  01 RSNDMSK PIC X(*).
  01 WSNDMASK PIC X(*).
  01 ESNDMSK PIC X(*).
  01 RRETMASK PIC X(*).
  01 WRETMASK PIC X(*).
  01 ERETMASK PIC X(*).
  01 ECBLIST-PTR USAGE IS POINTER.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.
```

Where * is the size of the select mask

**PROCEDURE DIVISION.**

```assembly
  CALL 'EZASOKET' USING SOC-FUNCTION MAXSOC TIMEOUT
    RSNDMSK WSNDMASK ESNDMSK
    RRETMASK WRETMASK ERETMASK
    BY VALUE ECBLIST-PTR
    BY REFERENCE ERRNO RETCODE.
```

* The bit mask lengths can be determined from the expression:

\[
((\text{maximum socket number} + 32)/32 \text{ (drop the remainder)}) \times 4
\]

* Figure 110. SELECTEX call instruction example
Parameter values set by the application

**SOC-FUNCTION**
A 16-byte character field containing SELECT. The field is left-justified and padded on the right with blanks.

**MAXSOC**
A fullword binary field specifying the largest socket descriptor number being checked.

**TIMEOUT**
If TIMEOUT is a positive value, it specifies a maximum interval to wait for the selection to complete. If TIMEOUT-SECONDS is a negative value, the SELECTEX call blocks until a socket becomes ready or an ECB or ECB in a list is posted. To poll the sockets and return immediately, set TIMEOUT to be zeros.

TIMEOUT is specified in the two-word TIMEOUT as follows:
- TIMEOUT-SECONDS, word one of the TIMEOUT field, is the seconds component of the timeout value.
- TIMEOUT-MICROSEC, word two of the TIMEOUT field, is the microseconds component of the timeout value (0—999999).

For example, if you want SELECTEX to time out after 3.5 seconds, set TIMEOUT-SECONDS to 3 and TIMEOUT-MICROSEC to 500000.

**RSNDMSK**
The bit-mask array to control checking for read interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for read interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

**WSNDMSK**
The bit-mask array to control checking for write interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for write interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

**ESNDMSK**
The bit-mask array to control checking for exception interrupts. If this parameter is not specified or the specified bit-mask is zeros, the SELECT will not check for exception interrupts. The length of this bit-mask array is dependent on the value in MAXSOC.

**SELECB**
An ECB which, if posted, causes completion of the SELECTEX.

**ECBLIST-PTR**
A pointer to an ECB list. The application must set the high order bit in the ECB list address and pass that address using the BY VALUE option. The remaining parameters must be set back to the default by specifying BY REFERENCE before ERRNO.

Parameter values returned to the application

**ERRNO**
A fullword binary field; if RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.
RETCODE
A fullword binary field

<table>
<thead>
<tr>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0</td>
<td>The number of ready sockets.</td>
</tr>
<tr>
<td>0</td>
<td>Either the SELECTEX time limit has expired (ECB value is 0) or one of the caller’s ECBs has been posted (ECB value is nonzero and the caller’s descriptor sets is set to 0). The caller must initialize the ECB values to 0 before issuing the SELECTEX socket command.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

RRETMSK
The bit-mask array returned by the SELECT if RSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

WRETMSK
The bit-mask array returned by the SELECT if WSNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

ERETMSK
The bit-mask array returned by the SELECT if ESNDMSK is specified. The length of this bit-mask array is dependent on the value in MAXSOC.

SEND
The SEND call sends data on a specified connected socket.

The FLAGS field allows you to:
- Send out-of-band data, such as interrupts, aborts, and data marked urgent. Only stream sockets created in the AF_INET address family support out-of-band data.
- Suppress use of local routing tables. This implies that the caller takes control of routing and writing network software.

For datagram sockets, SEND transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes, with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place this call in a loop, reissuing the call until all data has been sent.

Note: See “EZACIC04” on page 584 for a subroutine that will translate EBCDIC input data to ASCII.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
</tbody>
</table>
Amode: 31-bit or 24-bit. 

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

ASC mode: Primary address space control (ASC) mode.

Interrupt status: Enabled for interrupts.

Locks: Unlocked.

Control parameters: All parameters must be addressable by the caller and in the primary address space.

Figure 111 shows an example of SEND call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SEND'.
  01 S PIC 9(4) BINARY.
  01 FLAGS PIC 9(8) BINARY.
     88 NO-FLAG VALUE IS 0.
     88 OOB VALUE IS 1.
     88 DONT-ROUTE VALUE IS 4.
  01 NBYTE PIC 9(8) BINARY.
  01 BUF PIC X(length of buffer).
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE
         BUF ERRNO RETCODE.
```

Figure 111. SEND call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

**SOC-FUNCTION**

A 16-byte character field containing SEND. The field is left-justified and padded on the right with blanks.

S A halfword binary number specifying the socket descriptor of the socket that is sending data.

**FLAGS**

A fullword binary field with values as follows:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>No flag is set. The command behaves like a WRITE call.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.) Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>DONT-ROUTE</td>
<td>4</td>
<td>Do not route. Routing is provided by the calling program.</td>
</tr>
</tbody>
</table>
NBYTE
A fullword binary number set to the number of bytes of data to be transferred.

BUF
The buffer containing the data to be transmitted. BUF should be the size specified in NBYTE.

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

SENDMSG
The SENDMSG call sends messages on a socket with descriptor S passed in an array of messages.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode:</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks:</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 112 on page 554 shows an example of SENDMSG call instructions.
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SENDMSG'.
  01 S PIC 9(4) BINARY.
  01 MSG-HDR.
    03 MSG-NAME USAGE IS POINTER.
    03 MSG-NAME-LEN PIC 9(8) BINARY.
    03 IOV USAGE IS POINTER.
    03 IOVCNT USAGE IS POINTER.
    03 MSG-ACCRIGHTS USAGE IS POINTER.
    03 MSG-ACCRIGHTS-LEN USAGE IS POINTER.
  01 FLAGS PIC 9(8) BINARY.
    88 NO-FLAG VALUE IS 0.
    88 OOB VALUE IS 1.
    88 DONTROUTE VALUE IS 4.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC S9(8) BINARY.
  01 SENDMSG-IPV4ADDR PIC 9(8) BINARY.
  01 SENDMSG-IPV6ADDR.
    05 FILLER PIC 9(16) BINARY.
    05 FILLER PIC 9(16) BINARY.

LINKAGE SECTION.
  01 L1.
    03 SENDMSG-IOVECTOR.
      05 IOV1A USAGE IS POINTER.
      05 IOV1AL PIC 9(8) COMP.
      05 IOV1L PIC 9(8) COMP.
      05 IOV2A USAGE IS POINTER.
      05 IOV2AL PIC 9(8) COMP.
      05 IOV2L PIC 9(8) COMP.
      05 IOV3A USAGE IS POINTER.
      05 IOV3AL PIC 9(8) COMP.
      05 IOV3L PIC 9(8) COMP.
  03 SENDMSG-BUFFER1 PIC X(16).
  03 SENDMSG-BUFFER2 PIC X(16).
  03 SENDMSG-BUFFER3 PIC X(16).
  03 SENDMSG-BUFNO PIC 9(8) COMP.

* IPv4 socket address structure.
  03 NAME.
    05 FAMILY PIC 9(4) BINARY.
    05 PORT PIC 9(4) BINARY.
    05 IP-ADDRESS PIC 9(8) BINARY.
    05 RESERVED PIC X(8) BINARY.

* IPv6 socket address structure.
  03 NAME.
    05 FAMILY PIC 9(4) BINARY.
    05 PORT PIC 9(4) BINARY.
    05 FLOWINFO PIC 9(8) BINARY.
    05 IP-ADDRESS.
      10 FILLER PIC 9(16) BINARY.
      10 FILLER PIC 9(16) BINARY.
    05 SCOPE-ID PIC 9(8) BINARY.

Figure 112, SENDMSG call instruction example (Part 1 of 2)
PROCEDURE DIVISION USING L1.

* For IPv6.
  MOVE 19 TO FAMILY.
  MOVE 1234 TO PORT.
  MOVE 0 TO FLOWINFO.
  MOVE SENDMSG-IPV6ADDR TO IP-ADDRESS.
  MOVE 0 TO SCOPE-ID.

* For IPv4.
  MOVE 2 TO FAMILY.
  MOVE 1234 TO PORT.
  MOVE SENDMSG-IPV4ADDR TO IP-ADDRESS.

SET MSG-NAME TO ADDRESS OF NAME.
MOVE LENGTH OF NAME TO MSG-NAME-LEN.
SET IOV TO ADDRESS OF SENDMSG-IOVECTOR.
MOVE 3 TO SENDMSG-BUFNO.
SET MSG-IOVCNT TO ADDRESS OF SENDMSG-BUFNO.
SET IOV1A TO ADDRESS OF SENDMSG-BUFFER1.
MOVE 0 TO IOV1AL.
MOVE LENGTH OF SENDMSG-BUFFER1 TO IOV1L.
SET IOV2A TO ADDRESS OF SENDMSG-BUFFER2.
MOVE 0 TO IOV2AL.
MOVE LENGTH OF SENDMSG-BUFFER2 TO IOV2L.
SET IOV3A TO ADDRESS OF SENDMSG-BUFFER3.
MOVE 0 TO IOV3AL.
MOVE LENGTH OF SENDMSG-BUFFER3 TO IOV3L.
SET MSG-ACCRIGHTS TO NULLS.
SET MSG-ACCRIGHTS-LEN TO NULLS.
MOVE 0 TO FLAGS.
MOVE 'MESSAGE TEXT 1 ' TO SENDMSG-BUFFER1.
MOVE 'MESSAGE TEXT 2 ' TO SENDMSG-BUFFER2.
MOVE 'MESSAGE TEXT 3 ' TO SENDMSG-BUFFER3.

call 'EZASOKET' USING soc-function S msg-hdr flags errno retcode.

Figure 112. SENDMSG call instruction example (Part 2 of 2)

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDMSG. The field is left-justified and padded on the right with blanks.

S  A value or the address of a halfword binary number specifying the socket descriptor.

MSG  A pointer to an array of message headers from which messages are sent.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>On input, a pointer to a buffer where the sender's address is stored upon</td>
</tr>
<tr>
<td></td>
<td>completion of the call. The storage being pointed to should be for an IPv4</td>
</tr>
<tr>
<td></td>
<td>socket address or an IPv6 socket address. The IPv4 socket address structure</td>
</tr>
<tr>
<td></td>
<td>contains the following fields:</td>
</tr>
<tr>
<td>FAMILY</td>
<td>Output parameter. A halfword binary number specifying</td>
</tr>
</tbody>
</table>
the IPv4 addressing family. The value for IPv4 socket
descriptor (S parameter) is decimal 2, indicating AF_INET.

PORT Output parameter. A halfword binary number specifying
the port number of the sending socket.

IP-ADDRESS
Output parameter. A fullword binary number specifying
the 32-bit IPv4 Internet address of the sending socket.

RESERVED
Output parameter. An 8-byte reserved field. This field is
required, but is not used.

The IPv6 socket address structure contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
</table>
| FAMILY  | Output parameter. A halfword binary number specifying
the IPv6 addressing family. The value for IPv6 socket
descriptor (S parameter) is decimal 19, indicating
AF_INET6. |
| PORT    | Output parameter. A halfword binary number specifying
the port number of the sending socket. |
| FLOWINFO| A fullword binary field specifying the traffic class and flow
label. This field must be set to 0. |
| IP-ADDRESS | Output parameter. A 16-byte binary field set to the 128-bit
IPv6 Internet address of the sending socket. |
| SCOPE-ID| A fullword binary field which identifies a set of interfaces
as appropriate for the scope of the address carried in the
IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID
field does not identify the set of interfaces to be used, and
may be specified for any address types and scopes. For a
link scope IPv6-ADDRESS, SCOPE-ID may specify a link
index which identifies a set of interfaces. For all other
address scopes, SCOPE-ID must be set to 0. |
| NAME-LEN| On input, a pointer to the size of the address buffer. |
| IOV     | On input, a pointer to an array of three fullword structures with
the number of structures equal to the value in IOVCNT and the
format of the structures as follows:

Fullword 1
A pointer to the address of a data buffer.

Fullword 2
Reserved.

Fullword 3
A pointer to the length of the data buffer referenced in
Fullword 1. |

In COBOL, the IOV structure must be defined separately in the
Linkage section, as shown in the example.
IOVCNT
  On input, a pointer to a fullword binary field specifying the number of data buffers provided for this call.

ACCRIGHTS
  On input, a pointer to the access rights received. This field is ignored.

ACCRIGHTS-LEN
  On input, a pointer to the length of the access rights received. This field is ignored.

FLAGS
  A fullword field containing the following:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>No flag is set. The command behaves like a WRITE call.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.) Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>DONTROUTE</td>
<td>4</td>
<td>Do not route. Routing is provided by the calling program.</td>
</tr>
</tbody>
</table>

Parameter values returned to the application

ERRNO
  A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
  A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

SENDTO
  SENDTO is similar to SEND, except that it includes the destination address parameter. The destination address allows you to use the SENDTO call to send datagrams on a UDP socket, regardless of whether the socket is connected.

The FLAGS parameter allows you to:
  • Send out-of-band data, such as interrupts, aborts, and data marked as urgent.
  • Suppress use of local routing tables. This implies that the caller takes control of routing, which requires writing network software.

For datagram sockets, SENDTO transmits the entire datagram if it fits into the receiving buffer. Extra data is discarded.

For stream sockets, data is processed as streams of information with no boundaries separating the data. For example, if a program is required to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes,
with the number of bytes sent returned in RETCODE. Therefore, programs using stream sockets should place SENDTO in a loop that repeats the call until all data has been sent.

**Note:** See “EZACIC04” on page 584 for a subroutine that will translate EBCDIC input data to ASCII.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

**Figure 113 on page 559** shows an example of SENDTO call instructions.
WORKING-STORAGE SECTION.
01 SOC-FUNCTION PIC X(16) VALUE IS 'SENDTO'.
01 S PIC 9(4) BINARY.
01 FLAGS PIC 9(8) BINARY.
   88 NO-FLAG VALUE IS 0.
   88 OOB VALUE IS 1.
   88 DONT-ROUTE VALUE IS 4.
01 NBYTE PIC 9(8) BINARY.
01 BUF PIC X(length of buffer).

* IPv4 socket address structure.
01 NAME
   03 FAMILY PIC 9(4) BINARY.
   03 PORT PIC 9(4) BINARY.
   03 IP-ADDRESS PIC 9(8) BINARY.
   03 RESERVED PIC X(8).

* IPv6 socket address structure.
01 NAME
   03 FAMILY PIC 9(4) BINARY.
   03 PORT PIC 9(4) BINARY.
   03 FLOWINFO PIC 9(8) BINARY.
   03 IP-ADDRESS.
   10 FILLER PIC 9(16) BINARY.
   10 FILLER PIC 9(16) BINARY.
   03 SCOPE-ID PIC 9(8) BINARY.
01 ERRNO PIC 9(8) BINARY.
01 RETCODE PIC 9(S9) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION S FLAGS NBYTE
   BUF NAME ERRNO RETCODE.

Figure 113. SENDTO call instruction example

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SENDTO. The field is left-justified and padded on the right with blanks.

S
A halfword binary number set to the socket descriptor of the socket sending the data.

FLAGS
A fullword field that returns one of the following:

<table>
<thead>
<tr>
<th>Literal Value</th>
<th>Binary Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO-FLAG</td>
<td>0</td>
<td>No flag is set. The command behaves like a WRITE call.</td>
</tr>
<tr>
<td>OOB</td>
<td>1</td>
<td>Send out-of-band data. (Stream sockets only.) Even if the OOB flag is not set, out-of-band data can be read if the SO-OOBINLINE option is set for the socket.</td>
</tr>
<tr>
<td>DONT-ROUTE</td>
<td>4</td>
<td>Do not route. Routing is provided by the calling program.</td>
</tr>
</tbody>
</table>

NBYTE
A fullword binary number set to the number of bytes to transmit.
BUF  Specifies the buffer containing the data to be transmitted. BUF should be the size specified in NBYTE.

NAME  Specifies the IPv4 socket address structure as follows:

FAMILY  A halfword binary field containing the IPv4 addressing family. For TCP/IP the value must be decimal 2, indicating AF_INET.

PORT  A halfword binary field containing the port number bound to the socket.

IP-ADDRESS  A fullword binary field containing the socket’s 32-bit IPv4 Internet address.

RESERVED  Specifies eight-byte reserved field. This field is required, but not used.

Specifies the IPv6 socket address structure as follows:

FAMILY  A halfword binary field containing the IPv6 addressing family. For TCP/IP the value is decimal 19, indicating AF_INET6.

PORT  A halfword binary field containing the port number bound to the socket.

FLOWINFO  A fullword binary field specifying the traffic class and flow label. This field must be set to 0.

IP-ADDRESS  A 16-byte binary field set to the 128-bit IPv6 Internet address, in network byte order.

SCOPE-ID  A fullword binary field which identifies a set of interfaces as appropriate for the scope of the address carried in the IPv6-ADDRESS field. A value of 0 indicates the SCOPE-ID field does not identify the set of interfaces to be used, and may be specified for any address types and scopes. For a link scope IPv6-ADDRESS, SCOPE-ID may specify a link index which identifies a set of interfaces. For all other address scopes, SCOPE-ID must be set to 0.

Parameter values returned to the application

ERRNO  A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE  A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥0</td>
<td>A successful call. The value is set to the number of bytes transmitted.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>
SETSOCKOPT

The SETSOCKOPT call sets the options associated with a socket. SETSOCKOPT can be called only for sockets in the AF_INET or AF_INET6 domains.

The OPTVAL and OPTLEN parameters are used to pass data used by the particular set command. The OPTVAL parameter points to a buffer containing the data needed by the set command. The OPTLEN parameter must be set to the size of the data pointed to by OPTVAL.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

Figure 114 shows an example of SETSOCKOPT call instructions.

WORKING-STORAGE SECTION.

01 SOC-FUNCTION PIC X(16) VALUE IS 'SETSOCKOPT'.
01 S PIC 9(4) BINARY.
01 OPTNAME PIC 9(8) BINARY.
01 OPTVAL PIC 9(16) BINARY.
01 OPTLEN PIC 9(8) BINARY.
01 ERRNO PIC 9(8) BINARY.
01 RETCODE PIC 9(8) BINARY.
01 OPTVAL PIC 9(16) BINARY.
01 OPTLEN PIC 9(8) BINARY.
01 ERRNO PIC 9(8) BINARY.
01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
CALL 'EZASOKET' USING SOC-FUNCTION S OPTNAME OPTVAL OPTLEN ERRNO RETCODE.

Figure 114. SETSOCKOPT call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SETSOCKOPT. The field is left-justified and padded to the right with blanks.

S A halfword binary number set to the socket whose options are to be set.
OPTNAME

Input parameter. See the table below for a list of the options and their unique requirements.

See Appendix D, “GETSOCKOPT/SETSOCKOPT command values,” on page 863 for the numeric values of OPTNAME.

Note: COBOL programs cannot contain field names with the underscore character. Fields representing the option name should contain dashes instead.

OPTVAL

Contains data which further defines the option specified in OPTNAME. For the SETSOCKOPT API, OPTVAL will be an input parameter. See the table below for a list of the options and their unique requirements.

OPTLEN

Input parameter. A fullword binary field containing the length of the data returned in OPTVAL. See the table below for determining on what to base the value of OPTLEN.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP_ADD_MEMBERSHIP</td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.</td>
<td></td>
</tr>
</tbody>
</table>


### Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP_ADD_SOURCE_MEMBERSHIP</strong></td>
<td>Use this option to enable an application to join a source multicast group on a specific interface and a specific source address. You must specify an interface and a source address with this option. Applications that want to receive multicast datagrams need to join source multicast groups. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
</tr>
<tr>
<td><strong>IP_BLOCK_SOURCE</strong></td>
<td>Use this option to enable an application to block multicast packets that have a source address that matches the given IPv4 source address. You must specify an interface and a source address with this option. The specified multicast group must have been joined previously. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
</tr>
<tr>
<td><strong>IP_DROP_MEMBERSHIP</strong></td>
<td>Use this option to enable an application to exit a multicast group or to exit all sources for a multicast group. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 interface address. See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ. See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ.</td>
</tr>
</tbody>
</table>
Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IP_DROP_SOURCE_MEMBERSHIP</strong></td>
<td>Use this option to enable an application to exit a source multicast group. This is an IPv4-only socket option.</td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
</tr>
<tr>
<td><strong>IP_MULTICAST_IF</strong></td>
<td>Use this option to set or obtain the IPv4 interface address used for sending outbound multicast datagrams from the socket application. This is an IPv4-only socket option.</td>
<td>A 4-byte binary field containing an IPv4 interface address.</td>
</tr>
<tr>
<td></td>
<td>Note: Multicast datagrams can be transmitted only on one interface at a time.</td>
<td></td>
</tr>
<tr>
<td><strong>IP_MULTICAST_LOOP</strong></td>
<td>Use this option to control or determine whether a copy of multicast datagrams are looped back for multicast datagrams sent to a group to which the sending host itself belongs. The default is to loop the datagrams back. The default is to loop the datagrams back.</td>
<td>A 1-byte binary field. To enable, set to 1. To disable, set to 0.</td>
</tr>
<tr>
<td></td>
<td>This is an IPv4-only socket option.</td>
<td></td>
</tr>
<tr>
<td><strong>IP_MULTICAST_TTL</strong></td>
<td>Use this option to set or obtain the IP time-to-live of outgoing multicast datagrams. The default value is '01' meaning that multicast is available only to the local subnet. This is an IPv4-only socket option.</td>
<td>A 1-byte binary field containing the value of '00'x to 'FF'x.</td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>IP_UNBLOCK_SOURCE</strong></td>
<td>Contains the IP_MREQ_SOURCE structure as defined in SYS1.MACLIB(BPXYSOCK). The IP_MREQ_SOURCE structure contains a 4-byte IPv4 multicast address followed by a 4-byte IPv4 source address and a 4-byte IPv4 interface address.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(CBLOCK) for the PL/I example of IP_MREQ_SOURCE.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IP-MREQ-SOURCE.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>IPV6_JOIN_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>If the interface index number is 0, then the stack chooses the local interface.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>IPV6_LEAVE_GROUP</strong></td>
<td>Contains the IPV6_MREQ structure as defined in SYS1.MACLIB(BPXYSOCK). The IPV6_MREQ structure contains a 16-byte IPv6 multicast address followed by a 4-byte IPv6 interface index number.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>If the interface index number is 0, then the stack chooses the local interface.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See the SEZAINST(CBLOCK) for the PL/I example of IPV6_MREQ.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of IPV6-MREQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 20. **OPTNAME options for GETSOCKOPT and SETSOCKOPT** (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IPV6_MULTICAST_HOPS</strong></td>
<td>Use to set or obtain the hop limit used for outgoing multicast packets.</td>
<td>Use IPv6_V6ONLY to restrict sending and receiving of only IPv6 packets.</td>
</tr>
<tr>
<td>This is an IPv6-only socket option.</td>
<td>Contains a 4-byte binary value specifying the multicast hops. If not specified, then the default is 1 hop.</td>
<td>Contains a 4-byte binary value indicating the number of multicast hops.</td>
</tr>
<tr>
<td></td>
<td>-1 indicates use stack default.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 – 255 is the valid hop limit range.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> An application must be APF authorized to enable it to set the hop limit value above the system defined hop limit value. CICS applications cannot execute as APF authorized.</td>
<td></td>
</tr>
</tbody>
</table>

| **IPV6_MULTICAST_IF**                  | Use this option to set or obtain the index of the IPv6 interface used for sending outbound multicast datagrams from the socket application. |                                              |
| This is an IPv6-only socket option.    | Contains a 4-byte binary field containing an IPv6 interface index number.                   | Contains a 4-byte binary field containing an IPv6 interface index number.                   |

| **IPV6_MULTICAST_LOOP**                | Use this option to control or determine whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host itself belongs. The default is to loop multicast datagrams back. | A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0. |
| This is an IPv6-only socket option.    | Contains a 4-byte binary value in the range 0 – 255 indicating the number of unicast hops. |                                              |

| **IPV6_UNICAST_HOPS**                  | Use this option to set or obtain the hop limit used for outgoing unicast IPv6 packets.     | A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0. |
| This is an IPv6-only socket option.    | Contains a 4-byte binary value specifying the unicast hops. If not specified, then the default is 1 hop. |                                              |
|                                        | -1 indicates use stack default.                                                             |                                              |
|                                        | 0 – 255 is the valid hop limit range.                                                      |                                              |
|                                        | **Note:** APF authorized applications are permitted to set a hop limit that exceeds the system configured default. CICS applications cannot execute as APF authorized. |                                              |

| **IPV6_V6ONLY**                        | Use this option to set or determine whether the socket is restricted to send and receive only IPv6 packets. The default is to not restrict the sending and receiving of only IPv6 packets. | A 4-byte binary field. If enabled, contains a 1. If disabled, contains a 0. |
| This is an IPv6-only socket option.    | A 4-byte binary field.                                                                    |                                              |
|                                        | To enable, set to 1.                                                                     |                                              |
|                                        | To disable, set to 0.                                                                    |                                              |
Table 20. **OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)**

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>GETSOCKOPT, OPTVAL (input)</th>
<th>SETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCAST_BLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ.</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_JOIN_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address. See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td>N/A</td>
</tr>
</tbody>
</table>


### Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MCAST_LEAVE_GROUP</strong></td>
<td>Contains the GROUP_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a multicast group or exit all sources for a given multicast groups.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_LEAVE_SOURCE_GROUP</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to exit a source multicast group.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
<tr>
<td><strong>MCAST_UNBLOCK_SOURCE</strong></td>
<td>Contains the GROUP_SOURCE_REQ structure as defined in SYS1.MACLIB(BPXYSOCK). The GROUP_SOURCE_REQ structure contains a 4-byte interface index number followed by a socket address structure of the multicast address and a socket address structure of the source address.</td>
<td>N/A</td>
</tr>
<tr>
<td>Use this option to enable an application to unblock a previously blocked source for a given multicast group. You must specify an interface index and a source address with this option.</td>
<td>See SEZAINST(CBLOCK) for the PL/I example of GROUP_SOURCE_REQ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See SEZAINST(EZACOBOL) for the COBOL example of GROUP-SOURCE-REQ.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_ASCII</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to ASCII data option. When SO_ASCII is set, data is translated to ASCII. When SO_ASCII is not set, data is not translated to or from ASCII.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_BROADCAST</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. The default is disabled.</td>
<td>To enable, set to 1 or a positive value.</td>
<td>A 4-byte field.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_DEBUG</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use SO_DEBUG to set or determine the status of the debug option. The default is disabled. The debug option controls the recording of debug information.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_EBCDIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine the translation to EBCDIC data option. When SO_EBCDIC is set, data is translated to EBCDIC. When SO_EBCDIC is not set, data is not translated to or from EBCDIC. This option is ignored by EBCDIC hosts.</td>
<td>To enable, set to ON.</td>
<td>If enabled, contains ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_ERROR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to request pending errors on the socket or to check for asynchronous errors on connected datagram sockets or for other errors that are not explicitly returned by one of the socket calls. The error status is clear afterwards.</td>
<td>N/A</td>
<td>A 4-byte binary field containing the most recent ERRNO for the socket.</td>
</tr>
</tbody>
</table>
Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT  (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SO_KEEPALIVE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether the keep alive mechanism periodically sends a packet on an otherwise idle connection for a stream socket.</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td>The default is disabled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When activated, the keep alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.</td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SO_LINGER</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to control or determine how TCP/IP processes data that has not been transmitted when a CLOSE is issued for the socket. The default is disabled.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields.</td>
<td>Contains an 8-byte field containing two 4-byte binary fields.</td>
</tr>
<tr>
<td>Notes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. This option has meaning only for stream sockets.</td>
<td>Assembler coding:</td>
<td>Assembler coding:</td>
</tr>
<tr>
<td>2. If you set a zero linger time, the connection cannot close in an orderly manner, but stops, resulting in a RESET segment being sent to the connection partner. Also, if the aborting socket is in nonblocking mode, the close call is treated as though no linger option had been set.</td>
<td>ONOFF DS F</td>
<td>ONOFF DS F</td>
</tr>
<tr>
<td>When SO_LINGER is set and CLOSE is called, the calling program is blocked until the data is successfully transmitted or the connection has timed out.</td>
<td>LINGER DS F</td>
<td>LINGER DS F</td>
</tr>
<tr>
<td>When SO_LINGER is not set, the CLOSE returns without blocking the caller, and TCP/IP continues to attempt to send data for a specified time. This usually allows sufficient time to complete the data transfer.</td>
<td>COBOL coding:</td>
<td>COBOL coding:</td>
</tr>
<tr>
<td>Use of the SO_LINGER option does not guarantee successful completion because TCP/IP only waits the amount of time specified in OPTVAL for SO_LINGER.</td>
<td>ONOFF PIC 9(B) BINARY.</td>
<td>ONOFF PIC 9(B) BINARY.</td>
</tr>
<tr>
<td></td>
<td>LINGER PIC 9(B) BINARY.</td>
<td>LINGER PIC 9(B) BINARY.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPTNAME options (input)</td>
<td>SETSOCKOPT, OPTVAL (input)</td>
<td>GETSOCKOPT, OPTVAL (output)</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>SO_OOBINLINE</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
<tr>
<td><strong>SO_RCVBUF</strong></td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to a positive value specifying the size of the data portion of the TCP/IP receive buffer.</td>
<td>If enabled, contains a positive value indicating the size of the data portion of the TCP/IP receive buffer.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to a 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
</tbody>
</table>

**SO_OOBINLINE**

Use this option to control or determine whether out-of-band data is received.

*Note:* This option has meaning only for stream sockets.

When this option is set, out-of-band data is placed in the normal data input queue as it is received and is available to a RECV or a RECVFROM even if the OOB flag is not set in the RECV or the RECVFROM.

When this option is disabled, out-of-band data is placed in the priority data input queue as it is received and is available to a RECV or a RECVFROM only when the OOB flag is set in the RECV or the RECVFROM.

**SO_RCVBUF**

Use this option to control or determine the size of the data portion of the TCP/IP receive buffer.

The size of the data portion of the receive buffer is protocol-specific, based on the following values prior to any SETSOCKOPT call:

- TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP Socket
- UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set for a UDP Socket
- The default of 65535 for a raw socket

Chapter 13. CALL instruction application programming interface 571
Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO_REUSEADDR</td>
<td>A 4-byte binary field.</td>
<td>A 4-byte binary field.</td>
</tr>
<tr>
<td></td>
<td>To enable, set to 1 or a positive value.</td>
<td>If enabled, contains a 1.</td>
</tr>
<tr>
<td></td>
<td>To disable, set to 0.</td>
<td>If disabled, contains a 0.</td>
</tr>
</tbody>
</table>

Use this option to control or determine whether local addresses are reused. The default is disabled. This alters the normal algorithm used with BIND. The normal BIND algorithm allows each Internet address and port combination to be bound only once. If the address and port have been already bound, then a subsequent BIND will fail and result error will be EADDRINUSE.

When this option is enabled, the following situations are supported:

- A server can BIND the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so multiple bind() calls can be made to the same class D address and port number.
- If you require multiple servers to BIND to the same port and listen on INADDR_ANY, refer to the SHAREPORT option on the PORT statement in TCPIP.PROFILE.

| SO_SNDBUF              | A 4-byte binary field.      | A 4-byte binary field.      |
|                       | To enable, set to a positive value specifying the size of the data portion of the TCP/IP send buffer. | If enabled, contains a positive value indicating the size of the data portion of the TCP/IP send buffer. |
|                       | To disable, set to 0.        | If disabled, contains a 0.  |

Use this option to control or determine the size of the data portion of the TCP/IP send buffer. The size is of the TCP/IP send buffer is protocol specific and is based on the following:

- The TCPSendBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set for a TCP socket.
- The UDPSendBufsize keyword on the UDPCONFIG statement in the PROFIE.TCPIP data set for a UDP socket.
- The default of 65535 for a raw socket.

| SO_TYPE                | N/A                           | A 4-byte binary field indicating the socket type: |
|                       |                               | X'1' indicates SOCK_STREAM. |
|                       |                               | X'2' indicates SOCK_DGRAM.  |
|                       |                               | X'3' indicates SOCK_RAW.    |

Use this option to return the socket type.
Table 20. OPTNAME options for GETSOCKOPT and SETSOCKOPT (continued)

<table>
<thead>
<tr>
<th>OPTNAME options (input)</th>
<th>SETSOCKOPT, OPTVAL (input)</th>
<th>GETSOCKOPT, OPTVAL (output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP_KEEPALIVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether a socket-specific timeout value (in seconds) is to be used in place of a configuration-specific value whenever keep alive timing is active for that socket. When activated, the socket-specified timer value remains in effect until respecified by SETSOCKOPT or until the socket is closed. Refer to the z/OS Communications Server: IP Programmer’s Guide and Reference for more information on the socket option parameters.</td>
<td>A 4-byte binary field. To enable, set to a value in the range of 1 – 2 147 460. To disable, set to a value of 0.</td>
<td>A 4-byte binary field. If enabled, contains the specific timer value (in seconds) that is in effect for the given socket. If disabled, contains a 0 indicating keep alive timing is not active.</td>
</tr>
<tr>
<td>TCP_NODELAY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use this option to set or determine whether data sent over the socket is subject to the Nagle algorithm (RFC 896). Under most circumstances, TCP sends data when it is presented. When this option is enabled, TCP will wait to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP will send small amounts of data even before the acknowledgment for the previous data sent is received. Note: Use the following to set TCP_NODELAY OPTNAME value for COBOL programs:</td>
<td>A 4-byte binary field. To enable, set to a 0. To disable, set to a 1 or nonzero.</td>
<td>A 4-byte binary field. If enabled, contains a 0. If disabled, contains a 1.</td>
</tr>
</tbody>
</table>

**SHUTUTDOWN**

One way to terminate a network connection is to issue the CLOSE call which attempts to complete all outstanding data transmission requests prior to breaking the connection. The SHUTDOWN call can be used to close one-way traffic while completing data transfer in the other direction. The HOW parameter determines the direction of traffic to shutdown.

When the CLOSE call is used, the SETSOCKOPT OPTVAL LINGER parameter determines the amount of time the system will wait before releasing the connection. For example, with a LINGER value of 30 seconds, system resources (including the IMS or CICS transaction) will remain in the system for up to 30 seconds after the CLOSE call is issued. In high volume, transaction-based systems like CICS and IMS, this can impact performance severely.

If the SHUTDOWN call is issued when the CLOSE call is received, the connection can be closed immediately, rather than waiting for the 30-second delay.
If you issue `SHUTDOWN` for a socket that currently has outstanding socket calls pending, see Table 3 on page 35 to determine the effects of this operation on the outstanding socket calls.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
<tr>
<td>Note:</td>
<td>See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 115 shows an example of SHUTDOWN call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'SHUTDOWN'.
  01 S PIC 9(4) BINARY.
  01 HOW PIC 9(8) BINARY.
  88 END-FROM VALUE 0.
  88 END-TO VALUE 1.
  88 END-BOTH VALUE 2.
  01 ERRNO PIC 9(8) BINARY.
  01 RETCODE PIC 9(8) BINARY.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION S HOW ERRNO RETCODE.
```

Figure 115. SHUTDOWN call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

**Parameter values set by the application**

**SOC-FUNCTION**

A 16-byte character field containing SHUTDOWN. The field is left-justified and padded on the right with blanks.

**S**

A halfword binary number set to the socket descriptor of the socket to be shutdown.

**HOW**

A fullword binary field. Set to specify whether all or part of a connection is to be shut down. The following values can be set:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (END-FROM)</td>
<td>Ends further receive operations.</td>
</tr>
<tr>
<td>1 (END-TO)</td>
<td>Ends further send operations.</td>
</tr>
</tbody>
</table>
2 (END-BOTH)

Ends further send and receive operations.

Parameter values returned to the application

ERRNO

A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE

A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

SOCKET

The SOCKET call creates an endpoint for communication and returns a socket descriptor representing the endpoint.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

Figure 116 on page 576 shows an example of SOCKET call instructions.
For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing SOCKET. The field is left-justified and padded on the right with blanks.

AF
A fullword binary field set to the addressing family. For TCP/IP the value is set to decimal 2 for AF_INET, or decimal 19, indicating AF_INET6.

SOCTYPE
A fullword binary field set to the type of socket required. The types are:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stream sockets provide sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data.</td>
</tr>
<tr>
<td>2</td>
<td>Datagram sockets provide datagrams, which are connectionless messages of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered multiple times.</td>
</tr>
<tr>
<td>3</td>
<td>Raw sockets provide the interface to internal protocols (such as IP and ICMP).</td>
</tr>
</tbody>
</table>

PROTO
A fullword binary field set to the protocol to be used for the socket. If this field is set to 0, the default protocol is used. For streams, the default is TCP; for datagrams, the default is UDP.

PROTO numbers are found in the hlq.etc.proto data set. For IPv6 raw sockets, PROTO cannot be set to the following:

<table>
<thead>
<tr>
<th>Protocol name</th>
<th>Numeric value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPPROTO_HOPOPTS</td>
<td>0</td>
</tr>
<tr>
<td>IPPROTO_TCP</td>
<td>6</td>
</tr>
<tr>
<td>IPPROTO_UDP</td>
<td>17</td>
</tr>
<tr>
<td>IPPROTO_IPV6</td>
<td>41</td>
</tr>
</tbody>
</table>
IPPROTO_ROUTING 43
IPPROTO_FRAGMENT 44
IPPROTO_ESP 50
IPPROTO_AH 51
IPPROTO_NONE 59
IPPROTO_DSTOPTS 60

Parameter values returned to the application

ERRNO
A fullword binary field. If RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0</td>
<td>Contains the new socket descriptor.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

TAKESOCKET
The TAKESOCKET call acquires a socket from another program and creates a new socket. Typically, a child server issues this call using client ID and socket descriptor data that it obtained from the concurrent server. See “GIVESOCKET” on page 509 for a discussion of the use of GETSOCKET and TAKESOCKET calls.

Note: When TAKESOCKET is issued, a new socket descriptor is returned in RETCODE. You should use this new socket descriptor in subsequent calls such as GETSOCKOPT, which require the S (socket descriptor) parameter.

The following requirements apply to this call:

| Authorization: Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: Task. |
| Cross memory mode: PASN = HASN. |
| Amode: 31-bit or 24-bit. |

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: Primary address space control (ASC) mode. |
| Interrupt status: Enabled for interrupts. |
| Locks: Unlocked. |
| Control parameters: All parameters must be addressable by the caller and in the primary address space. |

Figure 117 on page 578 shows an example of TAKESOCKET call instructions.
Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TAKESOCKET. The field is left-justified and padded to the right with blanks.

SOCRECV
A halfword binary field set to the descriptor of the socket to be taken. The socket to be taken is passed by the concurrent server.

CLIENT
Specifies the client ID of the program that is giving the socket. In CICS and IMS, these parameters are passed by the Listener program to the program that issues the TAKESOCKET call.
- In CICS, the information is obtained using EXEC CICS RETRIEVE.
- In IMS, the information is obtained by issuing GU TIM.

DOMAIN
A fullword binary field set to the domain of the program giving the socket. It is decimal 2, indicating AF_INET, or decimal 19, indicating AF_INET6.

Note: The TAKESOCKET can only acquire a socket of the same address family from a GIVESOCKET.

NAME
Specifies an 8-byte character field set to the MVS address space identifier of the program that gave the socket.

TASK
Specifies an 8-byte field set to the task identifier of the task that gave the socket.

RESERVED
A 20-byte reserved field. This field is required, but not used.

Parameter values returned to the application

ERRNO
A fullword binary field. If the value of RETCODE is negative, the field contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.
RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 0</td>
<td>Contains the new socket descriptor.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

TERMAPI
This call terminates the session created by INITAPI.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization</td>
<td>Supervisor state or problem state, any PSW key.</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASC mode</td>
<td>Primary address space control (ASC) mode.</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for interrupts.</td>
</tr>
<tr>
<td>Locks</td>
<td>Unlocked.</td>
</tr>
<tr>
<td>Control parameters</td>
<td>All parameters must be addressable by the caller and in the primary address space.</td>
</tr>
</tbody>
</table>

Figure 118 shows an example of TERMAPI call instructions.

```
WORKING-STORAGE SECTION.
  01 SOC-FUNCTION PIC X(16) VALUE IS 'TERMAPI'.

PROCEDURE DIVISION.
  CALL 'EZASOKET' USING SOC-FUNCTION.
```

Figure 118. TERMAPI call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

SOC-FUNCTION
A 16-byte character field containing TERMAPI. The field is left-justified and padded to the right with blanks.

WRITE
The WRITE call writes data on a connected socket. This call is similar to SEND, except that it lacks the control flags available with SEND.

For datagram sockets the WRITE call writes the entire datagram if it fits into the receiving buffer.

Stream sockets act like streams of information with no boundaries separating data. For example, if a program wishes to send 1000 bytes, each call to this function can send any number of bytes, up to the entire 1000 bytes. The number of bytes sent...
will be returned in RETCODE. Therefore, programs using stream sockets should place this call in a loop, calling this function until all data has been sent.

See "EZACIC04" on page 584 for a subroutine that will translate EBCDIC output data to ASCII.

The following requirements apply to this call:

| Authorization: | Supervisor state or problem state, any PSW key. |
| Dispatchable unit mode: | Task. |
| Cross memory mode: | PASN = HASN. |
| Amode: | 31-bit or 24-bit. |

**Note:** See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

Figure 119 shows an example of WRITE call instructions.

```plaintext
WORKING-STORAGE SECTION.
   01 SOC-FUNCTION PIC X(16) VALUE IS 'WRITE'.
   01 S PIC 9(4) BINARY.
   01 NBYTE PIC 9(8) BINARY.
   01 BUF PIC X(length of buffer).
   01 ERRNO PIC 9(8) BINARY.
   01 RETCODE PIC S9(8) BINARY.

PROCEDURE DIVISION.
   CALL 'EZASOKET' USING SOC-FUNCTION S NBYTE BUF
                ERRNO RETCODE.
```

Figure 119. WRITE call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

**Parameter values set by the application**

**SOC-FUNCTION**

A 16-byte character field containing WRITE. The field is left-justified and padded on the right with blanks.

**S**

A halfword binary field set to the socket descriptor.

**NBYTE**

A fullword binary field set to the number of bytes of data to be transmitted.

**BUF**

Specifies the buffer containing the data to be transmitted.

**Parameter values returned to the application**

**ERRNO**

A fullword binary field. If RETCODE is negative, the field contains an
error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

RETCODE
A fullword binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥0</td>
<td>A successful call. A return code greater than 0 indicates the number of bytes of data written.</td>
</tr>
<tr>
<td>−1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

WRITEV
The WRITEV function writes data on a socket from a set of buffers.

The following requirements apply to this call:

<table>
<thead>
<tr>
<th>Authorization:</th>
<th>Supervisor state or problem state, any PSW key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task.</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN = HASN.</td>
</tr>
<tr>
<td>Amode:</td>
<td>31-bit or 24-bit.</td>
</tr>
</tbody>
</table>

Note: See “Addressability mode (Amode) considerations” under “Environmental restrictions and programming requirements” on page 453.

| ASC mode: | Primary address space control (ASC) mode. |
| Interrupt status: | Enabled for interrupts. |
| Locks: | Unlocked. |
| Control parameters: | All parameters must be addressable by the caller and in the primary address space. |

Figure 120 on page 582 shows an example of WRITEV call instructions.
Parameter values set by the application

**S**
A value or the address of a halfword binary number specifying the descriptor of the socket from which the data is to be written.

**IOV**
An array of tripleword structures with the number of structures equal to the value in IOVCNT and the format of the structures as follows:

- **Fullword 1**
  The address of a data buffer.

- **Fullword 2**
  Reserved.

- **Fullword 3**
  The length of the data buffer referenced in Fullword 1.

**IOVCNT**
A fullword binary field specifying the number of data buffers provided for this call.

Parameters returned by the application

**ERRNO**
A fullword binary field. If RETCODE is negative, this contains an error number. See Appendix B, “Return codes,” on page 835 for information about ERRNO return codes.

**RETCODE**
A fullword binary field.

**Value**  **Meaning**
<0 Check ERRNO for an error code.
0 Connection partner has closed connection.
>0 Number of bytes sent.

Using data translation programs for socket call interface

In addition to the socket calls, you can use the following utility programs to translate data:

Data translation

TCP/IP hosts and networks use ASCII data notation; MVS TCP/IP and its subsystems use EBCDIC data notation. In situations where data must be translated from one notation to the other, you can use the following utility programs:

- EZACIC04 translates EBCDIC data to ASCII data using the translation table documented in the z/OS Communications Server: IP Configuration Reference.
- EZACIC05 translates ASCII data to EBCDIC data using the translation table documented in the z/OS Communications Server: IP Configuration Reference.
- EZACIC14 provides an alternative to EZACIC04 and translates EBCDIC data to ASCII data using the translation table documented in Figure 128 on page 598.
- EZACIC15 provides an alternative to EZACIC05 and translates ASCII data to EBCDIC data using the translation table documented in Figure 130 on page 600.

Bit-string processing

In C-language, bit strings are often used to convey flags, switch settings, and so on; TCP/IP makes frequent uses of bit strings. However, since bit strings are difficult to decode in COBOL, TCP/IP includes the following:

- EZACIC06 translates bit-masks into character arrays and character arrays into bit-masks.
- EZACIC08 interprets the variable length address list in the HOSTENT structure returned by GETHOSTBYNAME or GETHOSTBYADDR.
- EZACIC09 interprets the ADDRINFO structure returned by GETADDRINFO.
EZACIC04

The EZACIC04 program is used to translate EBCDIC data to ASCII data. Figure 121 shows how EZACIC04 translates a byte of EBCDIC data.

Figure 121. EZACIC04 EBCDIC-to-ASCII table

<table>
<thead>
<tr>
<th>ASCII output by EZACIC04</th>
<th>second hex digit of byte of EBCDIC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>1A</td>
</tr>
<tr>
<td>3</td>
<td>1A</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>26</td>
</tr>
</tbody>
</table>

Figure 122 shows an example of EZACIC04 call instructions.

WORKING-STORAGE SECTION.
01 OUT-BUFFER PIC X(length of output).
01 LENGTH PIC 9(B) BINARY.

PROCEDURE DIVISION.
CALL 'EZACIC04' USING OUT-BUFFER LENGTH.

Figure 122. EZACIC04 call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

OUT-BUFFER
A buffer that contains the following:
• When called, EBCDIC data
• Upon return, ASCII data
LENGTH
   Specifies the length of the data to be translated.
EZACIC05

The EZACIC05 program is used to translate ASCII data to EBCDIC data. EBCDIC data is required by COBOL, PL/I, and assembler language programs. Figure 123 shows how EZACIC05 translates a byte of ASCII data.

Figure 123. EZACIC05 ASCII-to-EBCDIC table

<table>
<thead>
<tr>
<th>EBCDIC output by EZACIC05</th>
<th>second hex digit of byte of ASCII data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>00</td>
</tr>
<tr>
<td>2</td>
<td>00</td>
</tr>
<tr>
<td>3</td>
<td>00</td>
</tr>
<tr>
<td>4</td>
<td>00</td>
</tr>
<tr>
<td>5</td>
<td>00</td>
</tr>
<tr>
<td>6</td>
<td>00</td>
</tr>
<tr>
<td>7</td>
<td>00</td>
</tr>
<tr>
<td>8</td>
<td>00</td>
</tr>
<tr>
<td>9</td>
<td>00</td>
</tr>
<tr>
<td>A</td>
<td>00</td>
</tr>
<tr>
<td>B</td>
<td>00</td>
</tr>
<tr>
<td>C</td>
<td>00</td>
</tr>
<tr>
<td>D</td>
<td>00</td>
</tr>
<tr>
<td>E</td>
<td>00</td>
</tr>
<tr>
<td>F</td>
<td>00</td>
</tr>
</tbody>
</table>

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

IN-BUFFER

A buffer that contains the following:
- When called, ASCII data
- Upon return, EBCDIC data
LENGTH
  Specifies the length of the data to be translated.
**EZACIC06**

The SELECT call uses bit strings to specify the sockets to test and to return the results of the test. Because bit strings are difficult to manage in COBOL, you might want to use the assembler language program EZACIC06 to translate them to character strings to be used with the SELECT call.

Figure 125 shows an example of EZACIC06 call instructions.

```cobol
WORKING-STORAGE SECTION.
  01 CHAR-MASK.
    05 CHAR-STRING PIC X(nn).

  01 CHAR-ARRAY REDEFINES CHAR-MASK.
    05 CHAR-ENTRY-TABLE OCCURS nn TIMES.
      10 CHAR-ENTRY PIC X(1).

  01 BIT-MASK.
    05 BIT-ARRAY-FWDS OCCURS (nn+31)/32 TIMES.
      10 BIT_ARRAY_WORD PIC 9(8) COMP.

  01 BIT-FUNCTION-CODES.
    05 CTOB PIC X(4) VALUE 'CTOB'.
    05 BTOC PIC X(4) VALUE 'BTOC'.

  01 CHAR-MASK-LENGTH PIC 9(8) COMP VALUE nn.

PROCEDURE CALL (to convert from character to binary)
  CALL 'EZACIC06' USING CTOB
    BIT-MASK
    CHAR-MASK
    CHAR-MASK-LENGTH
    RETCODE.

PROCEDURE CALL (to convert from binary to character)
  CALL 'EZACIC06' USING BTOC
    BIT-MASK
    CHAR-MASK
    CHAR-MASK-LENGTH
    RETCODE.
```

Figure 125. EZACIC06 call instruction example

For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

**TOKEN**

Specifies a 16-character identifier. This identifier is required and it must be the first parameter in the list.

**CHAR-MASK**

Specifies the character array where \( nn \) is the maximum number of sockets in the array. The first character in the array represents socket 0, the second represents socket 1, and so on. Note that the index is 1 greater than the socket number [for example, CHAR-ENTRY(1) represents socket 0, CHAR-ENTRY(2) represents socket 1, and so on.]

**BIT-MASK**

Specifies the bit string to be translated for the SELECT call. Within each fullword of the bit string, the bits are ordered right to left. The right-most bit in the first fullword represents socket 0 and the left-most bit represents...
socket 31. The right-most bit in the second fullword represents socket 32 and the left-most bit represents socket 63. The number of fullwords in the bit string should be calculated by dividing the sum of 31 and the character array length by 32 (truncate the remainder).

**COMMAND**
- **BTOC** specifies bit string to character array translation.
- **CTOB** specifies character array to bit string translation.

**CHAR-MASK-LENGTH**
Specifies the length of the character array. This field should be no greater than 1 plus the MAXSNO value returned on the INITAPI (which is usually the same as the MAXSOC value specified on the INITAPI).

**RETCODE**
A binary field that returns one of the following:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>-1</td>
<td>Check ERRNO for an error code.</td>
</tr>
</tbody>
</table>

**Example:** If you want to use the SELECT call to test sockets 0, 5, and 32, and you are using a character array to represent the sockets, you must set the appropriate characters in the character array to 1. In this example, index positions 1, 6 and 33 in the character array are set to 1. Then you can call EZACIC06 with the COMMAND parameter set to CTOB. When EZACIC06 returns, the first fullword of BIT-MASK contains B’00000000000000000000000010000001' to indicate that sockets 0 and 5 will be checked. The second word of BIT-MASK contains B’00000000000000000000000000000001' to indicate that socket 32 will be checked. These instructions process the bit string shown in the following example:

```fortran
MOVE ZEROS TO CHAR-STRING.
MOVE '1' TO CHAR-ENTRY(1), CHAR-ENTRY(6), CHAR-ENTRY(33).
CALL 'EZACIC06' USING TOKEN CTOB BIT-MASK CH-MASK
  CHAR-MASK-LENGTH RETCODE.
MOVE BIT-MASK TO ....
```

When the select call returns and you want to check the bit-mask string for socket activity, enter the following instructions.

```fortran
MOVE ...... TO BIT-MASK.
CALL 'EZACIC06' USING TOKEN BTOC BIT-MASK CH-MASK
  CHAR-MASK-LENGTH RETCODE.
PERFORM TEST- SOCKET THRU TEST- SOCKET- EXIT VARYING IDX
  FROM 1 BY 1 UNTIL IDX EQUAL CHAR- MASK- LENGTH.

TEST- SOCKET.
  IF CHAR- ENTRY(IDX) EQUAL '1'
    THEN PERFORM SOCKET- RESPONSE THRU SOCKET- RESPONSE- EXIT
  ELSE NEXT SENTENCE.

TEST- SOCKET- EXIT.
EXIT.
```
EZACIC08

The GETHOSTBYNAME and GETHOSTBYADDR calls were derived from C socket calls that return a structure known as HOSTENT. A given TCP/IP host can have multiple alias names and host Internet addresses.

TCP/IP uses indirect addressing to connect the variable number of alias names and Internet addresses in the HOSTENT structure that are returned by the GETHOSTBYADDR AND GETHOSTBYNAME calls.

If you are coding in PL/I or assembler language, the HOSTENT structure can be processed in a relatively straight-forward manner. However, if you are coding in COBOL, HOSTENT can be more difficult to process and you should use the EZACIC08 subroutine to process it for you.

It works as follows:

1. GETHOSTBYADDR or GETHOSTBYNAME returns a HOSTENT structure that indirectly addresses the lists of alias names and Internet addresses.

2. Upon return from GETHOSTBYADDR or GETHOSTBYNAME, your program calls EZACIC08 and passes it the address of the HOSTENT structure.

   EZACIC08 processes the structure and returns the following:
   - The length of host name, if present
   - The host name
   - The number of alias names for the host
   - The alias name sequence number
   - The length of the alias name
   - The alias name
   - The host Internet address type, always 2 for AF_INET
   - The host Internet address length, always 4 for AF_INET
   - The number of host Internet addresses for this host
   - The host Internet address sequence number
   - The host Internet address

3. If the GETHOSTBYADDR or GETHOSTBYNAME call returns more than one alias name or host Internet address, the application program should repeat the call to EZACIC08 until all alias names and host Internet addresses have been retrieved.

   Figure 126 on page 591 shows an example of EZACIC08 call instructions.
For equivalent PL/1 and assembler language declarations, see “Converting parameter descriptions” on page 456.

Parameter values set by the application

**HOSTENT-ADDR**
This fullword binary field must contain the address of the HOSTENT structure (as returned by the GETHOSTBYxxxx call). This variable is the same as the variable HOSTENT in the GETHOSTBYADDR and GETHOSTBYNAME socket calls.

**HOSTALIAS-SEQ**
This halfword field is used by EZACIC08 to index the list of alias names. When EZACIC08 is called, it adds 1 to the current value of HOSTALIAS-SEQ and uses the resulting value to index into the table of alias names. Therefore, for a given instance of GETHOSTBYxxxx, this field should be set to 0 for the initial call to EZACIC08. For all subsequent calls to EZACIC08, this field should contain the HOSTALIAS-SEQ number returned by the previous invocation.

**HOSTADDR-SEQ**
This halfword field is used by EZACIC08 to index the list of IP addresses. When EZACIC08 is called, it adds 1 to the current value of HOSTADDR-SEQ and uses the resulting value to index into the table of IP addresses. Therefore, for a given instance of GETHOSTBYxxxx, this field should be set to 0 for the initial call to EZACIC08. For all subsequent calls to EZACIC08, this field should contain the HOSTADDR-SEQ number returned by the previous call.
Parameter values returned to the application

**HOSTNAME-LENGTH**
This halfword binary field contains the length of the host name (if host name was returned).

**HOSTNAME-VALUE**
This 255-byte character string contains the host name (if host name was returned).

**HOSTALIAS-COUNT**
This halfword binary field contains the number of alias names returned.

**HOSTALIAS-SEQ**
This halfword binary field is the sequence number of the alias name currently found in HOSTALIAS-VALUE.

**HOSTALIAS-LENGTH**
This halfword binary field contains the length of the alias name currently found in HOSTALIAS-VALUE.

**HOSTALIAS-VALUE**
This 255-byte character string contains the alias name returned by this instance of the call. The length of the alias name is contained in HOSTALIAS-LENGTH.

**HOSTADDR-TYPE**
This halfword binary field contains the type of host address. For FAMILY type AF_INET, HOSTADDR-TYPE is always 2.

**HOSTADDR-LENGTH**
This halfword binary field contains the length of the host Internet address currently found in HOSTADDR-VALUE. For FAMILY type AF_INET, HOSTADDR-LENGTH is always set to 4.

**HOSTADDR-COUNT**
This halfword binary field contains the number of host Internet addresses returned by this instance of the call.

**HOSTADDR-SEQ**
This halfword binary field contains the sequence number of the host Internet address currently found in HOSTADDR-VALUE.

**HOSTADDR-VALUE**
This fullword binary field contains a host Internet address.

**RETURN-CODE**
This fullword binary field contains the EZACIC08 return code:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>-1</td>
<td>HOSTENT address is not valid.</td>
</tr>
<tr>
<td>-2</td>
<td>A value of HOSTALIAS-SEQ is not valid.</td>
</tr>
<tr>
<td>-3</td>
<td>A value of HOSTADDR-SEQ is not valid.</td>
</tr>
</tbody>
</table>
The GETADDRINFO call was derived from the C socket call that return a structure known as RES. A given TCP/IP host can have multiple sets of NAMES. TCP/IP uses indirect addressing to connect the variable number of NAMES in the RES structure that is returned by the GETADDRINFO call. If you are coding in PL/I or assembler language, the RES structure can be processed in a relatively straight-forward manner. However, if you are coding in COBOL, RES can be more difficult to process and you should use the EZACIC09 subroutine to process it for you. It works as follows:

1. GETADDRINFO returns a RES structure that indirectly addresses the lists of socket address structures.
2. Upon return from GETADDRINFO, your program calls EZACIC09 and passes it the address of the next address information structure as referenced by the NEXT argument. EZACIC09 processes the structure and returns the following:
   a. The socket address structure
   b. The next address information structure.
3. If the GETADDRINFO call returns more than one socket address structure the application program should repeat the call to EZACIC09 until all socket address structures have been retrieved.

Figure 127 on page 594 shows an example of EZACIC09 call instructions.
WORKING-STORAGE SECTION.

* Variables used for the GETADDRINFO call
  01 getaddrinfo-parms.
    02 node-name pic x(255).
    02 node-name-len pic 9(8) binary.
    02 service-name pic x(32).
    02 service-name-len pic 9(8) binary.
    02 canonical-name-len pic 9(8) binary.
    02 ai-passive pic 9(8) binary value 1.
    02 ai-canonnameok pic 9(8) binary value 2.
    02 ai-numerichost pic 9(8) binary value 4.
    02 ai-numericerv pic 9(8) binary value 8.
    02 ai-v4mapped pic 9(8) binary value 16.
    02 ai-all pic 9(8) binary value 32.
    02 ai-addrconfig pic 9(8) binary value 64.

* Variables used for the EZACIC09 call
  01 ezacic09-parms.
    02 res usage is pointer.
    02 res-name-len pic 9(8) binary.
    02 res-canonical-name pic x(256).
    02 res-name usage is pointer.
    02 res-next-addrinfo usage is pointer.

* Socket address structure
  01 server-socket-address.
    05 server-family pic 9(4) Binary Value 19.
    05 server-port pic 9(4) Binary Value 9997.
    05 server-flowinfo pic 9(8) Binary Value 0.
    05 server-ipaddr.
      10 filler pic 9(16) binary value 0.
      10 filler pic 9(16) binary value 0.
    05 server-scopeid pic 9(8) Binary Value 0.

Figure 127. EZACIC09 call instruction example (Part 1 of 3)
LINKAGE SECTION.
01 LI.
  03 HINTS-ADDRINFO.
      05 HINTS-AI-FLAGS PIC 9(8) BINARY.
      05 HINTS-AI-FAMILY PIC 9(8) BINARY.
      05 HINTS-AI-SOCKTYPE PIC 9(8) BINARY.
      05 HINTS-AI-PROTOCOL PIC 9(8) BINARY.
      05 FILLER PIC 9(8) BINARY.
      05 FILLER PIC 9(8) BINARY.
      05 FILLER PIC 9(8) BINARY.
  03 HINTS-ADDRINFO-PTR USAGE IS POINTER.
  03 RES-ADDRINFO-PTR USAGE IS POINTER.

* * RESULTS ADDRESS INFO
* *
01 RESULTS-ADDRINFO.
  05 RESULTS-AI-FLAGS PIC 9(8) BINARY.
  05 RESULTS-AI-FAMILY PIC 9(8) BINARY.
  05 RESULTS-AI-SOCKTYPE PIC 9(8) BINARY.
  05 RESULTS-AI-PROTOCOL PIC 9(8) BINARY.
  05 RESULTS-AI-ADDR-LEN PIC 9(8) BINARY.
  05 RESULTS-AI-CANONICAL-NAME USAGE IS POINTER.
  05 RESULTS-AI-ADDR-PTR USAGE IS POINTER.
  05 RESULTS-AI-NEXT-PTR USAGE IS POINTER.

* * SOCKET ADDRESS STRUCTURE FROM EZACIC09.
* *
01 OUTPUT-NAME-PTR USAGE IS POINTER.
01 OUTPUT-IP-NAME.
  03 OUTPUT-IP-FAMILY PIC 9(4) BINARY.
  03 OUTPUT-IP-PORT PIC 9(4) BINARY.
  03 OUTPUT-IP-SOCK-DATA PIC X(24).
  03 OUTPUT-IPV4-SOCK-DATA REDEFINES OUTPUT-IP-SOCK-DATA.
      05 OUTPUT-IPV4-IPADDR PIC 9(8) BINARY.
      05 FILLER PIC X(20).
  03 OUTPUT-IPV6-SOCK-DATA REDEFINES OUTPUT-IP-SOCK-DATA.
      05 OUTPUT-IPV6-FLOWINFO PIC 9(8) BINARY.
      05 OUTPUT-IPV6-IPADDR.
          10 FILLER PIC 9(16) BINARY.
          10 FILLER PIC 9(16) BINARY.
      05 OUTPUT-IPV6-SCOPEID PIC 9(8) BINARY.

Figure 127. EZACIC09 call instruction example (Part 2 of 3)
PROCEDURE DIVISION USING L1.

* Get and address from the resolver.
* move 'yournodename' to node-name.
move 12 to node-name-len.
move spaces to service-name.
move 0 to service-name-len.
move af-inet6 to hints-ai-family.
move 49 to hints-ai-flags
move 0 to hints-ai-socktype.
move 0 to hints-ai-protocol.
set address of results-addrinfo to res-addrinfo-ptr.
set hints-addrinfo-ptr to address of hints-addrinfo.
call 'EZASOKET' using socket-getaddrinfo
   node-name node-name-len
   service-name service-name-len
   hints-addrinfo-ptr
   res-addrinfo-ptr
   canonical-name-len
   errno retcode.

* Use EZACIC09 to extract the IP address
* set address of results-addrinfo to res-addrinfo-ptr.
set res to address of results-addrinfo.
move zeros to res-name-len.
move spaces to res-canonical-name.
set res-name to nulls.
set res-next-addrinfo to nulls.
call 'EZACIC09' using res
   res-name-len
   res-canonical-name
   res-name
   res-next-addrinfo
   retcode.
set address of output-ip-name to res-name.
move output-ipv6-ipaddr to server-ipaddr.

Figure 127. EZACIC09 call instruction example (Part 3 of 3)

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 456.

Parameter values set by the application:

RES  This fullword binary field must contain the address of the ADDRINFO structure (as returned by the GETADDRINFO call). This variable is the same as the RES variable in the GETADDRINFO socket call.

RES-NAME-LEN  A fullword binary field that will contain the length of the socket address structure as returned by the GETADDRINFO call.

Parameter values returned to the application:

Description
RES-CANONICAL-NAME  A field large enough to hold the canonical name. The maximum field size is 256 bytes. The canonical name length field will indicate the length of the canonical name as returned by the GETADDRINFO call.

RES-NAME  The address of the subsequent socket address structure.
**RES-NEXT**  The address of the next address information structure.

**RETURN-CODE**

CODE This fullword binary field contains the EZACIC09 return code:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful call.</td>
</tr>
<tr>
<td>−1</td>
<td>Invalid RES address.</td>
</tr>
</tbody>
</table>
EZACIC14

The EZACIC14 program is an alternative to EZACIC04, which translates EBCDIC data to ASCII data. Figure 128 shows how EZACIC14 translates a byte of EBCDIC data.

<table>
<thead>
<tr>
<th>ASCII output by EZACIC14</th>
<th>second hex digit of byte of EBCDIC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>1</td>
<td>10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F</td>
</tr>
<tr>
<td>2</td>
<td>80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F</td>
</tr>
<tr>
<td>3</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>4</td>
<td>20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F</td>
</tr>
<tr>
<td>5</td>
<td>E0 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>6</td>
<td>2D 2E 2F 00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>7</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>8</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>9</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>A</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>B</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>C</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>D</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>E</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
<tr>
<td>F</td>
<td>00 01 02 03 04 05 06 07 08 09 A B C D E F</td>
</tr>
</tbody>
</table>

Figure 128. EZACIC14 EBCDIC-to-ASCII table

Figure 129 shows an example of EZACIC14 call instructions.

WORKING-STORAGE SECTION.
01 OUT-BUFFER PIC X(length of output).
01 LENGTH PIC 9(8) BINARY.

PROCEDURE DIVISION.
CALL 'EZACIC14' USING OUT-BUFFER LENGTH.

For equivalent PL/I and assembler language declarations, see "Converting parameter descriptions" on page 456.

OUT-BUFFER
A buffer that contains the following:
• When called, EBCDIC data
• Upon return, ASCII data
LENGTH
  Specifies the length of the data to be translated.
EZACIC15

The EZACIC15 program is an alternative to EZACIC05, which translates ASCII data to EBCDIC data. Figure 130 shows how EZACIC15 translates a byte of ASCII data.

<table>
<thead>
<tr>
<th>EBCDIC output by EZACIC15</th>
<th>second hex digit of byte of ASCII data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>A</td>
<td>A0</td>
</tr>
<tr>
<td>B</td>
<td>B0</td>
</tr>
<tr>
<td>C</td>
<td>C0</td>
</tr>
<tr>
<td>D</td>
<td>D0</td>
</tr>
<tr>
<td>E</td>
<td>E0</td>
</tr>
<tr>
<td>F</td>
<td>F0</td>
</tr>
</tbody>
</table>

Figure 130. EZACIC15 ASCII-to-EBCDIC table

Figure 131 shows an example of EZACIC15 call instructions.

WORKING-STORAGE SECTION.
01 OUT-BUFFER PIC X(length of output).
01 LENGTH PIC 9(8) BINARY.

PROCEDURE DIVISION.
CALL 'EZACIC15' USING OUT-BUFFER LENGTH.

For equivalent PL/1 and assembler language declarations, see "Converting parameter descriptions" on page 456.

OUT-BUFFER
A buffer that contains the following:
- When called, ASCII data
- Upon return, EBCDIC data
LENGTH
Specifies the length of the data to be translated.
Call interface sample programs

This section provides sample programs for the call interface that you can use for a PL/I or COBOL application program.

The following are the sample programs available in the SEZAINST data set:

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EZASOKPS</td>
<td>PL/I call interface sample IPv4 server program</td>
</tr>
<tr>
<td>EZASOKPC</td>
<td>PL/I call interface sample IPv4 client program</td>
</tr>
<tr>
<td>EZASO6PS</td>
<td>PL/I call interface sample IPv6 server program</td>
</tr>
<tr>
<td>EZASO6PC</td>
<td>PL/I call interface sample IPv6 client program</td>
</tr>
<tr>
<td>CBLOCK</td>
<td>PL/I common variables</td>
</tr>
<tr>
<td>EZACOBOL</td>
<td>COBOL common variables</td>
</tr>
<tr>
<td>EZASO6CS</td>
<td>COBOL call interface sample IPv6 server program</td>
</tr>
<tr>
<td>EZASO6CC</td>
<td>COBOL call interface sample IPv6 client program</td>
</tr>
</tbody>
</table>

Sample code for IPv4 server program

The EZASOKPS PL/I sample program is a server program that shows you how to use the following calls:
- ACCEPT
- BIND
- CLOSE
- GETSOCKNAME
- INITAPI
- LISTEN
- READ
- SOCKET
- TERMAPI
- WRITE
EZASOKPS: PROC OPTIONS(MAIN);
/* INCLUDE CBLOCK - common variables */
% include CBLOCK;

ID.TCPNAME = 'TCPIP'; /* Set TCP to use */
ID.ADSNAME = 'EZASOKPS'; /* and address space name */
open file(driver);

EZASOKPS: PROC OPTIONS(MAIN);
/* Execute INITAPI */
/* */
/* Uncomment this code to set max sockets to the maximum. */
/* */
/* MAXSOC_INPUT = 65535; */
/* MAXSOC_FWD = MAXSOC_INPUT; */
/* */
call ezasoket(INITAPI, MAXSOC, ID, SUBTASK,
               MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/* Execute SOCKET */

Figure 132. EZASOKPS PL/1 sample server program for IPv4 (Part 1 of 4)
call ezasoket(SOCKET, AF_INET, TYPE_STREAM, PROTO, ERRNO, RETCODE);
if retcode < 0 then do;
    msg = blank;  /* clear field */
    msg = 'FAIL: socket, stream, internet' || errno;
    write file(driver) from (msg);
    goto getout;
end;
else sock_stream = retcode;

/*********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;  /* internet address */
call ezasoket(BIND, SOCK_STREAM, NAME_ID, ERRNO, RETCODE);
if retcode < 0 then do;
    msg = blank;  /* clear field */
    msg = 'FAIL: bind' || errno;
    write file(driver) from (msg);
    goto getout;
end;

/*********************************************************************/

name_id.port = 8888;
name_id.address = '01234567'BX;  /* internet address */
call ezasoket(GETSOCKNAME, SOCK_STREAM, NAME_ID, ERRNO, RETCODE);
msg = blank;  /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: getsockname, stream, internet' || errno;
    write file(driver) from (msg);
    end;
else do;
    msg = 'getsockname = ' || name_id.address;
    write file(driver) from (msg);
end;

/*********************************************************************/

/*

Figure 132. EZASOKPS PL/1 sample server program for IPv4 (Part 2 of 4)
backlog = 5;
call ezasoket(LISTEN, SOCK_STREAM, BACKLOG, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;         /* clear field */
   msg = 'FAIL: listen w/ backlog = 5' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/**************************************************************/
/* Execute ACCEPT */
/**************************************************************/
name_id.port = 8888;
name_id.address = '01234567'BX;   /* internet address */
call ezasoket(ACCEPT, SOCK_STREAM, NAME_ID, ERRNO, RETCODE);
msg = blank;         /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: accept' || errno;
   write file(driver) from (msg);
end;
else do;
   accpsock = retcode;
   msg = 'accept socket = ' || accpsock;
   write file(driver) from (msg);
end;

/**************************************************************/
/* Execute READ */
/**************************************************************/
nbyte = length(bufin);
call ezasoket(READ, ACCPSOCK, NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank;         /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: read' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'read = ' || bufin;
   write file(driver) from (msg);
   bufout = bufin;
   nbyte = retcode;
end;

/**************************************************************/
/*
Figure 132. EZASOKPS PL/1 sample server program for IPv4 (Part 3 of 4)
Sample program for IPv4 client program

The EZASOKPC PL/I sample program is a client program that shows you how to use the following calls provided by the call socket interface:

- CONNECT
- GETPEERNAME
- INITAPI
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE

Figure 132. EZASOKPS PL/I sample server program for IPv4 (Part 4 of 4)
EZASOKPC: PROC OPTIONS(MAIN);

INCLUDE CBLOCK - common variables
% include CBLOCK;
ID.TCPNAME = 'TCPIP'; /* Set TCP to use */
ID.ADSNAME = 'EZASOKPC'; /* and address space name */
open file(driver);

EXECUTE INITAPI

EXECUTE SOCKET

Figure 133. EZASOKPC PL/1 sample client program for IPv4 (Part 1 of 3)
goto getout;
end;
sock_stream = retcode;        /* save socket descriptor */

/*************************************************************/
/* Execute CONNECT */
/*************************************************************/
name_id.port = 8888;
name_id.address = '01234567'BX;    /* internet address */
call ezasoket(CONNECT, SOCK_STREAM, NAME_ID,
               ERRNO, RETCODE);
if retcode < 0 then do;
   msg = blank;              /* clear field */
   msg = 'FAIL: connect, stream, internet' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/*************************************************************/
/* Execute GETPEERNAME */
/*************************************************************/
call ezasoket(GETPEERNAME, SOCK_STREAM,
              NAME_ID,  ERRNO, RETCODE);
msg = blank;            /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: getpeernname' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'getpeernname = ' || name_id.address;
   write file(driver) from (msg);
end;

/*************************************************************/
/* Execute WRITE */
/*************************************************************/
bufout = message;
 nbytes = length(message);
call ezasoket(WRITE, SOCK_STREAM, NBYTE, BUFOUT,
             ERRNO, RETCODE);
msg = blank;            /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;

Figure 133. EZASOKPC PL/1 sample client program for IPv4 (Part 2 of 3)
Sample code for IPv6 server program

The EZASO6PS PL/I sample program is a server program that shows you how to use the following calls provided by the call socket interface:

- ACCEPT
- BIND
- CLOSE
- EZACIC09
- FREEADDRINFO
- GETADDRINFO
- GETHOSTNAME
- GETSOCKNAME

Figure 133. EZASOKPC PL/I sample client program for IPv4 (Part 3 of 3)
- INITAPI
- LISTEN
- NTOP
- PTON
- READ
- SOCKET
- TERMAPI
- WRITE
EZASO6PS: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables */
% include CBLOCK;
ID.TCPNAME = 'TCPCS'; /* Set TCP to use */
ID.ADSNAME = 'EZASO6PS'; /* and address space name */
open file(driver);

/***************************************************************************/
/* Execute INITAPI */
/***************************************************************************/

/***************************************************************************/
/* Uncomment this code to set max sockets to the maximum. */
/* MAXSOC_INPUT = 65535; */
/* MAXSOC_FWD = MAXSOC_INPUT; */
/***************************************************************************/
call ezasoket(INITAPI, MAXSOC, ID, SUBTASK, MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
   msg = 'FAIL: initapi' || errno;
   write file(driver) from (msg);
   goto getout;
end;

/***************************************************************************/
/* Execute SOCKET */
/***************************************************************************/

Figure 134. EZASO6PS PL/1 sample server program for IPv6 (Part 1 of 6)
call ezasoket(SOCKET, AF_INET6, TYPE_STREAM, PROTO, ERRNO, RETCODE);
if retcode < 0 then do;
    msg = blank; /* clear field */
    msg = 'FAIL: socket, stream, internet' || errno;
    write file(driver) from (msg);
    goto getout;
else sock_stream = retcode;
end;
PRESENTABLE_ADDR = IPV6_LOOPBACK; /* Set IP address to use */
PRESENTABLE_ADDR_LEN = LENGTH(PRESENTABLE_ADDR); /* and its length */
call ezasoket(PTON, AF_INET6, PRESENTABLE_ADDR, PRESENTABLE_ADDR_LEN, NUMERIC_ADDR, ERRNO, RETCODE);
if retcode < 0 then do;
    msg = blank; /* clear field */
    msg = 'FAIL: pton' || errno;
    write file(driver) from (msg);
    goto getout;
end;
name6_id.address = NUMERIC_ADDR; /* IPV6 internet address */
call ezasoket(GETHOSTNAME, HOSTNAME_LEN, HOSTNAME, ERRNO, RETCODE);
msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: gethostname' || errno;
    write file(driver) from (msg);
    goto getout;
end;
else do;
    msg = 'gethostname = ' || HOSTNAME;
    write file(driver) from (msg);
    GAI_NODE = HOSTNAME; /* Set host name for getaddrinfo to use */
end;
GAI_SERVLEN = 0; /* set service length */
GAI_HINTS.FLAGS = ai_CANONNAMEOK; /* Request canonical name */
HINTS = ADDR(GAI_HINTS); /* Set results pointer */

Figure 134. EZASO6PS PL/1 sample server program for IPv6 (Part 2 of 6)
call ezasoket(GETADDRINFO,
    GAI_NODE, GAI_NODELEN,
    GAI_SERVICE, GAI_SERVLEN,
    HINTS, RES,
    CANONNAME_LEN,
    ERRNO, RETCODE);

msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: getaddrinfo' || errno;
    write file(driver) from (msg);
end;
else do; /* process returned RES */
    /******************************************************************************
    /* Call EZACIC09 to format the returned result address information */
    /******************************************************************************

    call ezacic09(RES, OPNAMELEN, OPCANON, OPNAME, OPNEXT,
        RETCODE);

    msg = blank; /* clear field */
    if retcode ^= 0 then do;
        msg = 'FAIL: EZACIC09' || RETCODE;
        write file(driver) from (msg);
    end;
    else do;
        msg = 'OPCANON = ' || OPCANON;
        write file(driver) from (msg);
    end;

    /******************************************************************************
    /* Execute FREEADDRINFO */
    /******************************************************************************

call ezasoket(FREEADDRINFO, RES,
    ERRNO, RETCODE);

    msg = blank; /* clear field */
    if retcode < 0 then do;
        msg = 'FAIL: freeaddrinfo' || errno;
        write file(driver) from (msg);
    end;
end; /* end from getaddrinfo */

name6_id.port = 8888;
call ezasoket(BIND, SOCK_STREAM, NAME6_ID,
    ERRNO, RETCODE);
if retcode < 0 then do;

Figure 134. EZASO6PS PL/1 sample server program for IPv6 (Part 3 of 6)
msg = blank; /* clear field */
msg = 'FAIL: bind' || errno;
write file(driver) from (msg);
goto getout;
end;

/***************************************************************
/* Execute GETSOCKNAME */
/***************************************************************
call ezasoket(GETSOCKNAME, SOCK_STREAM,
NAME6_ID, ERRNO, RETCODE);
msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: getsockname, stream, internet' || errno;
    write file(driver) from (msg);
end;

/***************************************************************
/* Execute LISTEN */
/***************************************************************
backlog = 5;
call ezasoket(LISTEN, SOCK_STREAM, BACKLOG,
ERRNO, RETCODE);
if retcode < 0 then do;
    msg = blank; /* clear field */
    msg = 'FAIL: listen w/ backlog = 5' || errno;
    write file(driver) from (msg);
    goto getout;
end;

/***************************************************************
/* Execute ACCEPT */
/***************************************************************
call ezasoket(ACCEPT, SOCK_STREAM,
NAME6_ID, ERRNO, RETCODE);
msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: accept' || errno;
    write file(driver) from (msg);
end;
else do;
    accpsock = retcode;
    msg = 'accept socket = ' || accpsock;
    write file(driver) from (msg);
end;

Figure 134. EZASO6PS PL/1 sample server program for IPv6 (Part 4 of 6)
call ezasoket(NTOP, AF_INET6, NUMERIC_ADDR, PRESENTABLE_ADDR, PRESENTABLE_ADDR_LEN, ERRNO, RETCODE);

msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: ntop' || errno;
    write file(driver) from (msg);
    goto getout;
end;
else do;
    msg = 'presentable address = ' || PRESENTABLE_ADDR;
    write file(driver) from (msg);
end;
/* */

nbyte = length(bufin);
call ezasoket(READ, ACCPSOCK, NBYTE, BUFIN, ERRNO, RETCODE);
msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: read' || errno;
    write file(driver) from (msg);
end;
else do;
    msg = 'read = ' || bufin;
    write file(driver) from (msg);
    bufout = bufin;
    nbyte = retcode;
end;
/* */
/* Execute WRITE */
/* */
/* */
call ezasoket(WRITE, ACCPSOCK, NBYTE, BUFOUT, ERRNO, RETCODE);
msg = blank; /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: write' || errno;
    write file(driver) from (msg);
end;
else do;
    msg = 'write = ' || bufout;

Figure 134. EZASO6PS PL/1 sample server program for IPv6 (Part 5 of 6)
Sample program for IPv6 client program

The EZASO6PC PL/I sample program is a client program that shows you how to use the following calls provided by the call socket interface:

- CONNECT
- GETNAMEINFO
- GETPEERNAME
- INITAPI
- PTON
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE

Figure 134. EZASO6PS PL/I sample server program for IPv6 (Part 6 of 6)
EZASO6PC: PROC OPTIONS(MAIN);

/* INCLUDE CBLOCK - common variables */
% include CBLOCK;

ID.TCPNAME = 'TCPCS'; /* Set TCP to use */
ID.ADSNAME = 'EZASO6PS'; /* and address space name */
open file(driver);

/*******************************************************************************/
/* Execute INITAPI */
/*******************************************************************************/
call ezasoket(INITAPI, MAXSOC, ID, SUBTASK, MAXSNO, ERRNO, RETCODE);
if retcode < 0 then do;
  msg = 'FAIL: initapi' || errno;
  write file(driver) from (msg);
  goto getout;
end;

/*******************************************************************************/
/* Execute SOCKET */
/*******************************************************************************/
call ezasoket(SOCKET, AF_INET6, TYPE_STREAM, PROTO, ERRNO, RETCODE);
if retcode < 0 then do;
  msg = blank; /* clear field */
  msg = 'FAIL: socket, stream, internet' || errno;
  write file(driver) from (msg);
end;

Figure 135. EZASO6PC PL/1 sample client program for IPv6 (Part 1 of 4)
goto getout;
end;
sock_stream = retcode;    /* save socket descriptor */

/**********************************************************************************************/
/* Execute PTON */
/*
*/
/**********************************************************************************************/
PRESENTABLE_ADDR = IPv6_LOOPBACK; /* Set the address to use */
PRESENTABLE_ADDR_LEN = LENGTH(PRESENTABLE_ADDR); /* and it's length */
call ezasoket(PTON, AF_INET6, PRESENTABLE_ADDR, 
PRESENTABLE_ADDR_LEN, NUMERIC_ADDR, 
ERRNO, RETCODE);

msg = blank;    /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: pton' || errno;
    write file(driver) from (msg);
    goto getout;
end;
msg = 'SUCCESS: pton converted ' || PRESENTABLE_ADDR;
name6_id.address = NUMERIC_ADDR;    /* IPV6 internet address */

/**********************************************************************************************/
/* Execute CONNECT */
/*
*/
/**********************************************************************************************/
name6_id.port = 8888;
call ezasoket(CONNECT, SOCK_STREAM, NAME6_ID, 
ERRNO, RETCODE);

if retcode < 0 then do;
    msg = blank;    /* clear field */
    msg = 'FAIL: connect, stream, internet' || errno;
    write file(driver) from (msg);
    goto getout;
end;

/**********************************************************************************************/
/* Execute GETPEERNAME */
/*
*/
/**********************************************************************************************/
call ezasoket(GETPEERNAME, SOCK_STREAM, 
NAME6_ID, ERRNO, RETCODE);

msg = blank;    /* clear field */
if retcode < 0 then do;
    msg = 'FAIL: getpeername' || errno;
    write file(driver) from (msg);
end;

/**********************************************************************************************/
/* Execute GETNAMEINFO */
/*
*/
/**********************************************************************************************/

Figure 135. EZASO6PC PL/1 sample client program for IPv6 (Part 2 of 4)
NAMELEN = 28; /* Set length of NAME */
GNI_HOST = blank; /* Clear Host name */
GNI_HOSTLEN = LENGTH(GNI_HOST); /* Set Host name length */
GNI_SERVICE = blank; /* Clear Service name */
GNI_SERVLEN = LENGTH(GNI_SERVICE); /* Set Service name length */
GNI_FLAGS = NI_NAMEREQD; /* Set an error if name is not found */
call ezasoket(GETNAMEINFO, NAME6_ID, NAMELEN,
   GNI_HOST, GNI_HOSTLEN,
   GNI_SERVICE, GNI_SERVLEN,
   GNI_FLAGS,
   ERRNO, RETCODE);

msg = blank; /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: getnameinfo' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'getnameinfo host=' || GNI_HOST;
   write file(driver) from (msg);
   msg = 'getnameinfo service=' || GNI_SERVICE;
   write file(driver) from (msg);
end;

bufout = message;
nbyte = length(message);
call ezasoket(WRITE, SOCK_STREAM, NBYTE, BUFIN,
   ERRNO, RETCODE);

msg = blank; /* clear field */
if retcode < 0 then do;
   msg = 'FAIL: write' || errno;
   write file(driver) from (msg);
end;
else do;
   msg = 'write = ' || bufout;
   write file(driver) from (msg);
end;

mbyte = length(bufin);
call ezasoket(READ, SOCK_STREAM,
   NBYTE, BUFIN, ERRNO, RETCODE);

msg = blank; /* clear field */

Figure 135. EZASO6PC PL/1 sample client program for IPv6 (Part 3 of 4)
Common variables used in PL/I sample programs

The CBLOCK common storage area contains the variables that are used in the PL/I programs in this section.
/**
 * Module Name: CBLOCK - SOKET common variables
 */

/**
 * Copyright: Licensed Materials - Property of IBM
 */

/**
 * "Restricted Materials of IBM"
 */

/**
 * 5694-A01
 */

/**
 * Copyright IBM Corp. 1994, 2007
 */

/**
 * US Government Users Restricted Rights -
 * Use, duplication or disclosure restricted by
 * GSA ADP Schedule Contract with IBM Corp.
 */

/**
 * Status: CSV1R9
 */

/**
 * SOKET common variables
 */

DCL ABS BUILTIN;
DCL ADDR BUILTIN;
DCL ACCEPT CHAR(16) INIT('ACCEPT');
DCL ACCPSOCK FIXED BIN(15); /* temporary ACCEPT socket */
DCL AF_INET FIXED BIN(31) INIT(2); /* internet domain */
DCL AF_INET6 FIXED BIN(31) INIT(19); /* internet v6 domain */
DCL AF_IUCV FIXED BIN(31) INIT(17); /* iucv domain */
DCL ai_PASSIVE FIXED BIN(31) INIT(1); /* flag: getaddrinfo hints */
DCL ai_CANONNAMEOK FIXED BIN(31) INIT(2); /* flag: getaddrinfo hints */
DCL ai_NUMERICHOST FIXED BIN(31) INIT(4); /* flag: getaddrinfo hints */
DCL ai_NUMERICSERV FIXED BIN(31) INIT(8); /* flag: getaddrinfo hints */
DCL ai_V4MAPPED FIXED BIN(31) INIT(10); /* flag: getaddrinfo hints */
DCL ai_ALL FIXED BIN(31) INIT(20); /* flag: getaddrinfo hints */
DCL ai_ADDRCONFIG FIXED BIN(31) INIT(40); /* flag: getaddrinfo hints */
DCL ALIAS CHAR(255); /* alternate NAME */
DCL API_TYPE FIXED BIN(15) INIT(2); /* default API type */
DCL BACKLOG FIXED BIN(31); /* max length of pending queue */
DCL BADNAME CHAR(20); /* temporary name */

Figure 136. CBLOCK PL/1 common variables (Part 1 of 10)
DCL BIND CHAR(16) INIT('BIND');
DCL BIT BUuLTIN;
DCL BITZERO BIT(1); /* bit zero value */
DCL BLANK255 CHAR(255) INIT(' '); /* */
DCL BLANK CHAR(100) INIT(' '); /* */
DCL BUF CHAR(80) INIT(' '); /* macro READ/WRITE buffer */
DCL BUFF CHAR(15) INIT(' '); /* short buffer */
DCL BUFFER CHAR(32767) INIT(' '); /* BUFFER */
DCL BUFIN CHAR(32767) INIT(' '); /* Read buffer */
DCL BUFOUT CHAR(32767) INIT(' '); /* WRITE buffer */
DCL NCHBUFF CHAR(3200) INIT(' '); /* BUFFER */
DCL CANONNAME_LEN FIXED BIN(31); /* getaddrinfo canonical name length */

DCL 1 CLIENT,
  /* socket addr of connection peer */
  2 DOMAIN FIXED BIN(31) INIT(2), /* domain of client (AF_INET) */
  2 NAME CHAR(8) INIT(' '), /* addr identifier for client */
  2 TASK CHAR(8) INIT(' '), /* task identifier for client */
  2 RESERVED CHAR(20) INIT(' '), /* reserved */
DCL CLOSE CHAR(16) INIT('CLOSE');
DCL COMMAND FIXED BIN(31) INIT(3); /* Query FNDELAY flag */
DCL CONNECT CHAR(16) INIT('CONNECT');
DCL COUNT FIXED BIN(31) INIT(100); /* elements in GRP_IOCTL_TABLE */
DCL DATA.SOCK FIXED BIN(15); /* temporary datagram socket */
DCL DEF FIXED BIN(31) INIT(0); /* default protocol */
DCL DONE_SENDING CHAR(1); /* ready flag */
DCL DRIVER FILE OUTPUT UNBUF ENV(FB RECSIZE(100)) RECORD;
DCL ERETMASK CHAR(4); /* indicate exception events */
DCL ERR FIXED BIN(31); /* error number variable */
DCL ERRNO FIXED BIN(31) INIT(0); /* error number */
DCL ESNDMASK CHAR(4); /* check for pending */
DCL EXIT LABEL; /* common exit point */
DCL EZACIC05 ENTRY OPTIONS(ASM,INTER) EXT; /* translate ascii>ebcdic */
DCL EZACIC09 ENTRY OPTIONS(ASM,INTER) EXT; /* format getaddrinfo res */
DCL EZASOKET ENTRY OPTIONS(ASM,INTER) EXT; /* socket call */
DCL FCNTL CHAR(16) INIT('FCNTL');
  | DCL FIONBIO BIT(32) INIT('8004A77E'BX); /* flag: nonblocking */
  | DCL FIONREAD BIT(32) INIT('4004A77F'BX); /* flag: readable bytes */
DCL FLAGS FIXED BIN(31) INIT(0); /* default: no flags */
  /* 1 = OOB, SEND OUT-OF-BAND */
  /* 4 = DON'T ROUTE */
DCL FREADADDRINFO CHAR(16) INIT('FREADADDRINFO');
DCL GAI_NODE CHAR(255) INIT(' '); /* getaddrinfo node */
DCL GAI_NODELEN FIXED BIN(31) INIT(255); /* getaddrinfo node length */
DCL GAI_SERVICE CHAR(32) INIT(' '); /* getaddrinfo service */
DCL GAI_SERVLEN FIXED BIN(31) INIT(32); /* getaddrinfo service */
DCL 1 GAI_HINTS,
  /* getaddrinfo hints addrinfo */
  2 FLAGS FIXED BIN(31) INIT(0), /* hints flags */
  2 AF FIXED BIN(31) INIT(0), /* hints family */
  2 SOTYPE FIXED BIN(31) INIT(0), /* hints socket type */
  2 PROTO FIXED BIN(31) INIT(0), /* hints protocol */
  2 NAMELEN FIXED BIN(31) INIT(0),
  2 CANONNAME FIXED BIN(31) INIT(0),

Figure 136. CBLOCK PL/1 common variables (Part 2 of 10)
2 NAME     FIXED BIN(31) INIT(0),
2 NEXT     FIXED BIN(31) INIT(0);
DCL 1 GAI_ADDRINFO BASED(RES), /* getaddrinfo RES addrinfo */
   2 FLAGS     FIXED BIN(31),
   2 AF       FIXED BIN(31),
   2 SCOTYPE   FIXED BIN(31),
   2 PROTO     FIXED BIN(31),
   2 NAMELEN  FIXED BIN(31), /* RES socket address struct length*/
   2 CANONNAME POINTER, /* RES canonical name */
   2 NAME     POINTER, /* RES socket address structure */
   2 NEXT     POINTER; /* RES next addrinfo, zero if none.*/
DCL 1 GAI_NAME_ID BASED(GAI_ADDRINFO.NAME),
   2 LEN      BIT(8),
   2 FAMILY   BIT(8),
   2 PORT     FIXED BIN(15),
   2 ADDRESS  BIT(32),
   2 RESERVED1 CHAR(8);  
DCL 1 GAI_NAME6_ID BASED(GAI_ADDRINFO.NAME),
   2 LEN      BIT(8),
   2 FAMILY   BIT(8),
   2 PORT     FIXED BIN(15),
   2 FLOWINFO FIXED BIN(31),
   2 ADDRESS  CHAR(16),
   2 SCOPEID  FIXED BIN(31);
DCL GETADDRINFO CHAR(16) INIT('GETADDRINFO');
DCL GETCLIENTID CHAR(16) INIT('GETCLIENTID');
DCL GETHOSTBYADDR CHAR(16) INIT('GETHOSTBYADDR');
DCL GETHOSTBYNAME CHAR(16) INIT('GETHOSTBYNAME');
DCL GETHOSTNAME CHAR(16) INIT('GETHOSTNAME');
DCL GETHOSTID CHAR(16) INIT('GETHOSTID');
DCL GETIBMOPT CHAR(16) INIT('GETIBMOPT');
DCL GETNAMEINFO CHAR(16) INIT('GETNAMEINFO');
DCL GETPEERNAME CHAR(16) INIT('GETPEERNAME');
DCL GETSOCKNAME CHAR(16) INIT('GETSOCKNAME');
DCL GETSOCKOPT CHAR(16) INIT('GETSOCKOPT');
DCL GIVESOCKET CHAR(16) INIT('GIVESOCKET');
DCL GLOBAL CHAR(16) INIT('GLOBAL');
DCL GNI_FLAGS FIXED BIN(31); /* getnameinfo flags */
DCL GNI_HOST CHAR(255); /* getnameinfo host */
DCL GNI_HOSTLEN FIXED BIN(31); /* getnameinfo host length */
DCL GNI_SERVICE CHAR(32); /* getnameinfo service */
DCL GNI_SERVLEN FIXED BIN(31); /* getnameinfo service length */
DCL 1 GROUP_FILTER4 BASED, /* Group_Filter for IPv4 */
   2 GF4_HEADER, /* Header portion */
      3 GF4_INTERFACE FIXED BIN(31), /* Interface index */
         3 GF4_CHAR4, /* Padding */
      3 GF4_GROUP, /* Group Multi Address */
         4 GF4_SOCKET LEN BIT(8), /* Socket len */
         4 GF4_SOCKET_FAMILY BIT(8), /* Socket family */
         4 GF4_SOCKET_PORT FIXED BIN(15), /* Socket port */
         4 GF4_SOCKET_ADDR BIT(32), /* Socket address */
         4 GF4_RESERVED1 CHAR(8), /* Unused */

Figure 136. CBLOCK PL/1 common variables (Part 3 of 10)
Figure 136. CBLOCK PL/1 common variables (Part 4 of 10)
DCL 1 GROUP_SOURCE_REQ4 BASED, /* Group_Source_Req for IPv4 */
   2 GSR4_INTERFACE FIXED BIN(31), /* Interface index */
   2 * CHAR(4), /* Padding */
   2 GSR4_GROUP, /* Multicast group addr */
   3 GSR4.SOCK_LEN BIT(8), /* Socket len */
   3 GSR4.SOCK_FAMILY BIT(8), /* Socket family */
   3 GSR4.SOCK_SIN_PORT FIXED BIN(15), /* Socket port */
   3 GSR4.SOCK_SIN_ADDR BIT(32), /* Socket address */
   3 GSR4_RESERVED CHAR(8), /* Unused */
   3 * CHAR(112), /* */

DCL 1 GROUP_SOURCE_REQ6 BASED, /* Group_Source_Req for IPv6 */
   2 GSR6_INTERFACE FIXED BIN(31), /* Interface index */
   2 * CHAR(4), /* Padding */
   2 GSR6_GROUP, /* Multicast group addr */
   3 GSR6.SOCK_LEN BIT(8), /* Socket len */
   3 GSR6.SOCK_FAMILY BIT(8), /* Socket family */
   3 GSR6.SOCK_SIN_PORT FIXED BIN(15), /* Socket port */
   3 GSR6.SOCK_SIN_FLOWINFO FIXED BIN(31), /* flow info */
   3 GSR6.SOCK_SIN_ADDR CHAR(16), /* Socket address */
   3 GSR6.SOCK_SIN_SCOPEID FIXED BIN(31), /* Socket scopeid */
   3 * CHAR(100), /* */

DCL HINTS POINTER; /*getaddrinfo hints addrinfo pointer*/
DCL HINTS POINTER; /*getaddrinfo hints addrinfo pointer*/
DCL 1 HOMEIF, /* Home Interface Structure */
   2 ADDRESS CHAR(16); /* Home Interface Address */
DCL HOSTADDR BIT(32); /* host internet address */
DCL HOSTNAME CHAR(24); /* host name from GETHOSTNAME */
DCL HOSTNAME_LEN FIXED BIN(31) INIT(24); /* host name length GETHOSTNAME */
DCL HOW FIXED BIN(31) INIT(2); /* how shutdown is to be done */
DCL 1 FIXED BIN(15); /* loop index */
DCL ICMP FIXED BIN(31) INIT(2); /* prototype icmp ??? */
DCL 1 ID, /* */
   2 TCPNAME CHAR(8) INIT('TCP/IP'), /* remote address space */
   2 ADSNAME CHAR(8) INIT('USER9'), /* local address space */
DCL IDENT POINTER; /* TCP/IP Addr Space */
DCL ICONF CHAR(255); /* configuration structure */
DCL 1 IF_NAMEINDEX,

Figure 136. CBLOCK PL/1 common variables (Part 5 of 10)
DCL INDX BUILTIN;
DCL IOCTL CHAR(16) INIT('IOCTL');
DCL IOCTL_CMD FIXED BIN(31); /* ioctl command */
DCL IOCTL_REQARG POINTER; /* send pointer to data area*/
DCL IOCTL_RETARG POINTER; /* return pointer to data area*/
DCL IOCTL_REQ0 FIXED BIN(31); /* command request argument */
DCL IOCTL_REQ04 FIXED BIN(31); /* command request argument */
DCL IOCTL_REQ08 FIXED BIN(31); /* command request argument */
DCL IOCTL_REQ32 CHAR(32) INIT(' '); /* command request argument */
DCL IOCTL_RET0 FIXED BIN(31); /* command return argument */
DCL IOCTL_RET04 FIXED BIN(31); /* command return argument */
DCL INITAPI CHAR(16) INIT('INITAPI!'); /* */
DCL IP FIXED BIN(31) INIT(1); /* prototype ip ??? */
DCL 1 IP_MREQ,
  2 IMP_MULTIADDR BIT(32), /* IP multicast addr of group */
  2 IMP_INTERFACE BIT(32); /* local IP addr of interface */
DCL 1 IPV6 MREQ,
  2 IPV6M_MULTIADDR CHAR(16),
  2 IPV6MR_INTERFACE FIXED BIN(31); DCL 1 IP_MREQ_SOURCE BASED,
    2 IMRS_MULTIADDR BIT(32), /* Multi source API structure */
    2 IMRS_SOURCEADDR BIT(32), /* IP multicast addr of grp */
    2 IMRS_INTERFACE BIT(32); /* local IP addr of intf */
DCL 1 IP_MSFILTER BASED,
  2 IMSF_HEADER, /* Header portion */
    3 IMSF_MULTIADDR BIT(32), /* Multicast address */
    3 IMSF_INTERFACE BIT(32), /* Interface address */
    3 IMSF_FM MODE FIXED BIN(31), /* Filter mode */
    3 IMSF_NUMSRC FIXED BIN(31), /* Num of sources */
  2 IMSF_SLST CHAR(0); /* Source list */
DCL 1 IMSF_SRCENTRY BASED, /* Source Entry */
  2 IMSF_SRCADDR BIT(32); /* Source IP address */
DCL IP_MULTICAST TTL BIT(32) INIT('00100003'BX);
DCL IP_MULTICAST LOOP BIT(32) INIT('00100004'BX);
DCL IP_MULTICAST IF BIT(32) INIT('00100007'BX);
DCL IP_ADD_MEMBERSHIP BIT(32) INIT('00100005'BX);
DCL IP_DROP_MEMBERSHIP BIT(32) INIT('00100006'BX);
DCL IP_BLOCK_SOURCE BIT(32) INIT('0010000A'BX);
DCL IP_UNBLOCK_SOURCE BIT(32) INIT('0010000B'BX);
DCL IP_ADD_SOURCE_MEMBERSHIP BIT(32) INIT('0010000C'BX);
DCL IP_DROP_SOURCE_MEMBERSHIP BIT(32) INIT('0010000D'BX);

Figure 136. CBLOCK PL/1 common variables (Part 6 of 10)
Figure 136. CBLOCK PL/1 common variables (Part 7 of 10)
2 NCH_EYECATCHER CHAR(4) INIT('6NCH'), /* Eye Catcher '6NCH' */
2 NCH_IOCTL BIT(32) INIT('C014F608'BX), /* The IOCTL being processed */ /* with this instance of the */ /* NetConfHdr. (RAS item) */
2 NCH_BUFFER_LENGTH FIXED BIN(31) INIT(3200), /* Buffer Length */
2 NCH_BUFFER_PTR POINTER, /* Buffer Pointer */
2 NCH_NUMENTRYRET FIXED BIN(31); /* Number of HomeIF returned via */ /* SIOC HOMEIF6 or the number of */ /* GRT6RtEntry's returned via */ /* SIOC GRT6TABLE. */

DCL NI_NOFQDN FIXED BIN(31) INIT(1); /* flag: getnameinfo */
DCL NI_NUMERICHOST FIXED BIN(31) INIT(2); /* flag: getnameinfo */
DCL NI_NAMEREQD FIXED BIN(31) INIT(4); /* flag: getnameinfo */
DCL NI_NUMERICSERV FIXED BIN(31) INIT(8); /* flag: getnameinfo */
DCL NI_DGRAM FIXED BIN(31) INIT(16); /* flag: getnameinfo */
DCL NI_NUMERICSCOPE FIXED BIN(31) INIT(32); /* flag: getnameinfo */
DCL NOTE(3) CHAR(25) INIT('Now is the time for 198 g', 'ood people to come to the', ' aid of their parties!');

DCL NS FIXED BIN(15); /* socket descriptor, new */
DCL NTOP CHAR(16) INIT('NTOP'); /* Numeric to Presentation */
DCL NULL BUILTIN;
DCL 1 NUMERIC_ADDR CHAR(16); /* NTOP/PTON Numeric address */
DCL OPNAMELEN FIXED BIN(31); /* Socket address structure length */
DCL OPCANON CHAR(256); /* Canonical name */
DCL OPNAME POINTER; /* Socket address structure */
DCL OPNEXT POINTER; /* Next result address info in chain */
DCL OPTL FIXED BIN(31); /* length of OPTVAL string */
DCL OPTLEN FIXED BIN(31); /* length of OPTVAL string */
DCL OPTN CHAR(15); /* OPTNAME value (macro) */
DCL OPTNAME FIXED BIN(31); /* OPTNAME value (call) */
DCL OPTVAL CHAR(255); /* GETSOCKOPT option data */
DCL OPTVALD FIXED BIN(31); /* SETSOCKOPT option data */
DCL 1 OPT_STRUCT, /* structure for option */
    2 ON_OFF FIXED BIN(31) INIT(1), /* enable option */
    2 TIME FIXED BIN(31) INIT(5); /* time-out in seconds */
DCL 1 OPT_STRUCT, /* structure for option */
    2 ON FIXED BIN(31), /* used for getsockopt */
    2 TIMEOUT FIXED BIN(31); /* time-out in seconds */
DCL PLITEST BUILTIN; /* debug tool */
DCL PRESENTABLE_ADDR CHAR(45); /* NTOP/PTON presentable address */
DCL PRESENTABLE_ADDR_LEN FIXED BIN(15);

Figure 136. CBLOCK PL/1 common variables (Part 8 of 10)
/ NTOP/PTON presentable address length*/
DCL PROTO FIXED BIN(31) INIT(0); /* prototype default */
DCL PTON CHAR(16) INIT('PTON'); /* Presentation to numeric */
DCL READ CHAR(16) INIT('READ');
DCL READW CHAR(16) INIT('READV');
DCL RECV CHAR(16) INIT('RECV');
DCL RECVFROM CHAR(16) INIT('RECVFROM');
DCL RECVMSG CHAR(16) INIT('RECVMSG');
DCL REUSE CHAR(16) INIT('4'); /* toggle, reuse local addr */
DCL REQARG FIXED BIN(31); /* command request argument */
DCL RES POINTER; /* getaddrinfo RES addrinfo ptr */
DCL RETARG FIXED BIN(31); /* return argument data area */
DCL RETCODE FIXED BIN(31) INIT(0); /* return code */
DCL RTENTRY CHAR(50) INIT('dummy table'); /* router entry */
DCL SAVEFAM FIXED BIN(15); /* temporary family name */
DCL SELECT CHAR(16) INIT('SELECT');
DCL SELECTEX CHAR(16) INIT('SELECTEX');
DCL SEND CHAR(16) INIT('SEND');
DCL SENDMSG CHAR(16) INIT('SENDMSG');
DCL SENDTO CHAR(16) INIT('SENDTO');
DCL SELECB CHAR(4) INIT('1');
DCL SELECT CHAR(16) INIT('SELECT');
DCL SELECTEX CHAR(16) INIT('SELECTEX');
DCL SEND CHAR(16) INIT('SEND');
DCL SENDMSG CHAR(16) INIT('SENDMSG');
DCL SENDTO CHAR(16) INIT('SENDTO');
DCL SETADEYE1 CHAR(8) INIT('SETAPPLD');
DCL SETADVER FIXED BIN(15) INIT(1);
DCL SETADCONTLEN FIXED BIN(15) INIT(48);
DCL SETADBUFLN FIXED BIN(15) INIT(40);
DCL 1 SETAPPLDATA,
  2 SET_AD_EYE1 CHAR(8),
  2 SET_AD_LEN FIXED BIN(15),
  2 * CHAR(4),
  2 SETAD_PTR64,
  3 SETAD_PTRHW CHAR(4),
  3 SETAD_PTR POINTER;
DCL SETADEYE2 CHAR(8) INIT('APPLDATA');
DCL 1 SETADCONTAINER,
  2 SET_AD_EYE2 CHAR(8),
  2 SET_AD_PTR CHAR(40);
DCL SETSOCKOPT CHAR(16) INIT('SETSOCKOPT');
DCL SHUTDOWN CHAR(16) INIT('SHUTDOWN');
DCL SIOCADDRT BIT(32) INIT('8030A70A'BX); /* flag: add routing entry*/
DCL SIOCATMARK BIT(32) INIT('4004A707'BX); /* flag: out-of-band data*/
DCL SIOCDELRT BIT(32) INIT('8030A708'BX); /* flag: delete routing */
DCL SIOCIFADDR BIT(32) INIT('C020A70D'BX); /* flag: network int addr*/
DCL SIOCIGIFCONF BIT(32) INIT('C008A714'BX); /* flag: net int config*/
DCL SIOCIGIFBROADCAST BIT(32) INIT('C020A712'BX); /* flag net broadcast*/
DCL SIOCIGIFNETCONF BIT(32) INIT('C008A714'BX); /* flag: net int config*/
DCL SIOCIGIFNETDAD BIT(32) INIT('C020A710F'BX); /* flag: net des addr*/
DCL SIOCIGIFFLAGS BIT(32) INIT('C020A711'BX); /* flag: net int flags*/

Figure 136. CBLOCK PL/1 common variables (Part 9 of 10)
DCL SIOCGIFMETRIC BIT(32) INIT('C020A717'BX); /* flag: get rout metr*/
DCL SIOCGIFNAMEINDEX BIT(32) INIT('4006F603'BX); /* flag: name and indexes */
DCL SIOCGIFNETMASK BIT(32) INIT('C020A715'BX); /* flag: network mask*/
DCL SIOCGIFNONSENSE BIT(32) INIT('B669F02E'BX); /* flag: nonsense */
DCL SIOCISIFMETRIC BIT(32) INIT('8020A718'BX); /* flag: set rout metr*/
DCL SIOCAPPDATA BIT(32) INIT('801B090C'BX); /* Set APPLDATA */
DCL SIOCPIPMSFILTER BIT(32) INIT('C000A724'BX);
   /* flag: get multicast src filter */
DCL SIOCIPMSFILTER BIT(32) INIT('8000A725'BX);
   /* flag: set multicast src filter */
DCL SIOCOMMSFILTER BIT(32) INIT('C000F610'BX);
   /* flag: get multicast src filter */
DCL SIOCOMMSFILTER BIT(32) INIT('8000F611'BX);
   /* flag: set multicast src filter */
/* The following constant is defined in EZBZTLS1, but is also */
/* included here for completeness. */
/* DCL SIOCCTLSCTL BIT(32) INIT('C038D908'BX) */
DCL SIO SOCKET FIXED BIN(15); /* socket descriptor */
DCL SOCKET CHAR(16) INIT('SOCKET');
DCL SOCK_DATAGRAM FIXED BIN(15); /* socket descriptor datagram */
DCL SOCK_RAW FIXED BIN(15); /* socket descriptor raw */
DCL SOCK_STREAM FIXED BIN(15); /* stream socket descriptor */
DCL SOCK_STREAM_1 FIXED BIN(15); /* stream socket descriptor */
DCL SO_BROADCAST FIXED BIN(31) INIT(32); /* toggle, broadcast msg */
DCL SO_ERROR FIXED BIN(31) INIT(4103); /* check/clear async error */
DCL SO_KEEPALIVE FIXED BIN(31) INIT(8); /* request status of stream*/
DCL SO_LINGER FIXED BIN(31) INIT(128); /* toggle, linger on close */
DCL SO_OOBINLINE FIXED BIN(31) INIT(256); /*toggle, out-of-bound data*/
DCL SO_REUSEADDR FIXED
   BIN(31) INIT(4); /* toggle, local address reuse*/
DCL SO_SNDBUF FIXED BIN(31) INIT(4097);
DCL SO_TYPE FIXED BIN(31) INIT(4104); /* return type of socket */
DCL STRING BUILTIN;
DCL SUBSTR BUILTIN;
DCL SUBTASK CHAR(8) INIT('ANYNAME'); /* task/path identifier */
DCL SYNC CHAR(16) INIT('SYNC');
DCL TAKESOCKET CHAR(16) INIT('TAKESOCKET');
DCL TASK CHAR(16) INIT('TASK');
DCL TERMAPI CHAR(16) INIT('TERMAPI'); /* */
DCL TIME BUILTIN;
DCL 1 TIMEOUT,
   2 TIME_SEC FIXED BIN(31), /* value in secs */
   2 TIME_MSEC FIXED BIN(31); /* value in millisecs */
DCL TYPE_DATAGRAM FIXED BIN(31) INIT(2); /* fixed length connectionless*/
DCL TYPE_RAW FIXED BIN(31) INIT(3); /* internal protocol interface */
DCL TYPE_STREAM FIXED BIN(31) INIT(1); /* two-way byte stream */
DCL WREMMSK CHAR(4); /* indicate WRITE EVENTS */
DCL WRITE CHAR(16) INIT('WRITE');
DCL WRITEV CHAR(16) INIT('WRITEV');
DCL WSNDSMK CHAR(4); /*check for pending write events */
DCL TCP_KEEPALIVE BIT(32) INIT('80000008'BX);
DCL TCP_NODELAY BIT(32) INIT('80000001'BX);

Figure 136. CBLOCK PL/1 common variables (Part 10 of 10)

Common variables used in COBOL sample programs

The EZACOBOL common storage area contains the variables that are used in the COBOL programs in this section.
Figure 137. EZACOBOL COBOL common variables (Part 1 of 5)
01 SIOCGMSFILTER        PIC X(4) VALUE X'C000F610'.
01 SIOCSMSFILTER        PIC X(4) VALUE X'8000F611'.
01 SIOCSAPPLDATA        PIC X(4) VALUE X'8018D90C'.

* Structure allows applications to allocate space for either form of inet socket address
* 01 SOCKADDR-STORAGE.
  05 SS-LEN       PIC X(1).
  05 SS-FAMILY    PIC X(1).
  05 SS-DATA     PIC X(126).

* IP-MREQ for IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP
* 01 IP-MREQ.
  05 IMR-MULTIADDR PIC 9(8) BINARY.
  05 IMR-INTERFACE PIC 9(8) BINARY.

* IP-MREQ-SOURCE for
  * IP_ADD_SOURCE_MEMBERSHIP
  * IP_DROP_SOURCE_MEMBERSHIP
  * IP_BLOCK_SOURCE
  * IP_UNBLOCK_SOURCE
* 01 IP-MREQ-SOURCE.
  05 IMR-MULTIADDR PIC 9(8) BINARY.
  05 IMR-SOURCEADDR PIC 9(8) BINARY.
  05 IMR-INTERFACE PIC 9(8) BINARY.

* IPV6-MREQ for IPV6_JOIN_GROUP and IPV6_LEAVE_GROUP
* 01 IPV6-MREQ.
  05 IPV6MR-MULTIADDR.
    10 FILLER       PIC 9(16) BINARY.
    10 FILLER       PIC 9(16) BINARY.
  05 IPV6MR-INTERFACE PIC 9(8) BINARY.

* GROUP-REQ for
  * MCAST_JOIN_GROUP
  * MCAST_LEAVE_GROUP
* 01 GROUP-REQ.
  05 GR-INTERFACE    PIC 9(8) BINARY.
  05 FILLER         PIC X(4).
  05 GR-GROUP       PIC X(128).
  05 GR-GROUP-R     REDEFINES GR-GROUP.
    10 GR-GROUP-SOCK-LEN PIC X(1).
    10 GR-GROUP-SOCK-FAMILY PIC X(1).
    10 GR-GROUP-SOCK-DATA PIC X(26).
    10 GR-GROUP-SOCK-SIN REDEFINES GR-GROUP-SOCK-DATA.
      15 GR-GROUP-SOCK-SIN-PORT PIC 9(4) BINARY.
      15 GR-GROUP-SOCK-SIN-ADDR PIC 9(8) BINARY.
      15 FILLER         PIC X(8).
      15 FILLER         PIC X(12).
      10 GR-GROUP-SOCK-SIN6 REDEFINES GR-GROUP-SOCK-DATA.

Figure 137. EZACOBOL COBOL common variables (Part 2 of 5)
Figure 137. EZACOBOL COBOL common variables (Part 3 of 5)
* 77 MCAST-INCLUDE PIC 9(8) BINARY VALUE 0.
 77 MCAST-EXCLUDE PIC 9(8) BINARY VALUE 1.
 77 MCAST-NUMSRC-MAX PIC 9(8) BINARY VALUE 64.

* IP-MSFILTER

* 01 IP-MSFILTER.
  02 IMSF-HEADER.
    03 IMSF-MULTIADDR PIC 9(8) BINARY.
    03 IMSF-INTERFACE PIC 9(8) BINARY.
    03 IMSF-FMODE PIC 9(8) BINARY.
      88 IMSF-FMODE-INCLUDE VALUE 0.
      88 IMSF-FMODE-EXCLUDE VALUE 1.
    03 IMSF-NUMSRC PIC 9(8) BINARY.
    02 IMSF-SLIST.
      03 IMSF-SRCENTRY OCCURS 1 TO 64 TIMES DEPENDING ON IMSF-NUMSRC.
      05 IMSF-SRCADDR PIC 9(8) BINARY.

* GROUP-FILTER

* 01 GROUP-FILTER.
  02 GF-HEADER.
    03 GF-INTERFACE PIC 9(8) BINARY.
    03 FILLER PIC X(4).
    03 GF-GROUP PIC X(128).
    03 GF-GROUP-R REDEFINES GF-GROUP.
      05 GF-GROUP-SOCK-LEN PIC X(1).
      05 GF-GROUP-SOCK-FAMILY PIC X(1).
      05 GF-GROUP-SOCK-DATA PIC X(26).
      05 GF-GROUP-SOCK-SIN REDEFINES GF-GROUP-SOCK-DATA.
        10 GF-GROUP-SOCK-SIN-PORT PIC 9(4) BINARY.
        10 GF-GROUP-SOCK-SIN-ADDR PIC 9(8) BINARY.
        10 FILLER PIC X(8).
        10 FILLER PIC X(12).
      05 GF-GROUP-SOCK-SIN6 REDEFINES GF-GROUP-SOCK-DATA.
        10 GF-GROUP-SOCK-SIN6-PORT PIC 9(4) BINARY.
        10 GF-GROUP-SOCK-SIN6-ADDR PIC 9(16) BINARY.
        10 GF-GROUP-SOCK-SIN6-SCOPEID PIC 9(8) BINARY.
        10 FILLER PIC X(100).
      03 GF-FMODE PIC 9(8) BINARY.
        88 GF-FMODE-INCLUDE VALUE 0.
        88 GF-FMODE-EXCLUDE VALUE 1.
      03 GF-NUMSRC PIC 9(8) BINARY.
    02 GF-SLIST.
      03 GF-SRCENTRY OCCURS 1 TO 64 TIMES DEPENDING ON GF-NUMSRC.
        05 GF-SRCADDR PIC X(128).
        05 GF-SRCADDR-R REDEFINES GF-SRCADDR.
        10 GF-SLIST-SOCK-LEN PIC X(1).
        10 GF-SLIST-SOCK-FAMILY PIC X(1).

Figure 137. EZACOBOL COBOL common variables (Part 4 of 5)
COBOL call interface sample IPv6 server program

The EZASO6CS program is a server program that shows you how to use the following calls provided by the call socket interface:

- ACCEPT
- BIND
- CLOSE
- EZACIC09
- FREEADDRINFO
- GETADDRINFO
- GETCLIENTID
- GETHOSTNAME
- INITAPI
- LISTEN
- NTOP
- PTON
- READ
- SOCKET
- TERMAPI

Figure 137. EZACOBOL COBOL common variables (Part 5 of 5)
**WRITE**

****************************************************************************
* MODULE NAME: EZASO6CS - THIS IS A VERY SIMPLE IPV6 SERVER *
* *
* Copyright: Licensed Materials - Property of IBM *
* *
* "Restricted Materials of IBM" *
* *
* 5694-A01 *
* *
* (C) Copyright IBM Corp. 2002, 2003 *
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* US Government Users Restricted Rights - *
* Use, duplication or disclosure restricted by *
* GSA ADP Schedule Contract with IBM Corp. *
* *
* Status: CSV1R5 *
* *
* LANGUAGE: COBOL II *
* *
****************************************************************************

Identification Division.
*****************************************************************************

Program-id. EZASO6CS.
*****************************************************************************

Environment Division.
*****************************************************************************

Data Division.
*****************************************************************************

Working-storage Section.
*****************************************************************************

* Socket interface function codes *
*****************************************************************************

01 soket-functions.
 02 soket-accept   pic x(16) value 'ACCEPT' .
 02 soket-bind     pic x(16) value 'BIND' .
 02 soket-close    pic x(16) value 'CLOSE' .
 02 soket-connect  pic x(16) value 'CONNECT' .
 02 soket-fcntl    pic x(16) value 'FCNTL' .
 02 soket-freeaddrinfo pic x(16) value 'FREEADDRINFO' .
 02 soket-getaddrinfo pic x(16) value 'GETADDRINFO' .
 02 soket-getclientid pic x(16) value 'GETCLIENTID' .
 02 soket-gethostbyaddr pic x(16) value 'GETHOSTBYADDR' .
 02 soket-gethostbyname pic x(16) value 'GETHOSTBYNAME' .
 02 soket-gethostid pic x(16) value 'GETHOSTID' .
 02 soket-gethostname pic x(16) value 'GETHOSTNAME' .
 02 soket-getnameinfo pic x(16) value 'GETNAMEINFO' .
 02 soket-getpeername pic x(16) value 'GETPEERNAME' .
 02 soket-getsockname pic x(16) value 'GETSOCKNAME' .

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 1 of 13)
02 soket-getsockopt pic x(16) value 'GETSOCKOPT'.
02 soket-givesocket pic x(16) value 'GIVESOCKET'.
02 soket-initapi pic x(16) value 'INITAPI'.
02 soket-ioctl pic x(16) value 'IOCTL'.
02 soket-listen pic x(16) value 'LISTEN'.
02 soket-nstop pic x(16) value 'NSTOP'.
02 soket-pton pic x(16) value 'PTON'.
02 soket-read pic x(16) value 'READ'.
02 soket-recv pic x(16) value 'RECV'.
02 soket-recevfrom pic x(16) value 'RECVFROM'.
02 soket-select pic x(16) value 'SELECT'.
02 soket-send pic x(16) value 'SEND'.
02 soket-sendto pic x(16) value 'SENDTO'.
02 soket-setsockopt pic x(16) value 'SETSOCKOPT'.
02 soket-shutdown pic x(16) value 'SHUTDOWN'.
02 soket-socket pic x(16) value 'SOCKET'.
02 soket-takesocket pic x(16) value 'TAKESOCKET'.
02 soket-termapi pic x(16) value 'TERMAPI'.
02 soket-write pic x(16) value 'WRITE'.

*---------------------------------------------------------------*
* Work variables                                              *
*---------------------------------------------------------------*
01 errno pic 9(8) binary value zero.
01 retcode pic 9(8) binary value zero.
01 client-ipaddr-dotted pic x(15) value space.
01 server-ipaddr-dotted pic x(15) value space.
01 ezacomm-function pic x value space.
01 88 CONNECTED value 'Y'.
01 saved-message-id pic x(8) value space.
01 close-down-message-received value '*CLSDWN*'.
01 Terminate-Options pic x value space.
01 Opened-API value 'A'.
01 Opened-Socket value 'S'.
01 saved-message-id-len pic 9(8) binary value 8.
01 Cur-time .
02 Hour pic 9(2).
02 Minute pic 9(2).
02 Second pic 9(2).
02 Hund-Sec pic 9(2).
01 S pic 9(4) comp.

*---------------------------------------------------------------*
* Variables used for the INITAPI call                          *
*---------------------------------------------------------------*
01 maxsoc-fwd pic 9(8) binary.
01 maxsoc-rdf redefines maxsoc-fwd.
02 filler pic x(2).
02 maxsoc pic 9(4) binary.
01 initapi-ident.
05 tcpname pic x(8) value 'TCPCS'.
05 asname pic x(8) value space.
01 subtask pic x(8) value 'EZASO6CS'.
01 maxsnr pic 9(8) binary value 1.

*---------------------------------------------------------------*
* Variables returned by the GETCLIENTID Call                  *
*---------------------------------------------------------------*

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 2 of 13)
01 clientid.
   05 clientid-domain pic 9(8) Binary value 19.
   05 clientid-name pic x(8) value space.
   05 clientid-task pic x(8) value space.
   05 filler pic x(20) value low-value.

* Variables used for the SOCKET call
*---------------------------------------------------------------*
01 AF-INET pic 9(8) Binary Value 2.
01 AF-INET6 pic 9(8) Binary Value 19.
01 SOCK-STREAM pic 9(8) Binary Value 1.
01 SOCK-DATAGRAM pic 9(8) Binary Value 2.
01 IPPROTO-IP pic 9(8) Binary Value zero.
01 IPPROTO-TCP pic 9(8) Binary Value 6.
01 IPPROTO-UDP pic 9(8) Binary Value 17.
01 IPPROTO-IPV6 pic 9(8) Binary Value 41.
01 socket-descriptor pic 9(4) Binary Value zero.

* Variables returned by the GETHOSTNAME Call
*---------------------------------------------------------------*
01 host-name-len pic 9(8) binary.
01 host-name pic x(24).
01 host-name-char-count pic 9(4) binary.
01 host-name-unstrung pic x(24) value spaces.

* Variables used/returned by the GETADDRINFO Call
*---------------------------------------------------------------*
01 node-name pic x(255).
01 node-name-len pic 9(8) binary.
01 service-name pic x(32).
01 service-name-len pic 9(8) binary.
01 canonical-name-len pic 9(8) binary.
01 ai-passive pic 9(8) binary value 1.
01 ai-canonicalnameok pic 9(8) binary value 2.
01 ai-numerichost pic 9(8) binary value 4.
01 ai-numericserv pic 9(8) binary value 8.
01 ai-v4mapped pic 9(8) binary value 16.
01 ai-all pic 9(8) binary value 32.
01 ai-addrconfig pic 9(8) binary value 64.

* Variables used for the BIND call
*---------------------------------------------------------------*
01 server-socket-address.
   05 server-family pic 9(4) Binary value 19.
   05 server-port pic 9(4) Binary value 1031.
   05 server-flowinfo pic 9(8) Binary value 0.
   05 server-ipaddr.
      10 filler pic 9(16) Binary value 0.
      10 filler pic 9(16) Binary value 0.
   05 server-scopeid pic 9(8) Binary value 0.
01 NBYTE PIC 9(8) COMP value 80.
01 BUF PIC X(80).
01 BACKLOG PIC S9(8) COMP VALUE 10.

*---------------------------------------------------------------*

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 3 of 13)
Variables used/returned by the EZACIC09 call

01 input-addrinfo-ptr usage is pointer.
01 output-name-len pic 9(8) binary.
01 output-canonical-name pic x(256).
01 output-name usage is pointer.
01 output-next-addrinfo usage is pointer.

Variables used for the LISTEN call

01 backlog-level pic 9(4) Binary Value zero.

Variables used for the ACCEPT call

01 socket-descriptor-new pic 9(4) Binary Value zero.

Variables used for the NTOP/PTON call

01 IN6ADDR-ANY pic x(45) value '::'.
01 IN6ADDR-LOOPBACK pic x(45) value '::1'.
01 ntop-family pic 9(8) Binary.
01 pton-family pic 9(8) Binary.
01 presentable-addr pic x(45) value spaces.
01 presentable-addr-len pic 9(4) Binary value 45.
01 numeric-addr.
  05 filler pic 9(16) Binary Value 0.
  05 filler pic 9(16) Binary Value 0.

Variables used by the RECV Call

01 client-socket-address.
  05 client-family pic 9(4) Binary Value 19.
  05 client-port pic 9(4) Binary Value 1032.
  05 client-flowinfo pic 9(8) Binary Value zero.
  05 client-ipaddr.
    10 filler pic 9(16) Binary Value 0.
    10 filler pic 9(16) Binary Value 0.
  05 client-scopeid pic 9(8) Binary Value zero.

Buffer and length field for recv and send operation

01 send-request-len pic 9(8) Binary Value zero.
01 read-request-len pic 9(8) Binary Value zero.
01 read-buffer pic x(4000) value space.
01 filler redefines read-buffer.
  05 message-id pic x(8).
  05 filler pic x(3992).

recv and send flags

01 send-flag pic 9(8) Binary value zero.
01 recv-flag pic 9(8) Binary value zero.

---

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 4 of 13)
Error message for socket interface errors

*---------------------------------------------------------------*
77 failure     pic S9(8) comp.
01 ezaerror-msg.
  05 filler       pic x(9) Value 'Function='.
  05 ezaerror-function  pic x(16) Value space.
  05 filler       pic x value ' '.
  05 filler       pic x(8) Value 'Retcode='.
  05 ezaerror-retcode  pic ---99.
  05 filler       pic x value ' '.
  05 filler       pic x(9) Value 'Errormo='.
  05 ezaerror-errno  pic zzz99.
  05 filler       pic x value ' '.
  05 ezaerror-text  pic x(90) value ' '.

*================
Linkage Section.
*================
01 L1.
  03 hints-addrinfo.
    05 hints-ai-flags  pic 9(8) binary.
    05 hints-ai-family pic 9(8) binary.
    05 hints-ai-socktype pic 9(8) binary.
    05 hints-ai-protocol pic 9(8) binary.
    05 filler       pic 9(8) binary.
    05 filler       pic 9(8) binary.
    05 filler       pic 9(8) binary.
    05 filler       pic 9(8) binary.
  03 hints-addrinfo-ptr usage is pointer.
  03 results-addrinfo-ptr usage is pointer.

* Results address info
* 01 results-addrinfo.
  05 results-ai-flags  pic 9(8) binary.
  05 results-ai-family pic 9(8) binary.
  05 results-ai-socktype pic 9(8) binary.
  05 results-ai-protocol pic 9(8) binary.
  05 results-ai-addr-len pic 9(8) binary.
  05 results-ai-canonical-name usage is pointer.
  05 results-ai-addr-ptr usage is pointer.
  05 results-ai-next-ptr usage is pointer.

* Socket address structure from EZACIC09.
* 01 output-name-ptr usage is pointer.
  01 output-ip-name.
    03 output-ip-family pic 9(4) Binary.
    03 output-ip-port  pic 9(4) Binary.
    03 output-ip-sock-data pic x(24).
    03 output-ipv4-sock-data redefines output-ip-sock-data.
    05 output-ipv4-ipaddr pic 9(8) Binary.
    05 filler       pic x(20).
    03 output-ipv6-sock-data redefines output-ipv6-sock-data.

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 5 of 13)
output-ip-sock-data.
  05 output-ipv6-flowinfo pic 9(8) Binary.
  05 output-ipv6-1paddr.
    10 filler pic 9(16) Binary.
    10 filler pic 9(16) Binary.
  05 output-ipv6-scopeid pic 9(8) Binary.

*=============================================*
Procedure Division using L1.
*=============================================*

*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*
* PROCEDURE CONTROLS                                       *
*~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~*

Perform Initialize-API thru Initialize-API-Exit.
Perform Get-ClientID thru Get-ClientID-Exit.
Perform Sockets-Descriptor thru Sockets-Descriptor-Exit.
Perform Presentation-To-Numeric thru Presentation-To-Numeric-Exit.
Perform Get-Host-Name thru Get-Host-Name-Exit.
Perform Get-Address-Info thru Get-Address-Info-Exit.
Perform Bind-Socket thru Bind-Socket-Exit.
Perform Listen-To-Socket thru Listen-To-Socket-Exit.
Perform Accept-Connection thru Accept-Connection-Exit.
Move 45 to presentable-addr-len.
Move spaces to presentable-addr.
Move server-ipaddr to numeric-addr.
Move 19 to ntop-family.
Perform Numeric-TO-Presentation thru Numeric-To-Presentation-Exit.
Perform Read-Message thru Read-Message-Exit.
Perform Write-Message thru Write-Message-Exit.
Perform Close-Socket thru Exit-Now.

* Initialize socket API
* Initialize-API.
  Move soket-initapi to ezaerror-function.
* If you want to set maxsoc to the max, uncomment the next line.*
* Move 65535 to maxsoc-fwd.
  Call 'EZASOKET' using soket-initapi maxsoc initapi-ident
  subtask maxsoc errno retcode.
  Move 'Initapi failed' to ezaerror-text.
  If retcode < 0 move 12 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
  Move 'A' to Terminate-Options.
  Initialize-API-Exit.
  Exit.

* Let us see the client-id

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 6 of 13)
*---------------------------------------------------------------*
Get-ClientID.
move soket-getclientid to ezaerror-function.
Call 'EZASOKET' using soket-getclientid clientid errno retcode.
Display 'Client ID = ' clientid-name
'task=' clientid-task.
Move 'Getclientid failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Get-ClientID-Exit.
Exit.

*---------------------------------------------------------------*
* Get us a stream socket descriptor. 
*---------------------------------------------------------------*
Sockets-Descriptor.
move soket-socket to ezaerror-function.
Call 'EZASOKET' using soket-socket AF-INET6 SOCK-STREAM
IPPROTO-IP errno retcode.
Move 'Socket call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Move retcode to socket-descriptor.
Move 'S' to Terminate-Options.
Sockets-Descriptor-Exit.
Exit.

*---------------------------------------------------------------*
* Use PTON to create an IP address to bind to. 
*---------------------------------------------------------------*
Presentation-To-Numeric.
move soket-pton to ezaerror-function.
move IN6ADDR-LOOPBACK to presentable-addr.
Call 'EZASOKET' using soket-pton AF-INET6
presentable-addr presentable-addr-len numeric-addr errno retcode.
Move 'PTON call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
move numeric-addr to server-ipaddr.
Presentation-To-Numeric-Exit.
Exit.

*---------------------------------------------------------------*
* Get the host name. 
*---------------------------------------------------------------*
Get-Host-Name.
move soket-gethostname to ezaerror-function.
move 24 to host-name-len.
Call 'EZASOKET' using soket-gethostname
host-name-len host-name errno retcode.
display 'Host name = ' host-name.

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 7 of 13)
Move 'GETHOSTNAME call failed' to ezaerror-text.
   If retcode < 0  move 24 to failure.
   Perform Return-Code-Check thru Return-Code-Exit.
Get-Host-Name-Exit.
   Exit.

*---------------------------------------------------------------*
* Get address information                                      *
*---------------------------------------------------------------*
Get-Address-Info.
   move soket-getaddrinfo to ezaerror-function.
   move 0 to host-name-char-count.
   inspect host-name tallying host-name-char-count
      for characters before x'00'.
   unstring host-name delimited by x'00'
      into host-name-unstrung
      count in host-name-char-count.
   string host-name-unstrung delimited by ''
      into node-name.
   move host-name-char-count to node-name-len
   display 'Node name = ' node-name-len.
   move spaces to service-name.
   move 0 to service-name-len.
   move 0 to hints-ai-family.
   move ai-canonnameok to hints-ai-flags
   move 0 to hints-ai-socktype.
   move 0 to hints-ai-protocol.
   display 'GETADDRINFO Input fields: '
   display 'Node name = ' node-name.
   display 'Service name = ' service-name.
   display 'Service name length = ' service-name-len.
   display 'Hints family = ' hints-ai-family.
   display 'Hints flags = ' hints-ai-flags.
   display 'Hints socktype = ' hints-ai-socktype.
   display 'Hints protocol = ' hints-ai-protocol.
   set address of results-addrinfo to results-addrinfo-ptr.
   move soket-getaddrinfo to ezaerror-function.
   set hints-addrinfo-ptr to address of hints-addrinfo.
   Call 'EZASOKET' using soket-getaddrinfo
      node-name node-name-len
      service-name service-name-len
      hints-addrinfo-ptr
      results-addrinfo-ptr
      canonical-name-len
      errno retcode.
   Move 'GETADDRINFO call failed' to ezaerror-text.
   If retcode < 0  move 24 to failure
      Perform Return-Code-Check thru Return-Code-Exit
   else
      Perform Return-Code-Check thru Return-Code-Exit
      display 'Address of results addrinfo is '
         results-addrinfo-ptr.
      set address of results-addrinfo to results-addrinfo-ptr
      set input-addrinfo-ptr to address of results-addrinfo

Figure 138. EZAS06CS COBOL call interface sample IPv6 server program (Part 8 of 13)
display 'Address of input-addrinfo-ptr is ' input-addrinfo-ptr.
Perform Format-Result-AI thru Format-Result-AI-Exit
Perform Set-Next-Addrinfo thru Set-Next-Addrinfo-Exit until output-next-addrinfo is equal to NULLS
Perform Free-Address-Info Exit.
Get-Address-Info-Exit.
Exit.

*---------------------------------------------------------------*
* Set next addrinfo address                                      *
*---------------------------------------------------------------*
Set-Next-Addrinfo.
  display 'Setting next addrinfo address as '
    results-ai-next-ptr.
  display 'Address of output-next-addrinfo as '
    output-next-addrinfo.
  set address of results-addrinfo to output-next-addrinfo.
  display 'Address of input-addrinfo-ptr is '
    input-addrinfo-ptr.
Perform Format-Result-AI thru Format-Result-AI-Exit.
Set-Next-Addrinfo-Exit.
Exit.

*---------------------------------------------------------------*
* Format result address information                              *
*---------------------------------------------------------------*
Format-Result-AI.
  move 'EZACIC09' to ezaerror-function.
  move zeros to output-name-len.
  move spaces to output-canonical-name.
  set output-name to nulls.
  set output-next-addrinfo to nulls.
  Call 'EZACIC09' using input-addrinfo-ptr
    output-name-len
    output-canonical-name
    output-name
    output-next-addrinfo
    retcode.
  Move 'EZACIC09 call failed' to ezaerror-text.
  display 'EZACIC09 output:'
  display 'Canonical name = ' output-canonical-name.
  display 'name length = ' output-name-len.
  display 'name = ' output-name.
  display 'next addrinfo = ' output-next-addrinfo.
  If retcode < 0 move 24 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
  display 'Formatting result address ip address'.
  set address of output-ip-name to output-name.
  move results-ai-family to ntop-family.
  display 'ntop-family = ' ntop-family.
  if ntop-family = AF-INET then
    display 'Formatting ipv4 address'

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 9 of 13)
move output-ipv4-ipaddr to numeric-addr
move 16 to presentable-addr-len
else
    display 'Formatting ipv6 address'
    move output-ipv6-ipaddr to numeric-addr
    move 45 to presentable-addr-len.
    move spaces to presentable-addr.
    Perform Numeric-To-Presentation thru Numeric-To-Presentation-Exit.
Format-Result-AI-Exit.
Exit.

*---------------------------------------------------------------*
* Release resolver storage                                      *
*---------------------------------------------------------------*
Free-Address-Info.
    move soket-freeaddrinfo to ezaerror-function.
    Call 'EZASOKET' using soket-freeaddrinfo
        results-addrinfo-ptr
        errno retcode.
    Move 'FREEADDRINFO call failed' to ezaerror-text.
    If retcode = 0 move 24 to failure.
    Perform Return-Code-Check thru Return-Code-Exit.
Free-Address-Info-Exit.
Exit.

*---------------------------------------------------------------*
* Bind socket to our server port number                         *
*---------------------------------------------------------------*
Bind-Socket.
    move soket-bind to ezaerror-function.
    Call 'EZASOKET' using soket-bind socket-descriptor
        server-socket-address errno retcode.
    Display 'Port = ' server-port
        'Address = ' presentable-addr.
    Move 'Bind call failed' to ezaerror-text.
    If retcode = 0 move 24 to failure.
    Perform Return-Code-Check thru Return-Code-Exit.
Bind-Socket-Exit.
Exit.

*---------------------------------------------------------------*
* Listen to the socket                                          *
*---------------------------------------------------------------*
Listen-To-Socket.
    Move soket-listen to ezaerror-function.
    Call 'EZASOKET' using soket-listen socket-descriptor
        backlog errno retcode.
    Display 'Backlog = ' backlog.
    Move 'Listen call failed' to ezaerror-text.
    If retcode = 0 move 24 to failure.
    Perform Return-Code-Check thru Return-Code-Exit.
Listen-To-Socket-Exit.
Exit.

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 10 of 13)
/* Accept a connection request */

Accept-Connection.
Move socket-accept to ezaerror-function.
Call 'EZASOKET' using socket-accept socket-descriptor
server-socket-address errno retcode.
Move retcode to socket-descriptor-new.
Display 'New socket=' retcode.
Move 'Accept call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Accept-Connection-Exit.
Exit.

/* Use NTOP to display the IP address. */

Numeric-To-Presentation.
Move socket-ntop to ezaerror-function.
Call 'EZASOKET' using socket-ntop ntop-family
numeric-addr
presentable-addr presentable-addr-len
errno retcode.
Display 'Presentable address = ' presentable-addr.
Move 'NTOP call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Numeric-TO-Presentation-Exit.
Exit.

/* Read a message from the client. */

Read-Message.
Move socket-read to ezaerror-function.
Move spaces to buf.
Display 'New socket descriptr = ' socket-descriptor-new.
Call 'EZASOKET' using socket-read socket-descriptor-new
nbyte buf
errno retcode.
Display 'Message received = ' buf.
Move 'Read call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Read-Message-Exit.
Exit.

/* Write a message to the client. */

Write-Message.
Move socket-write to ezaerror-function.
Move 'Message from EZASO6SC' to buf.
Call 'EZASOKET' using socket-write socket-descriptor-new

Figure 138. EZASO6SC COBOL call interface sample IPv6 server program (Part 11 of 13)
nbyte buf
errno retcode.
Move 'Write call failed' to ezaerror-text
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Write-Message-Exit.
Exit.

*---------------------------------------------------------------*
* Close connected socket                                      *
*---------------------------------------------------------------*
Close-Socket.
  move soket-close to ezaerror-function
  Call 'EZASOKET' using soket-close socket-descriptor-new
  errno retcode.
  Accept cur-time from time.
  Display cur-time ' EZASO6CS : CLOSE RETCODE=' RETCODE
  ' ERRNO= ' ERRNO.
  If retcode < 0 move 24 to failure
  move 'Close call failed' to ezaerror-text
  perform write-ezaerror-msg thru write-ezaerror-msg-exit.
Close-Socket-Exit.
  Exit.

*---------------------------------------------------------------*
* Terminate socket API                                         *
*---------------------------------------------------------------*
exit-term-api.
  Call 'EZASOKET' using soket-termapi.

*---------------------------------------------------------------*
* Terminate program                                            *
*---------------------------------------------------------------*
exit-now.
  move failure to return-code.
  Goback.

*---------------------------------------------------------------*
* Subroutine                                                    *
* ------------                                                    *
* Write out an error message                                    *
*---------------------------------------------------------------*
write-ezaerror-msg.
  move errno to ezaerror-errno.
  move retcode to ezaerror-retcode.
  display ezaerror-msg.
  write-ezaerror-msg-exit.
  exit.

*---------------------------------------------------------------*

Figure 138. EZASO6CS COBOL call interface sample IPv6 server program (Part 12 of 13)
The EZASO6CC program is a client module that shows you how to use the following calls provided by the call socket interface:

- CLOSE
- CONNECT
- GETCLIENTID
- GETNAMEINFO
- INITAPI
- NTOP
- PTON
- READ
- SHUTDOWN
- SOCKET
- TERMAPI
- WRITE
Identification Division.
***********************************************************************
Program-id. EZASO6CC.
***********************************************************************
Environment Division.
***********************************************************************
Data Division.
***********************************************************************
Working-storage Section.
***********************************************************************
* Socket interface function codes
***********************************************************************
01 soket-functions.
   02 soket-accept    pic x(16) value 'ACCEPT'.
   02 soket-bind      pic x(16) value 'BIND'.
   02 soket-close     pic x(16) value 'CLOSE'.
   02 soket-connect   pic x(16) value 'CONNECT'.
   02 soket-fcntl     pic x(16) value 'FCNTL'.
   02 soket-freeaddrinfo pic x(16) value 'FREEADDRINFO'.
   02 soket-getaddrinfo pic x(16) value 'GETADDRINFO'.
   02 soket-getclientid pic x(16) value 'GETCLIENTID'.
   02 soket-gethostbyaddr pic x(16) value 'GETHOSTBYADDR'.
   02 soket-gethostbyname pic x(16) value 'GETHOSTBYNAME'.
   02 soket-gethostid pic x(16) value 'GETHOSTID'.
   02 soket-gethostname pic x(16) value 'GETHOSTNAME'.
   02 soket-getnameinfo pic x(16) value 'GETNAMEINFO'.
   02 soket-getpeername pic x(16) value 'GETPEERNAME'.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 1 of 9)
* Work variables *

01 errno pic 9(8) binary value zero.
01 retcode pic s9(8) binary value zero.
01 index-counter pic 9(8) binary value zero.
01 buffer-element.
   05 buffer-element-nbr pic 9(5).
   05 filler pic x(3) value space.
01 server-ipaddr-dotted pic x(15) value space.
01 client-ipaddr-dotted pic x(15) value space.
01 close-server pic 9(8) Binary value zero.
   88 close-server-down value 1.
01 Connect-Flag pic x value space.
   88 CONNECTED value 'Y'.
01 Client-Server-Flag pic x value space.
   88 CLIENTS value 'C'.
   88 SERVERS value 'S'.
01 Terminate-Options pic x value space.
   88 Opened-API value 'A'.
   88 Opened-Socket value 'S'.
01 timer-accum pic 9(8) Binary value zero.
01 timer-interval pic 9(8) Binary value 2000.
01 Cur-time.
   02 Hour pic 9(2).
   02 Minute pic 9(2).
   02 Second pic 9(2).
   02 Hund-Sec pic 9(2).
77 Failure Pic 9(8) comp.

* Variables used for the INITAPI call *

01 maxsoc-fwd pic 9(8) Binary.
01 maxsoc-rdf redefines maxsoc-fwd.
   02 filler pic x(2).

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 2 of 9)
02 maxsoc pic 9(4) Binary.
01 initapi-ident.
   05 tcpname pic x(8) Value 'TCPCS'.
   05 asname pic x(8) Value space.
01 subtask pic x(8) Value 'EZSO6CC'.
01 maxsno pic 9(8) Binary Value 1.

* Variables used by the SHUTDOWN Call *
01 how pic 9(8) Binary.

* Variables returned by the GETCLIENTID Call *
01 clientid.
   05 clientid-domain pic 9(8) Binary value 19.
   05 clientid-name pic x(8) value space.
   05 clientid-task pic x(8) value space.
   05 filler pic x(20) value low-value.

* Variables returned by the GETNAMEINFO Call *
01 name-len pic 9(8) Binary.
01 host-name pic x(255).
01 host-name-len pic 9(8) Binary.
01 service-name pic x(32).
01 service-name-len pic 9(8) Binary.
01 name-info-flags pic 9(8) Binary value 0.
01 ni-nofqdn pic 9(8) Binary value 1.
01 ni-numerichost pic 9(8) Binary value 2.
01 ni-namereqd pic 9(8) Binary value 4.
01 ni-numericserver pic 9(8) Binary value 8.
01 ni-dgram pic 9(8) Binary value 16.

* Variables used for the SOCKET call *
01 AF-INET pic 9(8) Binary Value 2.
01 AF-INET6 pic 9(8) Binary Value 19.
01 SOCK-STREAM pic 9(8) Binary Value 1.
01 SOCK-DATAGRAM pic 9(8) Binary Value 2.
01 SOCK-RAW pic 9(8) Binary Value 3.
01 IPPROTO-IP pic 9(8) Binary Value zero.
01 IPPROTO-TCP pic 9(8) Binary Value 6.
01 IPPROTO-UDP pic 9(8) Binary Value 17.
01 IPPROTO-IPV6 pic 9(8) Binary Value 41.
01 socket-descriptor pic 9(4) Binary Value zero.

* Server socket address structure *
01 server-socket-address.
   05 server-afinet pic 9(4) Binary Value 19.
   05 server-port pic 9(4) Binary Value 1031.
   05 server-flowinfo pic 9(8) Binary Value zero.
   05 server-ipaddr.
      10 filler pic 9(16) Binary Value 6.
      10 filler pic 9(16) Binary Value 0.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 3 of 9)
05 server-scopeid pic 9(8) Binary Value zero.
01 NBYTE PIC 9(8) COMP value 80.
01 BUF PIC X(80).

* Variables used by the BIND Call

01 client-socket-address.
  05 client-family pic 9(4) Binary Value 19.
  05 client-port pic 9(4) Binary Value 1032.
  05 client-flowinfo pic 9(8) Binary Value 0.
  05 client-ipaddr.
    10 filler pic 9(16) Binary Value 0.
  05 client-scopeid pic 9(8) Binary Value 0.

* Buffer and length fields for send operation

01 send-request-length pic 9(8) Binary value zero.
01 send-buffer.
  05 send-buffer-total pic x(4000) value space.
  05 closedown-message redefines send-buffer-total.
  10 closedown-id pic x(8).
  10 filler pic x(3992).
  05 send-buffer-seq redefines send-buffer-total pic x(8) occurs 500 times.

* Variables used for the NTOP/PTON call

01 IN6ADDR-ANY pic x(45) value '::'.
01 IN6ADDR-LOOPBACK pic x(45) value '::1'.
01 presentable-addr pic x(45) value spaces.
01 presentable-addr-len pic 9(4) Binary value 45.
01 numeric-addr.
  05 filler pic 9(16) Binary Value 0.
  05 filler pic 9(16) Binary Value 0.

* Buffer and length fields for recv operation

01 read-request-length pic 9(8) Binary value zero.
01 read-buffer pic x(4000) value space.

* Other fields for send and recvfrom operation

01 send-flag pic 9(8) Binary value zero.
01 recv-flag pic 9(8) Binary value zero.

* Error message for socket interface errors

01 ezaerror-msg.
  05 filler pic x(9) Value 'Function='.
  05 ezaerror-function pic x(16) Value space.
  05 filler pic x value ' '.
  05 filler pic x(8) Value 'Retcode='.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 4 of 9)
Linkage Section.

*================
*=============================================*
Procedure Division.
*=============================================*

* PROCEDURE CONTROLS *

Perform Initialize-API thru Initialize-API-Exit.
Perform Get-Client-ID thru Get-Client-ID-Exit.
Perform Sockets-Descriptor thru Sockets-Descriptor-Exit.
Perform Presentation-To-Numeric thru Presentation-To-Numeric-Exit.
Perform CONNECT-Socket thru CONNECT-Socket-Exit.
Perform Numeric-TO-Presentation thru Numeric-TO-Presentation-Exit.
Perform Get-Name-Information thru Get-Name-Information-Exit.
Perform Write-Message thru Write-Message-Exit.
Perform Shutdown-Send thru Shutdown-Send-Exit.
Perform Read-Message thru Read-Message-Exit.
Perform Shutdown-Receive thru Shutdown-Receive-Exit.
Perform Close-Socket thru Exit-Now.

*---------------------------------------------------------------*
* Initialize socket API*
*---------------------------------------------------------------*
Initialize-API.
Move soket-initapi to ezaerror-function.
Call 'EZASOKET' using soket-initapi maxsoc initapi-ident
subtask maxsno errno retcode.
Move 'Initapi failed' to ezaerror-text.
If retcode < 0 move 12 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Move 'A' to Terminate-Options.
Initialize-API-Exit.
Exit.

*---------------------------------------------------------------*
* Let us see the client-id*
*---------------------------------------------------------------*
Get-Client-ID.
Move soket-getclientid to ezaerror-function.
Call 'EZASOKET' using soket-getclientid clientid errno
retcode.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 5 of 9)
Display 'Our client ID = ' clientid-name ' ' clientid-task.
Move 'Getclientid failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Move 'C' to client-server-flag.
Get-Client-ID-Exit.
Exit.

*---------------------------------------------------------------*

* Get us a stream socket descriptor *
*---------------------------------------------------------------*
Sockets-Descriptor.
Move soket-socket to ezaerror-function.
Call 'EZASOKET' using soket-socket AF-INET6 SOCK-STREAM
IPPROTO-IP errno retcode.
Move 'Socket call failed' to ezaerror-text.
If retcode < 0 move 60 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
Move 'S' to Terminate-Options.
Move retcode to socket-descriptor.
Sockets-Descriptor-Exit.
Exit.

*---------------------------------------------------------------*

* Use PTON to create an IP address to bind to. *
*---------------------------------------------------------------*
Presentation-To-Numeric.
move soket-pton to ezaerror-function.
move INADDR-LOOPBACK to presentable-addr.
Call 'EZASOKET' using soket-pton AF-INET6
presentable-addr presentable-addr-len numeric-addr
errno retcode.
Move 'PTON call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
move numeric-addr to server-ipaddr.
Presentation-To-Numeric-Exit.
Exit.

*---------------------------------------------------------------*

* CONNECT *
*---------------------------------------------------------------*
Connect-Socket.
Move space to Connect-Flag.
Move zeros to errno retcode.
move soket-connect to ezaerror-function.
CALL 'EZASOKET' USING SOKET-CONNECT socket-descriptor
server-socket-address errno retcode.
Move 'Connection call failed' to ezaerror-text.
If retcode < 0 move 24 to failure.
Perform Return-Code-Check thru Return-Code-Exit.
If retcode = 0 Move 'Y' to Connect-Flag.
Connect-Socket-Exit.
Exit.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 6 of 9)
* Use NTOP to display the IP address.

```
Numeric-To-Presentation.
  move soket-ntop to ezaerror-function.
  move server-ipaddr to numeric-addr.
  move soket-ntop to ezaerror-function.
  Call 'EZASOKET' using soket-ntop AF-INET6
       numeric-addr
       presentable-addr presentable-addr-len
       errno retcode.
  Display 'Presentable address = ' presentable-addr.
  Move 'NTOP call failed' to ezaerror-text.
  If retcode < 0 move 24 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
Numeric-TO-Presentation-Check thru Return-Code-Exit.
Exit.
```

* Use GETNAMEINFO to get the host and service names

```
Get-Name-Information.
  move 28 to name-len.
  move 255 to host-name-len.
  move 32 to service-name-len.
  move ni-namereqd to name-info-flags.
  move soket-getnameinfo to ezaerror-function.
  Call 'EZASOKET' using soket-getnameinfo
       server-socket-address name-len
       host-name host-name-len
       service-name service-name-len
       name-info-flags
       errno retcode.
  Display 'Host name = ' host-name.
  Display 'Service = ' service-name.
  Move 'Getaddrinfo call failed' to ezaerror-text.
  If retcode < 0 move 24 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
Get-Name-Information-Exit.
Exit.
```

* Write a message to the server

```
Write-Message.
  move soket-write to ezaerror-function.
  Move 'Message from EZASO6CC' to buf.
  Call 'EZASOKET' using soket-write socket-descriptor
       nbyte buf
       errno retcode.
  Move 'Write call failed' to ezaerror-text.
  If retcode < 0 move 84 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
Write-Message-Exit.
```

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 7 of 9)
Exit.

*---------------------------------------------------------------*
* Shutdown to pipe                                            *
*---------------------------------------------------------------*
Shutdown-Send.
  Move soket-shutdown to ezaerror-function.
  move 1 to how.
  Call 'EZASOKET' using soket-shutdown socket-descriptor
      how
      errno retcode.
  Move 'Shutdown call failed' to ezaerror-text.
  If retcode < 0 move 99 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
Shutdown-Send-Exit.
Exit.

*---------------------------------------------------------------*
* Read a message from the server.                             *
*---------------------------------------------------------------*
Read-Message.
  Move soket-read to ezaerror-function.
  Move spaces to buf.
  Call 'EZASOKET' using soket-read socket-descriptor
      nbyte buf
      errno retcode.
  If retcode < 0
      Move 'Read call failed' to ezaerror-text
      move 120 to failure
      Perform Return-Code-Check thru Return-Code-Exit.
Read-Message-Exit.
Exit.

*---------------------------------------------------------------*
* Shutdown receive pipe                                        *
*---------------------------------------------------------------*
Shutdown-Receive.
  Move soket-shutdown to ezaerror-function.
  move 0 to how.
  Call 'EZASOKET' using soket-shutdown socket-descriptor
      how
      errno retcode.
  Move 'Shutdown call failed' to ezaerror-text.
  If retcode < 0 move 99 to failure.
  Perform Return-Code-Check thru Return-Code-Exit.
Shutdown-Receive-Exit.
Exit.

*---------------------------------------------------------------*
* Close socket                                                 *
*---------------------------------------------------------------*
Close-Socket.
  Move soket-close to ezaerror-function.
  Call 'EZASOKET' using soket-close socket-descriptor
  errno retcode.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 8 of 9)
Move 'Close call failed' to ezaerror-text.
If retcode < 0 move 132 to failure
  perform write-ezaerror-msg thru write-ezaerror-msg-exit.
Accept Cur-Time from TIME.
  Display Cur-Time ' EZASO6CC: ' ezaerror-function
    ' RETCODE=' RETCODE ' ERRNO=' ERRNO.
Close-Socket-Exit.
  Exit.

*---------------------------------------------------------------*
* Terminate socket API                                        *
*---------------------------------------------------------------*
exit-term-api.
  ACCEPT cur-time from TIME.
  Display cur-time ' EZASO6CC: TERMAPI '
    ' RETCODE=' RETCODE ' ERRNO=' ERRNO.
  Call 'EZASOKET' using soket-termapi.

*---------------------------------------------------------------*
* Terminate program                                           *
*---------------------------------------------------------------*
exit-now.
  Move failure to return-code.
  Goback.

*---------------------------------------------------------------*
* Subroutine.                                                  *
*---------------------------------------------------------------*
write-ezaerror-msg.
  Move errno to ezaerror-errno.
  Move retcode to ezaerror-retcode.
  Display ezaerror-msg.
  write-ezaerror-msg-exit.
  Exit.

*---------------------------------------------------------------*
* Check Return Code after each Socket Call                     *
*---------------------------------------------------------------*
Return-Code-Check.
  Accept Cur-Time from TIME.
  Display Cur-Time ' EZASO6CC: ' ezaerror-function
    ' RETCODE=' RETCODE ' ERRNO=' ERRNO.
  IF RETCODE < 0
    Perform Write-ezaerror-msg thru write-ezaerror-msg-exit
    Move zeros to errno retcode
  IF Opened-Socket Go to Close-Socket
  ELSE IF Opened-API Go to exit-term-api
  ELSE Go to exit-now.
    Move zeros to errno retcode.
  Return-Code-Exit.
  Exit.

Figure 139. EZASO6CC COBOL call interface sample IPv6 client program (Part 9 of 9)
Chapter 14. REXX socket application programming interface

The z/OS Communications Server socket API for REXX supports IPv4 and IPv6 socket call instructions.

The REXX socket API uses the REXX built-in function RXSOCKET to access the z/OS Communications Server socket interface. This API provides similar socket functions to those in other high-level languages. When possible, the REXX socket functions match the C socket functions; an example of the corresponding LE C/C++ socket function is included when applicable.

Overview of the REXX socket API

This section contains introductory material about REXX socket APIs.

Supported REXX APIs

z/OS Communications Server supports the REXX Sockets API and the REXX FTP API.

The REXX FTP API is documented in z/OS Communications Server: IP Programmer’s Guide and Reference. The REXX Sockets API is documented in this deliverable. Unless noted in z/OS Communications Server: New Function Summary, this REXX socket API is upward compatible. Application programs that use new functions will not be downward compatible.

Rule: Unless indicated otherwise, all socket commands that are listed are enabled for IPv4 and IPv6.

Tip: This API is compatible with compiled REXX.

Prerequisites for using REXX sockets

To use REXX sockets, the EZBRXSOC load module must be included.

The EZBRXSOC load module is defined with two load module aliases: RXSOCKET and SOCKET. When a program invokes the REXX socket function, either the load module or an alias is called. The load module and its aliases reside in the TCPIPSEZALOAD data set. The examples in this documentation use the SOCKET alias.

Requirement: The EZBRXSOC load module and its aliases must be included in one of the following items:

- The system LNKLST
- The STEPLIB DD concatenation of the job that is running the program that uses REXX sockets

Format of the REXX socket function and return values

You can issue socket commands in REXX by calling the built-in socket function.
Format
This function uses the following format, which is similar to that used to invoke C sockets:

```plaintext
SOCKET(command, arguments)
```

Parameters
`command`
The socket API command to be issued, for example, SEND.

`arguments`
One or more parameters separated by a comma. All parameters are passed as space-delimited strings.

Returned value
The socket function returns a space-delimited string. If the REXX socket library can issue the socket command, the return value consists of the REXX TCP/IP error number value, the return code, and any additional socket information. If the REXX socket library cannot process the socket command, the return value consists of a REXX socket library error value and information about what caused the error.

Tip: For an error condition, the REXX socket library returns both the numeric and text versions of the error, for example, 2009 ESOCKETNOTDEFINED Socket not defined.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

Example
Consider the following code sample:

```plaintext
src = socket("ACCEPT", l_socketid);
```

where:

- "ACCEPT" is the socket command.
- `l_socketid` is an argument that is required by the ACCEPT command. In this example, it specifies the socket descriptor of the listening socket.

When a new connection is available, the ACCEPT command returns the following string:

```plaintext
src = 0 45
```

where 0 is the return code, and 45 is the file descriptor of the new connection.

**REXX programming hints and tips**
This topic contains information that you might find helpful when you use REXX sockets.
Capitalization

Throughout the documentation, REXX socket API commands and constants are capitalized when they are used in descriptive text. For example, the LISTEN command places a socket descriptor in passive mode.

Quotation marks

Throughout the documentation, REXX socket API commands and constants are enclosed in quotation marks (") when they are used in code examples, for example, `src = socket("ACCEPT", sockfd);`

Although the use of quotation marks is optional, consider using quotation marks to prevent programming errors. Using quotation marks forces the socket function to use string literals rather than REXX variables. When REXX encounters an uninitialized variable, it initializes that variable with the name of the variable. The command `socket(ACCEPT, sockid)` is valid because the uninitialized variable ACCEPT is initialized to the character string ACCEPT. However, if the program initializes the ACCEPT variable with a value other than the character string ACCEPT, the socket function fails.

Guideline: Unless otherwise indicated by a specific socket command, all socket commands and constant values must be passed as character strings.

Splitting a function over multiple lines

The socket function, with parameters, might exceed 80 characters. In such cases, you can split the function across multiple lines by using the REXX continuation character, a comma (,). Consider the following examples:

Continuing a string across two lines

```rexx
  _string1 = "This is a string split between",
           "two lines."
```

Continuing a string when the continuation occurs on a parameter boundary

```rexx
  src = socket( "GETADDRINFO", "CHILE",,
               23,"AI_CANONNAMEOK")
```

In this example, the first comma after the parameter "CHILE" indicates the end of the parameter. The second comma indicates that the REXX statement continues on the next line.

Return codes

To avoid problems, an application should check the return code of a socket command after each socket call. The examples in this topic do not always follow this recommendation. The examples are intended to show how to issue the socket command.

Guideline: Use either the REXX PARSE feature or the WORD function to access the return code. For example,
```rexx
  parse var _ retcode src remainder;
  if src = 0 then do
      /* DO SOME STUFF */
  end;
  else do
      /* Process the error */
  end;
```
Allocating and deallocating socket sets

To use the socket commands provided by the REXX socket function, a socket set must be active. To allocate a socket set, use the INITIALIZE socket command. The INITIALIZE command creates a socket set and can support multiple socket calls. The subtaskid value identifies the socket set and usually corresponds to the application name. The service value indicates the TCP/IP stack name to form an affinity with.

Restriction: When the INITIALIZE command is issued, the REXX socket API forms an affinity with the default TCP/IP stack. In an INET environment, the affinity is created with the active stack. In a CINET environment, the affinity is created with the default stack. The default stack is determined either by the first BPXPRMxx SUBFILESYSTYPE statement or by the SUBFILESYSTYPE statement with the keyword DEFAULT. For additional information, see z/OS Communication Server: MVS Initialization and Tuning Reference.

Guideline: Before you exit the program or when you do not need the socket environment, use the TERMINATE socket command to deallocate the socket set.

Blocking and nonblocking mode

A socket can be in blocking or nonblocking mode. In blocking mode, commands such as SEND and RECV block the caller until either the operation is completed successfully or an error occurs. In nonblocking mode, the caller is not blocked, but the operation ends immediately with either the 35 EWOULDBLOCK or 36 EINPROGRESS return code. Use the FCNTL or IOCTL commands to switch the socket between blocking and nonblocking modes.

When a socket is in nonblocking mode, you can use the SELECT command to monitor the socket for one or more socket events. The socket can be monitored for events that indicate that the socket is ready for writing or reading, or whether an exception has occurred.

Transferring a socket to a subtask

If the application uses the GIVESOCKET and TAKESOCKET commands to transfer a socket from a parent program to a subtask, both the parent and subtask must agree on a mechanism for exchanging the client ID and the socket descriptor. The parent program can use the SELECT command to monitor when the subtask takes the socket. After the subtask takes the socket, the parent then can close the socket that was given.

SO_ASCII and SO_EBCDIC socket options

The socket options SO_ASCII and SO_EBCDIC identify the socket data type for use by the REXX RXSOCKET program. Setting the SO_EBCDIC option to ON has no effect, and setting the SO_ASCII option to ON causes all incoming data on the socket to be translated from ASCII to EBCDIC and all outgoing data on the socket to be translated from EBCDIC to ASCII.
How structures are represented

Instead of using binary-based data structures, the REXX socket library represents all data structures as strings of space-delimited values, where each value represents a field in the data structure.

The REXX language is a type-independent language. All data is manipulated and represented using a character format. When an application passes data into the REXX socket library, the data must be a space-delimited string. When the REXX socket library returns socket information, it returns the information as a space-delimited string on the return value.

Rules:

- All IPv4 addresses are represented as strings in dotted decimal format.
- All IPv6 addresses are represented as strings in IPv6 colon hexadecimal format.
- When a NAME string is returned as a result, the IP address is in IPv4 dotted decimal or IPv6 colon hexadecimal format.

Tip: When you specify a NAME string as an input parameter to a command, you can specify the ipaddress field either as an IP address or as a host name to be resolved by a name server. For example, you can code NAME="AF_INET 1049 MYHOST", where AF_INET is the address family, 1049 is the port number, and MYHOST is the host name to be resolved to an IP address.

struct sockaddr_in

This structure represents an IPv4 socket address. In the REXX socket library, this structure is represented by the NAME string. The NAME string has the following format:

```
NAME = "domain portid ipaddress"
```

where:

domain
  The number 2 or AF_INET

portid
  The local or remote port to which the socket is to be bound or connected

ipaddress
  The IPv4 address of the local or remote host to which the socket is to be bound or connected

The following string is an example of an IPv4 NAME string:

```
NAME = "AF_INET 24 10.11.103.1"
```

struct sockaddr_in6

This structure represents an IPv6 socket address. In the REXX socket library, this structure is represented by the NAME string. The NAME string has the following format:

```
NAME = "domain portid flowinfo ipaddress scopeid"
```

where:
*domain*
   The number 19 or AF_INET6.

*portid*
   The local or remote port to which the socket is to be bound or connected.

*flowinfo*
   This value must be set to 0.

*ipaddress*
   The IPv6 address of the local or remote host to which the socket is to be bound or connected.

*scopeid*
   Identifies the interfaces that are applicable for the scope of the address that is specified in the *ipaddress* field. For a link-local IP address, the *scopeid* field can specify a link index, which identifies a set of interfaces. For all other scopes, the *scopeid* field must be set to 0. Setting the *scopeid* field to 0 indicates that any address type and scope can be specified.

The following string is an example of an IPv6 NAME string:
```
NAME = "AF_INET6 24 0 2001:10:11:103::1 0"
```

**struct ip_mreq**

This structure represents the mapping between an IPv4 multicast address and an IPv4 interface. In the REXX socket library, this structure is represented by the *ipmreq* string. The *ipmreq* string has the following format:
```
ipmreq = "maddress iaddress"
```

where:

*maddress*
   An IPv4 multicast address

*iaddress*
   The IPv4 interface address

The following string is an example of an IPv4 *ipmreq* string:
```
ipmreq = "224.224.224.1 10.123.21.3"
```

**struct ipv6_mreq**

This structure represents the mapping between an IPv6 multicast address and an interface index. In the REXX socket library, this structure is represented by the *ipmreq* string. The *ipmreq* string has the following format:
```
ipmreq = "maddress index"
```

where:

*maddress*
   An IPv6 multicast address

*index*
   An interface index number

The following string is an example of an IPv6 *ipmreq* string:
```
ipmreq = "FF05::101 34"
```
**struct ip_mreq_source**

This structure represents a multicast source filter. It is used with the IOCTL command to filter the multicast packets that an application wants to receive; it also defines the remote host from which the packets are sent. In the REXX socket library, this structure is represented by the `ip_mreq_source` string. The `ip_mreq_source` string has the following format:

```
ipmreqsource = "maddress saddress iaddress"
```

where:

- **maddress**
  - An IPv4 multicast address
- **saddress**
  - An IPv4 source address of a remote host
- **iaddress**
  - An IPv4 interface address

The following string is an example of an `ip_mreq_source` string:

```
ipmreqsource = "224.224.224.2 10.1.2.3 10.123.21.3"
```

**Restriction:** This structure supports IPv4 addresses only.

**struct group_req**

This structure represents a protocol-independent mapping between a multicast IP address and an interface index. It is used with the IOCTL command to join and leave multicast groups. In the REXX socket library, this structure is represented by the `groupreq` string. The `groupreq` string has the following format:

```
groupreq = "index NAME"
```

where:

- **index**
  - An interface index
- **NAME**
  - The NAME string of a multicast socket address

The following strings are examples of `groupreq` strings:

```
groupreq = "15664 AF_INET 5000 224.224.224.2"
groupreq = "15667 AF_INET6 5000 0 FF05::101 0"
```

**struct group_req_source**

This structure represents a protocol-independent mapping between a multicast IP address, an interface index, and a source address for a remote host. It is used with the IOCTL command to filter the multicast packets that an application wants to receive; it also defines the remote host from which the packets are sent. In the REXX socket library, this structure is represented by the `groupreqsource` string. The `groupreqsource` string has the following format:

```
groupreqsource = "index M_NAME S_NAME"
```

where:
An interface index

M_NAME
   The NAME string of a multicast socket address

S_NAME
   The NAME string of a source socket address

The following strings are examples of `groupreqsource` strings:

- `groupreqsource = "15664 AF_INET 5000 224.224.224.2 AF_INET 5000 10.1.2.3"
- `groupreqsource = "15667 AF_INET6 5000 0 FF05::101 0 AF_INET6 5000 0 FF01:10:1:2::3 0"

**REXX runtime functions**

This section describes the subcommands that are supported by the REXX socket function. When applicable, the LE C/C++ Equivalent call is also shown.

### Commands to process socket sets

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</tr>
<tr>
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</tr>
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### Commands to open, close, and manipulate sockets

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**“SOCKET” on page 751**

Use the SOCKET command to open a socket descriptor in the active socket set.

**“TAKE_SOCKET” on page 756**

Use the TAKE_SOCKET command to take a socket descriptor that is passed from another program using the GIVESOCKET command. A socket descriptor can be taken by an application only when the socket is in the same address family.

### Commands to exchange data on sockets

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<td>Use the SEND command to send an outgoing message on the connected socket.</td>
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<td>Use the SENDTO command to send an outgoing message on a socket descriptor. This command differs from the SEND command in that it includes the destination address as a parameter.</td>
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<td>Use the WRITE command to send an outgoing message on the connected socket. The WRITE command is similar to the SEND command, except that the WRITE command does not support the control flags that are available with the SEND command.</td>
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### Commands to resolve host names and IP addresses

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<td>Use the GETADDRINFO command to resolve host or service name information.</td>
</tr>
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<td><strong>“GETHOSTBYADDR” on page 689</strong></td>
<td>Use the GETHOSTBYADDR command to resolve an IPv4 address to a host name.</td>
</tr>
<tr>
<td><strong>“GETHOSTBYNAME” on page 690</strong></td>
<td>Use the GETHOSTBYNAME command to resolve a host name to an IPv4 address.</td>
</tr>
</tbody>
</table>
Use the ACCEPT command to accept new connections from a client.
This command is valid only for stream sockets. Connection requests are processed in the order in which they are received. When a new connection is accepted, a new socket ID is created with the same properties as the listening socket ID. The new socket ID cannot be used to accept new connections. The original socket remains available to accept new connection requests.

This command supports both blocking and nonblocking sockets.

**Rule:** When the listening socket is in blocking mode, the ACCEPT command blocks the caller until a new connection request is received. When the listening socket is in nonblocking mode, the ACCEPT command immediately returns the 35 EWOULDBLOCK return code.

**Tip:** When you use blocking or nonblocking socket calls, use the SELECT command to check for new connection requests before you call the ACCEPT command. The availability of a new connection is reported as a READ event on the listening socket. The new socket should not be accepted until after the READ event is received.

**Format**

```
>---SOCKET---("ACCEPT", socketid)
```

**Parameters**

socketid

The socket descriptor of the listening socket where new connection requests are queued

**Returned value**

The command returns a string that contains the return code, the new scopeid value for the accepted connection, and the NAME string of the connecting client. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 663.

Consider the following IPv4 and IPv6 examples:

**IPv4**

The string, 0 6 AF_INET 50000 10.1.2.3, is an example of what this command returns. 0 is the function return code, 6 is the new socket ID of the accepted connection, AF_INET is the address family to which the socket belongs, 50000 is the remote port from which the client is connecting, and 10.1.2.3 is the remote address from which the client is connecting.

**IPv6**

The string, 0 6 AF_INET6 5462 0 2001:10:11:103::1 0, is an example of what this command returns. 0 is the function return code, 6 is the new socket ID of the accepted connection, AF_INET6 is the address family to which the socket belongs, 5462 is the remote port from which the client is connecting, 0 is the flowinfo value, 2001:10:11:103::1 is the remote address from which the client is connecting, and 0 is the scopeid value. For IPv6 connections, the flowinfo and scopeid fields are set to 0.
See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2006 ESOCKETNOTDEFINED
- 2007 EMAXSOCKETSREACHED
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALVALIDNAME

**LE C/C++ equivalent**

```c
#include <string.h>

int accept(int socket, struct sockaddr *address, int *address_len);
```

**Code example**

```c
/* REXX EZARXR01 */
/*
 * This sample demonstrates the use of the INITIALIZE, SOCKET, BIND
 * LISTEN, ACCEPT, RECV, CLOSE, and TERMINATE socket commands.
 * The program creates a listening socket and then goes into a
 * loop and blocks on the accept command. When a new connection is
 * ACCEPTED the program will issue one receive command and then close the
 * connection. If the data received is the string "DONE", then the
 * program will close the listening socket and terminate. Otherwise the
 * program will wait for the next connection.
 * RESTRICTION: This program is designed to read 1 packet with a max
 * size of 512 bytes.
 * GUIDELINE: It is generally recommended that a program loop around
 * the RECV command to ensure that all data is read off
 * the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
  src = socket("SOCKET","AF_INET6","STREAM");
  if perror(src,"SOCKET") = 0 then do
    parse var src . l_sockid
    l_name6 = "AF_INET6 54004 0 :0 0";
    src = socket("BIND", l_sockid, l_name6);
    if perror(src,"BIND") = 0 then do
      src = socket("LISTEN", l_sockid);
      if perror(src,"LISTEN") = 0 then do
        l_Done = "FALSE";
        do until l_Done = "TRUE"
          say "Listening on socket "l_sockid;
        src = socket("ACCEPT", l_sockid );
        if perror(src,"ACCEPT") = 0 then do
          parse var src . l_newsockid . ;
          src = socket("RECV",l_newsockid,512);
          parse var src l_retcode l_datalen l_data
          if l_data = "DONE" | perror(src,"RECV") \= 0 then
            l_Done = "TRUE";
          src = socket("CLOSE",l_newsockid);
          src = perror(src,"Accepted socket close";
```
BIND

Use the BIND command to bind a local NAME string to a socket descriptor.

The format of the NAME string depends on the addressing family of the socket. An application can use the BIND command to specify the network interface from which the socket can receive TCP connection requests or UDP packets. A socket bound to a specific local-IP address receives only packets that are targeted to that address. Outgoing packets have as their source address the address that is used to bind the socket. The BIND command supports both stream or datagram sockets, and it can be issued by both clients or servers.

Guidelines:

- Do not bind a socket to a specific interface address. Binding a socket to a specific interface address limits network access to the application and might result in unexpected outages. To enable TCP connections to be accepted and UDP datagrams to be received over any interface, specify INADDR_ANY or IN6ADDR_ANY in the ipaddress field of the NAME parameter.
- A server (an application that calls the LISTEN command) should always bind to the same well-known port. When the socket is bound and the LISTEN command is issued, the bound socket is marked as being passive. Passive sockets cannot be used to send or receive data. They are used to receive new connection requests from remote clients using the ACCEPT command.
- The 48 EADDRINUSE error message indicates that a previous application is using the port. This error also can be received when a listening server is restarted. The TCP/IP stack maintains state information from the previous instance of the server for a fixed time before it releases a port and address for reuse. To avoid this situation, use the SETSOCKOPT command to set the SO_REUSEADDR socket option on the listening socket.

Format

```bash
SOCKET("BIND", socketid, name)
```
Parameters

socketid
   The socket descriptor.

name
   The socket address to which the socket is to be bound.
   The format for the name parameter depends on the socket type:

   AF_INET sockets (IPv4)
   name = "domain portid ipaddress"

   AF_INET6 sockets (IPv6)
   name = "domain portid flowinfo ipaddress scopeid"

where:

- The domain value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The portid value is 0 or the local port to which the socket will bind. When the portid field is set to 0, the stack selects the local port.
- The ipaddress value is the IP address to which the socket binds and the source address of outgoing packets. Other valid values are INADDR_ANY, IN6ADDR_ANY, INADDR_BROADCAST, BROADCAST, and LOOPBACK. When the ipaddress field is set to INADDR_ANY or IN6ADDR_ANY, the stack passes to the application any TCP connection requests or UDP datagrams that are received for the socket on any local interface. For outgoing packets, the stack selects the source address.

Tip: System administrators can override the INADDR_ANY or IN6ADDR_ANY value by specifying the BIND option on the PORT reservation statement in the TCPIP.PROFILE file. This is equivalent to coding the IP address on the name parameter. For more information, see z/OS Communication Server: IP Configuration Reference.

- The flowinfo value must be 0.
- The scopeid value identifies the interfaces that are applicable for the scope of the address that is specified in the ipaddress field. For a link-local IP address, the scopeid field can specify a link index, which identifies a set of interfaces. For all other scopes, the scopeid field must be set to 0. Setting the scopeid field to 0 indicates that any address type and scope can be specified.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 22 EINVAL
- 47 EAFNOSUPPORT
- 48 EADDRINUSE
The following REXX socket API error numbers can be returned:
- 49 EADDRNOTAVAIL
- 2001 EINVALDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
int bind(int socket, struct sockaddr *address, int *address_len);
```

**Returned value**

See the "ACCEPT" on page 668 command for an example of using the BIND command.

**CLOSE**

Use the CLOSE command to close a socket and release the resources that are associated with the socket descriptor.

If the socket descriptor is a connected stream socket, the connection to the remote host is also closed. If a connected stream socket is closed but has input data still pending on the socket, the CLOSE command causes the connection to be reset.

**Format**

```c
$--SOCKET--("CLOSE", socketid)--
```

**Parameters**

socketid

The socket descriptor

**Returned value**

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 9 EBADF

The following REXX socket API error numbers can be returned:
- 2001 EINVALDRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
int close(int socket);
```
Code example

/* REXX EZARXR02 */
/*
 * This sample demonstrates the use of the CLOSE socket commands.
 * The program will open a STREAM socket, and if successful,
 * the socket will be closed.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
 src = socket("SOCKET","AF_INET6","STREAM");
 if perror(src,"SOCKET") = 0 then do
 parse var src l_retcode l_sockid
 src = perror(socket("CLOSE",l_sockid),"CLOSE");
 end; /* SOCKET */
end; /* INITIALIZE */
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1),1) = 0 then return 0; else
 Say arg(2) "Error : "arg(1);
 return -1;

CONNECT

A client application uses the CONNECT command to establish a connection
between a local socket and a remote socket.

The command supports both blocking and nonblocking sockets. When the socket is
in blocking mode, the function does not return until a connection with the remote
peer is established or until an error is received. When the socket is in nonblocking
mode, the function returns immediately with either the 36 EINPROGRESS return
code or an error.

The CONNECT command performs differently depending on the socket type:

Stream (TCP) sockets
If the application has not already issued an explicit bind, the CONNECT
command completes the bind of the socket. The API then attempts to
establish a connection to the remote socket that is specified by the name
parameter. You can call the CONNECT command only once. Issuing
additional CONNECT commands results in a 56 EISCONN error.

Datagram (UDP) sockets
The CONNECT command enables an application to associate a socket with
the socket name of a peer. The socket then is considered to be a connected
UDP socket. You can call the CONNECT command multiple times with
different peer names to change the socket association.

Rules:
- Using the CONNECT command on a UDP socket does not change the
  UDP protocol from a connectionless to a connection-based protocol. The
  UDP socket remains connectionless. The primary benefit of using
  connected UDP sockets is to limit communication with a single remote
  application.
- When a UDP socket becomes a connected UDP socket, it can no longer
  use the SENDTO and RECVFROM commands. Connected UDP sockets
  use the socket commands READ, WRITE, SEND, or RECV to
  communicate with the remote peer, instead of using the SENTO and
  RECVFROM commands.
Tips:

- For nonblocking sockets, use the SELECT command to determine when a connection has been established. Test for the ability to write to the socket.
- A connected UDP socket can revert back to an unconnected UDP socket by calling CONNECT with 0 or AF_UNSPEC specified in the domain field of the name parameter.

Format

```
>>—SOCKET—(—"CONNECT"—,—socketid—,—name—)
```

Parameters

socketid
The descriptor of the local socket.

name
Identifies the remote socket.

The format for the name parameter depends on the socket type:

- **AF_INET sockets (IPv4)**
  
  ```
  name = "domain portid ipaddress"
  ```

- **AF_INET6 sockets (IPv6)**
  
  ```
  name = "domain portid flowinfo ipaddress scopeid"
  ```

where

- The domain value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The portid value is the port number.
- The ipaddress value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
- The flowinfo value must be 0.
- The scopeid value identifies the interfaces that are applicable for the scope of the address that is specified in the ipaddress field. For a link-local IP address, the scopeid field can specify a link index, which identifies a set of interfaces. For all other scopes, the scopeid field must be set to 0. Setting the scopeid field to 0 indicates that any address type and scope can be specified.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

Tip: When a connection attempt is made with a nonblocking socket, the string 36 EINPROGRESS is returned to the application. The program should check for this condition when using nonblocking sockets.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
The following REXX socket API error numbers can be returned:

- 9 EBADF
- 35 EWOULDBLOCK
- 36 EINPROGRESS
- 37 EALREADY
- 47 EAFNOSUPPORT
- 49 EADDRNOTAVAIL
- 51 ENETUNREACH
- 56 EISCONN
- 60 ETIMEDOUT
- 61 ECONNREFUSED

LE C/C++ equivalent

```c
int connect(int socket, struct sockaddr *address, int address_len);
```

**Code example**

```c
/* REXX EZARXR03 */
/*
 * This sample demonstrates the use of the INITIALIZE, SOCKET,
 * CONNECT, GETSOCKNAME, SEND, RECV, CLOSE and TERMINATE
 * socket commands.
 * The program will INITIALIZE a socket set and create a STREAM
 * socket. If successful an attempt will be made to connect to
 * port 7 using the loopback address and 7 bytes of data will be
 * sent. The program will then wait for the data to be echoed
 * back.
 * Port 7 is the well known port for the ECHO server. The ECHO
 * Server for the z/OS Communication Server is the MICSERV. For
 * Information on setting up the MICSERV see the IP Configuration
 * Reference.
 * The example EZARXR01 can be modified to echo data back by adding
 * a SEND command after the RECV command. This is left as an exercise.
 * GUIDELINE: It is generally recommended that a program loop around
 * the RECV command to ensure that all data is read off
 * the socket.
*/
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
  src = socket("SOCKET","AF_INET","STREAM");
  if perror(src,"SOCKET") = 0 then do
    l_socketid = WORD(src,2);
    l_RMTname = "AF_INET 7 127.0.0.1";
    src = socket("CONNECT",l_socketid,l_RMTname);
    if perror(src,"CONNECT") = 0 then do
      src = socket("GETSOCKNAME",l_socketid);
      if perror(src,"GETSOCKNAME") = 0 then do
        l_LOCname = SUBWORD(src,2);
        Say "The local socket name is: "l_LOCname;
        src = socket("SEND",l_socketid,"******");
        if perror(src,"SEND") = 0 then do
          src = socket("RECV",l_socketid);
          if perror(src,"RECV") = 0 then do
            Say "Echoed data: " word(src,3);
```
FCNTL

Use the FCNTL command to control the operating characteristics of a socket.

Format

```
SOCKET(−"FCNTL",−socketid,−fcmd[−,−fvalue])
```

Parameters

- **socketid**
  - The socket descriptor.

- **fcmd**
  - The command to be run. The following commands are available:
    - **F_SETFL**
      - Sets the status flags for the socket
    - **F_GETFL**
      - Retrieves the status flags of the socket

- **fvalue**
  - One of the following flags:
    - **BLOCKING**
      - Puts a socket into blocking mode. If the targeted socket is in nonblocking mode and there is no data on the socket, issuing this command causes socket commands that support nonblocking socket descriptors to return the 35 EWOULDBLOCK error message. By default, the fvalue parameter is set to BLOCKING.
    - **NON-BLOCKING**
      - Puts a socket into nonblocking mode. The value FNDELAY is also accepted.

Returned value

The command returns a string that contains the return code. If the F_GETFL flag is issued, the string also contains the flag. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.
The string 0 BLOCKING is an example of what this command might return.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EPERM
- 9 EBADF
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
int fcntl(int socket, int cmd, ...);
```

**Code example**

```c
/* REXX EXARXR04 */
/*
 * This sample demonstrates the use of the FCNTL
 * socket command.
 * The program will open a STREAM socket and use the
 * FCNTL command to set the socket to NON-BLOCKING
 * mode.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
    src = socket("SOCKET","AF_INET","STREAM");
    if perror(src,"SOCKET") = 0 then do
        l_socketid = WORD(src,2);
        src = socket("FCNTL",l_socketid,F_SETFL,"NON-BLOCKING");
        src = socket("FCNTL",l_socketid,F_GETFL);
        Say src;
    end; /* SOCKET */
    src = socket("CLOSE",l_socketid);
    src = perror(src,"CLOSE");
end;
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;
/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

**GETADDRINFO**

Use the GETADDRINFO command to resolve host or service name information.

This command translates the name of a service location (host name) or a service name. The command returns a set of NAME strings and associated information; this information can be used to create a socket with which to address the specified service or to send a datagram to the specified service. For information about the format of the NAME string, see "How structures are represented" on page 663.
Guideline: Use the application to cycle through each NAME string until a successful connection is established. An example is provided in "Code example" on page 684.

Tip: You can use a resolver trace to determine why a resolver command failed. See z/OS Communications Server: IP Diagnosis Guide.

Format

Socket(“GETADDRINFO”, node_service)

flags, family, socktype, protocol

Parameters

node_service
This variable takes one of the following formats:

node, service

where:

node
The host name or IP address. If the value of the node parameter is an IP address, you also must issue the AI_NUMERICHOST flag. The value of the node parameter can be up to 255 bytes in length.

Scope information can be appended to the host name, using the following format:

"node%scope information"

For example, you could set the node parameter to "Mynode%23". For more information, see z/OS Communication Server: IPv6 Network and Application Design Guide.

service
The TCP/IP service that is queried. If the value of the service parameter is a port number, you must specify the AI_NUMERICSERV flag. The value of the service parameter can be up to 32 bytes in length

flags
To specify multiple flags, code the flags parameter as a space-delimited string. The following flags are supported:

AI_PASSIVE
Specifies how to fill the returned socket NAME string. If this flag is set, the returned NAME string can be used with the BIND command to bind a socket for accepting new connection requests.

Rules:

• If the AI_PASSIVE flag is specified and the node parameter is not specified, the IP address portion of the NAME string is...
set to either the IPv4 address (INADDR_ANY) or to the IPv6 unspecified address (in6addr_any).

- If the AI_PASSIVE flag is not specified, then the returned NAME string can be used with the CONNECT or the SENDTO commands.
- If the AI_PASSIVE flag is not specified and the node parameter is not specified, the IP address portion of the NAME string is set to the default loopback address: 127.0.0.1 (IPv4) or ::1 (IPv6).

If you issue the following command:
```
src = socket("GETADDRINFO",,54123,"AI_PASSIVE","AF_UNSPEC")
```
Then the following string is returned:
```
0 ' ' AF_INET6 54123 0 ::0 0 AF_INET 54123 0.0.0.0
```
See example 2 in "Code example" on page 684 for one method of how to use this flag.

**AI_CANONNAMEOK**

Specifies that the canonical name that corresponds to the node parameter is returned. The node parameter must also be issued.

If you issue the following command:
```
src = socket("GETADDRINFO","chile",21,"AI_CANONNAMEOK")
```
Then the following string is returned:
```
0 host.department.com AF_INET 21 10.11.103.1
```
Tip: See "Code example" on page 684 for examples of how to use this flag.

**AI_NUMERICHOST**

If this flag is specified, the node parameter must be specified as an IP address, for example, 10.11.103.1. Otherwise, the command fails with a 1 EAI_NONAME return code.

If you issue the following command:
```
src = socket("GETADDRINFO","10.11.103.1","AI_NUMERICHOST")
```
Then the following string is returned:
```
0 ' ' AF_INET 10.11.103.1
```

**AI_NUMERICSERV**

If you specify this flag, then you must specify the service parameter as a port number, for example, 1821. Otherwise, the command fails with a 1 EAI_NONAME return code.

If you issue the following command:
```
src = socket("GETADDRINFO",,1821,"AI_NUMERICSERV")
```
Then the following string is returned:
```
0 ' ' AF_INET 10.11.103.1
```

**AI_V4MAPPED**

If you specify this flag and the family is AF_INET6 or AF_UNSPEC, the caller accepts IPv4-mapped IPv6 addresses.
Rules:

- When the AI_ALL flag is not specified and no IPv6 addresses are found, then a query is made for IPv4 addresses. Any IPv4 addresses that are found are returned as IPv4-mapped IPv6 addresses.
- If the value of the family parameter is not AF_INET6 or AF_UNSPEC, and if IPv6 is not supported on the system, then this flag is ignored.

If you issue the following command:

```bash
src = socket("GETADDRINFO","CHILE",,"AI_V4MAPPED AI_CANONNAMEOK");
```

Then the following string is returned:

```bash
0 host.department.com AF_INET6 0 0 ::FFFF:10.11.103.1 0
```

**AI_ALL**

If you specify this flag, then the NAME strings that are returned depend on the value of the family parameter.

Rules:

- If this flag is specified and the value of the family parameter is AF_INET6, then the AI_V4MAPPED flag must also be set to indicate that both IPv4-mapped IPv6 addresses and IPv6-mapped IP addresses are acceptable.
- If value of the family parameter is AF_UNSPEC and the system supports IPv6, then two queries are made. The first query is for IPv6 addresses; if any are found, they are returned. The second query is for IPv4 addresses. If the AI_V4MAPPED flag is not specified, the IPv4 addresses are returned as IPv4 addresses. If the AI_V4MAPPED flag is specified, the IPv4 addresses are returned as IPv4-mapped IPv6 addresses.
- If the value of the family parameter is not AF_INET6 or AF_UNSPEC, and if the system supports IPv6, then this flag is ignored.

If you issue the following command:

```bash
src = socket("GETADDRINFO","CHILE",, "AI_ALL AI_V4MAPPED AI_CANONNAMEOK",, "AF_UNSPEC");
```

The following string is returned (all on one line):

```bash
0 CHILE.department.com AF_INET6 0 0 ::FFFF:10.11.103.1 0
AF_INET6 0 0 2001:10:11:103::1 0
```

**AI_ADDRCONFIG**

If you specify this flag, then the node is queried if the resolver determines that one of the following conditions is true:

- The system is IPv6 enabled and has at least one IPv6 interface. In this case, the resolver makes a query for AAAA DNS records (IPv6).
- The system is IPv4 enabled and has at least one IPv4 interface. In this case, the resolver makes a query for A DNS records (IPv4).

The loopback address is not a valid interface for this flag.
family
Limits the returned information to a specific address family. The following families are supported:

AF_UNSPEC
Any protocol family. The value 0 is accepted also.

AF_INET
IPv4 families. The value 2 is accepted also.

AF_INET6
IPv6 families. The value 19 is accepted also.

socktype
Limits the returned information to a specific socket type. If no socket type is specified, the command returns address information for all types. The following socket types are supported:

<table>
<thead>
<tr>
<th>Type name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCK_STREAM</td>
<td>1</td>
<td>Stream socket</td>
</tr>
<tr>
<td>SOCK_DGRAM</td>
<td>2</td>
<td>Datagram socket</td>
</tr>
<tr>
<td>SOCK_RAW</td>
<td>3</td>
<td>Raw-protocol interface</td>
</tr>
</tbody>
</table>

Consider the following points:

• If the value of the socktype parameter is set to any value other than SOCK_STREAM, SOCK_DGRAM, or SOCK_RAW, the GETADDRINFO command fails with a 9 EAI_SOCKTYPE return code.
• If the value of the socktype parameter is SOCK_RAW, the value of the service parameter must be numeric.
• If the value of the socktype parameter is set to SOCK_STREAM or SOCK_DGRAM, then the resolver searches the services file for a service name.

If the socktype and protocol parameters are both specified as 0, then the GETADDRINFO command is processed in the following way:

• If the value of the service parameter is null or numeric, then any returned address information has the default socktype value of SOCK_STREAM.
• If the value of the service parameter is a service name, for example, FTP, then the GETADDRINFO command searches the appropriate services file twice. The first search uses SOCK_STREAM as the protocol, and the second search uses SOCK_DGRAM as the protocol. There is no default socket-type provision in this case.

If both the socktype and protocol parameters are specified as nonzero values, then the values must be compatible, regardless of the value specified by the service parameter. In this case, compatible means one of the following combinations of parameters:

• The socktype parameter is SOCK_STREAM and the protocol parameter is IPPROTO_TCP.
• The socktype parameter is SOCK_DGRAM and the protocol parameter is IPPROTO_UDP.
• The socktype parameter is SOCK_RAW, in which case the protocol parameter can have any value.
**protocol**

Limits the returned information to a specific protocol. The value 0 indicates that the caller accepts any protocol. The following protocols are supported:

<table>
<thead>
<tr>
<th>Protocol name</th>
<th>Decimal value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPPROTO_TCP</td>
<td>6</td>
<td>TCP</td>
</tr>
<tr>
<td>IPPROTO_UDP</td>
<td>16</td>
<td>UDP</td>
</tr>
</tbody>
</table>

Consider the following points:

- If the `socktype` parameter is 0 and the `protocol` parameter is not 0, the only acceptable input values for the `protocol` parameter are IPPROTO_TCP and IPPROTO_UDP. If any other values are issued for the `protocol` parameter, the GETADDRINFO command fails with a 7 EAI_BADFLAGS return code.
- If the `protocol` and `socktype` parameters are both specified as 0, then the GETADDRINFO command is processed in the following way:
  - If the `service` parameter value is null or numeric, then any returned address information assumes that the socket type is SOCK_STREAM.
  - If the `service` parameter is specified as a service name, for example, FTP, then the GETADDRINFO command searches the applicable services file twice. The first search uses the protocol SOCK_STREAM, and the second search uses the protocol SOCK_DGRAM. There is no default socket type provision in this case.
- If both the `protocol` and `socktype` parameters are specified as nonzero values, the values must be compatible, regardless of the value that is specified by the `service` parameter. In this context, compatible means one of the following combinations of parameters:
  - The `socktype` parameter is SOCK_STREAM and the `protocol` parameter is IPPROTO_TCP.
  - The `socktype` parameter is SOCK_DGRAM and the `protocol` parameter is IPPROTO_UDP.
  - The `socktype` parameter is SOCK_RAW, in which case the `protocol` parameter can have any value.
- If the lookup for the value specified by the `service` parameter fails (for example, the `service` name does not appear in the applicable services file), then the GETADDRINFO command fails with the 8 EAI_SERVICE return code.

**Returned value**

The command returns a string that contains the return code, canonical name, and a NAME string or list of NAME strings. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the GETADDRINFO command:

```
0 RALEIGH.IBM.COM name1 name2 name3
```

In the example, 0 is the return code, RALEIGH.IBM.COM is the canonical name, and name1 name2 name3 is a list of NAME strings. Depending on the flags that were issued, these names can be IPv4 or IPv6 values.
Tip: For a description of the format of a socket name, see "CONNECT" on page 674 or "BIND" on page 671.

See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 1 EAI_NONAME
- 2 EAI_AGAIN
- 5 EAI_FAIMLY
- 6 EAI_MEMORY
- 7 EAI_BADFLAGS
- 8 EAI_SERVICE
- 9 EAI_SOCKTYPE
- 9 EBADF
- 35 EWOULDBLOCK

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2006 ESOCKETNOTALLOCATED

**LE C/C++ equivalent**

```c
int getaddrinfo(const char *nodename, const char *servname,  
                 const struct addrinfo *hints, struct addrinfo **res);
```

**Code example**

```c
/* REXX EZARXR05 */
/*
 * This sample demonstrates a use of the GETADDRINFO command.
 * It is possible that the GETADDRINFO command will return
 * more then one name address. The program shows one
 * technique that can be used to parse the information
 * returned. After a successful connection has been established
 * the program will sends data to a server listenyenig on port
 * 54777. The program then waits for a reply.
 *
 * HINT: The program code provided under the IOCTL command can
 * be used as a server for this sample.
 *
 * GUIDELINE: It is generally recommended that a program loop around
 * the RECV command to ensure that all data is read off
 * the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
  src = socket("SOCKET","AF_INET6","SOCK_STREAM");
  if perror(src,"SOCKET") \
    = 0 then signal ENDPROGRAM
parse var src l_retcode l_sockid
/**************************************************************************/
* Issue GETADDRINFO command. Request that all IPv6 address
* information be returned, and if possible provide the
* canon name. IPv4 addresses are to be mapped to
* IPv6 mapped addresses. Names will be returned as AF_INET6
* NAMES.
**************************************************************************/
src = socket("GETADDRINFO","MVS150",54777,,
            "AI_ALL AI_CANONNAMEOK AI_NUMERICSERV",
if perror(src,"GETADDRINFO") = 0 then do
  parse var src l_retcode l_canonname l_names
  l_LOCName = "AF_INET6 0 0 INADDR_ANY 0"
  src = socket("BIND", l_sockid, l_LOCname);
  if perror(src,"BIND") ≠ 0 then Signal ENDPGRAM

  /* It is possible that GETADDRINFO returned multiple
     names structures. Cycle through them until a
     successful connection is achieved or none are left. */
  l_done = "FALSE"
  l_connectOK = "FALSE"
  do while l_names ≠ "" | l_done = "FALSE"
    if word(l_names,1) ≠ "AF_INET6" then do
      parse var l_names l_port l_flow l_addr l_scope
      l_RMTname = "AF_INET6 "l_port" "l_flow" "l_addr,
    end; /* AF_INET6 */
    else do
      parse var l_names l_port l_addr
      l_RMTname = "AF_INET "l_port" "l_addr;
    end; /* AF_INET */
    Say "Attempting connection using RMT NAME: ",
    l_RMTname;
    src = socket("CONNECT",l_sockid,l_RMTname);
    if perror(src,"CONNECT") = 0 then do
      Say "...Connected"
      l_connectOK = "TRUE"
      l_done = "TRUE"
    end; /* CONNECT */
    else l_done = "TRUE"
  end; /* DO LOOP */
  if l_connectOK = "TRUE" then do
    l_data = time() "**** **** **** **** ";
    src = socket("GETSOCKNAME",l_sockid);
    Say "GETSOCKNAME: "src;
    src = socket("SEND",l_sockid,l_data);
    if perror(src,"SEND") = 0 then do
      src = socket("RECV",l_sockid);
      if perror(src,"RECV") ≠ 0 then do
        parse var src l_amtdata l_data
        Say "Received " l_amtdata " bytes from ",
        l_addr " on " port " l_port"
        Say "The received data is: ",l_data;
      end; /* RECV */
      end; /* SEND */
      end; /* CONNECT OK */
    else do /* CONNECT not OK */
      Say "No Connection to remote host could be",
      "established";
  end;
  end; /* GETADDRINFO */
end; /* INITIALIZE */

ENDPROGRAM:
s=socket("CLOSE",l_sockid);
s=error(s,"CLOSE")
s=socket("TERMINATE","MYSET01")
s=error(s,"TERMINATE")
exit 0;
/ This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error: "arg(1);
    return -1;
/* REXX EZARXR32 */
/* This example shows how to use the GETADDRINFO command */
/* to obtain a list of NAME constructs suitable for */
/* use with the BIND command using the well-known port 54123. */
/* The addr fields of the NAME constructs returned will be */
/* set to */
/* This example also shows how to use the SELECT command to */
/* monitor listening sockets for new connections. */
/* In the case of 2 name constructs being returned the */
/* first successful bind will be used. */
/* HINT: To limit the NAME structures to a specific */
/* Address family change AF_UNSPEC to either */
/* AF_INET or AF_INET6 */
/* HINT: Coding a hostname for the node parame" will result */
/* in the ipaddress fields of the NAME constructs to */
/* have a specific interface address assigned. */
*/

l_selectlist = '';
src = socket("GETADDRINFO","AI_PASSIVE","AI_CANONNAMEOK","AF_UNSPEC");
parse var src l_retcode l_canname l_names
l_bindok = "FALSE";
Say "Canonname returned is: "l_canname;
do while l_names \= ''
    select
        when word(l_names,1) = "AF_INET" then do
            l_SockName = word(l_names,1) word(l_names,2),
            word(l_names,3)
            l_names = subword(l_names,4);
        end;
        when word(l_names,1) = "AF_INET6" then do
            l_SockName = word(l_names,1) word(l_names,2),
            word(l_names,3) word(l_names,4),
            word(l_names,5);
            l_names = subword(l_names,6);
        end;
        otherwise
            l_sockname = "unknown";
        end;
src=socket("SOCKET",word(l_sockname,1),"STREAM");
if word(src,1) = 0 then do
    l_socket = word(src,2);
    src = socket("BIND",l_socket,l_sockname);
    if word(src,1) = 0 then do
        src = socket("LISTEN",l_socket);
        if word(src,1) = 0 then do
            Say "Listening on socket: "l_sockname;
            l_selectlist = l_selectlist""l_socket;
            l_bindOK = "TRUE";
        end;
    end;
end;
end;
if l_selectlist \= 0 then do
    Say "The following sockets will be monitored" l_selectlist;
l_fdset = "READ "l_selectlist" WRITE EXCEPTION";
src = socket("SELECT",l_fdset,0);
if word(src,1) = 0 & word(src,2) \= 0 then do
    l_socklist = subword(src,3);
do while l_socklist \= '"
        parse var l_socklist l_sockid l_socklist
        src = socket("ACCEPT",l_sockid);
        if word(src,1) = 0 then do
            l_newsock = word(src,2);
            /* DO SOME STUFF WITH l_newsock */
            src = socket("CLOSE",l_newsock);
        end;
    end;
src = socket("CLOSE",word(l_selectlist,1));
src = socket("CLOSE",word(l_selectlist,2));
end;
src = socket("TERMINATE","MYSET01");
exit word(src,1);

GETCLIENTID
Use the GETCLIENTID command to retrieve the client ID for the calling application. The client ID is the identifier by which the calling application is known to the TCP/IP address space.

Tip: The client ID that is returned by the GETCLIENTID command can be used with the GIVESOCKET and TAKESOCKET commands.

Format

```
| SOCKET | (|"GETCLIENTID"|) | domain |
```

Parameters

`domain`
The domain. This parameter is optional for IPv4, but it is required for IPv6. If this parameter is not specified, by default, the `domain` parameter is set to `AF_INET`. The following domain values are supported:

- `AF_UNSPEC` or `0`
- `AF_INET` or `2`
- `AF_INET6` or `19`

Returned value
The command returns a string that contains the return code and the application identifier. The return code can be `0` or the REXX API error number. The return code `0` indicates that the requested socket command was completed successfully.

The application identifier has the following format:

```
clientid = domain userid socketset
```

The following examples show what is returned for the specific address families:
IPv4 0 AF_INET IBMUSER SOCSET01
IPv6 0 AF_INET6 IBMUSER SOCSET01

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:
- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2013 EINVALCLIENTID

**LE C/C++ equivalent**

```c
int getclientid(int domain, struct clientid *clientid);
```

**Code example**

```c
/* REXX EZARXR06 */
/* *
 * This sample demonstrates the use of the GETCLIENTID
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") \= 0 then signal ENDPROGRAM;
src = socket("GETCLIENTID");
Say src;
ENDPROGRAM:
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word of arg 1 is not zero */
perror: if word(arg(1),1) \= 0 then return 0; else
   Say arg(2) "Error : "arg(1);
   return -1;
```

**GETDOMAINNAME**

Use the GETDOMAINNAME command to retrieve the name of the domain to which the current TCP/IP stack belongs.

**Tip:** You can use a resolver trace to determine why a resolver command failed. See z/OS Communications Server: IP Diagnosis Guide.

**Format**

```
---SOCKET---("GETDOMAINNAME")---
```

**Parameters**

This command has no parameters.

**Returned value**

The command returns a string that contains the return code and the domain, for example, 0 RALEIGH.IBM.COM.
See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

```rexx
/* REXX EZARXR07 */
/*
 * This sample demonstrates the use of the GETDOMAINNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src, "INITIALIZE") = 0 then do
    Say socket("GETDOMAINNAME");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src, "TERMINATE");
exit 0;

/* This routine returns -1 if the first word of arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```

**GETHOSTBYADDR**

Use the GETHOSTBYADDR command to resolve an IPv4 address to a host name.

This command uses a domain name system (DNS) server. If the IP address is not resolved by the DNS server, then the resolver searches the local hosts tables. For information about the local host tables, see z/OS Communications Server: IP Configuration Guide.

**Restriction:** This command does not support IPv6 addresses.

**Tips:**

- Use either the GETADDRINFO or GETNAMEINFO command to resolve a IPv6 address to a host name.
- You can use a resolver trace to determine why a resolver command failed. See z/OS Communications Server: IP Diagnosis Guide.

**Format**

```rexx
SOCKET(―"GETHOSTBYADDR"―,―ipaddress―[,―domain―])
```

**Parameters**

- `ipaddress`
    - The IP address of the remote host.
The network domain to which the IP address belongs. The only supported domain is AF_INET or 2.

**Returned value**

This command returns a string that contains the return code and the host name, for example, 0 ABCD.RALEIGH.IBM.COM. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2017 EIPADDRNOTFOUND

**LE C/C++ equivalent**

```c
struct hostent *gethostbyaddr(char *address, int address_len, int domain);
```

**Code example**

```rexx
/* REXX EZARXR08 */
/*
 * This sample demonstrates the use of the GETHOSTBYADDR
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
  Say socket("GETHOSTBYADDR","128.123.222.1");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;
```

**GETHOSTBYNAME**

Use the GETHOSTBYNAME command to resolve a host name to an IPv4 address.

This command uses a DNS server. Any trailing blanks are removed from the host name. If the host is multi-homed, then this command returns a list of the space-delimited IP addresses that are associated with the host name. If the host name is not resolved by the DNS server, then the resolver searches the local hosts tables. For information about the local host tables, see [z/OS Communications Server: IP Configuration Guide](#).

**Restriction:** This command does not support IPv6 addresses.

**Tips:**
Use either the GETADDRINFO or GETNAMEINFO command to resolve a IPv6 address to a host name.
You can use a resolver trace to determine why a resolver command failed. See z/OS Communications Server: IP Diagnosis Guide.

Format

```plaintext
++-SOCKET-("GETHOSTBYNAME", hostname)
```

Parameters

`hostname`

The name of the remote host. The parameter cannot be longer than 255 characters.

`Fully qualified hostname`

The fully qualified name of the host in the format `hostname.domainname`. The parameter cannot be longer than 255 characters.

Returned value

This command returns string that contains the return code and one or more space-delimited IPv4 addresses, for example, 0 1.2.3.4 5.4.3.2 1.2.3.5. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2016 EHOSTNOTFOUND
- 2019 ENORECOVERY

LE C/C++ equivalent

```c
struct hostent *gethostbyname(char *name);
```

Code example

```rexx
/* REXX EZARXR09 */
/*
 * This sample demonstrates the use of the GETHOSTBYNAME
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
    Say socket("GETHOSTBYNAME", "MYCOMPANY");
    Say socket("GETHOSTBYNAME", "MYCOMPANY.somewhere.com");
end;

src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;
```
/* This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error: "arg(1);
    return -1;

GETHOSTID

Use the GETHOSTID command to return the primary IPv4 address for the current host. The primary address is the IP address of the default home address that is specified in the TCP/IP configuration file for the stack with which the current socket set is associated.

Restriction:  This command does not support IPv6 addresses.

Format

>>—SOCKET—(—"GETHOSTID"—)>

Parameters

This command has no parameters.

Returned value

This command returns a string that contains the return code and the primary IPv4 address of the host, for example, "0 10.11.103.1". The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

• 2001 EINVALIDRXSOCKETCALL
• 2005 ESUBTASKNOTACTIVE
• 2016 EHOSTNOTFOUND
• 2019 ENORECOVERY

LE C/C++ equivalent

int gethostid();

Code example

/* REXX EZARXR10 */
/*
 * This sample demonstrates the use of the GETHOSTID
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
    say socket("GETHOSTID");
end;
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
ext = exit 0;
This routine returns -1 if the first word if arg 1 is not zero */

perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;

GETHOSTNAME

Use the GETHOSTNAME command to return the name of the host on which the application is running.

Format

```
>>-socket—(—"gethostname" —)
```

Parameters

This command has no parameters.

Returned value

This command returns a string that contains the return code and the name of the host system, for example, 0 MYHOST01. If the host name is longer than 256 bytes, it is truncated. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

- 2018 ETRYAGAIN

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```
rc = int gethostname(char *name, size_t namelen);
```

Code example

```
/* REXX EZARXR11 */
/*
 * This sample demonstrates the use of the GETHOSTNAME
 * socket command.
 */
src = socket("INITIALIZE","MYHOST01");
if perror(src,"INITIALIZE") = 0 then do
    src = socket("GETHOSTNAME");
    Say "Host name is: "WORD(src,2);
end;
src = socket("TERMINATE","MYHOST01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;
```
GETNAMEINFO

Use the GETNAMEINFO command to translate a socket address to a node name and service location.

This command can be used for both IPv4 or IPv6 socket addresses.

**Tip:** You can use a resolver trace to determine why a resolver command failed. See *z/OS Communications Server: IP Diagnosis Guide*.

**Format**

```c
socket(("GETNAMEINFO", name), flags)
```

**Parameters**

`name`

An IPv4 or IPv6 NAME string. If the NAME string is an IPv4-mapped IPv6 address, then the embedded IPv4 address is extracted; then, the lookup is performed on the IPv4 address. If the NAME string is an IPv6 unspecified address, the lookup is not performed and the EAI_NONAME error code is returned.

The format for the `name` parameter depends on the socket type:

**AF_INET sockets (IPv4)**

`name = "domain portid ipaddress"`

**AF_INET6 sockets (IPv6)**

`name = "domain portid flowinfo ipaddress scopeid"`

where

- The `domain` value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
- The `portid` value is the port number.
- The `ipaddress` value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
- The `flowinfo` value must be 0.
- The `scopeid` value identifies the interfaces that are applicable for the scope of the address that is specified in the `ipaddress` field. For a link-local IP address, the `scopeid` field can specify a link index, which identifies a set of interfaces. For all other scopes, the `scopeid` field must be set to 0. Setting the `scopeid` field to 0 indicates that any address type and scope can be specified.

If the `scopeid` field is specified and the destination is not a link-local address, the resolver ignores the `scopeid` field.

`flags`

An optional parameter that specifies the type of information that is returned. Separate multiple flags with spaces. If no flag is issued, the fully qualified host name is returned. The following flags are supported:

**NI_NOFQDN**

Returns the host name of the fully qualified domain name.
NI_NUMERICHOST
Returns only the numeric form of the host address.

NI_NAMEREQD
Returns an error if the host name cannot be found.

NI_NUMERICSERV
Returns the numeric form of the service.

NI_DGRAM
Indicates that the service query is for a datagram socket. If this flag is not issued, the GETNAMEINFO command assumes that the query is for a stream socket.

NI_NUMERICSCOPE
Returns only the numeric form of the scopeid interface index.

Returned value
This command returns a string that contains the return code, the host name, and the service. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

If a link-local IPv6 address is passed as input and the value of the scopeid parameter is not 0, then scope information is appended to the host name, using the format host name%scope information. For more information about scope information and the GETNAMEINFO command, see z/OS Communication Server: IPv6 Network and Application Design Guide.

The following string is an example of what is returned by the GETNAMEINFO command:
0 BOB01.THEWORLD.COM%23 echo

In the example, 0 is the return code, BOB01.THEWORLD.COM is the host name, 23 is the scope ID, and echo denotes the service. The numeric scope information is returned only if the NI_NUMERICSCOPE flag is issued.

For information about the format of the NAME string, see "How structures are represented" on page 663. See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
• 1 EAI_NONAME
• 5 EAI_FAMILY
• 7 EAI_BADFLAGS

The following REXX socket API error numbers can be returned:
• 2001 EINVALDRXSOCKETCALL
• 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent
/* REXX EZARXR13 */
/*
* This sample demonstrates the use of the GETNAMEINFO
* socket command.
/*
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then
  Say socket("GETNAMEINFO", "AF_INET6 21 0 2000:197:11:103::1 0");
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;

Code example

/* REXX EZARXR13 */
/*
 * This sample demonstrates the use of the GETNAMEINFO
 * socket command.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then
  Say socket("GETNAMEINFO", "AF_INET6 21 0 2000:197:11:103::1 0");
src = socket("TERMINATE","MYSET01");
src = perror(src,"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;

GETPEERNAME

Use the GETPEERNAME command to return the name of the remote peer that is
connected to the socket.

Format

**SOCKET(−"GETPEERNAME",−socketid−)**

Parameters

socketid

The socket descriptor

Returned value

This command returns a string that contains the return code and the name of the
remote peer, for example, 0 NAME. The return code can be 0, a REXX socket API
error number, or the REXX TCP/IP error number that is set by the socket
command. The return code 0 indicates that the requested socket command was
completed successfully.

For information about the format of the NAME string, see "How structures are
represented" on page 663. See Appendix B, "Return codes," on page 835 for
additional information about the numeric error codes that are returned by this
command.
Returned value

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALNAME

LE C/C++ equivalent

```c
int getpeername(int socket, struct sockaddr *name, int *namelen);
```

Code example

```c
/* REXX EZARXR14 */

/*
 * This sample demonstrates the use of the GETPEERNAME
 * socket command.
 */
srcc = socket("INITIALIZE","MYSET01");
src = perror(src, "INITIALIZE") = 0 then do
  src = socket("SOCKET","AF_INET","STREAM");
  if perror(src, "SOCKET") = 0 then do
    l_socketid = word(src, 2);
    l_RMTName = "AF_INET 7 127.0.0.1";
    src = socket("CONNECT", l_socketid, l_RMTName);
    if perror(src, "CONNECT") = 0 then do
      src = getpeername(l_socketid, l_RMTName);
      if perror(src, "GETPEERNAME") = 0 then do
        l_PeerName = Subword(src, 2);
        say "The remote peer is: " l_PeerName;
      end;
    end;
  end;
end;
srcc = perror(socket("CLOSE", l_socketid), "CLOSE");
end;
srcc = perror(socket("TERMINATE", "MYSET01"), "TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1), 1) = 0 then return 0; else
  Say arg(2) "Error : " arg(1);
  return -1;
```

GETPROTOBYNAME

Use the GETPROTOBYNAME command to translate a network protocol name to a protocol number.

**Format**

```c
SOCKET("GETPROTOBYNAME", protocolname)
```
Parameters

protocolname

The name of the network protocol

Returned value

This command returns a string that contains the return code and the protocol number, for example, 0 6. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

struct protoent *getprotobyname(char name);

Code example

/* REXX EZARXR15 */
/* */
/* This sample demonstrates the use of the GETPROTOBYNAME */
/* socket command. */
if perror(socket("INITIALIZE","MYSET01","INITIALIZE") = 0,
    then do
    src = socket("GETPROTOBYNAME","TCP");
    Say "The TCP protocol is assigned the number of",
    WORD(src,2);
    end;
src = perror(socket("TERMINATE","MYSET01","TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;

GETPROTOBYNUMBER

Use the GETPROTOBYNUMBER command to translate a network protocol number to a protocol name.

Format

```
//--SOCKET--("GETPROTOBYNUMBER", protocolnumber)
```

Parameters

protocolnumber

The number of the network protocol
Returned value

This command returns a string that contains the return code and the protocol name, for example, 0 TCP. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

struct protoent *getprotobynumber(int proto);

Code example

/* REXX EZARXR16 */
/*
 * This sample demonstrates the use of the GETPROTOBYPNUMBER
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
   src = socket("GETPROTOBYPNUMBER","6");
   Say "The name assigned to protocol 6 is "WORD(src,2);
   end;
   src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
   exit 0;
/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
   Say arg(2) "Error : "arg(1);
   return -1;

GETSERVBYNAME

Use the GETSERVBYNAME command to retrieve a service and port number.

Format

<---SOCKET(--GETSERVBYNAME---,servicename---TCP---protocolname-->)---

Parameters

servicename

The service name.

protocolname

The name of a network protocol, for example, TCP or UDP. By default, the protocolname parameter is set to TCP.
Returned value

This command returns a string containing the return code, service name, the port number that the service is using, and the network protocol, for example, 0 FTP 21 TCP. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

struct servent *getservbyname(char *name, char *proto);

Code example

/* REXX EZARXR17 */
/*
 * This sample demonstrates the use of the GETSERVBYNAME
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01","INITIALIZE") = 0,
then do
    src = socket("GETSERVBYNAME","FTP");
    Say "The FTP service is assigned "SUBWORD(src,2);
end;
src = perror(socket("TERMINATE","MYSET01","TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg l is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
    Say arg(2) "Error : "arg(1);
    return -1;

GETSERVBYPORT

Use the GETSERVBYPORT command to translate a port number to the name of the service that is using the port.

Format

```
$socket {--GETSERVBYPORT --portid [,-protocolname]}$TCP
```

Parameters

portid
The port number of the service

protocolname
The name of a network protocol, for example, TCP or UDP. By default, the protocolname parameter is set to TCP.
Returned value

This command returns a string that contains the return code, service name, the port number that the service is using, and the network protocol, for example, 0 FTP 21 TCP. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

```c
struct servent *getservbyport(int port, char *proto);
```

Code example

```rexx
/* REXX EZARXR18 */
/*
 * This sample demonstrates the use of the GETSERVBYPORT
 * socket command.
 */
if perror(socket("INITIALIZE","MYSET01"),"INITIALIZE") = 0,
   then do
   src = socket("GETSERVBYPORT","21");
   Say "Port 21 is using service "SUBWORD(src,2);
end;
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1),1) = 0 then return 0; else
   Say arg(2) "Error : "arg(1);
   return -1;
```

GETSOCKNAME

Use the GETSOCKNAME command to retrieve the name of a bound socket.

Stream sockets are not assigned a name until after a successful BIND, CONNECT, or ACCEPT command is completed.

Tip: Use this command to discover the port number that is assigned to a socket after the socket has been implicitly bound, for example, after a CONNECT command has been completed.

Format

```rexx
SOCKET—("GETSOCKNAME",—socketid—)
```

Parameters

`socketid`

The socket descriptor
Returned value

This command returns a string that contains the return code and the NAME string of the bound socket, for example, 0 AF_INET 7 0 2001:197:11:103::1 0. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

For information about the format of the NAME string, see "How structures are represented" on page 663. See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALNAME

LE C/C++ equivalent

int getsockname(int socket, struct sockaddr *name, int *namelen);

Code example

/* REXX EZARXR19 */
/*
 * This sample demonstrates the use of the GETSOCKNAME socket command. After the remote peer is obtained
 * send is echoed to the remote server.
 * GUIDELINE: It is generally recommended that a program loop around
 * the RECV command to ensure that all data is read off
 * the socket. This sample does not follow the guideline.
 */
src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") = 0 then do
    src = socket("SOCKET","AF_INET","STREAM");
    if perror(src,"SOCKET") = 0 then do
        l_socketid = WORD(src,2);
        l_RMTname = "AF_INET 7 127.0.0.1";
        src = socket("CONNECT",l_socketid,l_RMTname);
        if perror(src,"CONNECT") = 0 then do
            src = socket("GETSOCKNAME",l_socketid);
            if perror(src,"GETSOCKNAME") = 0 then do
                l_LOCname = SUBWORD(src,2);
                Say "The local socket name is: "l_LOCname;
            end;
            src = socket("SEND",l_socketid,******");
            if perror(src,"SEND") = 0 then do
                src = socket("RECV",l_socketid);
                if perror(src,"RECV") = 0 then
                    Say "Echoed data: " word(src,3);
            end;
    end;
end;
/* This routine returns -1 if the first word if arg 1 is not zero */
pererror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;

GETSOCKOPT

Use the GETSOCKOPT command to retrieve the active socket options that were set
by the SETSOCKOPT command.

You can specify multiple options with this command; however, at least one option
is required.

Format

GETSOCKOPT(″GETSOCKOPT″,socketid,levelname,optname)

Parameters

socketid
  The local socket descriptor.

levelname
  The protocol level. The following protocol levels are supported:
  IPPROTO_TCP
    Retrieve the socket options that are set at the TCP layer
  IPPROTO_IP
    Retrieve the IPv4 socket options that are set at the IP layer
  IPPROTO_IPV6
    Retrieve the IPv6 socket options that are set at the IP layer
  SOL_SOCKET
    Retrieve the socket options that are set at the socket layer

optname
  The option to be retrieved. The options that can be retrieved depend on the
  value of the levelname parameter.

The following rules apply:
  • Options that begin with SO_ require the SOL_SOCKET protocol level.
  • Options that begin with TCP_ require the IPPROTO_TCP protocol level.
  • Options that begin with IP_ require the IPPROTO_IP protocol level.
  • Options that begin with IPV6_ require the IPPROTO_IPV6 protocol level.

The following values are supported for the optname parameter:

IP_MULTICAST_IF
  (IPv4-only) Retrieves the IPv4 interface address that is used to send
  outbound multicast datagrams from the socket application. When you
specify this option, the GETSOCKOPT command returns a string that
contains the return code and interface address, for example, 0
10.11.103.1.

IP_MULTICAST_LOOP
(IPV4-only) Determines what occurs when datagrams are sent to a
group to which the sending host belongs. If this option is enabled, the
IP layer loops back a copy of multicast datagrams for local delivery. By
default, this option is enabled. When you specify this option, the
GETSOCKOPT command returns either 1 (enabled) or 0 (disabled).

IP_MULTICAST_TTL
(IPV4-only) Retrieves the IP time-to-live of outgoing multicast
datagrams. By default, this option is set to the binary value '01',
which means that multicast is available to the local subnet only. When
you specify this option, the GETSOCKOPT command returns a string
that contains the return code and a value in the range 0-255, for
example, 0 227.

IPV6_MULTICAST_HOPS
(IPV6-only) Retrieves the hop limit used for outgoing multicast packets.
When you specify this option, the GETSOCKOPT command returns a
string that contains the return code and the hop limit, which is a
number in the range 0-255.

IPV6_MULTICAST_IF
(IPV6-only) Retrieves the index of the IPv6 interface that is used to
send outbound multicast datagrams from the socket application. When
you specify this option, the GETSOCKOPT command returns a string
that contains the return code and the IPv6 interface index, for example,
0 1523.

IPV6_MULTICAST_LOOP
(IPV6-only) Determines what occurs when datagrams are sent to a
group to which the sending host belongs. If this option is enabled, the
IP layer loops back a copy of multicast datagrams for local delivery. By
default, this option is enabled. When you specify this option, the
GETSOCKOPT command returns either 1 (enabled) or 0 (disabled).

IPV6_UNICAST_HOPS
(IPV6-only) Retrieves the hop limit used for outgoing unicast IPv6
packets. When you specify this option, the GETSOCKOPT command
returns a string that contains the return code and the hop limit, which
is a number in the range 0-255.

IPV6_V6ONLY
(IPV6-only) Determines whether the socket is restricted to sending or
receiving IPv6 packets only. By default, a socket is not restricted. When
you specify this option, the GETSOCKOPT command returns a string
that contains the return code and a number: 1 (enabled) or 0 (disabled).

SO_ASCII
(REXX only) Determines whether all incoming data is translated from
ASCII to EBCDIC, and whether all outgoing data is translated from
EBCDIC to ASCII. This option returns a string that contains the error
code and either ON (enabled) or OFF (disabled). If the option is
enabled, the name of the translation table is returned also. The
following string is an example of what might be returned: 0 ON
MYTRANDB.
The translation tables are searched in the following order:

1. `user_prefix.subtaskid.TCPXLBIN`
2. `user_prefix.userid.TCPXLBIN`
3. `system_prefix.STANDARD.TCPXLBIN`
4. `system_prefix.RXSOCKET.TCPXLBIN`
5. Internal tables

The following descriptions apply:

- The `user_prefix` value is either the user ID or the job name of the REXX program.
- The `system_prefix` value is either TCPIP or the DATASETPREFIX value from the `hlq.TCPIP.DATA`. You can change the `system_prefix` value to match your site convention.
- The `subtaskid` value is the name of the socket set.
- The `userid` value is the user ID under which the REXX EXEC is running.

When the internal tables are used, the data is converted in the following way:

<table>
<thead>
<tr>
<th>ASCII</th>
<th>second hex digit of byte of ASCII data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
| 0     | 00|01|02|03|37|2D|2E|2F|16|05|2B|0C|0D|0E|0F | 1
| 1     | 10|11|12|13|3C|3D|32|31|1B|1A|3F|3E|3D|3C|3B|3A | 2
| 2     | 40|4F|7F|7B|5B|6C|50|7D|4D|5D|5C|4E|6B|60|48|61 | 3
| 3     | FF|F2|F3|F4|F5|F6|F7|F8|F9|7A|5E|4C|7E|6E|6F | 4
| 4     | CF|C1|C2|C3|C4|C5|C6|C7|C8|9D|8D|7C|6C|5C|4C|3C | 5
| 5     | DF|D9|D1|D2|D3|D4|D5|D6|D7|8E|7E|6E|5E|4E|3E|2E | 6
| 6     | 79|81|B2|B3|B4|B5|B6|B7|B8|91|89|79|69|59|49|39 | 7
| 7     | 8B|B9|AA|A3|A4|A5|A6|A7|A8|A9|B0|B1|B2|B3|B4|B5 | 8
| 8     | 93|30|1A|33|34|35|36|38|39|3A|3B|3C|3D|3E|3F | 9
| 9     | 41|42|43|44|45|46|47|48|49|51|52|53|54|55|56 | A
| A     | 58|59|62|63|64|65|66|67|6B|69|70|71|72|73|74 | B
| B     | 76|77|78|80|8A|8B|8C|8D|8E|8F|90|9A|9B|9C|9D | C
| C     | 9F|A0|AA|AB|AC|AD|AE|AF|B0|B1|B2|B3|B4|B5|B6 | D
| D     | BB|B9|BA|BB|BC|BD|BE|BF|CA|CB|CC|CD|CE|CF|DA | E
| E     | DC|DD|DF|EA|EB|EC|ED|EE|EF|FA|FB|FC|FD|FE|FF | F

Figure 140. ASCII to EBCDIC
<table>
<thead>
<tr>
<th>EBCDIC to ASCII</th>
<th>second hex digit of byte of EBCDIC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>90</td>
</tr>
<tr>
<td>A</td>
<td>A0</td>
</tr>
<tr>
<td>B</td>
<td>B0</td>
</tr>
<tr>
<td>C</td>
<td>C0</td>
</tr>
<tr>
<td>D</td>
<td>D0</td>
</tr>
<tr>
<td>E</td>
<td>E0</td>
</tr>
</tbody>
</table>

**Figure 141. EBCDIC to ASCII**

SO_BROADCAST

(REXX only) Determines whether a program can send broadcast messages over the socket to destinations that can receive datagram messages. By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

**Restriction:** This option has no meaning for stream sockets. It is valid only for datagram sockets.

SO_DEBUG

(REXX only) Determines whether debug information is recorded. By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

**Restriction:** This option is valid only for stream sockets.

SO_DONTROUTE

Determines whether normal routing determination is bypassed for outgoing packets on the socket. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).
Restriction: When a packet is sent, if the local interface cannot be
determined from the destination address, the 51
ENETUNREACH error message is returned.

SO_EBCDIC
(REXX only) Determines whether data is translated to and from
EBCDIC. This option is ignored by EBCDIC hosts. When you specify
this option, the GETSOCKOPT command returns a string that contains
the return code and either ON (enabled) or OFF (disabled). If the
option is enabled, the name of the translation table is returned also.

Restriction: This option has no effect on the data that is processed by
the socket library.

SO_ERROR
Retrieves information about pending errors on the socket or other
errors that are not explicitly returned by any socket commands. The
error status is cleared after each call. When you specify this option, the
GETSOCKOPT command returns a string that contains the return code
and the most recent error, for example, 0 36.

SO_KEEPALIVE
Determines if the keep alive mechanism periodically sends a packet on
an otherwise idle connection for a stream socket. When enabled, if the
remote TCP/IP does not respond to the packet or to retransmissions of
the packet, the connection is terminated with the ETIMEDOUT error. By
default, this option is disabled. When you specify this option, the
GETSOCKOPT command returns a string that contains the return code
and a number: 1 (enabled) or 0 (disabled).

Tip: The site administrator can enable the global keep-alive
mechanism by modifying the TCPIP.PROFILE file. To modify the
TCPIP.PROFILE file, use the TCPCONFIG INTERVAL statement.

SO_LINGER
Determines how TCP/IP processes data that has not been transmitted
when the CLOSE command is issued for the socket. When this option
is enabled and the CLOSE command is issued, the calling program is
blocked until either the data is successfully transmitted or the
connection times out. When this option is disabled and the CLOSE
command is issued, the CLOSE command returns without blocking the
caller; then TCP/IP continues to attempt to send data for a specified
time, which usually provides sufficient time to complete the data
transfer. By default, this option is disabled. When you specify this
option, the GETSOCKOPT command returns a string that contains the
return code and either 1 (enabled) or 0 (disabled), for example, 0 1.

Restrictions:
- Using the SO_LINGER option does not guarantee that
  a data transfer will be completed, because TCP/IP
  waits only for the amount of time that is specified by
  SETSOCKOPT command.
- This option is valid only for stream sockets.

SO_OOBINLINE
Determines whether out-of-band data is available to the RECV or
RECVFROM commands. When this option is enabled, out-of-band data
is placed in the normal data input queue as it is received; this data is
then available to RECV or RECVFROM commands, even if the OOB flag is not set. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received; this data is then available to RECV or RECVFROM commands only if the OOB flag is set. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

**Restriction:** This option is valid only for stream sockets.

**SO_RCVBUF**

Retrieves the size of the data portion of the TCP/IP receive buffer. The size of the receive buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size of 65 535.

When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the size of the receive buffer or 0 (disabled).

**SO_REUSEADDR**

Determines whether local addresses are reused. Enabling this option alters the normal algorithm that is used with the BIND command. The normal BIND algorithm permits each Internet address and port combination to be bound only once. If the address and port already have been bound, a subsequent BIND command fails with the 48 EADDRINUSE error message. When this option is enabled, the following situations are supported:

- A server can bind the same port multiple times. Each invocation either must use a different local IP address, or it must use a wildcard address (INADDR_ANY or in6addr_any) only one time for each port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so that multiple BIND commands can be made to the same class D address and port number.

By default, this option is disabled. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

**Tip:** If you want multiple servers that bind to INADDR_ANY or IN6ADDR_ANY to listen on the same port number, use the SHAREPORT option on the PORT statement in TCPIP.PROFILE.

**SO_SNDBUF**

Determines the size of the data portion of the TCP/IP send buffer. The size of the send buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPSNDBufsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
• (UDP socket) The UDPRCVBufsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.

• (Raw socket) The default size of 65 535.

When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the size of the send buffer or 0 (disabled).

SO_TYPE
Retrieves the socket type. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (SOCK_STREAM), 2 (SOCK_DATAGRAM), or 3 (SOCK_RAW).

TCP_KEEPALIVE
Determines whether a socket-specific timeout value (in seconds) is used instead of a configuration-specific value, when keep alive timing is active for the socket. When enabled, the socket-specific timeout value remains in effect until either the socket is closed or it is reset by a SETSOCKOPT command. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the timeout value or 0 (disabled).

Tip: The site administrator can enable the global keep-alive mechanism by modifying the TCPIP.PROFILE file. To modify the TCPIP.PROFILE file, use the TCPCONFIG INTERVAL statement.

TCP_NODELAY
Determines whether the data that is sent over the socket is subject to the Nagle algorithm (RFC 896). When this option is enabled, TCP waits to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP sends data when it is presented. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and a number: 1 (enabled) or 0 (disabled).

TCP_MAXSEG
(IPPROTO_TCP protocol only) Retrieves the maximum segment size for a TCP send. When you specify this option, the GETSOCKOPT command returns a string that contains the return code and either the maximum segment size or 0 (disabled).

Returned value
The command returns a string that contains the return code and the option value. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
• 9 EBADF
• 22 ENOTSOCK
• 38 ENOTSOCK
• 42 ENOPROTOOPT
The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALNAME

**LE C/C++ equivalent**

```c
int getsockopt(int socket, int level, int option_name, char *option_value, int *option_len);
```

**Code example**

```c
/* REXX EZARXR20 */
/*
 * This sample demonstrates the use of the GETSOCKOPT
 * and SETSOCKOPT commands.
 * The program opens a STREAM socket and connects to port 7
 * (echo server) using the loop back address. Before sending
 * data the program issues the SETSOCKOPT command to set the
 * sockets send buffer to 32000 bytes. Data is then sent to
 * and received. After the data is received the GETSOCKOPT
 * GUIDELINE: It is generally recommended that a program loop around
 * the RECV command to ensure that all data is read off
 * the socket. This sample does not follow the guideline.
 * */

src = socket("INITIALIZE","MYSET01");
if perror(src,"INITIALIZE") \= 0 then signal ENDPROGRAM;
src = socket("SOCKET","AF_INET","STREAM");
if perror(src,"SOCKET") = 0 then do
  l_socketid = WORD(src,2);
  src = socket("GETSOCKOPT",l_socketid,"SOL_SOCKET",,
              "SO_SNDBUF");
  if perror(src,"GETSOCKOPT") = 0 then do
    Say "Current socket send buffer size is",
    word(src,2);
    if word(src,2) < 32000 then do
      Say "Increasing the socket send buffer size",
      "to 320000"
      src = socket("GETSOCKOPT",l_socketid,,
                  "SO_SNDBUF",32000);
      /* *******************************************/
      * Data can be sent even if command fails
      * so just post an message if an error occurs.
      * *******************************************/
    end;
  end;
end;
1_RMTname = "AF_INET 7 127.0.0.1";
src = socket("CONNECT",l_socketid,1_RMTname);
if perror(src,"CONNECT") = 0 then do
  src = socket("SEND",l_socketid,"******");
  if perror(src,"RECV","SEND") = 0 then do
    src = socket("RECV",l_socketid);
    if perror(src,"RECV") = 0 then
      Say "Echoed data: " word(src,3);
  end;
end;
src = perror(socket("CLOSE",l_socketid),"CLOSE");
end;
end;
```
ENDPROGRAM:
src = perror(socket("TERMINATE","MYSET01"),"CLOSE");
exit 0;
/
/* This routine returns -1 if the first word if arg 1 is not zero */
 perror: if word(arg(1),1) = 0 then return 0; else
 Say arg(2) "Error : "arg(1);
 return -1;

GIVESOCKET

Use the GIVESOCKET command to transfer a socket descriptor to another
application that is running on the same host.

The other application can use the TAKESOCKET command to take the socket. If
the socket is closed before an application can take it, then the socket is reset. Any
stream socket can be given.

Restriction: A socket given by the GIVESOCKET command can be taken only by a
process that issues the TAKESOCKET command with the same
address family.

Guideline: The application that issues the GIVESOCKET command can use the
SELECT command to test for a socket exception condition. The
exception condition indicates that the socket has been successfully
taken by another application. After the socket has been successfully
taken, the application that issued the GIVESOCKET command can
safely close the socket. For example, when a server accepts a new
connection, the server issues the GIVESOCKET command and then
monitors the socket for an exception condition using the SELECT
command. The server subtask issues the TAKESOCKET command.
After the subtask takes the socket, the server issues the CLOSE
command and waits for a new connection request.

Format

|--SOCKET--("GIVESOCKET"--,socketid--,clientid--)

Parameters

socketid
  The socket descriptor.

clientid
  The client ID of the application. The clientid parameter uses the following
  format:
  "domain jobname subtaskid"

where:

  domain
  The address family of the socket. The following domains are supported:
  • AF_INET or 2
  • AF_INET6 or 19
jobname
This optional field specifies the name of the address space that will issue
the TAKESOCKET command. If this field is not specified, any address
space can take the socket.

Guideline: To prevent possible security exposures, always specify the
jobname field.

subtaskid
This optional field specifies the name of the active socket set. It can be
specified only if the jobname field is specified also. If the subtaskid field is
specified but the value is not the name of the active socket set, then the
name of the active socket set is used. If the subtaskid field is not specified,
by default the name of the active socket set is used.

Consider the following situation: The GETCLIENTID command returns the
following string: AF_INET RUNC1 TTLSCXXX. If the application issues the
GIVESOCKET command using the clientid parameter value of "AF_INET
RUNC1 BBBB", BBBB is replaced with TTLSCXXX, because TTLSCXXX
is the name of the active socket set.

Returned value
The command returns a string that contains the return code. The return code can
be 0, a REXX socket API error number, or the REXX TCP/IP error number that is
set by the socket command. The return code 0 indicates that the requested socket
command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the
numeric error codes that are returned by this command.

The following REXX socket API error number can be returned:
• 9 EBADF

The following REXX socket API error numbers can be returned:
• 2001 EINVALDRXSOCKETCALL
• 2005 ESUBASKNOTACTIVE
• 2009 ESOCKETNOTDEFINED
• 2012 EINVALNAME

LE C/C++ equivalent
int givesocket(int d, struct clientid *clientid);

Code example
See the EZARXS04 REXX sample in the SEZAINST file for an example of using the
GIVESOCKET command.

INITIALIZE
Use the INITIALIZE command to preallocate a socket set.

A socket set is a number of preallocated sockets available to a single REXX
application. You can define multiple socket sets for one session, but only one
socket set can be active at a time. The INITIALIZE command must be issued
before any socket services are requested.
Restrictions:

- In a CINET environment, the INITIALIZE command establishes a
  stack affinity either to the default TCP/IP stack or the stack
  specified with the service parameter. The default stack is
determined by the BPXPARMxx SUBFILESYSTYPE statement that
contains the keyword DEFAULT or by the order of the
SUBFILESYSTYPE statements and currently active stacks. To
specify a stack other than the default, add the service parameter to
the INITIALIZE command. As different stacks are specified, the
results of the GETSOCKNAME command return the IP address of
the associated stack. If a valid service name is not supplied, the
INITIALIZE command fails with the 1004 E1BM1UCVRR return
code.

- In an INET environment, any service name is accepted. However,
  if the service name does not match an active SUBFILESYSTYPE
  statement defined in BPXPARMxx, the service name is changed to
  *INET.

Guideline: When multiple socket sets are initialized, the last socket set that is
initialized becomes the active socket set. Before closing a socket
belonging to a specific socket set, you must ensure that the socket set
that owns the socket is the active set. Otherwise, the CLOSE command
fails.

Format

```
SOCKET(INITIALIZE,subtaskid,40,maxdesc,service)
```

Parameters

**subtaskid**

The name of the socket set. This parameter can be 1-8 characters in length; it
cannot contain blanks.

**maxdesc**

The number of sockets descriptors that can be opened in this socket set. By
default, this parameter is set to 40.

**service**

The name of the TCP/IP service. This is the job name of an active TCP/IP
stack. The name of the TCP service must match one of the following values:

- The TYPE operand that was specified on the FILESYSTYPE statement
- The NAME operand of the SUBFILESYSTYPE statement that defined this
  physical file system in the BPXPRMxx PARMLIB member

Returned value

The command returns a string that contains the return code, the name of the
socket set, the number of socket descriptors that can be opened, and the name of
the TCP/IP services, for example, 0 MYTASK 40 TCPSVT. The return code can be 0, a
REXX socket API error number, or the REXX TCP/IP error number that is set by
the socket command. The return code 0 indicates that the requested socket
command was completed successfully.
For information about the format of the NAME string, see “How structures are represented” on page 663. See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 1004 EIBMIUCVERR

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2003 ESUBTASKINVALID
- 2004 ESUBTASKALREADYACTIVE2012 EINVALNAME

Tip: If the 2003 ESUBTASKINVALID error code is returned, issue the TERMINATE command and then reissue the INITIALIZE command. If the command continues to fail, verify that the value of service parameter is applicable for the system.

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

The example code described in “GETADDRINFO” on page 678 can be used to experiment with the INITIALIZE command in a CINET environment.

**IOCTL**

Use the IOCTL command to perform control functions on sockets.

**Format**

```
|SOCKET| ("IOCTL", socketid, icmd, [ivalue], [idata])|
```

**Parameters**

- **socketid**
  
The socket descriptor.

- **icmd**
  
The control function. The following commands are supported:

  - **FIONBIO**
    
    Enables or disables blocking mode. When the ivalue parameter is set to ON, the socket is set to nonblocking mode. When the ivalue parameter is set to OFF, the socket is in blocking mode. The command returns a string that contains the return code.

  - **FIONREAD**
    
    Requests the number of bytes on the receive queue that are ready for
reading. The command returns a string that contains the return code and the number of bytes that are ready for reading.

SIOCATMARK
Determines whether the current location in the input data points to out-of-band data. The command returns a string that contains the return code and YES or NO. YES indicates that there is out-of-band data.

SIOCGIFADDR
Obtains a network interface address. The ivalue parameter must specify the name of the network interface, for example, "OGETH13". The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network interface address, which has the following format: interface domain port ipaddress.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFBRDADDR
Obtains the network broadcast address of an interface. The ivalue parameter must specify the name of the network interface, for example, "OGETH13". The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network broadcast address, which has the following format: Hinterface domain port ipaddress.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFCONF
Obtains the list of the interfaces that are defined to the system. The ivalue parameter must specify the maximum number of interfaces to be returned. The command returns a string that contains the return code and a list of interfaces, which has the following format: interface domain port ipaddress

Restriction: Only IPv4 interface information is returned.

Tip: You can parse the information in the following way:
Drop st.
  l_retcode = socket("IOCTL",l_sockid,"SIOCGIFCONF",10);
  parse var l_retcode l_rc l_iflist
  i=0;
  do until l_iflist = ""
    i=i+1;
    parse var l_iflist st.i.interface st.i.domain st.i.port,
            st.i.address l_iflist
    st.i.name = st.i.domain st.i.port st.i.address;
  end;
  st.0 = 1;

SIOCGIFDSTADDR
Obtains the network destination address of an interface. The ivalue parameter must specify the name of the network interface, for example, "OGETH13". The network interface name can be 1-16 characters in length. The command returns a string that contains the return code and the network destination address, which has the following format: interface domain port ipaddress

Restriction: This function is valid only for IPv4 interfaces.
SIOCGIFNAMEINDEX

Obtains a list of all interface names and device indexes that are defined to the system. This list includes loopback addresses, but excludes VIPA addresses. The command returns a string that contains the return code and a list of interfaces, which have the following format:

interface_index interface_name.

Tip: You can parse the information in the following way:

```c
while (sysctlbyname("net.if.drmasc", &st, &siz, 0, 0) == 0)
{
    st+i=i+1;
    l_retcode = ' ';
    parse var l_retcode st+i.interindex st+i.name l_retcode;
}
```

SIOCGIFFLAGS

Obtains the network interface flags of an interface. The *ivalue* parameter must specify the link name of the interface, for example, "LOGETH13". The command returns a string that contains the return code, the interface name, the flags in four hexadecimal digits, and the symbolic names of the flags.

The following string is an example of what is returned by the SIOCGIFFLAGS function:

```
0 LOOPBACK 0049 IFF_UP IFF_LOOPBACK IFF_RUNNING
```

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFMETRIC

Obtains the network routing metric of an interface. The *ivalue* parameter must specify the link name of the interface, for example, "LOGETH13". The command returns a string that contains the return code, interface name, and routing metric.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIFNETMASK

Obtains the network mask of an interface. The *ivalue* parameter must specify the interface name, for example, "LOGETH13". The command returns a string that contains the return code, interface name, and a socket NAME with the network mask, for example, 0 LOFET13 AF_INET 0 255.255.240.0.

For more information about the format of the NAME string, see "How structures are represented" on page 663.

Restriction: This function is valid only for IPv4 interfaces.

SIOCGIPMFSFILTER

Obtains a list of the IPv4 source addresses from the stack for a specified interface and multicast group. The *ivalue* parameter must be a space-delimited string that contains an IPv4 multicast address, an IPv4 interface address, and the number of addresses to be returned, for example, "224.224.224.1 176.11.16.103 5". If the number of addresses to be returned is set to 0, all source filters are returned. The command returns a string that contains the return code, filter mode (either MCAST_INCLUDE or MCAST_EXCLUDE), number of IPv4 source addresses that are returned, and the IPv4 source addresses. Depending on the filter mode, source addresses are included or excluded.
The following string is an example of what is returned by the SIOCGIPMSFILTER function:
0 MCAST_INCLUDE 2 10.11.103.1 176.11.16.103

**SIOCGMSFILTER**
Obtains a list of the IPv4 or IPv6 source addresses for the specified interface index and multicast group. The *ivalue* parameter must be a space-delimited string that contains an interface index, a socket name for the multicast address, and the number of addresses to be returned, for example, "34 AF_INET 21 224.224.224.1 5". If the number of addresses to be returned is set to 0, all source addresses are returned. The command returns a string that contains the return code, filter mode (either MCAST_INCLUDE or MCAST_EXCLUDE), the number of source addresses that are returned, and a list of the source-socket name groups.

The following string is an example of what is returned by the SIOCGMSFILTER function:
0 MCAST_INCLUDE 1 AF_INET 21 176.11.16.103

In the example, AF_INET 12 176.11.16.103 is the source-socket name.

For more information about the format of the NAME string, see "How structures are represented" on page 663 or the BIND or CONNECT commands.

**SIOCSAPPLDATA**
Associates user-defined data with a socket descriptor. This data can be used to identify socket endpoints for network-management applications or tools such as Netstat or SMF. The *ivalue* parameter is a string that contains the user-defined data; it can be up to 40 bytes in length. The command returns an error code.

**Guideline:** The content of this field is determined by the application that owns the connection. See application-specific documentation for explanations of the layout, format, and meaning of this field. Typically, the field contains printable EBCDIC characters, although some applications might include binary data.

The application data is displayed by the following items only when the TCP connection has application data associated with it:

- Netstat reports. The information is displayed on the ALL/-A report. If the APPLDATA modifier is used, the information also is displayed on the ALLConn/-a and CONn/-c reports.
- The SMF 119 TCP connection termination record. For more information, see z/OS Communication Server: IP Configuration Reference.
- Network management applications. For more information, see z/OS Communications Server: IP Programmer's Guide and Reference.

**SIOCSIPMSFILTER**
Sets the list of the IPv4 source addresses and the filter mode for an interface and multicast group. The *ivalue* parameter must be a space-delimited string that contains an IPv4 multicast address, an IPv4 interface address, filter mode, the number of IPv4 source addresses to be added, and the list of IPv4 source addresses, for example:
The filter mode is one of the following values:

Include

MCAST_INCLUDE, INCLUDE, I, or 0

Exclude

MCAST_EXCLUDE, EXCLUDE, E, or 1

The maximum number of source addresses is 64. If the interface address is 0.0.0.0, then the stack selects the default IPv4-multicast interface address. The command returns a string that contains the return code.

SIOCSMSFILTER
Sets a list of the IPv4 or IPv6 source addresses and the filter mode for an interface and multicast group. The ivalue parameter must be a space-delimited string that contains an interface index, the socket address name for the multicast address, the filter mode, the number of source address names, and a list of the source address names, for example:

34 AF_INET6 56504 0 FF02::67:69 0 MCAST_INCLUDE 1 2001:10:11:103::1

The filter mode is one of the following values:

Include

MCAST_INCLUDE, INCLUDE, I, or 0

Exclude

MCAST_EXCLUDE, EXCLUDE, E, or 1

The maximum number of source addresses is 64. If the interface index is 0, then the stack selects an interface. The command returns a string that contains the return code.

For more information about the format of the NAME string, see "How structures are represented" on page 663.

SIOCTTLSCTL
Queries or controls Application Transparent Transport Layer Security (AT-TLS) for a TCP stream socket connection. If the socket is in blocking mode, this function blocks during the initial handshake. If the socket is in nonblocking mode, it returns the 36 EWOULDBLOCK error. See the Application Transparent TLS information in z/OS Communications Server: IP Programmer’s Guide and Reference for more information.

Unless the ivalue parameter is set to QUERYONLY, the application must be mapped to an AT-TLS policy and the parameter ApplicationControlled must be set to ON. The ivalue parameter can have the following values:

QUERYONLY
Requests security information about the current socket. This request can be issued by any application, regardless of the value of the ApplicationControlled parameter. If the socket is not mapped to an AT-TLS policy and the socket is in a writable state, issuing this command causes AT-TLS to try to locate and
assign a policy. The command returns a string that contains status information about the security level of the connection.

QUERYHOST
Queries the partner certificate to validate that the certificate matches the host name. The $ivar$ parameter must specify the host name. This request returns one of the following values:

0 Validation status unknown. This value is returned if no partner certificate is present. This can occur for servers if client authentication is not enabled in the policy.

1 Host name validation succeeded. The host name in the partner certificate matches the value of the $ivar$ parameter.

2 Host name validation failed. The host name in the partner certificate did not match the value of the $idata$ parameter.

QUERYRULENAME
Queries the TTLSRule name that is mapped to the connection. This request returns the TTLSRule name or *N/A*, if no mapping exists.

QUERYGROUPACTIONNAME
Queries the TTLSGroupAction name that is mapped to the connection. This request returns the TTLSGroupAction name or *N/A*, if no mapping exists.

QUERYENVIRONMENTACTIONNAME
Queries the TTLSEnvironmentAction name that is mapped to the connection. This request returns the TTLSEnvironmentAction name or *N/A*, if no mapping exists.

QUERYCONNECTIONACTIONNAME
Queries the TTLSConnectionAction name that is mapped to the connection. This request returns the TTLSConnectionAction name or *N/A*, if no mapping exists.

INITCONNECTION
Initializes a secure SSL connection using the role that is defined by the Handshake parameter in the mapped policy. When this command is successful, it returns a string that contains status information about the security level of the connection.

INITCONNHHSTIMEOUT
Initializes a secure SSL connection using the role that is defined by the Handshake parameter in the mapped policy. The Handshake parameter must be set to Server or ServerWithClientAuth. If the SSL handshake times out before receiving data from the client, SSL is stopped on the connection and the TCP connection remains established. Using this command is equivalent to requesting TTLS_INIT_CONNECTION and TTLS_ALLOW_HSTIMEOUT.

RESETSESSION
Resets the session ID so that it is not reused by another connection. When this command is successful, it returns a string that contains status information about the security level of the connection.
RESETCIPHER
Resets and renegotiates the cipher that is used for the secure session. If the session ID times out or has been reset, a full handshake is performed. Otherwise, a short handshake is performed. When this command is successful, it returns a string that contains status information about the security level of the connection.

STOPCONNECTION
Stops SSL security on the connection. The TCP connection remains established. Future sends and receives are not encrypted.

If an error occurs, the SIOCTTLSCTL function returns an error code. Unless otherwise specified in the ivalue parameter, if the command is completed successfully, it returns a string that contains the return code, policy status, connection status, security type, SSL protocol, the negotiated cipher, and the client user ID (if available). For example, the following string is an example of what is returned by the SIOCTTLSCTL function:

0 5 2 2 0300 05 userid

In the example, 0 is the return code, 5 is the policy status, 2 is the connection status, 2 is the security type, 0300 is the SSL protocol, 05 is the negotiated cipher, and userid is the client user ID.

The policy status is one of the following values:

1  AT-TLS function is off. The TCP/IP address space is not enabled to support AT-TLS.
2  No AT-TLS policy is defined for the connection.
3  A policy is defined for the connection, but AT-TLS is not enabled for the connection.
4  A policy is defined for the connection, and AT-TLS is enabled for the connection.
5  A policy is defined for the connection, and both AT-TLS and the ApplicationControlled parameter are enabled for this connection.

The connection status is one of the following values:

1  The connection is not secure.
2  The connection handshake is in progress.
3  The connection is secure.

The security type is one of the following values:

0  Unknown. The connection is not secure.
1  Client.
2  Server.
3  Server with client authentication and authentication type set to PASSTHRU.
Server with client authentication and authentication type set to FULL.

Server with client authentication and authentication type set to REQUIRED.

Server with client authentication and authentication type set to SAFCheck.

The SSL protocol is one of the following values:

0000 Unknown. The connection is not secure.
0200 SSL Version 2.
0300 SSL Version 3.
0301 TLS Version 1

The value FF indicates that the cipher has not been negotiated. See the TTLSCipherParms statement description in z/OS Communication Server: IP Configuration Reference for additional cipher values.

The client user ID is either the client user ID or no value is specified, which indicate that the client ID is unknown.

Rule: When using AT-TLS application control, you must ensure that no outstanding data resides in the socket receive buffers for the application. If data exists when AT-TLS is enabled, the negotiation will fail. To flush the receive buffers, you can issue a nonblocking RECV command on the socket before you issue the IOCTL command.

Tips:

- For TCP/IP socket error information concerning this command, see the Application Transparent TLS information in z/OS Communications Server: IP Programmer's Guide and Reference for more information.
- For information about SSL error numbers, see z/OS Cryptographic Services System Secure Sockets Layer Programming.

ivalue
Additional information that is needed to run the requested command. The value of the ivalue parameter can be either input or output; it is independent of the icmd parameter.

idata
Additional information that is needed to run the requested command. The value of the idata parameter can be either input or output; it is independent of the icmd and ivalue parameter.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.
The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 6 ENXIO
- 22 EINVAL
- 41 EPROTOTYPE
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

See the EZARXS05 REXX sample for an example of using the IOCTL command.

**LISTEN**

Use the LISTEN command to determine whether a socket is ready to accept client connection requests.

The LISTEN command applies only to stream sockets. The LISTEN command performs two actions:

1. The command completes the bind process, if it has not already been done explicitly.
2. Creates a connection request queue (the backlog queue). New connections received by the stack for this socket are placed on the backlog queue. The application then can issue the ACCEPT command to process these pending connections. If the backlog queue is full, the stack rejects new connection requests.

**Guideline:** Applications that issue the LISTEN command should bind to a well-known port using INADDR_ANY or IN6ADDR_ANY. If the LISTEN command completes the bind for IPv4, the socket is bound to AF_INET 0 INADDR_ANY. If the LISTEN command completes the bind for IPv6, the socket is bound to AF_INET 0 0 IN6ADDR_ANY 0.

**Format**

```
SOCKET("LISTEN", socketid, backlog)
```

**Parameters**

- `socketid`
  The socket descriptor
- `backlog`
  The number of pending connection requests. This parameter can have a value
in the range 0 to the maximum number that is specified by the SOMAXCONN parameter in the TCPIP profile. If the backlog parameter is set to 0, 1, or 2, then the backlog queue uses the default value of 2. If the backlog parameter is not specified, by default it is set to 10.

Returned value

The command returns a string that contains the return code. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 9 EBADF
- 22 EINVAL,
- 38 ENOTSOCK,
- 45 EOPNOTSUPP,

The following REXX socket API error numbers can be returned:
- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2006 ESOCKETNOTALLOCATED
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

See “ACCEPT” on page 668 for an example of how to use the LISTEN command.

READ

Use the READ command to read data on the specified socket. The maximum amount of data to be read is specified by the maxlength parameter. If the socket is in blocking mode and data is not available on the socket, the command blocks until data arrives.

Consider the following additional information:
- If the socket is a stream socket and the length of the data returned is 0, the remote peer has closed its side of the connection.
- If the socket is a connected datagram socket, the command returns data up to the length specified by the maxlength parameter. The remainder of the datagram is discarded. To ensure that the entire datagram is received, set the maxlength parameter to 65 535 or greater.

Guidelines:
For stream sockets, data is processed as streams of information with no boundaries separating the data. The application provides record management. Applications should place the command in a loop until all the data has been received.

For nonblocking sockets, use the SELECT command to determine whether there is data to be read on the socket.

Tip: If the SO.ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format

```plaintext
SOCKET(“READ”, socketid, maxlength)
```

Parameters

socketid
The socket descriptor.

maxlength
The maximum amount of data (in bytes) to be returned. The `maxlength` parameter can be a number in the range 0-100 000. By default, this parameter is set to 10 000.

Returned value

The command returns a string that contains the return code, the maximum length of the data returned, and the data, for example, 019 This is sample data. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully. The data length 0 indicates that the connection was closed by the remote peer.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EW OULD BLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
LE C/C++ equivalent

```c
ssize_t read(int fs, void *buf, size_t N);
```

Code example

```rexx
/* REXX EZARXRZ1 */
/*
* This sample demonstrates the use of the READ and RECV
* socket commands.
* To use the READ command, set the variable g_RECVCMD equal to "READ"
* to use the RECV command, set the variable g_RECVCMD equal to "RECV"
* The program creates a listening socket and then goes into a
* loop and blocks on the accept command. When a new connection is
* ACCEPTED the program will issue the READ or RECV command until
* the connection is terminated.
* If the data received is the string "DONE", then the
* program will close the accepted socket and wait for a new
* connection request.
*/
g_RECVCMD = "READ"
src = socket("INITIALIZE", "MYSET01", 10);
if perror(src, "INITIALIZE") = 0 then do
    src = socket("SOCKET", "AF_INET6", "STREAM");
    if perror(src, "SOCKET") = 0 then do
        parse var src . l_sockid
        l_name6 = "AF_INET6 54004 0 ::0 0";
        src = socket("BIND", l_sockid, l_name6);
        if perror(src, "BIND") = 0 then do
            src = socket("LISTEN", l_sockid);
            if perror(src, "LISTEN") = 0 then do
                say "Listening on socket " l_sockid;
                do forever
                    src = socket(g_RECVCMD, l_sockid, 512);
                    if perror(src, g_RECVCMD) = 0 then do
                        parse var src l_retcode l_datalen l_data
                        if l_datalen > 0 then do
                            l_totallen = l_totallen + l_datalen;
                        if l_packet = "" then do
                            l_packet = l_data;
                            if l_packet = "DONE" then
                                l_done = "TRUE"
                                end;
                            else l_packet = l_packet||l_data;
                        end;
                    end;
                end;
            end;
        end;
    end;
end;
```

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* remote side
  * **********************************************/
  Say "Connection has been closed",
  "received "l_totallen" bytes";
l_done = "TRUE";
end;
end;
else do
l_done = "TRUE";
end;
end; /* DO READ */
src = socket("CLOSE",l_newsockid);
src = perror(src,"CLOSE");
end; /* ACCEPT */
end; /* DO FOREVER */
end;
end; /* INITIALIZE */
src = perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;

/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;

RECV

Use the RECV command to receive data on a specified socket. The RECV
command can be issued only against connected sockets.

Consider the following additional information:
• If the socket is in blocking mode and data is not available, the command blocks
  until data arrives. If the socket is in nonblocking mode and data is not available,
  the command returns the 35 EWOULDBLOCK error code.
• If the socket is a stream socket and the length of the data returned is 0, the
  remote peer has closed its side of the connection.
• If the socket is a connected datagram socket, the command returns data up to
  the length specified by the maxlength parameter. The remainder of the datagram
  is discarded. To ensure that the entire datagram is received, set the maxlength
  parameter to 65 535 or greater.

Guidelines:
• For stream sockets, data is processed as streams of information with
  no boundaries separating the data. The application provides record
  management. Applications should place the command in a loop
  until all the data has been received.
• For nonblocking sockets, use the SELECT command to determine
  whether there is data to be read on the socket.

Tip: If the SO_ASCII socket option is enabled, then the data received is translated
from EBCDIC to ASCII.

Format

```bash
 SOCKET ( "RECV", <socketid>[, <maxlength>][, <recvflags>])
```
Parameters

socketid
   The socket descriptor.

maxlength
   The maximum amount of data (in bytes) to be returned. The maxlength
   parameter can be a number in the range 0-100 000. By default, this parameter
   is set to 10 000.

recvflags
   An optional parameter. The following flags are supported:

   MSG_OOB
   Read any out-of-bound data that is on the socket. This option is
   supported only by stream sockets in the AF_INET or AF_INET6
   address family. The values OOB and OUT_OF_BAND are also
   accepted.

   MSG_PEEK
   Receive a copy of the data that is currently in the socket receive buffer.
   The data is not removed from the buffer. When a subsequent RECV or
   RECVFROM command is issued without the MSG_PEEK flag, the data
   is removed from the buffer. The value PEEK is also accepted.

Returned value

The command returns a string that contains the return code, the maximum length
of the data returned, and the data, for example, 0 19 This is sample data. The
return code can be 0, a REXX socket API error number, or the REXX TCP/IP error
number that is set by the socket command. The return code 0 indicates that the
requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the
numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

LE C/C++ equivalent

int recv(int socket, char *buffer, int length, int flags);
**Code example**

See ["ACCEPT" on page 668] or ["READ" on page 723]. To use the RECV command, substitute the command RECV for the command READ.

**RECVFROM**

Use the RECVFROM command to receive data on the specified socket.

If the number of bytes is less than the number of bytes requested, the command returns the number of bytes that are available. If the socket is in blocking mode and data is not available on the socket, the command blocks until data arrives. When the socket is in nonblocking mode and data is not available, the command returns the 35 EWOULDBLOCK return code.

Consider the following additional information:
- If the socket is a stream socket and the length of the data returned is 0, the remote peer has closed its side of the connection.
- If the socket is a datagram socket, the command returns data up to the length specified by the maxlength parameter. The remainder of the datagram is discarded. If the socket is a datagram socket and the amount of data returned is 0, a datagram packet was received with no data.

**Guidelines:**

- Use the RECV command for stream and connected UDP sockets. For stream sockets, data is processed as streams of information with no boundaries separating the data. Applications should place the RECVFROM command in a loop until all the data has been received.
- If the socket is a datagram socket, the RECVFROM command returns the name of the remote partner. If the socket is a stream socket, use the command GETPEERNAME to determine the name of the remote partner.
- Use the SELECT command to determine whether there is data to be read on the socket.

**Tip:** If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

**Format**

```
SOCKET(″RECVFROM″,socketid,[maxlength],[recvflags])
```

**Parameters**

- `socketid`  
  The socket descriptor.

- `maxlength`  
  The maximum amount of data (in bytes) to be returned. The `maxlength` parameter can be a number in the range 0-100 000. By default, this parameter is set to 10 000.
recvflags

An optional parameter. The following flags are supported:

**MSG_OOB**
Read any out-of-bound data that is on the socket. This option is supported only by stream sockets in the AF_INET or AF_INET6 address family. The values OOB and OUT_OF_BAND are also accepted.

**MSG_PEEK**
Receive a copy of the data that is currently in the socket receive buffer. The data is not removed from the buffer. When a subsequent RECV or RECVFROM command is issued without the MSG_PEEK flag, the data is removed from the buffer. The value PEEK is also accepted.

**Returned value**

The command returns a string that contains the return code, a NAME string, the maximum length of the data returned, and the data. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following list are examples of what is returned by the RECVFROM command.

**IPv4 socket**

0 AF_INET 54004 10.1.2.3 19 This is sample data

**IPv6 socket**

0 AF_INET6 54004 0 2001:10:1:2::3 0 19 This is sample data

In the examples, 0 is the return code, AF_INET 54004 10.11.103.1 or AF_INET6 54004 0 2001:10:1:2::3 0 is the socket name of the remote partner, 19 is the length of the data received, and This is sample data is the data that was received on the socket.

For information about the format of the NAME string, see "How structures are represented" on page 663. See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EITNR
- 5 EIO
- 9 EBADF
- 22 EINVAL
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN
- 60 ETIMEDOUT

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
LE C/C++ equivalent

```c
int recvfrom(int socket, char *buffer, int length, int flags,
             struct sockaddr *address, int *address_length);
```

**Code example**

```c
/* REXX EZARXR22 */
/*
 * This sample demonstrates the use of the RECVFROM
 * socket command.
 */
src = socket("INITIALIZE","MYSET01",10);
if perror(src,"INITIALIZE") = 0 then do
  src = socket("SOCKET","AF_INET6","DATAGRAM");
  if perror(src,"SOCKET") = 0 then do
    parse var src l_retcode l_sockid l_LOCname = "AF_INET6 54004 0 :: 0";
    l_RMTname = "AF_INET6 54004 0 :: 0";
    l_data = time()"**** **** **** **** ";
    src = socket("BIND", l_sockid, l_LOCname);
    if perror(src,"BIND") = 0 then do
      src = socket("SENDTO", l_sockid, l_data,,l_RMTname);
      if perror(src,"SENDTO") = 0 then do
        parse var src . l_recvport . l_recvaddr .
        l_amtdata l_data
        Say "Received \"l_amtdata\" bytes from \"l_recvaddr,
        on port \"l_recvport;";
        Say "The received data is: \"l_data;";
      end;
    end;
  end;
end;
end;
src=perror(socket("CLOSE",l_sockid),"CLOSE");
src=perror(socket("TERMINATE","MYSET01"),"TERMINATE");
exit 0;
/* This routine returns -1 if the first word if arg 1 is not zero */
perror: if word(arg(1),1) = 0 then return 0; else
  Say arg(2) "Error : "arg(1);
  return -1;
```

**RESOLVE**

Use the RESOLVE command to resolve a host name or an IP address.

**Format**

```c
SOCKET("RESOLVE", ipaddress, hostname, fullhostname, timeout)
```

**Parameters**

- `ipaddress`
  - The IPv4 address of the system in dotted decimal format.
hostname

The host name, for example, BOB01. The maximum length is 255 characters.

Fullhostname

The fully qualified host name, for example, BOB01.THEWORLD.COM. The maximum length is 255 characters.

timeout

The resolver timeout value. By default, this is set to 30 seconds.

Returned value

The command returns a string that contains the return code, the IP address, and the host name. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the RESOLVE command:

```
0 10.201.202.1 BOB01.THEWORLD.COM
```

In the example, 0 is the return code, 10.201.202.1 is the host IP address, and BOB01.THEWORLD.COM is the host name.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

- 22 EINVAL

The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2012 EINVALIDNAME
- 2016 EHOSTNOTFOUND

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```rexx
/* REXX EZARXRZ3 */
/
* This sample demonstrates the use of the RESOLVE
* socket command.
*/
src = socket("INITIALIZE","MYSET01");
src = socket("RESOLVE","your.hostname.here");
if word(src,1) = 0 then do
    Say "The host name is "WORD(src,3)
    Say "The IP Address is "WORD(src,2);
end;
src = socket("TERMINATE","MYSET01");
exiut 0;
```
**SELECT**

Use the SELECT command to monitor groups of sockets to determine when one or more of the sockets is ready for a read operation, is ready for a write operation, or has an exception pending.

**Guidelines:**

- A close on the other side of a socket connection is reported not as an exception but as a read event, which returns 0 bytes of data.
- When the CONNECT command is called with a socket descriptor in nonblocking mode, setup completion is reported as a write event on the socket.
- The SELECT command returns an exception pending when either a connection is reset or when a TAKESOCKET command is completed for a socket that was previously given using the GIVESOCKET command.

**Format**

```
SOCKET("SELECT",fdset,timeo
```  

**Parameters**

- **fdset**
  
  Specifies the set of socket descriptors to be monitored for activity. The `fdset` parameter is a string in the following format:
  
  "READ" rdlist "WRITE" wrlist "EXCEPTION" exlist

  where:
  
  - The `rdlist` value is a space-delimited list of sockets to be monitored for reading.
  - The `wrlist` value is a space-delimited list of sockets to be monitored for writing.
  - The `exlist` value is a space-delimited list of sockets to be monitored for exceptions.

  To specify that all sockets are monitored, set the value of the `rdlist`, `wrlist`, or `exlist` string to an asterisk (*).

  For example, if you want to monitor the sockets with file descriptors 1, 2, and 3 to determine when the socket has data to be read, issue the following command:
  
  SOCKET("SELECT","READ 1 2 3 WRITE EXCEPTION",120);

  This code example also sets a `timeout` parameter of 120 seconds.

- **timeout**
  
  A positive integer that indicates the maximum length of time (in seconds) that the SELECT command will monitor the sockets. If no `timeout` parameter is specified, the sockets are monitored indefinitely.
Returned value

The command returns a string that contains the return code, the number of ready sockets, and information about the ready sockets. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

The following string is an example of what is returned by the SELECT command:

```
0 2 READ 1 3 WRITE EXCEPTION
```

In this example, 0 is the return code, 2 is the number of ready sockets, and 1 and 3 are the sockets that ready for READ operations. There are no sockets ready for WRITE operations or sockets with pending exceptions.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

```
/* REXX EZARXR24 */
/*
 * This is an example of a function command that can be used to
 * to determine if a connection is available. This procedure
 * would be called before calling the ACCEPT command.
 *
 * Two arguments are passed. The p_listensocketlist is a
 * list of 1 or more space-delimited socket descriptors to be
 * monitored. The p_timeout value is how long the SELECT
 * command should wait before returning.
 *
 * The monitored sockets can be BLOCKING or NON-BLOCKING
 * sockets.
 *
 * Example usage:
 *
 * INITIALIZE a socket set.
 * open a SOCKET descriptor.
 * BIND the socket to a well known port.
 * set the socket to passive mode using the LISTEN command.
 * LOOP:
 * Call the IsConnectionAvailable function
```
* If a connection is available, ACCEPT the connection
* and continue processing. Otherwise, do some other work,
* and loop.
* *
* Function Usage:
*  l_retcode = IsConnectionAvailable(l_sockid,60);
* *
* The function will return one of the following:
* - The list of socket descriptors that have
*   connections pending.
* *
* - The string "TIMEOUT". This indicates the select command
*   timed out before any connections arrived.
* *
* - The string "ERROR". This indicates an ERROR occurred
*   when the SELECT command was issued.
*/

IsConnectionAvailable: PROCEDURE
Parse arg p_listensocketlist, p_timeout
l_fdset = "READ" p_listensocketlist" WRITE EXCEPTION";
l_retvalue = SOCKET("SELECT",l_fdset,p_timeout);
parse var l_retvalue l_retcode l_numSockets;
if l_retcode = 0 then do
  if l_numsocket > 0 then do
    parse value l_retvalue with 'READ' l_sockidrdlist 'WRITE' .;
    parse value l_retvalue with 'WRITE' l_sockidwrlist 'EXCEPTION' .
    parse value l_retvalue with 'EXCEPTION' l_sockidexlist;
    l_retcode = l_sockidrdlist;
  end
  else do
    Say "Select command timed out";
    l_retcode = "TIMEOUT"
  end;
end;
else do
  l_retcode = "ERROR";
end;
return l_retcode;

Tip: See the IOCTL command for another example on how to use SELECT
command.

SEND

Use the SEND command to send an outgoing message on the connected socket.

When the socket is a TCP socket, the following conditions apply:
- If the socket is in blocking mode and if the total amount of data to be sent
  cannot be processed by the stack when the command is issued, the command
  blocks until the data can be sent.
- If the socket is in nonblocking mode and if the total amount of data to be
  written cannot be processed by the stack when the command is issued, the
  command returns the number of bytes that were successfully written. If none of
  the data can be written, the command returns the value -1 and the 35
  EWOULDBLOCK error message.

When the socket is a connected UDP socket, the SEND command either is
completed or failed. A connected UDP socket does not return the 35 EWOULDBLOCK
error message.

Guideline: Place the SEND command in a loop to ensure that all the data is
written. For a TCP socket, a partial write operation might occur
regardless of whether the socket is in blocking or nonblocking mode. A partial write operation occurs when the stack copies some but not all of the application data:

- If a partial write operation occurs on a socket in blocking mode, the blocking socket is interrupted. The return value contains the number of bytes written, and the return code contains the reason for the interruption. In such cases, consider ending the connection.
- If a partial write operation occurs on a socket in nonblocking mode, the return value indicates the number of bytes that were successfully sent. If this number is less than the number of bytes specified on theSEND command, repeat the SEND command until all data is written. The blocking condition can last for a long time, so use other strategies to ensure that the application does not remain in a busy loop sending data.

Tips:

- Use the SELECT command to determine whether a socket is ready to send additional data. To do so, test the socket for a WRITE event.
- If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

Format

```plaintext
SOCKET(“SEND”, socketid, data [sendflags])
```

Parameters

**socketid**

The socket descriptor.

**data**

The data to be sent.

**sendflags**

Optional flags that specify how the data is sent. The following flags are supported:

- **MSG_OOB**
  Sends the data out-of-band. Out-of-band data is supported only for stream sockets created in the AF_INET domain. The values OOB or OUT_OF_BAND are supported also.

- **MSG_DONTROUTE**
  Specifies that the data is routed by the calling program. The value DONTROUTE is supported also.

Returned value

The command returns a string that contains the return code and the amount of data sent, for example, 0 19. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.
See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 4 EINTR
- 9 EBADF
- 5 EIO
- 22 EINVAL
- 32 EPIPE
- 35 EWDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:
- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
int send(int socket, char *buffer, int length, int flags);
```

**Code example**

See the EZARXS03 REXX sample in the SEZAINST file for an example of using the SEND command.

**SENDTO**

Use the SENDTO command to send an outgoing message on a socket descriptor. This command differs from the SEND command in that it includes the destination address as a parameter.

This command is used primarily to send data using connectionless protocols such as UDP or RAW. Use the SENDTO command to send datagrams on a UDP socket regardless of whether the socket is connected.

**Guidelines:**
- For TCP or connected UDP sockets, use the SEND command.
- If the SO_ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

**Format**

```plaintext
> SOCKET { "SENDTO", socketid, data, sendflags, name }
```
Parameters

socketid
   The socket descriptor.

data
   The data to be sent.

sendflags
   Optional flags that specify how the data is sent. The following flag is supported:
   
   MSG_DONTROUTE
   Do not route the data. Routing is handled by the calling program. The DONTROUTE value is supported also.

name
   The socket name of the remote host to which the data is sent.
   The format for the name parameter depends on the socket type:

   AF_INET sockets (IPv4)
   name = "domain portid ipaddress"

   AF_INET6 sockets (IPv6)
   name = "domain portid flowinfo ipaddress scopeid"

   where
   • The domain value is the decimal number 2 for AF_INET and the decimal number 19 for AF_INET6.
   • The portid value is the port number.
   • The ipaddress value is the IP address of the remote host. It must be an IPv4 address for AF_INET and an IPv6 address for AF_INET6.
   • The flowinfo value must be 0.
   • The scopeid value identifies the interfaces that are applicable for the scope of the address that is specified in the ipaddress field. For a link-local IP address, the scopeid field can specify a link index, which identifies a set of interfaces. For all other scopes, the scopeid field must be set to 0. Setting the scopeid field to 0 indicates that any address type and scope can be specified.

Returned value

The command returns a string that contains the return code and an integer that specifies the amount of data that was sent, for example, 0 192. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

• 4 EINTR
• 9 EBADF
• 5 EIO
• 22 EINVAL
• 32 EPIPE
The following REXX socket API error numbers can be returned:

- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE
- 45 EOPNOTSUPP
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
int sendto(int socket, char *buffer, int length, int flags, struct sockaddr *address, int address_len);
```

**Code example**

See “RECVFROM” on page 728 for an example of using the SENDTO command.

**SETSOCKOPT**

Use the SETSOCKOPT command to set socket options.

**Format**

```c
SOCKET(−−SETSOCKOPT−−,−−socketid−−,−−levelname−−,−−optname−−,−−optvalue−−)
```

**Parameters**

- `socketid`
  The socket descriptor.

- `levelname`
  The protocol level. The following protocol levels are supported:

  - `IPPROTO_TCP`
    Set socket options at the TCP layer
  - `IPPROTO_IP`
    Set IPv4 socket options at the IP layer
  - `IPPROTO_IPV6`
    Set IPv6 socket options at the IP layer
  - `SOL_SOCKET`
    Set socket options at the socket layer

- `optname`
  The option or options. The following rules apply:

  - Options that begin with `SO_` require the `SOL_SOCKET` protocol level.
  - Options that begin with `TCP_` require the `IPPROTO_TCP` protocol level.
  - Options that begin with `IP_` require the `IPPROTO_IP` protocol level.
  - Options that begin with `IPV6_` require the `IPPROTO_IPV6` protocol level.
  - Options that begin with `MCAST` require the `IPPROTO_IP` or `IPPROTO_IPV6` protocol level.

The following values are supported for the `optname` parameter:
**IP_ADD_MEMBERSHIP**

(IPV4-only) Enables an application to join a multicast group on a specific interface. Applications in a multicast group can receive multicast datagrams. An application can join multiple multicast groups on the same interface or the same multicast group on multiple interfaces, but only one interface address can be specified with a single command. The *optvalue* parameter must be a string that contains the multicast address followed by the interface address on which the application wants to receive multicast datagrams, for example, “224.224.224.1 10.11.13.4”. This command returns the return code or error number.

**Tip:** Use the IOCTL command with the SIOCGIFADDR option to determine the interface address.

**IP_ADD_SOURCE_MEMBERSHIP**

(IPV4-only) Enables an application to join a multicast group on a specific interface and a specific source address. The *optvalue* parameter must be a string that contains the multicast address, the interface address, and the source address, for example, “224.224.224.1 10.11.16.103 10.11.107.1”. The source address represents a filter; the application only receives multicast packets if the source address matches the source address filter for the multicast group.

This command returns the return code or error number.

**Restrictions:**

- Only one interface address can be specified with a single call.
- The stack supports up to 64 source address filters for each multicast-group interface pair. If the number of filters exceeds the maximum, EN0BUF5 is returned.
- You can specify only a single source address with each call. If you want to join a multicast group and receive data from two different source addresses, then issue the SETSOCKOPT command twice.

**Guideline:** Applications that want to receive multicast datagrams need to join multicast groups. Use this option when the application wants to receive multicast packets on a specific group from one or more senders.

**IP_BLOCK_SOURCE**

(IPV4-only) Enables an application to block multicast packets that are sent from a specific address. The application must have previously joined the multicast group. The *optvalue* parameter must be a string that contains the multicast address, source address, and interface address, for example, “224.224.224.1 10.11.16.103 10.11.107.1”. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IP_DROP_MEMBERSHIP**

(IPV4-only) Enables an application to exit a multicast group. If source filtering is enabled, all source filters are deleted. The *optvalue* parameter must be a string that contains the multicast address and the interface address, for example, “224.224.224.1 10.11.13.4”. This option returns 0 if it is successfully completed; otherwise, it returns the error number.
**IP.Drop.Source.Membership**

(IPV4-only) Enables an application to leave a multicast-source multicast group. The application will no longer receive multicast packets from the group. The optvalue parameter must be a string that contains the multicast address, source address, and interface address, for example, “224.224.224.1 10.11.13.4 10.11.107.1”. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IP.Multicast.If**

(IPV4-only) Sets the IPv4 interface address that is used to send outbound multicast datagrams. Multicast datagrams can be sent only on one interface at a time. The optvalue parameter is the IP address of the interface. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IP.Multicast.Loop**

(IPV4-only) Controls whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host belongs. By default, loopback is enabled. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IP.Multicast.Ttl**

(IPV4-only) Sets the IP time-to-live of outgoing multicast datagrams. By default, this is set to 1; multicast is available only to the local subnet. The optvalue parameter must be an integer in the range 1-s255.

**IP.Unblock.Source**

(IPV4-only) Enables an application to unblock a previously blocked source address for an IPv4 multicast group. Only one interface address can be specified with a single call. The optvalue parameter must be a string that contains the multicast address, source address, and interface address, for example, “224.224.224.1 10.11.103.1 10.11.107.1”. This option returns 0 if it is successfully completed; otherwise, it returns the error number.


(IPv6-only) Enables an application to join a multicast group on a specific interface. Only applications that want to receive multicast datagrams need to join multicast groups. An application can join multiple multicast groups on the same interface, or it can join the same multicast group on multiple interfaces. The optvalue parameter must be a string that contains the multicast address and the index of the interface on which the application wants to receive multicast datagrams, for example, “FF02:225:9:10::11 3”. If the interface index is set to 0, the stack will chose the local address. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Guideline:** Use the SIOCGIFNAMEINDEX function of the IOCTL command to determine the index number for an interface.

**Restriction:** Only one interface address can be specified in a single call. A multicast address can be associated with a real interface only.


(IPv6-only) Enables an application to leave a multicast group. The optvalue parameter must be a string that contains the multicast address
and the interface address, for example, "FF02:225:9:10:11 3". The optvalue parameter must match the original IPV6_JOIN_GROUP parameters; for example, if the interface index specified for the IPV6_JOIN_GROUP was 0, then 0 also must be specified as the interface index for IPV6_LEAVE_GROUP command. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IPV6_MULTICAST_HOPS**
(IPv6-only) Sets the hop limit that is used for outgoing multicast packets. The optvalue parameter is optional; if it is not issued, the hop limit is set to 1.

The optvalue parameter can have the following values:
- 1: The default value for the stack is used.
- 0-255: The hop limit.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Restriction:** To set the hop limit value to be greater than the TCP/IP default value, a REXX-application user ID must have superuser authority.

**IPV6_MULTICAST_IF**
(IPv6-only) Sets the index of the IPv6 interface that is used to send outbound multicast datagrams from the socket application. The optvalue parameter must specify the interface index number, for example, 34. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IPV6_MULTICAST_LOOP**
(IPv6-only) Controls whether a multicast datagram is looped back on the outgoing interface by the IP layer for local delivery when datagrams are sent to a group to which the sending host belongs. By default, multicast datagrams are looped back. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**IPV6_UNICAST_HOPS**
(IPv6-only) Sets the hop limit that is used for outgoing unicast IPv6 packets. The optvalue parameter is optional; if it is not issued, the hop limit is set to 1.

The optvalue parameter can have the following values:
- 1: The default value for the stack is used.
- 0-255: The hop limit.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Restriction:** An application must be APF authorized to set the hop limit value to be greater than the TCP/IP default value. This option is not valid when used in CICS applications. CICS applications cannot run as APF authorized.
IPV6_V6ONLY
(IPv6-only) Restricts a socket to sending and receiving IPv6 packets only. By default, a socket is not restricted. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

MCAST_BLOCK_SOURCE
Enables an application to block multicast packets from a specific source address. The multicast group must have been previously joined. The optvalue parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address using the NAME string. The following string is an example of what might be coded for the optvalue parameter:

"45 AF_INET6 54666 0 FF02::32:1 0 AF_INET6 0 0 2001:10:11:107::1 0"

For more information about the format of the NAME string, see “How structures are represented” on page 663. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_JOIN_GROUP
Enables an application to join a multicast group on a specific interface. Only applications that want to receive multicast datagrams need to join multicast groups. The optvalue parameter must be a string that contains the interface index and a multicast address. Specify the multicast address using the socket address name format. The following string is an example of what you can code for the optvalue parameter:

"45 AF_INET 1234 224.224.224.1"

For more information about the format of the NAME string, see “How structures are represented” on page 663. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_JOIN_SOURCE_GROUP
Enables an application to join a source multicast group on a specific interface and source address. Only applications that want to receive multicast datagrams need to join source multicast groups. The optvalue parameter must be a string that contains the interface index, the multicast address, and the source address. Specify the multicast address and source address the using socket address name format. The following string is an example of what you can code for the optvalue parameter:

"45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 0 0 2001:10:11:107::1 0"

For more information about the format of the NAME string, see “How structures are represented” on page 663. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_LEAVE_GROUP
Enables an application to leave a multicast group or to leave all source multicast groups. The optvalue parameter must be a string that contains
the interface index and the multicast address; specify the multicast
address using the socket address name format. The following string is
an example of what you can code for the optvalue parameter:

"45 AF_INET6 1234 0 FF02::123:1 0"

For more information about the format of the NAME string, see “How
structures are represented” on page 663. This option returns 0 if it is
successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_LEAVE_SOURCE_GROUP
Enables an application to leave a source multicast group. The optvalue
parameter must be a string that contains the interface index, the
multicast address, and the source address. Specify the multicast
address and source address using the socket address name format. The
following string (all on one line) is an example of what you can code
for the optvalue parameter:

"45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 1234 0
2001:10:11:103::1 0"

For more information about the format of the NAME string, see “How
structures are represented” on page 663. This option returns 0 if it is
successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

MCAST_UNBLOCK_SOURCE
Enables an application to unblock multicast packets that are sent from
a specific address. The multicast group must have been previously
blocked. The optvalue parameter must be a string that contains the
interface index, the multicast address, and the source address. Specify
the multicast address and source address using the socket address
name format. The following string is an example of what you can code
for the
optvalue
parameter:

"45 AF_INET6 1234 0 FF02::123:1 0 AF_INET6 1234 0 2001:10:11:103::1 0"

For more information about the format of the NAME string, see “How
structures are represented” on page 663. This option returns 0 if it is
successfully completed; otherwise, it returns the error number.

Tip: This option is valid for both IPv4 and IPv6.

Restriction: Only one source address can be specified in a call.

SO_ASCII
(REXX only) Enables all incoming data to be translated from ASCII to
EBCDIC, and all outgoing data to be translated from EBCDIC to ASCII.
The optvalue parameter must be one of the following values: 0
(disabled) or 1 (enabled). This option returns a string that contains the
error code and either ON (enabled) or OFF (disabled). If the option is
enabled, the name of the translation table is returned also. The following string is an example of what might be returned: 0 ON MYTRANTB.

The translation tables are searched in the following order:
1. user_prefix.subtaskid.TCPXLBIN
2. user_prefix.userid.TCPXLBIN
3. system_prefix.STANDARD.TCPXLBIN
4. system_prefix.RXSOCKET.TCPXLBIN
5. Internal tables

The following descriptions apply:
- The user_prefix value is either the user ID or the job name of the REXX program.
- The system_prefix value is either TCPIP or the DATASETPREFIX value from the hlq.TCPIP.DATA. You can change the system_prefix value to match your site convention.
- The subtaskid value is the name of the socket set.
- The userid value is the user ID under which the REXX EXEC is running.

When the internal tables are used, the data is converted in the following way:
<table>
<thead>
<tr>
<th>ASCII to EBCDIC</th>
<th>second hex digit of byte of ASCII data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>F0</td>
</tr>
<tr>
<td>4</td>
<td>7C</td>
</tr>
<tr>
<td>5</td>
<td>0D</td>
</tr>
<tr>
<td>6</td>
<td>79</td>
</tr>
<tr>
<td>7</td>
<td>97</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>A</td>
<td>41</td>
</tr>
<tr>
<td>B</td>
<td>58</td>
</tr>
<tr>
<td>C</td>
<td>76</td>
</tr>
<tr>
<td>D</td>
<td>9F</td>
</tr>
<tr>
<td>E</td>
<td>BB</td>
</tr>
<tr>
<td>F</td>
<td>DC</td>
</tr>
</tbody>
</table>

Figure 142. ASCII to EBCDIC
### EBCDIC to ASCII

<table>
<thead>
<tr>
<th>EBCDIC to ASCII</th>
<th>second hex digit of byte of EBCDIC data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>9</td>
<td>90</td>
</tr>
</tbody>
</table>

#### Figure 143. EBCDIC to ASCII

**SO_BROADCAST**

Enables a program to send broadcast messages over the socket to destinations that can receive datagram messages. By default, this option is disabled. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Restriction:** This option is not valid for stream sockets.

**SO_DEBUG**

(REXX only) Control whether debugging information is recorded. By default, this option is disabled. The optvalue parameter must be either ON (enabled) or OFF (disabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number. This option is valid only for stream sockets.

**SO_DONTROUTE**

Bypasses normal routing algorithms for outgoing packets on the socket. If the local interface cannot be determined, when a packet is sent using one of the SEND commands, then the 51 ENETUNREACH error number is returned. This option returns either 1 (enabled) or 0 (disabled).
SO_EBCDIC
(REXX only) Enables data to be translated to and from EBCDIC. This option is ignored by EBCDIC hosts. The optvalue parameter must be either ON (enabled) or OFF (disabled). This option returns a string that contains the error code and either ON (enabled) or OFF (disabled). If the option is enabled, the name of the translation table is returned also. The following string is an example of what might be returned:
0 ON MYTRANTB

SO_KEEPALIVE
Sets the keep alive mechanism to periodically send a packet on an otherwise idle connection for a stream socket. By default, this option is disabled. When enabled, if the remote TCP/IP does not respond to the packet or to retransmissions of the packet, then the connection is terminated with the ETIMEOUT error. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Tip: You also can enable the keep alive mechanism by modifying the TCP/IP.PROFILE file.

SO_LINGER
Specifies how TCP/IP processes data that has not been transmitted when the CLOSE command is issued for the socket. When this option is enabled and the CLOSE command is issued, the calling program is blocked until either the data is successfully transmitted or the connection times out. When this option is disabled and the CLOSE command is issued, the CLOSE command returns without blocking the caller; then, TCP/IP continues to attempt to send data for a specified time, which usually provides sufficient time to complete the data transfer. By default, this option is disabled.

The optvalue parameter is a string in the following format:
linger = "onoff lertime"

where
- The onoff value is either 0 (disabled) or 1 (enabled).
- The lertime value is the number of seconds that TCP/IP tries to send data after the CLOSE command is issued.

This option returns 0 if it is successfully completed; otherwise, it returns the error number.

Restrictions:
- Using the SO_LINGER option does not guarantee that a data transfer will be completed, because TCP/IP waits only the amount of time that is specified.
- This option is valid only for stream sockets.

Guidelines:
- Avoid setting a linger time of 0. If you set the linger time to 0, the connection stops rather than closing in an orderly manner. This results in a RESET segment being sent to the connection partner. If the aborting socket is
in nonblocking mode, the CLOSE command is processed as though no linger option is set.

- Enable the SO_LINGER option only when necessary.

**SO_OOBINLINE**

Controls whether out-of-band data is received. When this option is enabled, out-of-band data is placed in the normal data input queue as it is received; this data is then available to RECV or RECVFROM commands, even if the OOB flag is not set. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received; this data is then available to RECV or RECVFROM commands only if the OOB flag is set. By default, this option is disabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Restriction:** This option is valid only for stream sockets.

**SO_RCVBUF**

Controls the size of the data portion of the TCP/IP receive buffer. The size of the receive buffer is protocol specific and is based on the following values:

- (TCP socket) The TCPRCVBufrsize keyword on the TCPCONFIG statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufrsize keyword on the UDPCONFIG statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size 65535.

The *optvalue* parameter must be either 0 (disabled) or a positive integer that specifies the size of the TCP/IP receive buffer. If you disable this option, the default system setting is used. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**SO_REUSEADDR**

Controls whether local addresses are reused. Enabling this option alters the normal algorithm that is used with the BIND command. The normal BIND algorithm permits each Internet address and port combination to be bound only once. If the address and port already have been bound, a subsequent BIND command fails with the 48 EADDRINUSE error. When this option is enabled, the following situations are supported:

- A server can bind the same port multiple times, if each invocation uses a different local IP address and the wild card address INADDR_ANY is used only one time for each port.
- A server with active client connections can be restarted and can bind to its port without having to close all of the client connections.
- For datagram sockets, multicasting is supported so that multiple BIND commands can be made to the same class D address and port number.

By default, this option is disabled. The *optvalue* parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

**Tip:** If you want to permit multiple servers to bind to INADDR_ANY or IN6ADDR_ANY and listen on the same port, use the SHAREPORT option on the PORT statement in TCPIP.PROFILE.
SO_SNDBUF
Controls the size of the data portion of the TCP/IP send buffer. The size of the send buffer is protocol specific and is based on the following values:
- (TCP socket) The TCPRCVBufsize keyword on the TCPCONF1G statement in the PROFILE.TCPIP data set.
- (UDP socket) The UDPRCVBufsize keyword on the UDPCONF1G statement in the PROFILE.TCPIP data set.
- (Raw socket) The default size 65 535.

The optvalue parameter must be either 0 (disabled) or a positive integer that specifies the size of the TCP/IP send buffer. If you disable this option, the default system setting is used. This option returns 0 if it is successfully completed; otherwise, it returns the error number.

TCP_KEEPALIVE
Specifies whether a socket-specific timeout value (in seconds) is used instead of a configuration-specific value, when keep alive timing is active for the socket. When enabled, the socket-specific timeout value remains in effect until either the socket is closed or it is reset by a SETSOCKOPT command. The optvalue parameter must be either 0 (disabled) or the keep alive value. This options returns a string that contains the return code and the keep alive value. If the option is disabled, the keep alive value is 0.

TCP_NODELAY
Specifies whether the data that is sent over the socket is subject to the Nagle algorithm (RFC 896). When this option is enabled, TCP waits to send small amounts of data until the acknowledgment for the previous data sent is received. When this option is disabled, TCP sends data when it is presented. The optvalue parameter must be one of the following values: 0 (disabled) or 1 (enabled). This option returns 0 if it is successfully completed; otherwise, it returns the error number.

optvalue
Additional information that is needed to run the requested command.

Returned value
The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See Appendix B, "Return codes," on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
- 9 EBADF
- 22 EINVAL
- 38ENOTSOCK
- 42ENOPROTOOCT
- 45ENOPNOTSUPP
- 60ETIMEDOUT

The following REXX socket API error numbers can be returned:
LE C/C++ equivalent

```c
int setsockopt(int socket, int level, int option_name, char *option_value,
               int *option_length);
```

Code example

See the EZARXS01 REXX sample in the SEZAINST file for an example of using the
SETSOCKOPT command.

SHUTDOWN

Use the SHUTDOWN command to shut down all or part of a duplex connection.

Format

```
>>-SOCKET-("SHUTDOWN", socketid, how)
```

Parameters

`socketid`

The socket descriptor of the connected socket.

`how`

Specifies which operations are to be ended. The following parameters are supported:

- **BOTH** Ends further send and receive operation on the socket. By default, this is the value of the `how` parameter. The value 2 is supported also.
- **SEND** Ends further send operations on the socket. The following values are supported also: 1, TO, SENDING, WRITE, WRITING.
- **READ** Ends further receive operations on the socket. The following values are supported also: 0, FROM, READING, RECEIVE, RECEIVING.

Returned value

The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP
The following REXX socket API error numbers can be returned:

- 2001 EINVALDRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALNAME

**LE C/C++ equivalent**

```c
long shutdown(int *s, int how);
```

**Code example**

See the EZARXS02 REXX sample in the SEZAINST file for an example of using the SHUTDOWN command.

**SOCKET**

Use the SOCKET command to open a socket descriptor in the active socket set.

**Restriction:** If the socket type is SOCK_RAW or RAW, the user ID associated with the REXX socket application must have z/OS UNIX System Services superuser authority. The user ID must have the UID value 0 or have read access to the BPX.SUPERUSER security profile. An application can attempt to obtain superuser authority by issuing the z/OS UNIX System Services SYSCALLS command: address syscall 'SETEUID 0'. If this command fails, the user ID does not have the authorization needed to run the program; contact your security administrator.

**Format**

```bash
SOCKET(--"SOCKET" [AF_INET, domain] [STREAM, type] [0, protocol])
```

**Parameters**

**domain**

The address family of the socket. The supported families are AF_INET (2) and AF_INET6 (19). By default, the domain parameter is set to AF_INET.

**type**

An optional parameter that specifies the type of socket to be created. By default, this parameter is set to STREAM. The following values are supported:

- STREAM or SOCK_STREAM
- DATAGRAM or SOCK_DATAGRAM
- RAW or SOCK_RAW

**protocol**

An optional parameter that specifies the protocol that is requested. By default, the value to which this parameter is set depends on the type parameter. The default protocol for stream sockets is TCP. The default protocol for datagram sockets is UDP. There is no default for RAW sockets. To enable the stack to select the applicable protocol, set the protocol parameter to 0.

The following protocols are supported:
Stream sockets
  IPPROTO_TCP or TCP

Datagram sockets
  IPPROTO_UDP or UDP

RAW sockets
  - IPPROTO_IP or IP
  - IPPROTO_IPV6 or IPV6
  - IPPROTO_ICMP or ICMP
  - IPPROTO_ICMPV6 or ICMPV6
  - IPPROTO_RAW or RAW

Returned value

The command returns a string that contains the return code and the new socket
descriptor, for example, 0 6. The return code can be 0, a REXX socket API error
number, or the REXX TCP/IP error number that is set by the socket command. The
return code 0 indicates that the requested socket command was completed
successfully.

See [Appendix B, “Return codes,” on page 835] for additional information about the
numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:
  - 9 EBADF
  - 22 EINVAL
  - 38 ENOTSOCK
  - 45 EOPNOTSUPP
  - 139 EPERM

The following REXX socket API error numbers can be returned:
  - 2001 EINVALRXSOCKETCALL
  - 2005 ESUBTASKNOTACTIVE
  - 2007 EMAXSOCKETSREACHED

LE C/C++ equivalent

int socket(int *domain, int type, int protocol);

Code example

/*  REXX EZARXR26 */
/*
 *  This sample demonstrates the use of the SOCKET
 *  socket command.
 *
 *  HINT: See other socket command descriptions for
 *         additional examples.
 */
src=SOCKET("initialize","myset01",20);
src=SOCKET("socket","af_INET","stream")
parse var src l_retcode l_socketid
if l_retcode = 0 then do
  Say "Socket Created Successfully. Socket descriptor is" l_socketid;
src=SOCKET("close",l_socketid);
parse var src l_retcode .
if l_retcode = 0 then
say "Socket "l_socketid" closed successfully";
else do
  say "Close of socket "l_socketid" failed.";
  say src;
end;
end;
else do
  Say "Socket not created."
  Say "..."src;
end;
x=SOCKET("TERMINATE","MYSET01");
exit;

**SOCKETSET**

Use the SOCKETSET command to retrieve the name of the active socket set. If you specify the name of a socket set as a parameter, then that socket set becomes the active socket set.

**Format**

```plaintext
SOCKET("SOCKETSET",subtaskid)
```

**Parameters**

*subtaskid*

The name of a socket set that was created with the INITIALIZE command.

**Returned value**

The command returns a string that contains the return code and the name of the active socket set, for example, 0 MYSET. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error number can be returned:

* None

The following REXX socket API error number can be returned:

* 2005 ESUBTASKNOTACTIVE

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

```rexx
/*  REXX EZARXR27 */
/*
 * This sample demonstrates the use of the SOCKET
 * socket command.
 */
src=socket("INITIALIZE","MYSET");
```
**SOCKETSETLIST**

Use the SOCKETSETLIST command to list the names of all available socket sets that are currently defined by the application.

**Rule:** All sockets sets are created with the INITIALIZE command.

**Format**

>>-SOCKET-("SOCKETSETLIST")

**Parameters**

This command has no parameters.

**Returned value**

If socket sets are defined, this command returns a string that contains 0 and names of the socket sets that are available to the application, for example, 0 subtask1 subtask2. If no socket sets are defined, 0 is returned.

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

```rexx
/* REXX E2ARXR28 */
/* *
* This program demonstrates the use of the SOCKETSETLIST
* socket command. The program will initialize two socket
* sets and then issue the SOCKETSETLIST command to obtain
* some information.
* */
src1=SOCKET("INITIALIZE","MYSET01",10);
Say "RC of INITIALIZATION of MYSET01 = "src1"
src2=SOCKET("INITIALIZE","MYSET02",29);
Say "RC of INITIALIZATION of MYSET02 = "src2"
src=SOCKET("SOCKETSETLIST");
parse var src l_retcode l_socketsets;
Say "Socket sets available are: "l_socketsets;
src=SOCKET("TERMINATE","MYSET01");
src=SOCKET("TERMINATE","MYSET02");
EXIT 0;
```

**SOCKETSETSTATUS**

Use the SOCKETSETSTATUS command to list information about a socket set.

**Format**

>>-SOCKET-("SOCKETSETSTATUS",subtaskid)

```rexx```
Parameters

subtaskid
An optional parameter that specifies the name of the socket set. If this parameter is not specified, then the SOCKETSETSTATUS command returns the status of the active socket set.

Returned value

The command returns a string that contains the return code, the name of the socket set, the state of the socket set, the number of sockets that are available for use, and the number of sockets that currently are being used. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

The state of a socket set is one of the following values:

CONNECTED
Indicates that the socket set has been initialized with the INITIALIZE command

SEVERED
Indicates that the socket set has been initialized using the INITIALIZE command, but a problem exists with the socket set

FREE
Indicates that the socket set has not been initialized

The following string is an example of what is returned by the SOCKETSETSTATUS command:

0 MYSET Connected Free 15 Used 1

In the example, 0 is the return code, MYSET is the name of the socket set, CONNECTED is the status of the socket set, 15 is the number of the free sockets, and 1 is the number of sockets that are in use.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error number can be returned:

- 2005 ESUBTASKNOTACTIVE

LE C/C++ equivalent

This command has no LE C/C++ equivalent.

Code example

/* REXX EZARXR29 */
/*
 * This sample demonstrates the use of the SOCKETSTATUS socket command. Error checking is not performed for the socket commands as the intent is to show what the command will return when multiple INITIALIZE commands are issued.
 */
x1=socket("INITIALIZE","MYTEST",15);
x2=socket("SOCKETSET");
x3=socket("SOCKETSETSTATUS");
x4=socket("SOCKET","AF_INET");
parse var x4 l_retcode l_x4_socketid;
if l_retcode = 0 then do
x5=socket("SOCKETSETSTATUS");
Say "FIRST INITIALIZE command:"
Say " INITIALIZE = "x1;
Say " SOCKETSET = "x2;
Say " SOCKETSETSTATUS = "x3;
Say " SOCKET = "l_retcode l_x4_socketid;
Say " SOCKETSETSTATUS = "x5;
Say "*** END";
y1=socket("INITIALIZE","REXXSET",15);
y2=socket("SOCKETSET");
y3=socket("SOCKETSETSTATUS");
y4=socket("SOCKETSETSTATUS","MYTEST");
y5=socket("SOCKET","AF_INET");
parse var y5 l_retcode l_y5_socketid;
if l_retcode = 0 then do
  y6=socket("SOCKETSETSTATUS");
  Say "SECOND INITIALIZE command:"
  Say " INITIALIZE = "y1;
  Say " SOCKETSET = "y2;
  Say " SOCKETSETSTATUS = "y3;
  Say " SOCKETSETSTATUS = "y4;
  Say " SOCKET = "l_retcode l_y5_socketid
  Say " SOCKETSETSTATUS = "y6;
  Say "*** END"
  rc2=socket("CLOSE",l_y5_socketid);
  say "rc2 = "rc2;
x=xsocket("SOCKET","AF_INET");
ex=socket("SOCKET","AF_INET");
ex=socket("TERMINATE","MYTEST");
ex=socket("TERMINATE","REXXSET");
exit;

TAKESOCKET

Use the TAKESOCKET command to take a socket descriptor that is passed from
another program using the GIVESOCKET command. A socket descriptor can be
taken by an application only when the socket is in the same address family.

Guidelines: An application that issues the TAKESOCKET command needs to
know both the client ID of the application that issued the
GIVESOCKET command and the socket descriptor that was passed.
REXX provides several techniques that can be used to pass this
information to the application that issues the TAKESOCKET
command:

- When the application that issues the GIVESOCKET command also
  will be the application to issue the TAKESOCKET command, the
  client ID and socket descriptor can be passed between the routines
  that are responsible for the two commands using standard REXX
  programming techniques. In this situation, consider setting the
  socket to nonblocking mode to permit additional socket processing
  to occur as needed. Use the SELECT command to determine when
  a socket is ready or when an exception occurred. Use this technique
  primarily during application development. If the socket descriptor
  is never given to a different application or subtask, avoid using the
  GIVESOCKET or TAKESOCKET commands.

- When the application that will take the socket descriptor is running
  in a different address space, consider using the following methods
to pass the information:
Pass the clientid value through the program startup parameters or by using an external input stream.

Use the z/OS UNIX System Services SYSCALLS interface and named pipes.

**Format**

```
--SOCKET--("TAKESOCKET",--clientid--,--socketid--)
```

**Parameters**

*clientid*

Identifies the application that issued the GIVESOCKET command. The clientid parameter has the following format:

```
clientid = "domain jobname substaskid"
```

All three fields are required:

*domain*

The address family of the socket. The supported families are AF_INET (2) and AF_INET6 (19).

*jobname*

The job name of the application that issued the GIVESOCKET command.

*substaskid*

The name of the socket set used by the application that issued the GIVESOCKET command.

*socketid*

The socket descriptor that was given by the application that issued the GIVESOCKET command.

**Returned value**

The command returns a string that contains the return code and the socket descriptor, for example, 0 1. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.

**Tip:** The 13 EACCESS return code indicates that the application that issued the TAKESOCKET command is not authorized to take the socket descriptor. The jobname field of the clientid parameter for the GIVESOCKET command must match the jobname field of the clientid parameter for the TAKESOCKET command.

See Appendix B, “Return codes,” on page 835 for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 9 EBADF
- 13 EACCESS
- 22 EINVAL
- 38 ENOTSOCK
- 45 EOPNOTSUPP
The following REXX socket API error numbers can be returned:

- 2001 EINVALRXXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED
- 2012 EINVALIDNAME

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

See the EZARXS06 REXX sample in the SEZAINST file for an example of using the TAKESOCKET command.

**TERMINATE**

Use the TERMINATE command to close all sockets in the specified socket set and to release the socket set.

A socket set is a number of preallocated sockets available to a single application. You can define multiple socket sets for one session, but only one socket set can be active at a time. When the active socket set is released, the next socket set in the stack becomes the active socket set.

**Format**

```
$socket(--"TERMINATE",--subtaskid
```

**Parameters**

*subtaskid*

An optional parameter that specifies the name of the socket set. If this parameter is not specified, then the active socket set is released.

**Returned value**

The command returns a string that contains the return code and the name of the socket set, for example, 0 MYTASKID. The return code can be 0 or the REXX API error number. The return code 0 indicates that the requested socket command was completed successfully.

See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.
**Code example**

```rexx
/* REXX EZARXR30 */
/*
 * This sample demonstrates the use of the TERMINATE
 * socket command.
 */
src = socket("INITIALIZE","MYSET01",10);
if word(src,1) = 0 then say "INITIALIZE SUCCESSFUL";
src = socket("TERMINATE", "MYSET01");
say "TERMINATE = " src;
exit 0;
```

**VERSION**

Use the VERSION command to retrieve the name, version number, and version date of the REXX socket library.

**Format**

```
S|-----SOCKET----("VERSION")-----|
```

**Parameters**

This command has no parameters.

**Returned value**

The command returns a string that contains the return code, version name, version number, and version date, for example, 0 REXX/SOCKETS z/OS V1R9 April 20, 2006. A return code of 0 indicates that the requested socket command was completed successfully.

**LE C/C++ equivalent**

This command has no LE C/C++ equivalent.

**Code example**

```rexx
/* REXX EZARXR31 */
/*
 * This sample demonstrates the use of the VERSION
 * socket command.
 */
src = socket("VERSION");
say "Version = " src;
exit 0;
```

**WRITE**

Use the WRITE command to send an outgoing message on the connected socket. The WRITE command is similar to the SEND command, except that the WRITE command does not support the control flags that are available with the SEND command.

When the socket is a TCP socket, the following conditions apply:

- If the socket is in blocking mode and the total amount of data to be sent cannot be processed by the stack when the command is issued, then the command blocks until the data can be sent.
- If the socket is in nonblocking mode and the total amount of data to be written cannot be processed by the stack when the command is issued, then the command returns the number of bytes that were successfully written. If none of the data can be written, the command returns the value -1 and the 35 EWOULDBLOCK error code.

When the socket is a connected UDP socket, the WRITE command either is completed or fails. A connected UDP socket does not return the 35 EWOULDBLOCK error code.

**Restriction:** The WRITE command does not support send flags.

**Guidelines:** Place the WRITE command in a loop to ensure that all the data is written. For a TCP socket, a partial write operation might occur regardless of whether the socket is in blocking or nonblocking mode. A partial write operation occurs when the stack copies some but not all of the application data:

- If a partial write operation occurs on a socket in blocking mode, the blocking socket is interrupted. The return value contains the number of bytes written, and the return code contains the reason for the interruption. In such cases, consider ending the connection.
- If a partial write operation occurs on a socket in nonblocking mode, the return value indicates the number of bytes that were successfully sent. If this is less than the number of bytes specified on the WRITE command, repeat the WRITE operation until all data is written. The blocking condition might last for a long time, so consider other strategies to ensure that the application does not remain in a busy loop sending data.

**Tips:**
- Use the SELECT command to determine whether a socket is ready to send additional data. To do so, test the socket for a WRITE event.
- If the SO.ASCII socket option is enabled, then the data received is translated from EBCDIC to ASCII.

**Format**

```
[ ]`SOCKET(-"WRITE",socketid,data)……………………………………….`
```

**Parameters**

- **socketid**
  - The socket descriptor
- **data**
  - The string to be sent

**Returned value**

The command returns a string that contains the return code and the length of the data string, for example, 0 19. The return code can be 0, a REXX socket API error number, or the REXX TCP/IP error number that is set by the socket command. The return code 0 indicates that the requested socket command was completed successfully.
See [Appendix B, “Return codes,” on page 835](#) for additional information about the numeric error codes that are returned by this command.

The following REXX TCP/IP error numbers can be returned:

- 4 EINTR
- 9 EBADF
- 5 EIO
- 22 EINVAL
- 32 EPIPE
- 35 EWOULDBLOCK
- 38 ENOTSOCK
- 40 EMSGSIZE
- 45 EINOTSOCK
- 54 ECONNRESET
- 57 ENOTCONN

The following REXX socket API error numbers can be returned:

- 2001 EINVALRXSOCKETCALL
- 2005 ESUBTASKNOTACTIVE
- 2009 ESOCKETNOTDEFINED

**LE C/C++ equivalent**

```c
ssize_t send(int socket, const void *buffer, size_t length, int flags);
```

**Code example**

See the SEND command. Substitute the command WRITE for the command SEND.

---

**REXX socket sample programs**

This section provides information about the sample programs that show how to use the REXX socket API. These programs are provided as is.

**Overview of REXX sample programs**

The sample programs and the jobs that you can use to run them are located in the SEZAINST file.

The following information applies to the batch jobs:

- The batch job REXXAPI runs standalone socket EXECs and TCP/IP clients.
- The batch job REXXAPIS runs TCP/IP servers.
- The batch job REXXAPIT runs the subtask that is required to test the REXAPI04 program.
<table>
<thead>
<tr>
<th>Name</th>
<th>REXX EXEC</th>
<th>MVS batch job</th>
<th>APIs demonstrated</th>
<th>Notes</th>
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<tbody>
<tr>
<td>EZARXS01</td>
<td>REXAPI01</td>
<td>REXXAPI</td>
<td>INITIALIZE SOCKET GETSOCKOPT SETSOCKOPT CONNECT GETSOCKNAME SEND RECV TERMINATE</td>
<td>Client, requires server REXAPI05</td>
</tr>
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<td>EZARXS02</td>
<td>REXAPI02</td>
<td>REXXAPI</td>
<td>INITIALIZE SOCKET CONNECT GETSOCKNAME SEND RECV SHUTDOWN TERMINATE</td>
<td>Client, requires server REXAPI05</td>
</tr>
<tr>
<td>EZARXS03</td>
<td>REXAPI03</td>
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<td>INITIALIZE SOCKET CONNECT IOCTL SEND RECV CLOSE TERMINATE</td>
<td>Client, uses server REXAPI05 or REXAPI04 demonstrating AT-TLS</td>
</tr>
<tr>
<td>EZARXS04</td>
<td>REXAPI04</td>
<td>REXXAPIS</td>
<td>INITIALIZE SOCKET BIND LISTEN ACCEPT GETCLIENTID GIVESOCKET SELECT CLOSE</td>
<td>Server, not enabled for AT-TLS</td>
</tr>
<tr>
<td>EZARXS05</td>
<td>REXAPI05</td>
<td>REXXAPIT</td>
<td>INITIALIZE SOCKET BIND LISTEN ACCEPT IOCTL SEND RECV CLOSE TERMINATE</td>
<td>Server, supports AT-TLS</td>
</tr>
<tr>
<td>EZARXS06</td>
<td>REXAPI06</td>
<td>REXXAPIT</td>
<td>INITIALIZE TAKESOCKET GETPEERNAME SEND RECV CLOSE TERMINATE</td>
<td>Child server subtask</td>
</tr>
<tr>
<td>Name</td>
<td>REXX EXEC</td>
<td>MVS batch job</td>
<td>APIs demonstrated</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
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<td>---------------</td>
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</tr>
<tr>
<td>EZARXRSC</td>
<td>RSCLIENT</td>
<td>REXXAPI</td>
<td>INITIALIZE, GETHOSTID, SOCKET, GETHOSTNAME, CONNECT, WRITE, READ, TERMINATE, SOCKETSETSTATUS</td>
<td>IPv4 client</td>
</tr>
<tr>
<td>EZARXR6C</td>
<td>R6CLIENT</td>
<td>REXXAPI</td>
<td>INITIALIZE, GETHOSTID, SOCKET, GETHOSTNAME, GETADDRINFO, CONNECT, WRITE, READ, TERMINATE, SOCKETSETSTATUS</td>
<td>IPv6 client</td>
</tr>
<tr>
<td>EZARXSS</td>
<td>RSSERVER</td>
<td>REXXAPIIS</td>
<td>INITIALIZE, GETHOSTNAME, SOCKET, BIND, LISTEN, IOCTL, SELECT, ACCEPT, RECV, CLOSE, SEND, TERMINATE, SETSOCKETSTATUS</td>
<td>IPv4 server</td>
</tr>
<tr>
<td>EZARXR6S</td>
<td>R6SERVER</td>
<td>REXXAPI</td>
<td>INITIALIZE, GETHOSTNAME, SOCKET, BIND, LISTEN, IOCTL, SELECT, ACCEPT, GETNAMEINFO, RECV, CLOSE, SEND, TERMINATE, SETSOCKETSTATUS</td>
<td>IPv6 server</td>
</tr>
<tr>
<td>EZARXJ01</td>
<td>n/a</td>
<td>REXXAPI</td>
<td>MVS sample job control</td>
<td>MVS job control for REXXAPI</td>
</tr>
<tr>
<td>EZARXJ02</td>
<td>n/a</td>
<td>REXXAPIS</td>
<td>MVS sample job control</td>
<td>MVS job control for REXXAPIS</td>
</tr>
<tr>
<td>EZARXJ03</td>
<td>n/a</td>
<td>REXXXAPIT</td>
<td>MVS sample job control</td>
<td>MVS job control for REXXXAPIT</td>
</tr>
</tbody>
</table>
The REXX-EXEC RSCLIENT sample program for IPv4

The client sample program is a REXX socket program that shows you how to use the commands that are provided by the REXX sockets API. The program connects to the server sample program and receives data, which is displayed on the screen. It uses sockets in blocking mode.

After parsing and testing the input parameters, the RSCLIENT EXEC program obtains a socket set using the INITIALIZE command and a socket using the SOCKET command. The program then connects to the server and writes the user ID, the node ID, and the number of lines requested on the connection to the server. It reads data in a loop; the data is displayed on the screen until the data length is 0, which indicates that the server has closed the connection. If an error occurs, the client program lists the return code, determines the status of the socket set, and ends the socket set.

The server adds the EBCDIC new-line character to the end of each record, and the client uses this character to determine the start of a new record. If the connection is abnormally closed, the records that were partially received are not displayed.

The REXX-EXEC RSSERVER sample program for IPv4

The server sample program shows an example of how to use sockets in nonblocking mode. The program waits for connect requests from client programs, accepts the requests, and then sends the data. The sample can handle multiple client requests in parallel processing.

The server program sets up a socket to accept connection requests from clients and then waits in a loop for events reported by the SELECT command. If a socket event occurs, it is processed. A read event can occur on the original socket for accepting connection requests and on sockets for accepted socket requests. A write event can occur only on sockets for accepted socket requests.

A read event on the original socket for connection requests means that a connection request from a client occurred. Read events on other sockets indicate that there is either data to receive or that the client has closed the socket. Write events indicate that the server can send more data. The server program sends only one line of data in response to a write event.

The server program keeps a list of sockets to which it wants to write. It keeps this list to avoid unwanted socket events. The TCP/IP protocol is not designed for one single-threaded program communicating on many different sockets, but for multithread applications where one thread processes only the events that originate from a single socket.

The REXX-EXEC R6CLIENT sample program for IPv6

The client sample program is a REXX socket program that shows you how to use the commands that are provided by the REXX sockets API. The program connects to the server sample program and receives data, which is displayed on the screen. It uses sockets in blocking mode.

After parsing and testing the input parameters, the R6CLIENT EXEC sample program obtains a socket set using the INITIALIZE command and a socket using the SOCKET command. The program then connects to the server and writes the user ID, the node ID, and the number of lines requested on the connection to the
server. It reads data in a loop; the data is displayed on the screen until the data
length is 0, which indicates that the server has closed the connection. If an error
occurs, the client program lists the return code, determines the status of the socket
set, and ends the socket set.

The server adds the EBCDIC new-line character to the end of each record, and the
client uses this character to determine the start of a new record. If the connection is
abnormally closed, the partially received records are not displayed.

**The REXX-EXEC R6SERVER sample program for IPv6**

The server sample program shows an example of how to use sockets in
nonblocking mode. The program waits for connect requests from client programs,
accepts the requests, and then sends data. The sample can handle multiple client
requests in parallel processing.

The server program sets up a socket to accept connection requests from clients and
waits in a loop for events that are reported by the SELECT command. If a socket
event occurs, it is processed. A read event can occur on the original socket for
accepting connection requests and on sockets for accepted socket requests. A write
event can occur only on sockets for accepted socket requests.

A read event on the original socket for connection requests means that a
connection request from a client occurred. Read events on other sockets indicate
that there is either data to receive or that the client has closed the socket. Write
events indicate that the server can send more data. The server program sends only
one line of data in response to a write event.

The server program keeps a list of sockets to which it wants to write. It keeps this
list to avoid unwanted socket events. The protocol is not designed for one
single-threaded program communicating on many different sockets, but for
multithread applications where one thread processes events only from a single
socket.

**AT-TLS security definitions for REXX samples**

When Application Transparent Transport Layer Security (AT-TLS) is enabled on the
TCP/IP stack, you must define the REXX sample applications to the Policy Agent.

The user must supply the necessary key rings. For information about creating
certificates and key rings, see the TLS/SSL security information in z/OS
Communications Server: IP Configuration Guide. These AT-TLS security definitions
assume that the REXXAPI and REXXAPIS sample jobs are being used.

**Running the REXX sample programs**

This topic describes how to run the REXX sample programs.

To run the REXX sample programs, complete the following steps:
1. Uncomment the MVS job control EXEC card.
2. Run the REXX EXEC.

**Testing the GIVESOCKET and TAKESOCKET commands**

This topic describes how to test the GIVESOCKET and TAKESOCKET commands
using the sample programs.
To test the GIVESOCKET and TAKESOCKET commands, complete the following steps:

1. Uncomment REXAPI04 from the job REXXAPIS and submit the sample job control to the JES reader.
2. Submit job REXXAPI using REXAPI03.
3. Submit REXXAPIT. REXXAPIT assumes that the socket being passed is 3 and that the client ID is AF_INET6 REXAPI TCPSVT.
Chapter 15. Pascal application programming interface

This section describes the Pascal language for IPv4 socket application program interface (API) provided with TCP/IP. This interface allows programmers to write application programs that use the TCP, UDP, and IP layers of the TCP/IP protocol suite. Topics include:

- Software requirements
- Data structures
- Using procedure calls
- Pascal return codes
- Procedure calls
- Sample Pascal program

To use the Pascal language API, you should have experience in Pascal language programming and be familiar with the principles of internetwork communication.

Your program uses procedure calls to initiate communication with the TCP/IP address space. Most of these procedure calls return with a code that indicates success or the type of failure incurred by the call. The TCP/IP address space starts asynchronous communication by sending you notification.

Note: The Pascal API will not be enhanced for IPv6 support.

Steps for procedure calls

Before you begin: To use the Pascal language API, you should have experience in Pascal language programming and be familiar with the principles of internetwork communication.

Perform the following steps to write the Pascal program.

1. Start TCP/UDP/IP service (BeginTcpIp).
2. Specify the set of notifications that TCP/UDP/IP can send you (Handle).
3. Establish a connection (TcpOpen, UdpOpen, RawIpOpen, and TcpWaitOpen).
   Note: If using TcpOpen, communication must wait for the appropriate notification of connection.
4. Transfer a data buffer to or from the TCP/IP address space (TcpSend, TcpFSend, TcpWaitSend, TcpReceive, TcpFReceive, TcpWaitReceive, UdpSend, UdpNReceive, RawIpSend, UdpReceive, and RawIpReceive).
   Notes:
   a. TcpWaitReceive and TcpWaitSend are synchronous calls.
   b. TcpFSend and TcpSend are the asynchronous ways of sending data on a TCP connection. Both procedures return to your program immediately. TcpSend does not wait under any circumstance.
c. TcpSend and TcpFSend differ in how they handle the situation when
TCP/IP address space has insufficient buffer space to accept the data being
sent.

d. In the case of insufficient buffer space, TCP/IP responds to TcpSend with
the return code NObufferSPACE. This return code is sent back to the
application. It is the application’s responsibility to wait for
BUFFERspaceAVAILABLE notification and resend the data.

e. In the case of TcpFSend with insufficient buffer space, the PASCAL API will
block until buffer space becomes available or an error is detected. This is
the only condition under which TcpFSend will block.

5. Check the status returned from TCP/IP in the form of notifications
(GetNextNote).

6. Repeat the data transfer operations (Steps 4 and 5) until the data is exhausted.

7. Terminate the connection (TcpClose, UdpClose, and RawIpClose).

   Note: If using TcpClose, you must wait for the connection to terminate.

8. Terminate the communication service (EndTcpIp).

You know you are done when control is returned to you. Control is returned, in
most instances, after the initiation of your request. When appropriate, some
procedures have alternative wait versions that return only after request completion.

A sample program is supplied with TCP/IP. See “Sample Pascal program” on page
810 for a listing of the sample program.

Software requirements

To develop programs in Pascal that interface directly to the TCP, UDP, and IP
protocol boundaries, you must have the IBM VS Pascal Compiler and Library
(5668-767).

Pascal API header files

The following is a list of the headers used by Pascal applications:

- cmcliend
- cmcomm
- cminter
- cmresglb

Compatibility considerations

Unless noted in z/OS Communications Server: New Function Summary an application
program compiled and link edited on a release of z/OS Communications Server IP
can be used on higher level releases. That is, the API is upward compatible.

Application programs that are compiled and link edited on a release of z/OS
Communications Server IP cannot be used on older releases. That is, the API is not
downward compatible.
Data structures

Programs containing Pascal language API calls must include the appropriate data structures. The data structures are declared in CMCOMM and CMCLIEN. To include these data sets in your program source, enter:

```
#include CMCOMM
#include CMCLIEN
```

Additional include statements are required in programs that use certain calls. The following list shows the members that need to be included for the various calls:

- CMRESGLB for GetHostResol
- CMINTER for GetHostNumber, GetHostString, IsLocalAddress, and IsLocalHost

The load modules are in the SEZACMTX data set. Include this data set in your SYSLIB concatenation when you are creating a load module to link an application program. You must specify SEZACMTX before the Pascal libraries when linking TCP/IP programs.

Connection state

ConnectionState is the current state of the connection. See [Figure 144](#) for the Pascal declaration of the ConnectionStateType data type. ConnectionStateType is used in StatusInfoType and NotificationInfoType. It defines the client program view of the state of a TCP connection, in a form more readily usable than the formal TCP connection state defined by RFC 793. See [Table 22 on page 770](#) for the mapping between TCP states and ConnectionStateType.

```
ConnectionStateType =
  (CONNECTIONclosing,
   LISTENING,
   NONEXISTENT,
   OPEN,
   RECEIVINGonly,
   SENDINGonly,
   TRYINGtoOPEN);
```

*Figure 144. Pascal declaration of connection state type*

**CONNECTIONclosing**
Indicates that no more data can be transmitted on this connection, because it is going through the TCP connection closing sequence.

**LISTENING**
Indicates that you are waiting for a foreign site to open a connection.

**NONEXISTENT**
Indicates that a connection no longer exists.

**OPEN**
Indicates that data can go either way on the connection.

**RECEIVINGonly**
Indicates that data can be received, but cannot be sent on this connection, because the client has done a TcpClose.
**SENDINGOnly**
Indicates that data can be sent out, but cannot be received on this connection, because the foreign application has done a TcpClose or equivalent.

**TRYINGtoOPEN**
Indicates that you are trying to contact a foreign site to establish a connection.

Table 22 lists the TCP connection states.

<table>
<thead>
<tr>
<th>TCP State</th>
<th>ConnectionStateType</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED</td>
<td>NONEXISTENT</td>
</tr>
<tr>
<td>LAST-ACK, CLOSING, TIME-WAIT</td>
<td>If there is incoming data that the client program has not received, then RECEIVINGOnly, otherwise CONNECTIONclosing.</td>
</tr>
<tr>
<td>CLOSE-WAIT</td>
<td>If there is incoming data that the client program has not received, then OPEN, otherwise SENDINGOnly.</td>
</tr>
<tr>
<td>ESTABLISHED</td>
<td>OPEN</td>
</tr>
<tr>
<td>FIN-WAIT-1, FIN-WAIT-2</td>
<td>RECEIVINGOnly</td>
</tr>
<tr>
<td>LISTEN</td>
<td>LISTENING</td>
</tr>
<tr>
<td>SYN-SENT, SYN-RECEIVED</td>
<td>TRYINGtoOPEN</td>
</tr>
</tbody>
</table>

**Connection information record**
The connection information record is used as a parameter in several of the procedure calls. It enables you and the TCP/IP program to exchange information about the connection. The Pascal declaration is shown in Figure 145.

```pascal
StatusInfoType =
  record
    Connection: ConnectionType;
    OpenAttemptTimeout: integer;
    Security: SecurityType;
    Compartment: CompartmentType;
    Precedence: PrecedenceType;
    BytesToRead: integer;
    UnackedBytes: integer;
    ConnectionState: ConnectionStateType;
    LocalSocket: SocketType;
    ForeignSocket: SocketType;
  end;
```

*Figure 145. Pascal declaration of connection information record*

**Connection**
A number identifying the connection that is described. This connection number is different from the connection number displayed by the NETSTAT command.

**OpenAttemptTimeout**
The number of seconds that TCP continues to attempt to open a
You specify this number. If the limit is exceeded, TCP stops trying to open the connection and shuts down any partially open connection.

**BytesToRead**
The number of data bytes received from the foreign host by TCP, but not yet delivered to the client. TCP maintains this value.

**UnackedBytes**
The number of bytes sent by your program, but not yet sent to the foreign TCP, or the number of bytes sent to the foreign TCP, but not yet acknowledged.

**ConnectionState**
The current state of the connection. ConnectionStateType defines the client program view of the state of a TCP connection, in a form more readily usable than the formal TCP connection state defined by RFC 793.

**LocalSocket**
The local internet address and local port. Together, these form one end of a connection. The foreign socket forms the other end. See Figure 146 for the Pascal declaration of the SocketType record.

**ForeignSocket**
The foreign, or remote, internet address and its associated port. These form one end of a connection. The local socket forms the other end. Figure 146 shows the Pascal declaration of a socket type.

```pascal
InternetAddressType = UnsignedIntegerType;
PortType = UnsignedHalfWordType;
SocketType = record
    Address: InternetAddressType;
    Port: PortType;
end;
```

*Figure 146. Pascal declaration of socket type*

**Address**
The internet address.

**Port**
The port.

**Notification record**
The notification record is used to provide event information. You receive this information by using the GetNextNote call. If it is a variant record, the number of fields depends on the type of notification. See Figure 147 on page 772 for the Pascal declaration of this record.
Figure 147. Notification record (Part 1 of 2)
Connection
The client’s connection number to which the notification applies. In the case of USERdefinedNOTIFICATION, this field is as supplied by the user in the AddUserNote call.

Protocol
In the case of USERdefinedNOTIFICATION, this field is as supplied by the user in the AddUserNote call. For all other notifications, this field is reserved.

NotificationTag
The type of notification being sent. A set of fields depends on the value of the tag. Possible tag values relevant to the TCP/UDP/IP interface and the corresponding fields are:

FSENDresponse:  
(  
  SendTurnCode: CallReturnCodeType;  
  SendRequestErr: Boolean;  
);  
PINGresponse:  
(  
  PingTurnCode: CallReturnCodeType;  
  ElapsedTime: TimeStampType  
);  
RAWIPpacketsDELIVERED:  
(  
  RawIpDataLength: integer;  
  RawIpFullLength: integer;  
);  
RAWIPspaceAVAILABLE:  
(  
  RawIpSpaceInBytes: integer;  
);  
SMSGreceived: ();  
TIMERexpired:  
(  
  Datum: integer;  
  AssociatedTimer: TimerPointerType  
);  
UDPdatagramDELIVERED:  
(  
  DataLength: integer;  
  ForeignSocket: SocketType;  
  FullLength: integer  
);  
UDPdatagramSPACEavailable: ();  
URGENTpending:  
(  
  BytesToRead: integer;  
  UrgentSpan: integer  
);  
USERdefinedNOTIFICATION:  
(  
  UserData: UserNotificationDataType  
);  
end;

Figure 147. Notification record (Part 2 of 2)
**BUFFERspaceAVAILABLE**
Notification given when space becomes available on a connection for which TcpSend previously returned NObufferSPACE.

**AmountOfSpaceInBytes**
The minimum number of bytes that the TCP/IP service has available for buffer space for this connection. The actual amount of buffer space might be more than this number.

**CONNECTIONstateCHANGED**
Indicates that a TCP connection has changed state.

**NewState**
The new state for this connection.

**Reason**
The reason for the state change. This field is meaningful only if the NewState field has a value of NONEXISTENT.

**Notes:**
1. The following is the sequence of state notifications for a connection.
   For active open:
   - OPEN
   - RECEIVINGonly or SENDINGonly
   - CONNECTIONclosing
   - NONEXISTENT
   For passive open:
   - OPEN
   - RECEIVINGonly or SENDINGonly
   - CONNECTIONclosing
   - NONEXISTENT

   Your program should be prepared for any intermediate step or steps to be skipped.

2. The normal TCP connection closing sequence can lead to a connection staying in CONNECTIONclosing state for up to two minutes, corresponding to the TCP state TIME-WAIT.

3. Reason codes giving the reason for a connection changing to NONEXISTENT are:
   - OK
   - UNREACHABLEnetwork
   - TIMEOUTopen
   - OPENrejected
   - REMOTEreset
   - WRONGsecORprc
   - FATALerror
   - TCPipSHUTDOWN

**DATAdelivered**
Notification given when your buffer (named in an earlier TcpReceive or TcpFReceive request) contains data.

**Note:** The data delivered should be treated as part of a byte stream, not as a message. There is no guarantee that the data sent in one TcpSend (or equivalent) call on the foreign host is delivered in a single DATAdelivered notification, even if the PushFlag is set.
BytesDelivered
Number of bytes of data delivered to you.

LastUrgentByte
Number of bytes of urgent data remaining, including data just delivered.

PushFlag
TRUE if the last byte of data was received with the push bit set.

FSENDresponse
Notification given when a TcpFSend request is completed, successfully or unsuccessfully.

SendTurnCode
The status of the send operation.

PINGresponse
Notification given when a PINGresponse is received.

PingTurnCode
The status of the PING operation.

ElapsedTime
The time elapsed between the sending of a request and the reception of a response. This field is valid only if PingTurnCode has a value of OK.

RAWIPpacketsDELIVERED
Notification given when your buffer (indicated in an earlier RawIpReceive request) contains a datagram. Only one datagram is delivered on each notification. Your buffer contains the entire IP header, plus as much of the datagram as fits in your buffer.

RawIpDataLength
The actual data length delivered to your buffer. If this is less than RawIpFullLength, the datagram was truncated.

RawIpFullLength
Length of the packet, from the TotalLength field of the IP header.

RAWIPspaceAVAILABLE
When space becomes available after a client does a RawIpSend and receives a NObufferSPACE return code, the client receives this notification to indicate that space is now available.

RawIpSpaceInBytes
The amount of space available always equals the maximum size IP datagram.

RESOURCESavailable
Notice given when resources needed for a TcpOpen or TcpWaitOpen are available. This notification is sent only if a previous TcpOpen or TcpWaitOpen returned ZEROresources.

SMSGreceived
Notification given when one or more special messages (Smsgs) arrive. The GetSmsg call is used to retrieve queued Smsgs.

TIMERexpired
Notification given when a timer set through SetTimer expires.
Datum
The data specified when SetTimer was called.

AssociatedTimer
The address of the timer that expired.

UDPdatagramDELETED
Notification given when the buffer, indicated in an earlier UdpNReceive or UdpReceive request, contains a datagram. Your buffer contains the datagram excluding the UDP header.

Note: If UdpReceive was used, your buffer contains the entire datagram excluding the header, with the length indicated by DataLength. If UdpNReceive was used, and DataLength is less than FullLength, your buffer contains a truncated datagram. The reason is that your buffer was too small to contain the entire datagram.

DataLength
Length of the data delivered to your buffer.

ForeignSocket
The source of the datagram.

FullLength
The length of the entire datagram, excluding the UDP header. This field is set only if UdpNReceive was used.

UDPdatagramSPACEAvailable
Notification given when buffer space becomes available for a datagram for which UdpSend previously returned NObufferSPACE because of insufficient resources.

URGENTpending
Notification given when there is urgent data pending on a TCP connection.

BytesToRead
The number of incoming bytes not yet delivered to the client.

UrgentSpan
Number of bytes that are not delivered to the last known urgent pointer. No urgent data is pending if this is negative.

USERdefinedNOTIFICATION
Notice generated from data passed to AddUserNote by your program.

UserData
A 40-byte field supplied by your program through AddUserNote. Connection and protocol fields also are set from the values supplied to AddUserNote.

File specification record
The file specification record is used to fully specify a data set. The Pascal declaration is shown in Figure 148 on page 777.
Using procedure calls

Your program uses procedure calls to initiate communication with the TCP/IP address space. Most of these procedure calls return with a code, which indicates success or the type of failure incurred by the call. See Table 23 on page 779 for an explanation of the return codes.

Before invoking any of the other interface procedures, use BeginTcpIp to start the TCP/UDP/IP service. Once the TCP/UDP/IP service has begun, use the Handle procedure to specify a set of notifications that the TCP/UDP/IP service can send you. To terminate the TCP/UDP/IP service, use the EndTcpIp procedure.

Notifications

The TCP/IP address space notifies you of asynchronous events. Also, some notifications are generated in your address space by the TCP interface. Notifications can be received only after BeginTcpIp.

The notifications are received by the TCP interface and kept in a queue. Use GetNextNote to get the next notification. The notifications are in Pascal variant record form. See Figure 147 on page 772 for more information.

TCP initialization procedures

The TCP Initialization procedures affect all present and future connections. Use these procedures to initialize the TCP environment for your program.

TCP termination procedure

The Pascal API has one termination procedure call. Use the EndTcpIp call when you have finished with the TCP/IP services.
TCP communication procedures
The TCP communication procedures apply to a particular client connection. Use these procedures to establish a connection and to communicate. You must call the BeginTcpIp initialization routine before you can begin using TCP communication procedures.

PING interface
The Ping interface lets a client send an ICMP echo request to a foreign host. You must call the BeginTcpIp initialization routine before you can begin using the PING Interface.

Monitor procedures
The MonQuery monitor procedure provides a mechanism for querying the TCP/IP address space.

Any program using this monitor procedure must include CMCOMM and CMCLIEN.

UDP communication procedures
The UDP communication procedures describe the programming interface for the User Datagram Protocol (UDP) provided in the TCP/IP product.

Raw IP interface
The Raw IP interface lets a client program send and receive arbitrary IP datagrams on any IP Internet protocol except TCP and UDP. Only one client can use any given protocol at one time. Only clients that are APF-authorized can use the Raw IP interface.

Timer routines
The timer routines are used with the TCP/UDP/IP interface. You must call the BeginTcpIp initialization routine before you can begin using the timer routines.

Host lookup routines
The host lookup routines (with the exception of GetHostResol ) are declared in the CMINTER member of the SEZACMAC data set. The host lookup routine GetHostResol is declared in the CMRESGLB member of the SEZACMAC data set. Any program using these procedures must include CMINTER or CMRESGLB after the INCLUDE statements for CMCOMM and CMCLIEN.

Assembler calls
AddUserNote is provided and can be called directly from an assembler language interrupt handler.

Other routines
This group includes the following procedures.
- GetSmsg
- ReadXlateTable
- SayCalRe
- SayConSt
- SayIntAd
- SayIntNum
Pascal return codes

When using Pascal procedure calls, check to determine whether the call has been completed successfully. Use the SayCalRe function (see “SayCalRe” on page 793) to convert the ReturnCode parameter to a printable form.

The SayCalRe function converts a return value into a descriptive message. For example, if SayCalRe is invoked with the return value BADlengthARGUMENT, it returns the message invalid length specified. See Table 23 for a description of Pascal return codes and their equivalent message text from SayCalRe.

Most return values are self-explanatory in the context where they occur. The return codes you see as a result of issuing a TCP/UDP/IP request are in the range −128 to 0.

Table 23. Pascal language return codes

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Return Code</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK</td>
<td>0</td>
<td>OK.</td>
</tr>
<tr>
<td>ABNORMALcondition</td>
<td>−1</td>
<td>Abnormal condition due to CSA storage shortage.</td>
</tr>
<tr>
<td>ALREADYclosing</td>
<td>−2</td>
<td>Connection is already closing.</td>
</tr>
<tr>
<td>BADlengthARGUMENT</td>
<td>−3</td>
<td>Length specified that is not valid.</td>
</tr>
<tr>
<td>CANNOTsendDATA</td>
<td>−4</td>
<td>Cannot send data.</td>
</tr>
<tr>
<td>CLIENTrestart</td>
<td>−5</td>
<td>Client reinitialized TCP/IP service.</td>
</tr>
<tr>
<td>CONNECTIONalreadyEXISTS</td>
<td>−7</td>
<td>Connection already exists.</td>
</tr>
<tr>
<td>ERRORinPROFILE</td>
<td>−8</td>
<td>Error in profile data set. Details are in PROFILE.TCPCERROR or the //SYSERROR DD file.</td>
</tr>
<tr>
<td>FATALerror</td>
<td>−9</td>
<td>Fatal error; not valid user parameter (storage key).</td>
</tr>
<tr>
<td>HASnoPASSWORD</td>
<td>−10</td>
<td>No password is in the RACF directory.</td>
</tr>
<tr>
<td>INCORRECTpassword</td>
<td>−11</td>
<td>TCPIP is not authorized to access the data set.</td>
</tr>
<tr>
<td>INVALIDrequest</td>
<td>−12</td>
<td>Request not valid.</td>
</tr>
<tr>
<td>INVALIDDuserID</td>
<td>−13</td>
<td>User ID not valid.</td>
</tr>
<tr>
<td>INVALIDvirtualADDRESS</td>
<td>−14</td>
<td>Virtual address not valid.</td>
</tr>
<tr>
<td>LOCALportNOTavailable</td>
<td>−16</td>
<td>The requested local port is not available.</td>
</tr>
<tr>
<td>NObufferSPACE</td>
<td>−19</td>
<td>No more space for data currently available. This applies to this connection only; space might still be available for other connections.</td>
</tr>
<tr>
<td>NONlocalADDRESS</td>
<td>−21</td>
<td>The internet address is not local to this host.</td>
</tr>
<tr>
<td>NOoutstandingNOTIFICATIONS</td>
<td>−22</td>
<td>No outstanding notifications.</td>
</tr>
<tr>
<td>NOsuchCONNECTION</td>
<td>−23</td>
<td>No such connection.</td>
</tr>
<tr>
<td>NOTtcpIPservice</td>
<td>−24</td>
<td>No TCP/IP service is available.</td>
</tr>
<tr>
<td>NOTyetBEGUN</td>
<td>−25</td>
<td>TCP/IP service not yet begun.</td>
</tr>
</tbody>
</table>
Table 23. Pascal language return codes (continued)

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Return Code</th>
<th>Message Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTyetOPEN</td>
<td>−26</td>
<td>The connection is not yet open.</td>
</tr>
<tr>
<td>OPENrejected</td>
<td>−27</td>
<td>Foreign host rejected the open attempt.</td>
</tr>
<tr>
<td>PARAMlocalADDRESS</td>
<td>−28</td>
<td>TcpOpen error: local address not valid.</td>
</tr>
<tr>
<td>PARAMstate</td>
<td>−29</td>
<td>TcpOpen error: initial state not valid.</td>
</tr>
<tr>
<td>PARAMtimeout</td>
<td>−30</td>
<td>Timeout parameter not valid.</td>
</tr>
<tr>
<td>PARAMunspecADDRESS</td>
<td>−31</td>
<td>TcpOpen error: unspecified foreign address in active open.</td>
</tr>
<tr>
<td>PARAMunspecPORT</td>
<td>−32</td>
<td>TcpOpen error: unspecified foreign port in active open.</td>
</tr>
<tr>
<td>PROFILEnotFOUND</td>
<td>−33</td>
<td>TCPIP cannot read PROFILE data set.</td>
</tr>
<tr>
<td>RECEIVEstillPENDING</td>
<td>−34</td>
<td>Receive is still pending on this connection.</td>
</tr>
<tr>
<td>REMOTEclose</td>
<td>−35</td>
<td>Foreign host unexpectedly closed the connection.</td>
</tr>
<tr>
<td>REMOTEmreset</td>
<td>−36</td>
<td>Foreign host abended the connection.</td>
</tr>
<tr>
<td>SOFTWAREerror</td>
<td>−37</td>
<td>Software error in TCP/IP.</td>
</tr>
<tr>
<td>TCPipSHUTDOWN</td>
<td>−38</td>
<td>TCP/IP is being shut down.</td>
</tr>
<tr>
<td>TIMEOUTopen</td>
<td>−40</td>
<td>Foreign host did not respond within OPEN timeout.</td>
</tr>
<tr>
<td>TOOmanyOPENS</td>
<td>−41</td>
<td>Too many open connections exist already.</td>
</tr>
<tr>
<td>UNAUTHORIZEDUser</td>
<td>−43</td>
<td>You are not authorized to issue this command.</td>
</tr>
<tr>
<td>UNIMPLEMENTEDRequest</td>
<td>−45</td>
<td>TCP/IP request not implemented.</td>
</tr>
<tr>
<td>UNREACHABLENetwork</td>
<td>−47</td>
<td>Destination network cannot be reached.</td>
</tr>
<tr>
<td>UNSPECIFIEDconnection</td>
<td>−48</td>
<td>Connection not specified.</td>
</tr>
<tr>
<td>VIRTUALmemoryTOOsmall</td>
<td>−49</td>
<td>Client address space has too little storage.</td>
</tr>
<tr>
<td>WRONGsecORrpc</td>
<td>−50</td>
<td>Foreign host disagreed on security or precedence.</td>
</tr>
<tr>
<td>ZEROresources</td>
<td>−56</td>
<td>TCP cannot handle more connections now.</td>
</tr>
<tr>
<td>UDPlocalADDRESS</td>
<td>−57</td>
<td>Local address for UDP not correct.</td>
</tr>
<tr>
<td>UDUnspecADDRESS</td>
<td>−59</td>
<td>Address was not specified; specification is necessary.</td>
</tr>
<tr>
<td>UDUnspecPORT</td>
<td>−60</td>
<td>Port was unspecified; specification is necessary.</td>
</tr>
<tr>
<td>FSENDstillPENDING</td>
<td>−62</td>
<td>FSend still pending on this connection.</td>
</tr>
<tr>
<td>ERRORopeningORreadingFILE</td>
<td>−80</td>
<td>Error opening or reading data set.</td>
</tr>
<tr>
<td>FILEformatINVALID</td>
<td>−81</td>
<td>File format is not valid.</td>
</tr>
<tr>
<td>SAYCALRE*</td>
<td>−130</td>
<td>Unknown TCP return code.</td>
</tr>
</tbody>
</table>

* Return codes that are not valid (out of the range -128 to 0) return Unknown TCP return codes when translated using SAYCALRE.

Procedure calls

This section provides the syntax, parameters, and other appropriate information for each Pascal procedure call supported by TCP/IP.
AddUserNote

This procedure can be called from assembler language code to add a USERdefinedNOTIFICATION notification to the queue and cause the initiation of GetNextNote if it is waiting for a notification. Figure 149 shows a sample calling sequence.

```
LA R13, PASCSAVE
LA R1, PASC Parm
L R15, =V(ADDUSERN)
BALR R14, R15
...

PASC SAVE DS 18F  Register save area
ENV DC F'0'  Zero initially. It is filled with an environment address. Pass it unchanged in subsequent calls to ADDUSERN.
DATA1 DS H  Data for Connection field of notification.
DATA2 DS C  Data for Protocol field of notification.
DATA3 DS X140  Data for UserData field of notification.
RC DS F  AddUserNote stores return code here.

PASC Parm DC A(ENV)
DC A(DATA1)
DC A(DATA2)
DC A(DATA3)
DC A(RC)
```

Figure 149. Sample calling sequence

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReturnCode</td>
<td>Indicates the success or failure of the call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• NObufferSPACE</td>
</tr>
</tbody>
</table>

BeginTcpIp

Use BeginTcpIp to inform the TCP/IP address space that you want to start using its services as shown in Figure 150.

```
procedure BeginTcpIp
(  var  ReturnCode: integer
);  external;
```

Figure 150. BeginTcpIp example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• ABNORMALcondition</td>
</tr>
<tr>
<td></td>
<td>• FATALerror</td>
</tr>
<tr>
<td></td>
<td>• NOtcpIpService</td>
</tr>
<tr>
<td></td>
<td>• TCPIP SHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• VIRTUAL membrane TOO small</td>
</tr>
</tbody>
</table>

For a description of the Pascal return codes, see Table 23 on page 779.
ClearTimer
This procedure resets the timer to prevent it timing out as shown in Figure 151.

```pascal
procedure ClearTimer
  (T: TimerPointerType);
  external;
```

Figure 151. ClearTimer example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>A timer pointer, as returned by a previous CreateTimer call.</td>
</tr>
</tbody>
</table>

CreateTimer
This procedure allocates a timer. The timer is not set in any way. See "SetTimer" on page 795 to activate the timer. Figure 152 shows an example.

```pascal
procedure CreateTimer
  (var T: TimerPointerType);
  external;
```

Figure 152. Create timer example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Set to a timer pointer that can be used in subsequent SetTimer, ClearTimer, and DestroyTimer calls.</td>
</tr>
</tbody>
</table>

DestroyTimer
This procedure deallocates (frees) a timer you created. Figure 153 shows an example.

```pascal
procedure DestroyTimer
  (var T: TimerPointerType);
  external;
```

Figure 153. Destroy timer example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>A timer pointer, as returned by a previous CreateTimer call.</td>
</tr>
</tbody>
</table>

EndTcpIp
Use EndTcpIp when you have finished with the TCP/IP services. The procedure shown in Figure 154 on page 783 releases ports and protocols in use that are not permanently reserved. It causes TCP to clean up the data structures it has associated with your commands.
GetHostNumber

The GetHostNumber procedure resolves a host name into an internet address. This is shown in Figure 155.

GetHostNumber uses a table lookup to convert the name of a host (alphanumeric name or dotted decimal number) to an internet address, and returns this address in the HostNumber field. When the name is a dotted decimal number, GetHostNumber returns the integer represented by that dotted decimal. The dotted decimal representation of a 32-bit number has 1 decimal integer for each of the 4 bytes, separated by dots. For example, 14.0.0.7 for X'0E000007'. Refer to the z/OS Communications Server: IP Configuration Reference for information about how to create host lookup tables.

The HostNumber field is set to NOhost if the host is not found.

```pascal
procedure GetHostNumber
    (const Name: string;
     var HostNumber: InternetAddressType
    );
  external;
```

**Figure 155. GetHostNumber example**

**Parameter** | **Description**
---|---
Name | The name or dotted decimal number to be converted. The maximum name length is 128 characters.
HostNumber | Set to the converted address, or NOhost if conversion fails.

GetHostResol

The GetHostResol procedure converts a host name into an internet address by using a name server. Figure 156 on page 784 shows an example.

GetHostResol passes the query to the remote name server through the resolver. The name server converts the name of a host (alphanumeric name or dotted decimal number) to an internet address, and returns this address in the HostNumber field. If the name server does not respond or does not find the name, the host name is converted to a host number by table lookup. When the name is a dotted decimal number, the integer represented by that dotted decimal is returned. The dotted decimal representation of a 32-bit number has 1 decimal integer for each of the 4 bytes, separated by dots. For example, 14.0.0.7 for X'0E000007'.

The HostNumber field is set to NOhost if the host is not found.
Parameter  Description
Name      The name or dotted decimal number to be converted. The maximum length is 255 characters.

HostNumber  Set to the converted address, or NOhost if conversion fails.

GetHostString
The GetHostString procedure call uses a table lookup to convert an internet address dotted decimal format to a host name, and returns this string in the Name field. The first host name found in the lookup is returned. If no host name is found, a gateway or network name is returned. If no gateway or network name is found, a null string is returned. An example is shown in Figure 157.

procedure GetHostString
   (   Address: InternetAddressType;
       Name: SiteNameType
   );
   external;

Figure 157. GetHostString example

Parameter  Description
Address    The address to be converted. The address must be in dotted decimal format.

Name       Set to the corresponding host, gateway, or network name, or to null string if a match is not found. The maximum length is 24 characters.

GetIdentity
This procedure returns the following information:
- The user ID of the MVS user
- The host machine name
- The network domain name
- The user ID of the TCP/IP address space

The host machine name and domain name are extracted from the HostName and DomainOrigin statements, respectively, in TCPIP.DATA. If a HostName statement is not specified, then the default host machine name is the name specified by the TCP/IP installer during installation (the name from the line containing the definition, VMCF, MVPXSSI, nodename, in the IEFSSNxX member of PARMLIB). The TCP/IP address space user ID is extracted from the TcpiUserid/TcpiJobname statement in TCPIP.DATA; if the statement is not specified, the default is TCPIP. Refer to the z/OS Communications Server: IP Configuration Reference for information about TCPIP.DATA search order.
Figure 158 shows the GetIdentity procedure.

procedure GetIdentity
  (
    var UserId:DirectoryNameType;
    var HostName, DomainName: String;
    var TcIpServiceName: DirectoryNameType;
    var Result: integer
  );
  external;

Figure 158. GetIdentity example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UserId</td>
<td>The user ID of the TSO user or the job name of a batch job that has invoked GetIdentity.</td>
</tr>
<tr>
<td>HostName</td>
<td>The host machine name.</td>
</tr>
<tr>
<td>DomainName</td>
<td>The network domain name.</td>
</tr>
<tr>
<td>TcIpServiceName</td>
<td>The user ID of the TCP/IP address space.</td>
</tr>
<tr>
<td>Result</td>
<td>Indicates success or failure of the call.</td>
</tr>
</tbody>
</table>

GetNextNote

Use this procedure to retrieve notifications from the queue. This procedure returns the next notification queued for you. Figure 159 shows an example of the GetNextNote procedure.

procedure GetNextNote
  (
    var Note: NotificationInfoType;
    ShouldWait: Boolean;
    var ReturnCode: integer
  );
  external;

Figure 159. GetNextNote example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note</td>
<td>Next notification is stored here when ReturnCode is OK.</td>
</tr>
<tr>
<td>ShouldWait</td>
<td>Set ShouldWait to TRUE if you want GetNextNote to wait until a notification becomes available. Set ShouldWait to FALSE if you want GetNextNote to return immediately. When ShouldWait is set to FALSE, ReturnCode is set to NOoutstandingNOTIFICATIONS if notification is not currently queued.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• NOoutstandingNOTIFICATIONS</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.
GetSmsg

Your program should call this procedure after receiving an SMSGreceived notification. Each call to GetSmsg retrieves one queued Smsg. Your program should exhaust all queued Smsgs by calling GetSmsg repeatedly until the Success field returns with a value of FALSE. After a value of FALSE is returned, do not call GetSmsg again until you receive another SMSGreceived notification. Figure 160 shows an example of the GetSmsg procedure.

```pascal
procedure GetSMsg
    var Smsg: SmsgType;
    var Success: Boolean;
); external;
```

**Figure 160. GetSmsg example**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smsg</td>
<td>Set to the returned Smsg if Success is set to TRUE.</td>
</tr>
<tr>
<td>Success</td>
<td>If Smsg returned TRUE; otherwise FALSE.</td>
</tr>
</tbody>
</table>

Handle

Use the Handle procedure to specify that you want to receive notifications in the given set as shown in Figure 161. You must always use it after calling the BeginTcpIp procedure and before accessing the TCP/IP services. This Pascal set of notifications can contain any of the NotificationEnumType values shown in Figure 147 on page 772.

```pascal
procedure Handle
    var Notifications: NotificationSetType;
); external;
```

**Figure 161. Handle example**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notifications</td>
<td>The set of notification types to be handled.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of the call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.

IsLocalAddress

This procedure queries the TCP/IP address space to determine whether the HostAddress is one of the addresses recognized for this host. If the address is local, it returns OK. If the address is not local, it returns NONlocalADDRESS. Figure 162 on page 787 shows an example.
Parameter | Description
---|---
HostAddress | The host address to be tested.
ReturnCode | Indicates whether the host address is local, or it might indicate an error. Possible return values are:
  - OK
  - NONlocalADDRESS
  - TCPIPSHUTDOWN
  - FATALerror
  - SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 779.

**IsLocalHost**

This procedure returns the correct host class for Name, which can be a host name or a dotted decimal address. Figure 163 shows an example of the IsLocalHost procedure.

The host classes are:

**HOSTLocal**

An internet address for the local host

**HOSTLoopback**

One of the dummy internet addresses used to designate various levels of loopback testing

**HOSTRemote**

A known host name for some remote host

**HOSTUnknown**

An unknown host name (or other error)

```pascal
procedure IsLocalAddress :
(  HostAddress: InternetAddressType;
  var ReturnCode: integer
); external;
```

**Figure 162. IsLocalAddress example**

```pascal
procedure IsLocalHost :
(  const Name: string;
  var Class: HostClassType
); external;
```

**Figure 163. IsLocalHost example**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The host name. The maximum name length is 255 characters.</td>
</tr>
<tr>
<td>Class</td>
<td>The host class</td>
</tr>
</tbody>
</table>
**MonQuery**

The MonQuery procedure is used to obtain status information or to request TCP/IP to perform certain actions.

```pascal
procedure MonQuery(
    QueryRecord: MonQueryRecordType;
    Buffer: integer;
    BufSize: integer;
    var ReturnCode: integer;
    var Length: integer
); external;
```

*Figure 164. MonQuery example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer</td>
<td>The address of the buffer to receive data.</td>
</tr>
<tr>
<td>BufSize</td>
<td>The size of the buffer.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of the call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• FATALerror</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
<tr>
<td></td>
<td>• TCPipSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• UNIMPLEMENTEDrequest</td>
</tr>
<tr>
<td></td>
<td>• UNAUTHORIZEDuser</td>
</tr>
<tr>
<td></td>
<td>• SOFTWAREerror</td>
</tr>
<tr>
<td>Length</td>
<td>The length of the data returned in the buffer.</td>
</tr>
<tr>
<td>QueryRecord</td>
<td>Your program sets up a QueryRecord to specify the type of status information to be retrieved. The MonQueryRecordType is shown in <em>Figure 165</em></td>
</tr>
</tbody>
</table>

```pascal
MonQueryRecordType =
record
  case QueryType: MonQueryType of
    QUERYhomeONLY: ();
  end;
end; { MonQueryRecordType }
```

*Figure 165. Monitor query record*

The only QueryType values available for customer use is:

**QUERYHomeONLY**

Used to obtain a list of the home Internet addresses (up to 255) recognized by TCP/IP. Your program sets the Buffer to the address of a variable of type HomeOnlyListType, and the BufSize to its length. When MonQuery returns, Length is set to the length of the Buffer that was used, if ReturnCode is OK. Divide the Length by size of the InternetAddressType to get the number of the home addresses that are returned.

For a description of Pascal return codes, see Table 23 on page 779.
PingRequest

Use this procedure to send an ICMP echo request to a foreign host. When a response is received or the timeout limit is reached, you receive a PingResponse notification.

```pascal
procedure PingRequest
(  ForeignAddress: InternetAddressType;
  Length: integer;
  Timeout: integer;
  var ReturnCode: integer
 );
```

**Figure 166. PingRequest example**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ForeignAddress</td>
<td>The address of the foreign host to receive an ICMP echo request.</td>
</tr>
<tr>
<td>Length</td>
<td>Indicates the length of the ICMP packet, excluding the IP header. The range of values for this field is 8—65507 bytes.</td>
</tr>
<tr>
<td>Timeout</td>
<td>The amount of time to wait for a response, in seconds.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of a call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• ABNORMALcondition</td>
</tr>
<tr>
<td></td>
<td>• BADlengthARGUMENT</td>
</tr>
<tr>
<td></td>
<td>• CONNECTIONalreadyEXISTS</td>
</tr>
<tr>
<td></td>
<td>• VIRTUALmemoryTOOsmall</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
<tr>
<td></td>
<td>• TIMEOUTopen</td>
</tr>
<tr>
<td></td>
<td>• PARAMtimeout</td>
</tr>
<tr>
<td></td>
<td>• SOFTWAREerror</td>
</tr>
<tr>
<td></td>
<td>• TCPipSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• UNAUTHORIZEDUser</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.

**Note:** CONNECTIONalreadyEXISTS, in this context, means a PING request is outstanding.

RawIpClose

This procedure tells the TCP/IP address space that the client does not handle the protocol any longer. Any queued incoming packets are discarded. Figure 167 on page 790 shows an example of the RawIpClose procedure.

When the client is not handling the protocol, a return code of NOsuchCONNECTION is received.
procedure RawIpClose
{
  ProtocolNo: integer;
  var ReturnCode: integer
);
  external;

Figure 167. RawIpClose example

Parameter    Description
-------------------
ProtocolNo    The number of the Internet protocol.
ReturnCode    Indicates the success or failure of a call. Possible return values are:
               • OK
               • NOsuchCONNECTION
               • NOTyetBEGIN
               • SOFTWAREerror
               • TCPipSHUTDOWN
               • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 779.

RawIpOpen

This procedure tells the TCP/IP address space that the client wants to send and receive packets of the specified protocol. Figure 168 shows an example.

Do not use protocols 6 and 17. They specify the TCP (6) and UDP (17) protocols. When you specify 6, 17, or a protocol that has been opened by another address space, you receive the LOCALportNOTavailable return code.

procedure RawIpOpen
{
  ProtocolNo: integer;
  var ReturnCode: integer
);
  external;

Figure 168. RawIpOpen example

Parameter    Description
-------------------
ProtocolNo    The number of the Internet protocol.
ReturnCode    Indicates success or failure of a call. Possible return values are:
               • OK
               • LOCALportNOTavailable
               • NObufferSPACE
               • NOTyetBEGIN
               • SOFTWAREerror
               • TCPipSHUTDOWN
               • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 779.

Note: You can open the ICMP protocol, but your program receives only those ICMP packets not interpreted by the TCP/IP address space.
RawIpReceive

Use the procedure shown in Figure 169 to specify a buffer to receive Raw IP datagrams of the specified protocol. You get the notification RAWIPpacketsDELIVERED when a packet is put in the buffer.

procedure RawIpReceive
{
    ProtocolNo: integer;
    Buffer: Address31Type;
    BufferLength: integer;
    var ReturnCode: integer
};

Figure 169. RawIpReceive example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProtocolNo</td>
<td>The number of the Internet protocol.</td>
</tr>
<tr>
<td>Buffer</td>
<td>The address of your buffer.</td>
</tr>
<tr>
<td>BufferLength</td>
<td>The length of your buffer. If you specify a length greater than 65535 bytes, only the first 65535 bytes are used.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of a call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• NOsuchCONNECTION</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
<tr>
<td></td>
<td>• SOFTWAREerror</td>
</tr>
<tr>
<td></td>
<td>• TCPipSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• UNAUTHORIZEDUser</td>
</tr>
<tr>
<td></td>
<td>• INVALIDvirtualADDRESS</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779

RawIpSend

This procedure shown in this example sends IP datagrams of the given protocol number. The entire packet, including the IP header, must be in the buffer. The TCP/IP address space uses the total length field of the IP header to determine where each packet ends. Subsequent packets begin at the next doubleword (eight-byte) boundary within the buffer.

The packets in your buffer are transmitted unchanged with the following exceptions:
• They can be fragmented; the fragment offset and flag fields in the header are filled.
• The version field in the header is filled.
• The checksum field in the header is filled.
• The source address field in the header is filled.

You get the return code NOsuchCONNECTION if the client is not handling the protocol, or if a packet in the buffer has another protocol. The return code BADlengthARGUMENT is received when:
• The DataLength is fewer than 40 bytes, or greater than 65535 bytes.
• NumPackets is 0.
• All packets do not fit into DataLength.

A ReturnCode value of NObufferSPACE indicates that the data is rejected, because TCP/IP is out of buffers. When buffer space is available, the notification RAWIPspaceAVAILABLE is sent to the client.

```pascal
procedure RawIpSend
  (  ProtocolNo: integer;
      Buffer: Address31Type;
      DataLength: integer;
      NumPackets: integer;
  var ReturnCode: integer
    );
  external;
```

Figure 170. RawIpSend example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProtocolNo</td>
<td>The number of the Internet protocol.</td>
</tr>
<tr>
<td>Buffer</td>
<td>The address of your buffer containing packets to send.</td>
</tr>
<tr>
<td>DataLength</td>
<td>The total length of data in your buffer.</td>
</tr>
<tr>
<td>NumPackets</td>
<td>The number of packets in your buffer.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates the success or failure of a call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• BADlengthARGUMENT</td>
</tr>
<tr>
<td></td>
<td>• NObufferSPACE</td>
</tr>
<tr>
<td></td>
<td>• NOSuchCONNECTION</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGIN</td>
</tr>
<tr>
<td></td>
<td>• SOFTWAREerror</td>
</tr>
<tr>
<td></td>
<td>• TCPipSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• UNAUTHORIZEDuser</td>
</tr>
<tr>
<td></td>
<td>• INVALIDvirtualADDRESS</td>
</tr>
</tbody>
</table>

Note: If your buffer contains multiple packets waiting to be sent, some of the packets might have been sent even if ReturnCode is not OK.

For a description of Pascal return codes, see Table 23 on page 779

**ReadXlateTable**

The procedure shown in Figure 171 on page 793 reads the binary translation table data set specified by TableName, and fills in the AtoETable and EtoATable translation tables.
procedure ReadXlateTable
{
    var TableName:DirectoryNameType;
    var AtoETable: AtoEType;
    var EtoATable: EtoAType;
    var TranslateTableSpec: SpecOfFiletype;
    var ReturnCode: integer
    );
external;

Figure 171. ReadXlateTable example

Parameter Description
TableName The name of the translate table. ReadXlateTable tries to read
user_id.TableName.TCPXLBIN. If that data set exists but it has an
incorrect format, ReadXlateTable returns with a ReturnCode
FILEformatINVALID. If user_id.TableName.TCPXLBIN does not
exist, ReadXlateTable tries to read hlq.TableName.TCPXLBIN.
ReturnCode reflects the status of reading that data set.
AtoETable Filled with ASCII-to-EBCDIC table if return code is OK.
EtoATable Filled with EBCDIC-to-ASCII table if return code is OK.
TranslateTableSpec
If ReturnCode is OK, TranslateTableSpec contains the complete
specification of the data set that ReadXlateTable used. If
ReturnCode is not OK, TranslateTableSpec contains the complete
specification of the last data set that ReadXlateTable tried to use.
ReturnCode Indicates success or failure of a call. Possible return values are:
• OK
• ERRORopeningORreadingFILE
• FILEformatINVALID

SayCalRe
This function returns a printable string describing the return code passed in
CallReturn. Figure 172 shows an example.

function SayCalRe
) )
    CallReturn: integer
    );
WordType;
external;

Figure 172. SayCalRe example

Parameter Description
CallReturn The return code to be described.

SayConSt
This function returns a printable string describing the connection state passed in
State. For example, if SayConSt is invoked with the type identifier
RECEIVINGonly, it returns the message Receiving only. Figure 173 on page 794
shows an example of this procedure.
## Parameter Description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>The connection state to be described.</td>
</tr>
</tbody>
</table>

### SayIntAd

This function converts the Internet address specified by InternetAddress to a printable string. If the address can be resolved to a name by use of local host tables, the name is returned. The address to name resolution depends on how the resolver is configured and if any local host tables exist. Refer to the [z/OS Communications Server: IP Configuration Guide](https://www.ibm.com) for information about configuring the resolver and how local host tables can be used. If the address cannot be resolved to a name, the dotted decimal format of the address is returned. Figure 174 shows an example of this procedure.

```c
function SayIntAd
{
    InternetAddress: InternetAddressType
}
```

### SayIntNum

This function converts the internet address specified by InternetAddress to a printable string, in dotted decimal form as shown in Figure 173.

```c
function SayIntNum
{
    InternetAddress: InternetAddressType
}
```

### SayNotEn

This function returns a printable string describing the notification enumeration type passed in Notification. For example, if SayNotEn is invoked with the type

```c
function SayConSt
{
    State: ConnectionStateType
}
```

*Figure 173. SayConSt example*

```c
function SayIntAd
{
    State: ConnectionStateType
}
```

*Figure 174. SayIntAd example*

```c
function SayIntNum
{
    InternetAddress: InternetAddressType
}
```

*Figure 175. SayIntNum example*
identifier FSENDreponse, it returns the message “Fsend response”.

```pascal
function SayNotEn
    (    Notification: NotificationEnumType
    )
    Wordtype;
external;
```

*Figure 176. SayNotEn example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification</td>
<td>The notification enumeration type to be described.</td>
</tr>
</tbody>
</table>

**SayPorTy**

This function returns a printable string describing the port number passed in Port, if it is a well-known port number such as port number 23, the Telnet port. Otherwise, the EBCDIC representation of the number is returned. 

```pascal
function SayPorTy
    (    Port: PortType
    )
    WordType;
external;
```

*Figure 177. SayPorTy example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port</td>
<td>The port number to be described.</td>
</tr>
</tbody>
</table>

**SayProTy**

This function converts the protocol type specified by Protocol to a printable string, if it is a well-known protocol number, such as 6 (TCP). Otherwise, the EBCDIC representation of the number is returned. 

```pascal
function SayProTy
    (    Protocol: ProtocolType
    )
    WordType;
external;
```

*Figure 178. SayProTy example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>The number of the protocol to be described.</td>
</tr>
</tbody>
</table>

**SetTimer**

The procedure shown in Figure 179 on page 796 sets a timer to expire after a specified time interval. Specify the amount of time in seconds. When it times out, you receive the TIMERexpired notification, which contains the data and the timer pointer.
Note: This procedure resets any previous time interval set on this timer.

```pascal
procedure SetTimer
(
  T: TimerPointerType;
  AmountOfTime: integer;
  Data: integer
); external;
```

*Figure 179. SetTimer example*

**Parameter**     **Description**
---                ---
T                 A timer pointer, as returned by a previous CreateTimer call.

**AmountOfTime** The time interval in seconds.

**Data** An integer value to be returned with the TIMERexpired notification.

**TcpAbort**

Use the procedure shown in *Figure 180* to shut down a specific connection immediately. Data sent by your application on the abended connection might be lost. TCP sends a reset packet to notify the foreign host that you have abended the connection, but there is no guarantee that the reset will be received by the foreign host.

```pascal
procedure TcpAbort
(
  Connection: ConnectionType;
  var ReturnCode: integer
); external;
```

*Figure 180. TcpAbort example*

**Parameter**     **Description**
---                ---
Connection The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.

**ReturnCode** Indicates success or failure of call. Possible return values are:
- OK
- ABNORMALcondition
- FATALerror
- NOsuchCONNECTION
- NOTyetBEGUN
- TCPIpSHUTDOWN
- SOFTWAREerror
- REMOTEreset

The connection is fully terminated when you receive the notification CONNECTIONstateCHANGED with the NewState field set to NONEXISTENT.

For a description of Pascal return codes, see *Table 23 on page 779*. 
TcpClose

Use the procedure shown in Figure 181 to begin the TCP one-way closing sequence. During this closing sequence, you, the local client, cannot send any more data. Data might be delivered to you until the foreign application also closes. TcpClose also causes all data sent on that connection by your application, and buffered by TCPIP, to be sent to the foreign application immediately.

    procedure TcpClose
    (          Connection: ConnectionType;
        var   ReturnCode: integer
    );
    external;

Figure 181. TcpClose example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>- OK</td>
</tr>
<tr>
<td></td>
<td>- ABNORMALcondition</td>
</tr>
<tr>
<td></td>
<td>- ALREADYclosing</td>
</tr>
<tr>
<td></td>
<td>- NoSuchCONNECTION</td>
</tr>
<tr>
<td></td>
<td>- NOTyetBEGIN</td>
</tr>
<tr>
<td></td>
<td>- TCPipSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>- SOFTWAREerror</td>
</tr>
<tr>
<td></td>
<td>- REMOTEreset</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.

Notes:

1. If you receive the notification CONNECTIONstateCHANGED with a NewState of SendingOnly, the remote application has done TcpClose (or an equivalent function) and is receiving only. Respond with TcpClose when you finish sending data on the connection.

2. The connection is fully closed when you receive the notification CONNECTIONstateCHANGED, with a NewState field set to NONEXISTENT.

TcpFReceive, TcpReceive, and TcpWaitReceive

The examples in this section illustrate TcpFReceive, TcpReceive, and TcpWaitReceive.

TcpFReceive and TcpReceive are the asynchronous ways of specifying a buffer to receive data for a given connection. Both procedures return to your program immediately. A return code of OK means that the request has been accepted. When received data has been placed in your buffer, your program receives a DATAdelivered notification.

TcpWaitReceive is the synchronous interface for receiving data from a TCP connection. TcpWaitReceive does not return to your program until data has been received into your buffer or until an error occurs. Therefore, it is not necessary that TcpWaitReceive receive a notification when data is delivered. The BytesRead parameter is set to the number of bytes received by the data delivery, but if the
number is less than 0, the parameter indicates an error.

```pascal
procedure TcpFReceive
{
  Connection: ConnectionType;
  Buffer: Address31Type;
  BytesToRead: integer;
  var ReturnCode: integer
};
external;
```

**Figure 182. TcpFReceive example**

```pascal
procedure TcpReceive
{
  Connection: ConnectionType;
  Buffer: Address31Type;
  BytesToRead: integer;
  var ReturnCode: integer
};
external;
```

**Figure 183. TcpReceive example**

```pascal
procedure TcpWaitReceive
{
  Connection: ConnectionType;
  Buffer: Address31Type;
  BytesToRead: integer;
  var BytesRead: integer
};
external;
```

**Figure 184. TcpWaitReceive example**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.</td>
</tr>
<tr>
<td>Buffer</td>
<td>The address of the buffer to contain the received data.</td>
</tr>
<tr>
<td>BytesToRead</td>
<td>The size of the buffer. TCP/IP usually buffers the incoming data until this many bytes are received. Data is delivered sooner if the sender specified the PushFlag, or if the sender does a TcpClose or equivalent.</td>
</tr>
</tbody>
</table>

**Note:** The order of TcpFReceive or TcpReceive calls on multiple connections and the order of DATAdelivered notifications among the connections are not necessarily related.

<table>
<thead>
<tr>
<th>BytesRead</th>
<th>Set when TcpWaitReceive returns. If it is greater than 0, it indicates the number of bytes received into your buffer. If it is less than or equal to 0, it indicates an error. Possible BytesRead values are:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• OK+</td>
</tr>
<tr>
<td></td>
<td>• ABNORMALcondition</td>
</tr>
<tr>
<td></td>
<td>• FATALerror</td>
</tr>
<tr>
<td></td>
<td>• TIMEOUTopen+</td>
</tr>
<tr>
<td></td>
<td>• UNREACHABLEnetwork+</td>
</tr>
</tbody>
</table>
ReturnCode Indicates success or failure of call. Possible return values are:

- OK
- ABNORMALcondition
- BADlengthARGUMENT
- FATALerror
- NOsuchCONNECTION
- NOTyetBEGUN
- NOTyetOPEN
- OPENrejected+
- RECEIVEstillPENDING
- REMOTEreset+
- TCPipSHUTDOWN+
- REMOTEclose
- INVALIDvirtualADDRESS
- SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 779.

(TcpWaitReceive):
1. For BytesRead OK, the function was initiated, but the connection is no longer receiving for an unspecified reason. Your program does not have to issue TcpClose, but the connection is not completely terminated until a NONEXISTENT notification is received for the connection.
2. For BytesRead REMOTEclose, the foreign host has closed the connection. Your program should respond with TcpClose.
3. If you receive any of the codes marked with (+), the function was initiated but the connection has now been terminated (see 2 on page 774). Your program should not issue TcpClose, but the connection is not completely terminated until NONEXISTENT notification is received for the connection.
4. TcpWaitReceive is intended to be used by programs that manage a single TCP connection. It is not suitable for use by multiple connection servers.
5. A return code of TCPipSHUTDOWN can be returned either because the connection initiation has failed, or because the connection has been terminated because of shutdown. In either case, your program should not issue any more TCP/IP calls.

TcpFSend, TcpSend, and TcpWaitSend

The examples in this section illustrate TcpFSend, TcpSend, and TcpWaitSend.

TcpFSend and TcpSend are the asynchronous ways of sending data on a TCP connection. Both procedures return to your program immediately (do not wait under any circumstance).

TcpWaitSend is a simple synchronous method of sending data on a TCP connection. It does not return immediately if the TCPIP address space has insufficient space to accept the data being sent.
In the case of insufficient buffer space, when space becomes available a BUFFERspaceAVAILABLE notification is received.

Your program can issue successive TcpWaitSend calls. Buffer shortage conditions are handled transparently. Errors at this point are most likely unable to recover or are caused by a terminated connection.

If you receive any of the codes listed for Reason in the CONNECTIONstateCHANGED notification, except for OK, the connection was terminated for the indicated reason. Your program should not issue a TcpClose, but the connection is not completely terminated until your program receives a NONEXISTENT notification for the connection.

```
procedure TcpFSend
   (     Connection: ConnectionType;
     Buffer: Address31Type;
     BufferLength: integer;
     PushFlag: Boolean;
     UrgentFlag: Boolean;
   var   ReturnCode: integer   
); external;
```

*Figure 185. TcpFSend example*

```
procedure TcpSend
   (     Connection: ConnectionType;
     Buffer: Address31Type;
     BufferLength: integer;
     PushFlag: Boolean;
     UrgentFlag: Boolean;
   var   ReturnCode: integer   
); external;
```

*Figure 186. TcpSend example*

```
procedure TcpWaitSend
   (     Connection: ConnectionType;
     Buffer: Address31Type;
     BufferLength: integer;
     PushFlag: Boolean;
     UrgentFlag: Boolean;
   var   ReturnCode: integer   
); external;
```

*Figure 187. TcpWaitSend example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInfoType record.</td>
</tr>
<tr>
<td>Buffer</td>
<td>The address of the buffer containing the data to send.</td>
</tr>
</tbody>
</table>
**BufferLength**  The size of the buffer.

**PushFlag**  Set to force the data, and previously queued data, to be sent immediately to the foreign application.

**UrgentFlag**  Is set to mark the data as urgent. The semantics of urgent data depends on your application.

**Note:** Use urgent data with caution. If the foreign application follows the Telnet-style use of urgent data, it might flush all urgent data, until a special character sequence is encountered.

**ReturnCode**  Indicates success or failure of call:
- OK
- ABNORMAL condition
- BAD length ARGUMENT
- CANNOT send DATA
- FATAL error
- NO buffer SPACE (TcpSend and TcpFSend)
- NO such CONNECTION
- NOT yet BEGIN
- NOT yet OPEN
- TCP ip SHUTDOWN
- INVALID virtual ADDRESS
- SOFTWARE error
- REMOTE reset

For a description of Pascal return codes, see [Table 23 on page 779](#).

**Notes:**
1. A successful TcpFSend, TcpSend, and TcpWaitSend means that TCP has received the data to be sent and stored it in its internal buffers. TCP then puts the data in packets and transmits it when the conditions permit.
2. Data sent in a TcpFSend, TcpSend, or TcpWaitSend request can be split into numerous packets by TCP, or the data can wait in TCP’s buffer space and share a packet with other TcpFSend, TcpSend, or TcpWaitSend requests.
3. The PushFlag is used to expedite when TCP sends the data.
   Setting the PushFlag to FALSE allows TCP to buffer the data and wait until it has enough data to transmit so as to use the transmission line more efficiently. There can be some delay before the foreign host receives the data.
   Setting the PushFlag to TRUE instructs TCP to put data into packets and transmit any buffered data from previous Send requests along with the data in the current TcpFSend, TcpSend, or TcpWaitSend request without delay or consideration of transmission line efficiency. A successful send does not imply that the foreign application has actually received the data, only that the data will be sent as soon as possible.
4. TcpWaitSend is intended for programs that manage a single TCP connection. It is not suitable for use by multiple connection servers.

**TcpNameChange**

Use the procedure shown in [Figure 188 on page 802](#) if the address space running the TCP/IP program is not named TCPIP and is not the same as specified in the TcpipUserid statement of the TCPIP DATA data set. (Refer to the [z/OS Communications Server: IP Configuration Reference](#))
If required, this procedure must be called before the BeginTcpIp procedure.

```haskell
procedure TcpNameChange
  (   NewNameOfTcp: DirectoryNameType
  );
  external;
```

*Figure 188. TcpNameChange example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NewNameOfTcp</td>
<td>The name of the address space running TCP/IP.</td>
</tr>
</tbody>
</table>

**TcpOpen and TcpWaitOpen**

The examples in this section illustrate TcpOpen and TcpWaitOpen.

Use TcpOpen or TcpWaitOpen to initiate a TCP connection. TcpOpen returns immediately, and connection establishment proceeds asynchronously with your program’s other operations. The connection is fully established when your program receives a CONNECTIONstateCHANGED notification with NewState set to OPEN. TcpWaitOpen does not return until the connection is established, or until an error occurs.

There are two types of TcpOpen calls: passive open and active open. A passive open call sets the connection state to LISTENING. An active open call sets the connection state to TRYINGtoOPEN.

```haskell
procedure TcpOpen
  (   var ConnectionInfo: StatusInfoType;
    var ReturnCode: integer
  );
  external;
```

*Figure 189. TcpOpen example*

```haskell
procedure TcpWaitOpen
  (   var ConnectionInfo: StatusInfoType;
    var ReturnCode: integer
  );
  external;
```

*Figure 190. TcpWaitOpen example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConnectionInfo</td>
<td>A connection information record.</td>
</tr>
<tr>
<td>Connection</td>
<td>Set this field to UNSPECIFIEDconnection. When the call returns, the field contains the number of the new connection if ReturnCode is OK.</td>
</tr>
</tbody>
</table>
ConnectionState
For active open, set this field to TRYINGtoOPEN.
For passive open, set this field to LISTENING.

OpenAttemptTimeout
Set this field to specify how long, in seconds, TCP
is to continue attempting to open the connection. If
the connection is not fully established during that
time, TCP reports the error to you. If you used
TcpOpen, you receive a notification. The type of
notification that you receive is
CONNECTIONstateCHANGED. It has a new state
of NONEXISTENT and a reason of TIMEOUTopen.
If you used TcpWaitOpen, it returns with
ReturnCode set to TIMEOUTopen.

Security
This field is reserved. Set it to DEFAULTsecurity.

Compartment
This field is reserved. Set it to
DEFAULTcompartment.

Precedence
This field is reserved. Set it to
DEFAULTprecedence.

LocalSocket
Active Open: You can use an address of
UNSPECIFIEDaddress (TCP/IP uses the home
address corresponding to the network interface
used to route to the foreign address) and a port of
UNSPECIFIEDport (TCP/IP assigns a port number,
in the range of 1000 to 65 534). You can specify the
address, the port, or both if particular values are
required by your application. The address must be
a valid home address for your node, and the port
must be available (not reserved, and not in use by
another application).

Passive Open: You usually specify a
predetermined port number, known by another
program, which can do an active open to connect
to your program. Alternatively, you can use
UNSPECIFIEDport to let TCP/IP assign a port
number, obtain the port number through TcpStatus,
and transmit it to the other program through an
existing TCP connection or manually. You generally
specify an address of UNSPECIFIEDaddress, so
that the active open to your port succeeds,
regardless of the home address to which it was
sent.

ForeignSocket
Active Open: The address and port must both be
specified, because TCP/IP cannot actively initiate a
connection without knowing the destination
address and port.

Passive Open: If your program is offering a service
to anyone who wants it, specify an address of
UNSPECIFIEDaddress and a port of
UNSPECIFIEDport. You can specify a particular
address and port if you want to accept an active
open only from a certain foreign application.
ReturnCode  Indicates success or failure of call. Possible return values are:
  • OK
  • ABNORMALcondition
  • FATALerror
  • LOCALportNOTavailable
  • NObufferSPACE
  • NOsuchCONNECTION
  • NOTyetBEGUN
  • OPENrejected (TcpWaitOpen Only)
  • PARAMlocalADDRESS
  • PARAMstate
  • PARAMtimeout
  • PARAMunspecADDRESS
  • PARAMunspecPORT
  • REMOTEreset (TcpWaitOpen Only)
  • SOFTWAREerror
  • TCPipSHUTDOWN
  • TIMEOUTopen (TcpWaitOpen Only)
  • TOOmanyOPENS
  • UNAUTHORIZEDuser (TcpWaitOpen Only)
  • UNREACHABLEnetwork (TcpWaitOpen Only)
  • ZEROresources

For a description of Pascal return codes, see Table 23 on page 779.

TcpOption

Use the procedure shown in Figure 191 to set an option for a TCP connection.

procedure TcpOption
  (  
  Connection: ConnectionType
  OptionName: integer
  OptionValue: integer;
  var ReturnValue: integer;
  ); external;

Figure 191. TcpOption example

Parameter       Description

Connection      The connection number, as returned by TcpOpen or TcpWaitOpen in the Connection field of the StatusInforType record.

OptionName      The code for the option.

Name             Description

OPTIONtcpKEEPALIVE
  If OptionValue is nonzero, then the keep-alive mechanism is activated for connection. If OptionValue is 0, then the keep-alive mechanism is deactivated for the connection. When activated, the keep-alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, then the connection state is changed to NONEXISTENT, with reason TIMEOUT connection.
OptionValue  The value for the option.
ReturnCode  Indicates success or failure of call.

Possible return values are:
- OK
- NOsuchCONNECTION
- NOTyetBEGUN
- TCPlpSHUTDOWN
- INVALIDrequest
- SOFTWAREerror
- REMOTEreset

For a description of Pascal return codes, see Table 23 on page 779.

**TcpStatus**

Use TcpStatus to obtain the current status of a TCP connection. Your program sets the Connection field of the ConnectionInfo record to the number of the connection whose status you want. Figure 192 shows an example of TcpStatus.

```pascal
procedure TcpStatus
(  
  var  ConnectionInfo: StatusInfoType;
  var  ReturnCode: integer
); external;
```

*Figure 192. TcpStatus example*

**Parameter**  **Description**

**ConnectionInfo**

If ReturnCode is OK, the following fields are returned.

**OpenAttemptTimeout**

If the connection is in the process of being opened (including a passive open), this field is set to the number of seconds remaining before the open is terminated if it has not completed. Otherwise, it is set to WAITforever.

**BytesToRead**

The number of bytes of incoming data queued for your program (waiting for TcpReceive, TcpFReceive, or TcpWaitReceive).

**UnackedBytes**

The number of bytes sent by your program but not yet sent to the foreign TCP, or the number of bytes sent to the foreign TCP, but not yet acknowledged.

**ConnectionState**

The current connection state.

**LocalSocket**

The local socket, consisting of a local address and a local port.

**ForeignSocket**

The foreign socket, consisting of a foreign address and a foreign port.
**ReturnCode**  Indicates the success or failure of the call. Possible return values are:
- OK
- NOsuchCONNECTION
- NOTyetBEGUN
- TCPipSHUTDOWN
- REMOTEreset
- SOFTWAREerror

For a description of Pascal return codes, see Table 23 on page 779.

**Note:** Your program cannot monitor connection state changes exclusively through polling with TcpStatus. It must receive CONNECTIONstateCHANGED notifications through GetNextNote for the TCP interface to work properly.

**UdpClose**

The procedure shown in Figure 193 closes the UDP socket specified in the ConnIndex field. All incoming datagrams on this connection are discarded.

```pascal
procedure UdpClose
  (ConnIndex: ConnectionIndexType;
   var ReturnCode: CallReturnCodeType
  );
  external;
```

*Figure 193. UdpClose example*

**Parameter Description**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConnIndex</td>
<td>The ConnIndex value returned from UdpOpen.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of a call. Possible return values are: OK, NOsuchCONNECTION, NOTyetBEGUN, TCPipSHUTDOWN, REMOTEreset, SOFTWAREerror</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.

**UdpNReceive**

The procedure shown in Figure 194 on page 807 notifies the TCP/IP address space that you are willing to receive UDP datagram data. This call returns immediately. The data buffer is not valid until you receive a UDPdatagramDELEVERED notification.
procedure UdpNReceive
(
    ConnIndex: ConnectionIndexType;
    BufferAddress: integer;
    BufferLength: integer;
    var ReturnCode: CallReturnCodeType
); external;

Figure 194. UdpNReceive example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConnIndex</td>
<td>The ConnIndex value returned from UdpOpen.</td>
</tr>
<tr>
<td>BufferAddress</td>
<td>The address of your buffer that is filled with a UDP datagram.</td>
</tr>
<tr>
<td>BufferLength</td>
<td>The length of your buffer. If you specify a length larger than 65 507</td>
</tr>
<tr>
<td></td>
<td>bytes, only the first 65 507 bytes are used.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of a call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• ABNORMALcondition</td>
</tr>
<tr>
<td></td>
<td>• FATALerror</td>
</tr>
<tr>
<td></td>
<td>• NoSuchCONNECTION</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
<tr>
<td></td>
<td>• RECEIVEstillPENDING</td>
</tr>
<tr>
<td></td>
<td>• TCPIPSHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>• SOFTWAREerror</td>
</tr>
<tr>
<td></td>
<td>• BADlengthARGUMENT</td>
</tr>
<tr>
<td></td>
<td>• INVALIDvirtualADDRESS</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779

UdpOpen
This procedure requests acceptance of UDP datagrams on the specified socket and
allows datagrams to be sent from the specified socket. When the socket port is
unspecified, UDP selects a port and returns it to the socket port field. When the
socket address is unspecified, UDP uses the default local address. If specified, the
address must be a valid home address for your node.

Note: When the local address is specified, only the UDP datagrams addressed to it
are delivered.

If the ReturnCode indicates the open was successful, use the returned ConnIndex
value on any further actions pertaining to this UDP socket. Figure 195 on page 808
shows an example.
Parameter  Description
LocalSocket  The local socket (address and port pair).
ConnIndex   The ConnIndex value returned from UdpOpen.
ReturnCode  Indicates success or failure of a call. Possible return values are:
  • OK
  • ABNORMALcondition
  • FATALerror
  • LOCALportNOTavailable
  • NObufferSPACE
  • NOTyetBEGIN
  • SOFTWAREerror
  • TCPipSHUTDOWN
  • UDPlocalADDRESS
  • TOOmanyOPENS
  • UNAUTHORIZEDuser

For a description of Pascal return codes, see Table 23 on page 779.

UdpReceive

The procedure shown in Figure 196 notifies the TCP/IP address space that you are willing to receive UDP datagram data.

UdpReceive is for compatibility with old programs only. New programs should use the UdpNReceive procedure, which allows you to specify the size of your buffer.

If you use UdpReceive, TCP/IP can put a datagram as large as 2012 bytes in your buffer. If a larger datagram is sent to your port when UdpReceive is pending, the datagram is discarded without notification.

Note: No data is transferred from the TCP/IP address space in this call. It only tells TCP/IP that you are waiting for a datagram. Data has been transferred when a UDPdatagramDELIVERED notification is received.

procedure UdpReceive
  (ConnIndex: ConnectionIndexType;
   DatagramAddress: integer;
   var ReturnCode: CallReturnCodeType
  );
  external;

Figure 196. UdpReceive example
Parameter Description
ConnIndex The ConnIndex value returned from UdpOpen.
DatagramAddress The address of your buffer that is filled with a UDP datagram.
ReturnCode Indicates success or failure of a call:
   • OK
   • ABNORMALcondition
   • FATALerror
   • NOsuchCONNECTION
   • NOTyetBEGUN
   • SOFTWAREerror
   • TCPipSHUTDOWN
   • INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 779.

UdpSend
The procedure shown in Figure 197 sends a UDP datagram to the specified foreign socket. The source socket is the local socket selected in the UdpOpen that returned the ConnIndex value that was used. The buffer does not include the UDP header. This header is supplied by TCP/IP.

When there is no buffer space to process the data, an error is returned. In this case, wait for a subsequent UDPdatagramSPACEavailable notification.

```pascal
procedure UdpSend
(   ConnIndex: ConnectionIndexType;
    ForeignSocket: SocketType;
    BufferAddress: integer;
    Length: integer;
    var ReturnCode: CallReturnCodeType
); external;
```

Figure 197. UdpSend example

Parameter Description
ConnIndex The ConnIndex value returned from UdpOpen.
ForeignSocket The foreign socket (address and port) to which the datagram is to be sent.
BufferAddress The address of your buffer containing the UDP datagram to be sent, excluding UDP header.
Length The length of the datagram to be sent, excluding UDP header. Maximum is 65507 bytes.
ReturnCode Indicates success or failure of a call. Possible return values are:
   • OK
   • BADlengthARGUMENT
   • NObufferSPACE
   • NOsuchCONNECTION
   • NOTyetBEGUN

Chapter 15. Pascal application programming interface  809
SOFTWAREerror  
TCPipSHUTDOWN  
UDPunspecADDRESS  
UDPunspecPORT  
INVALIDvirtualADDRESS

For a description of Pascal return codes, see Table 23 on page 779.

**Unhandle**

Use the procedure shown in Figure 198 when you no longer want to receive notifications in the given set.

If you request to unhandle the DATAdelivered notification, the Unhandle procedure returns with a code of INVALIDrequest.

```pascal
procedure Unhandle  
(  
    Notifications: NotificationSetType;  
    var  
    ReturnCode: integer  
);  
external;
```

*Figure 198. Unhandle example*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notifications</td>
<td>The set of notifications that you no longer want to receive.</td>
</tr>
<tr>
<td>ReturnCode</td>
<td>Indicates success or failure of call. Possible return values are:</td>
</tr>
<tr>
<td></td>
<td>• OK</td>
</tr>
<tr>
<td></td>
<td>• NOTyetBEGUN</td>
</tr>
<tr>
<td></td>
<td>• INVALIDRequest</td>
</tr>
</tbody>
</table>

For a description of Pascal return codes, see Table 23 on page 779.

**Sample Pascal program**

This section contains an example of a Pascal application program. The source code can be found in the SEZAINST data set.

**Building the sample Pascal API module**

The following steps describe how to build the Pascal API module:
1. Compile the sample Pascal program.
2. Link-edit the object code module to form an executable module sample.

**Running the sample module**

The following steps describe how to run the sample module:
1. Run the Pascal API sample program with the Receive option (shown in Figure 199 on page 811).
   Run PSAMPLE to start the sample program on the TSO command line. The following example is a typical response:
2. Run the Pascal API sample program with the Send option on a second TSO ID (shown in Figure 200).

Run PSAMPLE on the TSO command line to start the sample program. The following example is a typical response:

```
ENTER TSO COMMAND, CLIST, OR REXX EXEC BELOW:

==> psample

Transfer Mode: (Send or Receive) receive

Host Name or Internet Address: mvs1

mvs1
Transfer rate 483884. Bytes/sec.
Transfer rate 442064. Bytes/sec.
Transfer rate 478802. Bytes/sec.
Transfer rate 549568. Bytes/sec.
Transfer rate 635116. Bytes/sec.
Program terminated successfully.
***
```

Figure 199. Sample Pascal API with receive option

```
ENTER TSO COMMAND, CLIST, OR REXX EXEC BELOW:

==> psample

Transfer Mode: (Send or Receive) send

Host Name or Internet Address: mvs1

mvs1
Transfer rate 516540. Bytes/sec.
Transfer rate 487030. Bytes/sec.
Transfer rate 427816. Bytes/sec.
Transfer rate 566186. Bytes/sec.
Transfer rate 612128. Bytes/sec.
Program terminated successfully.
***
```

Figure 200. Sample Pascal API with send option

**Sample Pascal application program**

The following is an example of a Pascal application program.
program PSAMPLE;

const
  BUFFERlength = 8192;  { same as MAXdataBUFFERsize }

Figure 201. Sample Pascal application program (Part 1 of 6)
PORTnumber = 999;  { constant on both sides }  
CLOCKunitsPERthousand = '3E8000'x;

static
Buffer : packed array (..1..BUFFERlength.) of char;
BufferAddress : Address31Type;
ConnectionInfo : StatusInfoType;
Count : integer;
DataRate : real;
Difference : TimeStampType;
HostAddress : InternetAddressType;
IbmSeconds : integer;
Ignored : integer;
Line : string(80);
Note : NotificationInfoType;
PushFlag : boolean;  { for TcpSend }
RealRate : real;
ReturnCode : integer;
SendFlag : boolean;  { are we sending or receiving }
StartingTime : TimeStampType;
Thousands : integer;
TotalBytes : integer;
UrgentFlag : boolean;  { for TcpSend }

var RoundRealRate : integer;

{*******************************************************************************}
{print message, release resources and reset environment}{*******************************************************************************}
procedure Restore ( const Message: string;  
   const ReturnCode: integer );
%UHEADER
begin
Write(Message);
if ReturnCode <> OK then
 {* Write(SayCalRe(ReturnCode)); 
   WriteIn('');  *}
   Msg1(Output,1, addr(SayCalRe(ReturnCode)) )
else Msg0(Output,2);

EndTcpIp;
Close (Input);
Close (Output);
end;

begin
TernOut (Output);
TernIn (Input);

{ Establish access to TCP/IP services }
BeginTcpIp (ReturnCode);
if ReturnCode <> OK then begin
 {* WriteIn('BeginTcpip: ',SayCalRe(ReturnCode));  *}
   Msg1(Output,4, addr(SayCalRe(ReturnCode)) );
end;

Figure 201. Sample Pascal application program (Part 2 of 6)
return;
end;

{ Inform TCPIP which notifications will be handled by the program }
Handle ((.DATAdelivered,.BUFFERspaceAVAILABLE,
CONNECTIONstateCHANGED,
FSendResponse.),ReturnCode);
if ReturnCode <> OK then begin
  Restore ('Handle: ',ReturnCode);
  return;
end;

{ Prompt user for operation parameters }
{ Writeln('Transfer mode: (Send or Receive)'); }
Msg0(Output,5);
ReadLn (Line);
if (Substr(Ltrim(Line),1,1) = 's')
or (Substr(Ltrim(Line),1,1) = 'S') then
  SendFlag := TRUE
else
  SendFlag := FALSE;

{ Writeln('Host Name or Internet Address :'); }
Msg0(Output,6);
ReadLn (Line);
GetHostResol (Trim(Ltrim(Line)),HostAddress);
if HostAddress = NOhost then begin
  Restore ('GetHostResol failed. ',OK);
  return;
end;

{ Open a TCP connection: active for Send and passive for Receive }
{ - Connection value will be returned by TcpIp }
{ - initialize IBM reserved fields: Security, Compartment }
{ and Precedence }
{ for Active open - set Connection State to TRYINGtoOPEN }
{ - must initialize foreign socket }
{ for Passive open - set ConnectionState to LISTENING }
{ - may leave foreign socket uninitialized to }
{ accept any open attempt }
with ConnectionInfo do begin
  Connection := UNSPECIFIEDconnection;
  OpenAttemptTimeout := WAITforever;
  Security := DEFAULTsecurity;
  Compartment := DEFAULTcompartment;
  Precedence := DEFAULTprecedence;
  if SendFlag then begin
    ConnectionState := TRYINGtoOPEN;
    LocalSocket.Address := UNSPECIFIEDAddress;
    LocalSocket.Port := UNSPECIFIEDport;
    ForeignSocket.Address := HostAddress;
    ForeignSocket.Port := PORTnumber;
  end
  else begin
    ConnectionState := LISTENING;
  end

Figure 201. Sample Pascal application program (Part 3 of 6)
LocalSocket.Address := HostAddress;
LocalSocket.Port := PORTnumber;
ForeignSocket.Address := UNSPECIFIEDAddress;
ForeignSocket.Port := UNSPECIFIEDPort;

TcpWaitOpen (ConnectionInfo, ReturnCode);
if ReturnCode <> OK then begin
  Restore ('TcpWaitOpen: ', ReturnCode);
  return;
end;

{ Initialization }
BufferAddress := Addr(Buffer(.1.));
StartingTime := ClockTime;
TotalBytes := 0;
Count := 0;
PushFlag := false;  { let TcpIp buffer data for efficiency }
UrgentFlag := false;  { none of out data is Urgent }

{ Issue first TcpFSend or TcpReceive }
if SendFlag then
  TcpFSend (ConnectionInfo.Connection, BufferAddress,
  BUFFERLength, PushFlag, UrgentFlag, ReturnCode)
else
  TcpFReceive (ConnectionInfo.Connection, BufferAddress,
  BUFFERLength, ReturnCode);

if ReturnCode <> OK then begin
  /* Writeln('TcpSend/Receive: ',SayCalRe(ReturnCode)); */
  Msg1(Output,7, addr(SayCalRe(ReturnCode)));
  return;
end;

{ Repeat until 5M bytes of data have been transferred }
while (Count < 5) do begin
  { Wait until previous transfer operation is completed }
  GetNextNote(Note, True, ReturnCode);
  if ReturnCode <> OK then begin
    Restore('GetNextNote: ',ReturnCode);
    return;
  end;

  { Proceed with transfer according to the Notification received }
  { Notifications Expected: }
  { DATAdelivered - TcpFReceive function call is now complete }
  { - receive buffer contains data }
  { FSENDresponse - TcpFSend function call is now complete }
  { - send buffer is now available for use }
  case Note.NotificationTag of
    DATAdelivered:
      begin
      TotalBytes := TotalBytes + Note.BytesDelivered;
      (issue next TcpFReceive }

Figure 201. Sample Pascal application program (Part 4 of 6)
TCPReceive (ConnectionInfo.Connection, BufferAddress, BUFFERlength, ReturnCode);
  if ReturnCode <> OK then begin
    Restore('TCPReceive: ', ReturnCode);
    return;
  end;
end;

FUNCTIONresponse:
begin
  if Note.SendTurnCode <> OK then begin
    Restore('FUNCTIONresponse: ', Note.SendTurnCode);
    return;
  end else begin
    {issue next TcpFsend}
    TotalBytes := TotalBytes + BUFFERlength;
    TcpFSend (ConnectionInfo.Connection, BufferAddress, BUFFERlength, PushFlag, UrgentFlag, ReturnCode);
    if ReturnCode <> OK then begin
      Restore('TcpFSend: ', ReturnCode);
      return;
    end;
  end;
BUFFERSpaceAVAILABLE:
{ do nothing };
OTHERWISE
begin
  Restore('Unexpected Notification ', OK);
  return;
end; { Case on Note.NotificationTag }

{ is it time to print transfer rate? }
if TotalBytes < 1048576 then
  continue;

{ Print transfer rate after every 1M bytes of data transferred }
DoubleSubtract (ClockTime, StartingTime, Difference);
DoubleDivide (Difference, CLOCKunitsPERthousandth, Thousandths, Ignored);
RealRate := (TotalBytes/Thousandths) * 1000.0;
{ WriteLn('Transfer Rate ', RealRate:10:0, ' Bytes/sec.'); } /*
RoundRealRate := Round(RealRate);
Msg1(Output,8, addr(RoundRealRate));

StartingTime := ClockTime;
TotalBytes := 0;
Count := Count + 1;
end; { Loop while Count < 5 }

{ Close TCP connection and wait till partner also drops connection }
TcpClose (ConnectionInfo.Connection, ReturnCode);
if ReturnCode <> OK then begin

Figure 201. Sample Pascal application program (Part 5 of 6)
Restore ("TcpClose: ", ReturnCode);
    return;
end;

{ when partner also drops connection, program will receive }
{ CONNECTIONstateCHANGED notification with NewState = NONEXISTENT } repeat
    GetNextNote (Note, True, ReturnCode);
    if ReturnCode <> OK then begin
        Restore ("GetNextNote: ", ReturnCode);
        return;
    end;
    until (Note.NotificationTag = CONNECTIONstateCHANGED) &
        ((Note.NewState = NONEXISTENT) |
            (Note.NewState = CONNECTIONclosing));

Restore ("Program terminated successfully. ", OK);
end.

Figure 201. Sample Pascal application program (Part 6 of 6)
Appendix A. Multitasking C socket sample program

The first sample program is the server in the C language. It allocates a socket, binds to a port, calls listen() to perform a passive open, and uses select() to block until a client request arrives. When a client requests a connection, select() returns and accept() is called to establish the connection.

Note: Some hosts have more than one network address. By specifying a particular network address for the bind() call, a server specifies that it wants to honor connections from one particular network address only. If the server specifies the constant INADDR_ANY for this address, it accepts connections from any of the machine's network addresses.

This program uses the Multitasking Facility (MTF). The server has started a number of subtasks with the MTF task initialization service tinit(). When the server has accepted a connection, it calls tsched() to start the subtask that will handle the client. The server then uses givesocket() and takesocket() to pass the connection to the subtask. When the connection has been passed to the subtask, the main loop blocks in select() waiting for another client.

The second program is the subtask in C. When it begins, it does a takesocket(). It was passed two 8-byte names that define the parent task from which it will obtain the socket. After it gets the socket, it sends a message to this new client and then waits for the client to send a message back.

The third program is the client in C. It allocates a socket, binds to a port, and connects to a server port that is passed as the second parameter port number 691. Then it has a conversation with the server (actually the server's subtask) sending and receiving messages alternatively.

Notes:
1. When you compile the C sample programs, use DEF(MVS) in the CPARM list.
2. When you run the server program, specify PARMS='9999' to use port 9999.
3. When you run the client program, specify PARMS='MVSF 9999' to use port 9999. Replace MVSF with the host name of your MVS system.

Server sample program in C

The following C socket server program is the MTCSRVR member in the SEZAINST data set.
/** C socket Server Program */
/*
 * This code performs the server functions for multitasking, which
 * include
 * . creating subtasks
 * . socket(), bind(), listen(), accept()
 * . getclientid
 * . givesocket() to TCP/IP in preparation for the subtask
 * . to do a takesocket()
 * . select()
 * /* There are three test tasks running:
 * . server master
 * . server subtask - separate TCB within server address space
 * . client
 */

static char ibmcopyr[] =
"MTCSRVR - Licensed Materials - Property of IBM."
"This module is "Restricted Materials of IBM" *
"5647-A01 (C) Copyright IBM Corp. 1994, 1996. *
"See IBM Copyright Instructions."

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>

Figure 202. MTCSRVR C socket server program sample (Part 1 of 7)
```
#include <socket.h>
#include <inet.h>
#include <fcntl.h>
#include <errno.h>
#include <tcperrno.h>
#include <bsdtime.h>
#include <mtf.h>
#include <stdio.h>

int dotinit(void);
void getsock(int *s);
int dobind(int *s, unsigned short port);
int doaccept(int *s);
int testgive(int *s);
int dogive(int *clsocket, char *myname);

/*
 * Server Main.
 */
main(argc, argv)
    int argc;
    char **argv;
{
    unsigned short port;    /* port server for bind */
    int s;        /* socket for accepting connections */
    int rc;       /* return code */
    int count;    /* counter for number of sockets */
    int clsocket; /* client socket */
    char myname[8]; /* 8 char name of this address space */
    char mysname[8]; /* my subtask name */

    /* Check arguments. Should be only one: the port number to bind to. */
    if (argc != 2) {
        fprintf(stderr, "Usage: %s port\n", argv[0]);
        exit(1);
    }

    /* First argument should be the port. */
    port = (unsigned short) atoi(argv[1]);
    fprintf(stdout, "Server: port = %d \n", port);

    /* Create subtasks */
    rc = dotinit();
    if (rc < 0)
    
    perror("Srvc: error for tinit");
    printf("rc from tinit is %d\n", rc);

Figure 202. MTCSRVR C socket server program sample (Part 2 of 7)
getsock(&s);
printf("Srvr: socket = %d\n", s);

rc = dobind(&s, port);
if (rc < 0)
  tcperror("Srvr: error for bind");
printf("Srvr: rc from bind is %d\n", rc);

rc = dolisten(&s);
if (rc < 0)
  tcperror("Srvr: error for listen");
printf("Srvr: rc from listen is %d\n", rc);

/***************************************
* To do nonblocking mode,
* uncomment out this code.
*
rc = fcntl(s, F_SETFL, FNDELAY);
if (rc != 0)
  tcperror("Error for fcntl");
printf("rc from fcntl is %d\n", rc);

/*****************************************************************************/
rc = getname(myname, myname);
if (rc < 0)
  tcperror("Srvr: error for getclientid");
printf("Srvr: rc from getclientid is %d\n", rc);

/*----------------------------------------------------------------*/
/* . issue accept(), waiting for client connection */
/* . issue givesocket() to pass client's socket to TCP/IP */
/* . issue select(), waiting for subtask to complete takesocket() */
/* . close our local socket associated with client's socket */
/* . loop on accept(), waiting for another client connection */
/*----------------------------------------------------------------*/
rc = 0;
count = 0; /* number of sockets */
while (rc == 0) {
  clsocket = doaccept(&s);
  printf("Srvr: clsocket from accept is %d\n", clsocket);
  count = count + 1;
  printf("Srvr: ###number of sockets is %d\n", count);
  if (clsocket != 0) {
    rc = dogive(&clsocket, myname);
    if (rc != 0)
      tcperror("Srvr: error for dogive");
    printf("Srvr: rc from dogive is %d\n", rc);
    if (rc == 0) {
      rc = tsched(MTF_ANY,"csub", &clsocket, myname, mysnake);
      if (rc < 0)
        perror("error for tsched");
    }
  }
}

Figure 202. MTCSRVR C socket server program sample (Part 3 of 7)
rc = testgive(&clsocket);
printf("Srvr: rc from testgive is %d\n", rc);

sleep(60); /** do simplified situation first ***/
printf("Srvr: rc from close of clsocket is %d\n", rc);
/******************************
exit(0); /** do this simplified situation first ***
/*****************************/
} /** end of if (rc == 0) ****/
} /** end of if (clsocket != 0) ****/
} /********** end of while (rc == 0) ****/
} /************* end of main **********/  
/*****************************/  
/* dotinit() */
/* Call _tinit() to ATTACH subtask and fetch() subtask load module */
/*****************************/
int dotinit(void)
{
    int rc;
    int numsubs = 1;
    printf("Srvr: calling __tinit\n");
    rc = __tinit("mtccsub", numsubs);
    return rc;
}

/*****************************/
/* getsock() */
/* Get a socket */
/*****************************/
void getsock(int *s)
{
    int temp;
    temp = socket(AF_INET, SOCK_STREAM, 0);
    *s = temp;
    return;
}

/*****************************/
/* dobind() */
/* Bind to all interfaces */
/*****************************/
int dobind(int *s, unsigned short port)
{
    int rc;
    int temps;
    struct sockaddr_in tsock;
    memset(&tsock, 0, sizeof(tsock)); /* clear tsock to 0's */
tsock.sin_family = AF_INET;
tsock.sin_addr.s_addr = INADDR_ANY; /* bind to all interfaces */

Figure 202. MTCSRVR C socket server program sample (Part 4 of 7)
tsock.sin_port = htons(port);

temps = *s;
rc = bind(temps, (struct sockaddr *)&tsock, sizeof(tsock));
return rc;
}

/* -----------------------------------------------------------------------*/
/* dolisten() */
/* Listen to prepare for client connections. */
/* -----------------------------------------------------------------------*/
int dolisten(int *s)
{
    int rc;
    int temps;
    temps = *s;
    rc = listen(temps, 10); /* backlog of 10 */
    return rc;
}

/* -----------------------------------------------------------------------*/
/* getname() */
/* Get the identifiers by which TCP/IP knows this server. */
/* -----------------------------------------------------------------------*/
int getname(char *myname, char *mysname)
{
    int rc;
    struct clientid cid;
    memset(&cid, 0, sizeof(cid));
    rc = getclientid(AF_INET, &cid);
    memcpy(myname, cid.name, 8);
    memcpy(mysname, cid.subtaskname, 8);
    return rc;
}

/* -----------------------------------------------------------------------*/
/* doaccept() */
/* Select() on this socket, waiting for another client connection. */
/* If connection is pending, issue accept() to get client's socket */
/* -----------------------------------------------------------------------*/
int doaccept(int *s)
{
    int temps;
    int clsocket;
    struct sockaddr clientaddress;
    int addrlen;
    int maxfdpl;
    struct fd_set readmask;
    struct fd_set writmask;
    struct fd_set excpmask;
    int rc;
    struct timeval time;

    temps = *s;
    time.tv_sec = 1000;

Figure 202. MTCSRVR C socket server program sample (Part 5 of 7)
```c
int testgive(int *s)
{
    int temps;
    struct sockaddr clientaddress;
    int addrlen;
    int maxfdpl;
    struct fd_set readmask;
    struct fd_set writmask;
    struct fd_set excpmask;
    int rc;
    struct timeval time;

    temps = *s;
    time.tv_sec = 1000;
    time.tv_usec = 0;
    maxfdpl = temps + 1;

    FD_ZERO(&readmask);
    FD_ZERO(&writmask);
    FD_ZERO(&excpmask);

    FD_SET(temps, &readmask);
    FD_SET(temps, &writmask);
    FD_SET(temps, &excpmask);

    int rc = select(maxfdpl, &readmask, &writmask, &excpmask, &time);
    printf("Srvr: rc from select is %d\n", rc);
    if (rc < 0) {
        tcperror("error from select");
        return rc;
    } else if (rc == 0) {
        /* time limit expired */
        return rc;
    } else {
        /* this socket is ready */
        addrlen = sizeof(clientaddress);
        clsocket = accept(temps, &clientaddress, &addrlen);
        return clsocket;
    }
}
```

Figure 202. MTCSRVR C socket server program sample (Part 6 of 7)
The subtask sample program in C

The following C socket server program is the MTCCSUB member in the SEZAINST data set.
## C Socket Server Subtask Program

This code is started by the tsched() routine of C/370 MTF. Its purpose is to do a takesocket() and then send/recv with the client process.

```c
#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>
#include <socket.h>
#include <inet.h>
#include <fcntl.h>
#include <errno.h>
#include <tcperrno.h>
#include <bsdt ime.h>
#include <stdio.h>

/*
 * Server subtask

Figure 203. MTCCSUB C socket server program sample (Part 1 of 3)
```
csub(int *clsock, /* address of socket passed */
    char *tskname, /* address of caller's name */
    char *tsksname) /* address of caller's sname */
{
    int temps;       /* */
    int sendbytes;   /* # bytes sent */
    int recvbytes;   /* # bytes received */
    int clsocket;    /* client socket */
    int rc;          /* */
    char xtskname[8]; /* caller's name */
    char xtsksname[8]; /* caller's subtask name */

    clsocket = *clsock;
    memcpy(xtskname, tskname, 8); /* local copy */
    memcpy(xtsksname, tsksname, 8); /* local copy */
    rc = doget(&clsocket, xtskname, xtsksname);
    printf("Csub: returned from doget()\n");
    if (rc < 0)
      tcperror("Csub: Error from doget");
    printf("Csub: rc from doget is %d\n", rc);

    temps = rc;    /* new socket number */
    if (temps > -1) do {
      sendbytes = dosend(&temps);
      recvbytes = dorecv(&temps);
    } while (0);
    /* } while (recvbytes > 0); do simplified situation first ***/
    fflush(stdout);
    sleep(30);
}

Figure 203. MTCCSUB C socket server program sample (Part 2 of 3)
The client sample program in C

The following C socket server program is the MTCCLNT member in the
SEZAINST data set.
C Socket Client Program

This code sends and receives msgs with the server subtask.

#include <manifest.h>
#include <bsdtypes.h>
#include <in.h>
#include <netdb.h>
#include <socket.h>
#include <netinet.h>
#include <errmo.h>
#include <tcperrno.h>
#include <bsdt ime.h>
#include <stdio.h>

int dosend(int *s);
int dorecv(int *s);
int doconn(int *s, unsigned long *octaddrp, unsigned short port);
void getsock(int *s);

Figure 204. MTCCCLNT C socket server program sample (Part 1 of 4)
main(int argc, char **argv) {
    int gotbytes;    /* number of bytes received */
    int sndbytes;    /* number of bytes sent */
    int s;          /* socket descriptor */
    int rc;         /* return code */
    struct in_addr octaddr; /* host internet address (binary) */
    unsigned short port; /* port number sent as parameter */
    char *charaddr;  /* host internet address (dotted dec) */
    struct hostent *hostnm; /* server host name information */

    /* Check Arguments Passed. Should be hostname and port. */
    if (argc != 3) {
        fprintf(stderr, "Usage: %s %s hostnamen port\n", argv[0]);
        exit(1);
    }
    /* The host name is the first argument. Get the server address. */
    hostnm = gethostbyname(argv[1]);
    if (hostnm == (struct hostent *) 0) {
        fprintf(stderr, "Gethostbyname failed\n");
        exit(2);
    }
    octaddr.s_addr = *((unsigned long *)hostnm->h_addr);

    /* The port is the second argument. */
    port = (unsigned short) atoi(argv[2]);
    fprintf(stdout, "Clnt: port = %d\n", port);
    getsock(&s);
    printf("Clnt: our socket is %d\n", s);
    charaddr = inet_ntoa(octaddr);
    printf("Clnt: address of host is %8s\n", charaddr);
    rc = doconn(&s, &octaddr.s_addr, port);
    if (rc < 0)
        tcperror("Clnt: error for connect");
    else {
        printf("Clnt: rc from connect is %d\n", rc);
        do {
            gotbytes = dorecv(&s);
            sndbytes = dosend(&s);
        } while (0);
        /* While (sndbytes > 0); do simplified situation first ****/
        sleep(15);
    }
}

Figure 204. MTCCLNT C socket server program sample (Part 2 of 4)
void getsock(int *s)
{
    int temp;
    temp = socket(AF_INET, SOCK_STREAM, 0);
    *s = temp;
    return;
}

int doconn(int *s, unsigned long *octaddrp, unsigned short port)
{
    int rc;
    int temps;
    struct sockaddr_in tsock;
    memset(&tsock, 0, sizeof(tsock));
    tsock.sin_family = AF_INET;
    tsock.sin_port = htons(port);
    tsock.sin_addr.s_addr = *octaddrp;

    temps = *s;
    rc = connect(temps, (struct sockaddr *)&tsock, sizeof(tsock));
    return rc;
}

int dorecv(int *s)
{
    int temps;
    int gotbytes;
    char data[100];

    temps = *s;
    gotbytes = recv(temps, data, sizeof(data), 0);
    if (gotbytes < 0) {
        tcperror("Clnt: error for recv");
        return gotbytes;
    } else
        printf("Clnt: data recv: %s\n", data);
    return gotbytes;
}

Figure 204. MTCLNT C socket server program sample (Part 3 of 4)
int dosend(int *s)
{
    int temps;
    int sndbytes;
    char data[50];

    temps = *s;
    gets(data);
    printf("clnt: data to send: %s\n", data);
    sndbytes = send(temps, data, sizeof(data), 0);
    if (sndbytes < 0) {
        tcperror("Clnt: error for send");
    } else
        printf("Clnt: sent %d bytes to server subtask\n", sndbytes);
    return sndbytes;
}

Figure 204. MTCLNT C socket server program sample (Part 4 of 4)
Appendix B. Return codes

This section contains error return codes for socket calls. The error codes apply to all of the following socket APIs:

- TCP/IP C socket API
- X/Open Transport Interface
- Macro API for IPv4 or IPv6 that is written in z/OS assembler language
- Call instruction API for IPv4 or IPv6 socket applications
- z/OS Communications Server socket API for REXX
- Pascal language for IPv4 socket API

It also contains sockets extended return codes that apply only to the macro, call instruction, and REXX socket APIs.

If the return code is not listed in this section, it is a return code that is received from z/OS UNIX. See "z/OS UNIX System Services Messages and Codes" for the z/OS UNIX ERRNOs.

See "User abend U4093" on page 855 for a description of user abend U4093.

System error codes for socket calls

This section contains the error codes and the message names that refer to the following APIs:

- C sockets
- Macro
- Call instruction
- REXX sockets

The names in the Socket Type column are identifiers that apply to all of the above APIs and do not follow the naming convention for any specific API. These message numbers and codes are in the TCPERRNO.H include file.

When a socket call is processed, both a return code and an error number are returned to your program. If the return code is 0 or a positive number, the call completed normally. If the return code is a negative number, the call did not complete normally and an error number is returned. See the following table for the meaning of the error number that is returned.

For the following error conditions, a name is returned by C socket calls and a number is returned by the sockets extended interface calls. The error condition return codes can originate from the socket application programming interface or from a peer server program.

Sockets return codes (ERRNOs)

This section provides the system-wide message numbers and codes set by the system calls. These message numbers and codes are in the TCPERRNO.H include file supplied with TCP/IP Services.
## ERRNOs

### Table 24. Sockets ERRNOs

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EAI_NONAME</td>
<td>GETADDRINFO</td>
<td>NODE or HOST cannot be found.</td>
<td>Ensure the NODE or HOST name can be resolved.</td>
</tr>
<tr>
<td>1</td>
<td>EDOM</td>
<td>All</td>
<td>Argument too large.</td>
<td>Check parameter values of the function call.</td>
</tr>
<tr>
<td>1</td>
<td>EPERM</td>
<td>All</td>
<td>Permission is denied. No owner exists.</td>
<td>Check that TPC/IP is still active; check protocol value of socket () call.</td>
</tr>
<tr>
<td>1</td>
<td>EPERM</td>
<td>IOCTL (SIOCTTLSCTL) requesting both TTLS_INIT_CONNECTION and TTLS_RESET_SESSION or both TTLS_INIT_CONNECTION and TTLS_RESET_CIPHER</td>
<td>The combination of requests specified is not permitted.</td>
<td>Request TTLS_RESET_SESSION and TTLS_RESET_CIPHER only when TTLS_INIT_CONNECTION has been previously requested for the connection.</td>
</tr>
</tbody>
</table>
| 1            | EPERM        | IOCTL (SIOCTTLSCTL) | Denotes one of the following error conditions:  
- The TTLS_INIT_CONNECTION option was requested with either TTLS_RESET_SESSION, TTLS_RESET_CIPHER or TTLS_STOP_CONNECTION  
- The TTLS_STOP_CONNECTION option was requested along with TTLS_RESET_SESSION TTLS_RESET_CIPHER  
- The TTLS_ALLOW_HSTIMEOUT option was requested without TTLS_INIT_CONNECTION  
| 2            | EAI_AGAIN    | GETADDRINFO | For GETADDRINFO, NODE could not be resolved within the configured time interval. For GETNAMEINFO, HOST could not be resolved within the configured time interval. The Resolver address space has not been started. The request can be retried later. | Ensure the Resolver is active, then retry the request. |
### ERRNOs

Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>ENOENT</td>
<td>All</td>
<td>The data set or directory was not found.</td>
<td>Check files used by the function call.</td>
</tr>
<tr>
<td>2</td>
<td>ERANGE</td>
<td>All</td>
<td>The result is too large.</td>
<td>Check parameter values of the function call.</td>
</tr>
<tr>
<td>3</td>
<td>EAI_FAIL</td>
<td>FREEADDRINFO GETADDRINFO GETNAMEINFO</td>
<td>This is an unrecoverable error. NODELEN, HOSTLEN, or SERVLEN is incorrect. For FREEADDRINFO, the resolver storage does not exist.</td>
<td>Correct the NODELEN, HOSTLEN, or SERVLEN. Otherwise, call your system administrator.</td>
</tr>
<tr>
<td>3</td>
<td>ESRCH</td>
<td>All</td>
<td>The process was not found. A table entry was not located.</td>
<td>Check parameter values and structures pointed to by the function parameters.</td>
</tr>
<tr>
<td>4</td>
<td>EAI_OVERFLOW</td>
<td>GETNAMEINFO</td>
<td>The output buffer for the host name or service name was too small.</td>
<td>Increase the size of the buffer to 255 characters, which is the maximum size permitted.</td>
</tr>
<tr>
<td>4</td>
<td>EINTR</td>
<td>All</td>
<td>A system call was interrupted.</td>
<td>Check that the socket connection and TCP/IP are still active.</td>
</tr>
<tr>
<td>5</td>
<td>EAI_FAMILY</td>
<td>GETADDRINFO GETNAMEINFO</td>
<td>The AF or the FAMILY is incorrect.</td>
<td>Correct the AF or the FAMILY.</td>
</tr>
<tr>
<td>5</td>
<td>EIO</td>
<td>All</td>
<td>An I/O error occurred.</td>
<td>Check status and contents of source database if this occurred during a file access.</td>
</tr>
<tr>
<td>6</td>
<td>EAI_MEMORY</td>
<td>GETADDRINFO GETNAMEINFO</td>
<td>The resolver cannot obtain storage to process the host name.</td>
<td>Contact your system administrator.</td>
</tr>
<tr>
<td>6</td>
<td>ENXIO</td>
<td>All</td>
<td>The device or driver was not found.</td>
<td>Check status of the device attempting to access.</td>
</tr>
<tr>
<td>7</td>
<td>E2BIG</td>
<td>All</td>
<td>The argument list is too long.</td>
<td>Check the number of function parameters.</td>
</tr>
<tr>
<td>7</td>
<td>EAI_BADFLAGS</td>
<td>GETADDRINFO GETNAMEINFO</td>
<td>FLAGS has an incorrect value.</td>
<td>Correct the FLAGS.</td>
</tr>
<tr>
<td>8</td>
<td>EAI_SERVICE</td>
<td>GETADDRINFO</td>
<td>The SERVICE was not recognized for the specified socket type.</td>
<td>Correct the SERVICE.</td>
</tr>
<tr>
<td>8</td>
<td>ENOEXEC</td>
<td>All</td>
<td>An EXEC format error occurred.</td>
<td>Check that the target module on an exec call is a valid executable module.</td>
</tr>
<tr>
<td>9</td>
<td>EAI_SOCKTYPE</td>
<td>GETADDRINFO</td>
<td>The SOCTYPE was not recognized.</td>
<td>Correct the SOCTYPE.</td>
</tr>
<tr>
<td>9</td>
<td>EBADF</td>
<td>All</td>
<td>An incorrect socket descriptor was specified.</td>
<td>Check socket descriptor value. It might be currently not in use or incorrect.</td>
</tr>
</tbody>
</table>
### ERRNOs

**Table 24. Sockets ERRNOs (continued)**

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>EBADF</td>
<td>Givesocket</td>
<td>The socket has already been given. The socket domain is not AF_INET or AF_INET6.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>9</td>
<td>EBADF</td>
<td>Select</td>
<td>One of the specified descriptor sets is an incorrect socket descriptor.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>9</td>
<td>EBADF</td>
<td>Takesocket</td>
<td>The socket has already been taken.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>9</td>
<td>EAI_SOCKTYPE</td>
<td>GETADDRINFO</td>
<td>The SOCTYPE was not recognized.</td>
<td>Correct the SOCTYPE.</td>
</tr>
<tr>
<td>10</td>
<td>ECHILD</td>
<td>All</td>
<td>There are no children.</td>
<td>Check if created subtasks still exist.</td>
</tr>
<tr>
<td>11</td>
<td>EAGAIN</td>
<td>All</td>
<td>There are no more processes.</td>
<td>Retry the operation. Data or condition might not be available at this time.</td>
</tr>
<tr>
<td>12</td>
<td>ENOMEM</td>
<td>All</td>
<td>There is not enough storage.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>13</td>
<td>EACCES</td>
<td>All</td>
<td>Permission denied, caller not authorized.</td>
<td>Check access authority of file.</td>
</tr>
<tr>
<td>13</td>
<td>EACCES</td>
<td>Takesocket</td>
<td>The other application (listener) did not give the socket to your application. Permission denied, caller not authorized.</td>
<td>Check access authority of file.</td>
</tr>
<tr>
<td>13</td>
<td>EACCES</td>
<td>IOCTL (SIOCTTLSCTL)</td>
<td>The IOCTL is requesting a function that requires that the socket be mapped to policy that specifies ApplicationControlled On.</td>
<td>Check policy and add ApplicationControlled On if the application should be permitted to issue the controlled SIOCTTLSCTL functions.</td>
</tr>
<tr>
<td>14</td>
<td>EFAULT</td>
<td>All</td>
<td>An incorrect storage address or length was specified.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>14</td>
<td>EFAULT</td>
<td>IOCTL (SIOCSAPPLDATA)</td>
<td>An abend occurred while attempting to copy the SetADContainer structure from the address provided in the SetAD_ptr field.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>15</td>
<td>ENOTBLK</td>
<td>All</td>
<td>A block device is required.</td>
<td>Check device status and characteristics.</td>
</tr>
<tr>
<td>16</td>
<td>EBUSY</td>
<td>All</td>
<td>Listen has already been called for this socket. Device or file to be accessed is busy.</td>
<td>Check if the device or file is in use.</td>
</tr>
<tr>
<td>17</td>
<td>EEXIST</td>
<td>All</td>
<td>The data set exists.</td>
<td>Remove or rename existing file.</td>
</tr>
<tr>
<td>18</td>
<td>EXDEV</td>
<td>All</td>
<td>This is a cross-device link. A link to a file on another file system was attempted.</td>
<td>Check file permissions.</td>
</tr>
<tr>
<td>Error number</td>
<td>Message name</td>
<td>Socket type</td>
<td>Error description</td>
<td>Programmer’s response</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>19</td>
<td>ENODEV</td>
<td>All</td>
<td>The specified device does not exist.</td>
<td>Check file name and if it exists.</td>
</tr>
<tr>
<td>20</td>
<td>ENOTDIR</td>
<td>All</td>
<td>The specified directory is not a directory.</td>
<td>Use a valid file that is a directory.</td>
</tr>
<tr>
<td>21</td>
<td>EISDIR</td>
<td>All</td>
<td>The specified directory is a directory.</td>
<td>Use a valid file that is not a directory.</td>
</tr>
<tr>
<td>22</td>
<td>EINVAL</td>
<td>All types</td>
<td>An incorrect argument was specified.</td>
<td>Check the validity of function parameters.</td>
</tr>
<tr>
<td>22</td>
<td>EINVAL</td>
<td>Multicast Source filter APIs</td>
<td>Mix of any-source, source-specific or full-state APIs</td>
<td>Specify the correct type of APIs.</td>
</tr>
<tr>
<td>22</td>
<td>EINVAL</td>
<td>MCAST_Join_GROUP, MCAST_JOIN_SOURCE_ GROUP, MCAST_BLOCK_SOURCE, MCAST_LEAVE_GROUP, MCAST_LEAVE_SOURCE_ GROUP, MCAST_UNBLOCK_SOURCE, SIOCGMMSFILTER, SIOCSMMSFILTER</td>
<td>The socket address family or the socket length of the input multicast group or the source IP address is not correct.</td>
<td>Specify the correct value.</td>
</tr>
<tr>
<td>22</td>
<td>EINVAL</td>
<td>SIOCSMMSFILTER, SIOCSIPMSFILTER</td>
<td>The specified filter mode is not correct.</td>
<td>Specify the correct value.</td>
</tr>
<tr>
<td>23</td>
<td>ENFILE</td>
<td>All</td>
<td>Data set table overflow occurred.</td>
<td>Reduce the number of open files.</td>
</tr>
<tr>
<td>24</td>
<td>EFILE</td>
<td>All</td>
<td>The socket descriptor table is full.</td>
<td>Check the maximum sockets specified in MAXDESC().</td>
</tr>
<tr>
<td>25</td>
<td>ENOTTY</td>
<td>All</td>
<td>An incorrect device call was specified.</td>
<td>Check specified IOCTL() values.</td>
</tr>
<tr>
<td>26</td>
<td>EFBIG</td>
<td>All</td>
<td>A text data set is busy.</td>
<td>Check the current use of the file.</td>
</tr>
<tr>
<td>27</td>
<td>EFBIG</td>
<td>All</td>
<td>The specified data set is too large.</td>
<td>Check size of accessed dataset.</td>
</tr>
<tr>
<td>28</td>
<td>ENOSPC</td>
<td>All</td>
<td>There is no space left on the device.</td>
<td>Increase the size of accessed file.</td>
</tr>
<tr>
<td>29</td>
<td>ESPIPE</td>
<td>All</td>
<td>An incorrect seek was attempted.</td>
<td>Check the offset parameter for seek operation.</td>
</tr>
<tr>
<td>30</td>
<td>EROFS</td>
<td>All</td>
<td>The data set system is Read only.</td>
<td>Access data set for read only operation.</td>
</tr>
<tr>
<td>31</td>
<td>EMLINK</td>
<td>All</td>
<td>There are too many links.</td>
<td>Reduce the number of links to the accessed file.</td>
</tr>
<tr>
<td>32</td>
<td>EPIPE</td>
<td>All</td>
<td>The connection is broken. For socket write/send, peer has shut down one or both directions.</td>
<td>Reconnect with the peer.</td>
</tr>
<tr>
<td>32</td>
<td>EPIPE</td>
<td>IOCTL (SIOCTTLSCTL requesting TTLS_INIT_CONNECTION, TTLS_RESET_CIPHER, or TTLS_STOP_CONNECTION)</td>
<td>The TCP connection is not in the established state.</td>
<td>Issue the SIOCTTLSCTL IOCTL when the socket is connected.</td>
</tr>
</tbody>
</table>
Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>EDOM</td>
<td>All</td>
<td>The specified argument is too large.</td>
<td>Check and correct function parameters.</td>
</tr>
<tr>
<td>34</td>
<td>ERANGE</td>
<td>All</td>
<td>The result is too large.</td>
<td>Check function parameter values.</td>
</tr>
<tr>
<td>35</td>
<td>EWOULDBLOCK</td>
<td>Accept</td>
<td>The socket is in nonblocking mode and connections are not queued. This is not an error condition.</td>
<td>Reissue Accept().</td>
</tr>
<tr>
<td>35</td>
<td>EWOULDBLOCK</td>
<td>Read Recvfrom</td>
<td>The socket is in nonblocking mode and read data is not available. This is not an error condition.</td>
<td>Issue a select on the socket to determine when data is available to be read or reissue the Read()/Recvfrom().</td>
</tr>
<tr>
<td>35</td>
<td>EWOULDBLOCK</td>
<td>Send Sendto Write</td>
<td>The socket is in nonblocking mode and buffers are not available.</td>
<td>Issue a select on the socket to determine when data is available to be written or reissue the Send(), Sendto(), or Write().</td>
</tr>
<tr>
<td>35</td>
<td>EWOULDBLOCK</td>
<td>IOCTL (SIOCTTLSCTL)</td>
<td>The handshake is in progress and the socket is a non-blocking socket.</td>
<td>For a non-blocking socket, you can wait for the handshake to complete by issuing Select or Poll for Socket Writable.</td>
</tr>
<tr>
<td>36</td>
<td>EINPROGRESS</td>
<td>Connect</td>
<td>The socket is marked nonblocking and the connection cannot be completed immediately. This is not an error condition.</td>
<td>See the Connect() description for possible responses.</td>
</tr>
<tr>
<td>36</td>
<td>EINPROGRESS</td>
<td>IOCTL (SIOCTTLSCTL requesting TTLS_INIT_CONNECTION or TTLS_STOP_CONNECTION)</td>
<td>The handshake is already in progress and the socket is a non-blocking socket.</td>
<td>For a non-blocking socket, you can wait for the handshake to complete by issuing Select or Poll for Socket Writable.</td>
</tr>
<tr>
<td>37</td>
<td>EALREADY</td>
<td>Connect</td>
<td>The socket is marked nonblocking and the previous connection has not been completed.</td>
<td>Reissue Connect().</td>
</tr>
<tr>
<td>37</td>
<td>EALREADY</td>
<td>IOCTL (SIOCTTLSCTL requesting TTLS_INIT_CONNECTION or TTLS_STOP_CONNECTION)</td>
<td>For TTLS_INIT_CONNECTION, the socket is already secure. For TTLS_STOP_CONNECTION, the socket is not secure.</td>
<td>Modify the application so that it issues the SIOCTTLSCTL IOCTL that requests TTLS_INIT_CONNECTION only when the socket is not already secure and that requests TTLS_STOP_CONNECTION only when the socket is secure.</td>
</tr>
<tr>
<td>37</td>
<td>EALREADY</td>
<td>Maxdesc</td>
<td>A socket has already been created calling Maxdesc() or multiple calls to Maxdesc().</td>
<td>Issue Getablesize() to query it.</td>
</tr>
</tbody>
</table>
### Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>EALREADY</td>
<td>Setibmopt</td>
<td>A connection already exists to a TCP/IP image. A call to SETIBMOPT (IBMTCP_IMAGE), has already been made.</td>
<td>Only call Setibmopt() once.</td>
</tr>
<tr>
<td>38</td>
<td>ENOTSOCK</td>
<td>All</td>
<td>A socket operation was requested on a nonsocket connection. The value for socket descriptor was not valid.</td>
<td>Correct the socket descriptor value and reissue the function call.</td>
</tr>
<tr>
<td>39</td>
<td>EDESTADDRREQ</td>
<td>All</td>
<td>A destination address is required.</td>
<td>Fill in the destination field in the correct parameter and reissue the function call.</td>
</tr>
<tr>
<td>40</td>
<td>EMSGSIZE</td>
<td>Sendto Sendms Send Write</td>
<td>The message is too long. It exceeds the IP limit of 64K or the limit set by the setsockopt() call.</td>
<td>Either correct the length parameter, or send the message in smaller pieces.</td>
</tr>
<tr>
<td>41</td>
<td>EPROTOTYPE</td>
<td>All</td>
<td>The specified protocol type is incorrect for this socket.</td>
<td>Correct the protocol type parameter.</td>
</tr>
<tr>
<td>41</td>
<td>EPROTOTYPE</td>
<td>IOCTL (SIOCTTLSCTL)</td>
<td>Socket is not a TCP socket.</td>
<td>Issue the SIOCTTLSCTL IOCTL on TCP sockets only.</td>
</tr>
<tr>
<td>41</td>
<td>EPROTOTYPE</td>
<td>IOCTL (SIOCSAPPLDATA)</td>
<td>The request was not successful. The socket is not a stream (TCP) socket.</td>
<td>Issue the SIOCSAPPLDATA IOCTL on TCP sockets only.</td>
</tr>
<tr>
<td>42</td>
<td>ENOPROTOOPT</td>
<td>Getsockopt Setsockopt</td>
<td>The socket option specified is incorrect or the level is not SOL_SOCKET. Either the level or the specified opname is not supported.</td>
<td>Correct the level or opname.</td>
</tr>
<tr>
<td>42</td>
<td>ENOPROTOOPT</td>
<td>Getibmssockopt Setibmsockopt</td>
<td>Either the level or the specified opname is not supported.</td>
<td>Correct the level or opname.</td>
</tr>
<tr>
<td>43</td>
<td>EPROTOONOSUPPORT</td>
<td>Socket</td>
<td>The specified protocol is not supported.</td>
<td>Correct the protocol parameter.</td>
</tr>
<tr>
<td>44</td>
<td>ESOCKTNOSUPPORT</td>
<td>All</td>
<td>The specified socket type is not supported.</td>
<td>Correct the socket type parameter.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>IOCTL</td>
<td>The specified IOCTL command is not supported by this socket API.</td>
<td>Correct the IOCTL COMMAND.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>GETSOCKOPT</td>
<td>The specified GETSOCKOPT OPTNAME option is not supported by this socket API.</td>
<td>Correct the GETSOCKOPT OPTNAME option.</td>
</tr>
</tbody>
</table>
### ERRNOs

Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>IOCTL (SIOCTTLSCTL requesting TTLS_INIT_CONNECTION, TTLS_RESET_SESSION, TTLS_RESET_CIPHER or TTLS_STOP_CONNECTION)</td>
<td>Mapped policy indicates that AT-TLS is not enabled for the connection.</td>
<td>Modify the policy to enable AT-TLS for the connection.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>RECV, RECVFROM, RECVMSG, SEND, SENDTO, SENDMSG</td>
<td>The specified flags are not supported on this socket type or protocol.</td>
<td>Correct the FLAG.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>Accept, GiveSocket</td>
<td>The selected socket is not a stream socket.</td>
<td>Use a valid socket.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>Listen</td>
<td>The socket does not support the Listen call.</td>
<td>Change the type on the Socket() call when the socket was created. Listen() only supports a socket type of SOCK_STREAM.</td>
</tr>
<tr>
<td>45</td>
<td>EOPNOTSUPP</td>
<td>Getibmopt, Setibmopt</td>
<td>The socket does not support this function call. This command is not supported for this function.</td>
<td>Correct the command parameter. See Getibmopt() for valid commands. Correct by ensuring a Listen() was not issued before the Connect().</td>
</tr>
<tr>
<td>46</td>
<td>EPFNOSUPPORT</td>
<td>All</td>
<td>The specified protocol family is not supported or the specified domain for the client identifier is not AF_INET=2.</td>
<td>Correct the protocol family.</td>
</tr>
<tr>
<td>47</td>
<td>EAFNOSUPPORT</td>
<td>Bind, Connect, Socket</td>
<td>The specified address family is not supported by this protocol family.</td>
<td>For Socket(), set the domain parameter to AF_INET. For Bind() and Connect(), set Sin_Family in the socket address structure to AF_INET.</td>
</tr>
<tr>
<td>47</td>
<td>EAFNOSUPPORT</td>
<td>Getclient, GiveSocket</td>
<td>The socket specified by the socket descriptor parameter was not created in the AF_INET domain.</td>
<td>The Socket() call used to create the socket should be changed to use AF_INET for the domain parameter.</td>
</tr>
<tr>
<td>47</td>
<td>EAFNOSUPPORT</td>
<td>IOCTL</td>
<td>You attempted to use an IPv4-only ioctl on an AF_INET6 socket.</td>
<td>Use the correct socket type for the ioctl or use an ioctl that supports AF_INET6 sockets.</td>
</tr>
<tr>
<td>Error number</td>
<td>Message name</td>
<td>Socket type</td>
<td>Error description</td>
<td>Programmer’s response</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------</td>
<td>---------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>48</td>
<td>EADDRINUSE</td>
<td>Bind</td>
<td>The address is in a timed wait because a LINGER delay from a previous close or another process is using the address. This error can also occur if the port specified in the bind call has been configured as RESERVED on a port reservation statement in the TCP/IP profile.</td>
<td>If you want to reuse the same address, use Setsockopt() with SO_REUSEADDR. Refer to the section about Setsockopt() in z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for more information. Otherwise, use a different address or port in the socket address structure.</td>
</tr>
<tr>
<td>48</td>
<td>EADDRINUSE</td>
<td>IP_ADD_MEMBERSHIP, IP_ADD_SOURCE_MEMBERSHIP, IPV6_JOIN_GROUP, MCAST_JOIN_GROUP, MCAST_JOIN_SOURCE_GROUP</td>
<td>The specified multicast address and interface address (or interface index) pair is already in use.</td>
<td>Correct the specified multicast address, interface address, or interface index.</td>
</tr>
<tr>
<td>49</td>
<td>EADDRNOTAVAIL</td>
<td>Bind</td>
<td>The specified address is incorrect for this host.</td>
<td>Correct the function address parameter.</td>
</tr>
<tr>
<td>49</td>
<td>EADDRNOTAVAIL</td>
<td>Connect</td>
<td>The calling host cannot reach the specified destination.</td>
<td>Correct the function address parameter.</td>
</tr>
<tr>
<td>49</td>
<td>EADDRNOTAVAIL</td>
<td>Multicast APIs</td>
<td>The specified multicast address, interface address, or interface index is not correct.</td>
<td>Correct the specified address.</td>
</tr>
<tr>
<td>49</td>
<td>EADDRNOTAVAIL</td>
<td>IP_BLOCK_SOURCE, IP_ADD_SOURCE_MEMBERSHIP, MCAST_BLOCK_SOURCE, MCAST_JOIN_SOURCE_GROUP</td>
<td>A duplicate source IP address is specified on the multicast group and interface pair.</td>
<td>Correct the specified source IP address.</td>
</tr>
<tr>
<td>49</td>
<td>EADDRNOTAVAIL</td>
<td>IP_UNBLOCK_SOURCE, IP_DROP_SOURCE_MEMBERSHIP, MCAST_UNBLOCK_SOURCE, MCAST_LEAVE_SOURCE_GROUP</td>
<td>A previously blocked source multicast group cannot be found.</td>
<td>Correct the specified address.</td>
</tr>
<tr>
<td>50</td>
<td>ENETDOWN</td>
<td>All</td>
<td>The network is down.</td>
<td>Retry when the connection path is up.</td>
</tr>
<tr>
<td>51</td>
<td>ENETUNREACH</td>
<td>Connect</td>
<td>The network cannot be reached.</td>
<td>Ensure that the target application is active.</td>
</tr>
<tr>
<td>52</td>
<td>ENETRESET</td>
<td>All</td>
<td>The network dropped a connection on a reset.</td>
<td>Reestablish the connection between the applications.</td>
</tr>
<tr>
<td>53</td>
<td>ECONNABORTED</td>
<td>All</td>
<td>The software caused a connection abend.</td>
<td>Reestablish the connection between the applications.</td>
</tr>
<tr>
<td>54</td>
<td>ECONNRESET</td>
<td>All</td>
<td>The connection to the destination host is not available.</td>
<td>N/A</td>
</tr>
<tr>
<td>Error number</td>
<td>Message name</td>
<td>Socket type</td>
<td>Error description</td>
<td>Programmer’s response</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------</td>
<td>-------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>54</td>
<td>ECONNRESET</td>
<td>Send, Write</td>
<td>The connection to the destination host is not available.</td>
<td>The socket is closing. Issue Send() or Write() before closing the socket.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>All</td>
<td>No buffer space is available.</td>
<td>Check the application for massive storage allocation call.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>Accept</td>
<td>Not enough buffer space is available to create the new socket.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>Send, Sendto, Write</td>
<td>Not enough buffer space is available to send the new message.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>IOCTL (SIOCTTLSCTL, TTLS_Version1 requesting TTLS_RETURN_ CERTIFICATE or TTLS_Version2 query)</td>
<td>The buffer size provided is too small.</td>
<td>For TTLS_Version1 use the returned certificate length to allocate a larger buffer and reissue IOCTL with the larger buffer.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>Takesocket</td>
<td>Not enough buffer space is available to create the new socket.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>IOCTL (SIOCSAPPLDATA)</td>
<td>There is no storage available to store the associated data.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>55</td>
<td>ENOBUFS</td>
<td>IP_BLOCK_SOURCE, IP_ADD_SOURCE_, MEMBERSHIP, MCAST_BLOCK_SOURCE, MCAST_JOIN_SOURCE_, GROUP, SIOCSIPMSFILTER, SIOCSMSFILTER, setipv4sourcefilter</td>
<td>A maximum of 64 source filters can be specified per multicast address, interface address pair.</td>
<td>Remove unneeded source IP addresses and reenter the command.</td>
</tr>
<tr>
<td>56</td>
<td>EISCONN</td>
<td>Connect</td>
<td>The socket is already connected.</td>
<td>Correct the socket descriptor on Connect() or do not issue a Connect() twice for the socket.</td>
</tr>
<tr>
<td>57</td>
<td>ENOTCONN</td>
<td>All</td>
<td>The socket is not connected.</td>
<td>Connect the socket before communicating.</td>
</tr>
<tr>
<td>57</td>
<td>ENOTCONN</td>
<td>IOCTL (SIOCTTLSCTL)</td>
<td>The socket is not connected.</td>
<td>Issue the SIOCTTLSCTL IOCTL only after the socket is connected.</td>
</tr>
<tr>
<td>58</td>
<td>ESHUTDOWN</td>
<td>All</td>
<td>A Send cannot be processed after socket shutdown.</td>
<td>Issue read/receive before shutting down the read side of the socket.</td>
</tr>
<tr>
<td>59</td>
<td>ETOOMANYREFS</td>
<td>All</td>
<td>There are too many references. A splice cannot be completed.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>Error number</td>
<td>Message name</td>
<td>Socket type</td>
<td>Error description</td>
<td>Programmer's response</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>59</td>
<td>ETOOMANYREFS</td>
<td>IP_ADD_MEMBERSHIP, IP_ADD_SOURCE_MEMBERSHIP, MCAST_JOIN_GROUP, MCAST_JOIN_SOURCE_GROUP, IPv6_JOIN_GROUP</td>
<td>A maximum of 20 multicast groups per single UDP socket or a maximum of 256 multicast groups per single RAW socket can be specified.</td>
<td>Remove unneeded multicast groups and reenter the command.</td>
</tr>
<tr>
<td>60</td>
<td>ETIMEDOUT</td>
<td>Connect</td>
<td>The connection timed out before it was completed.</td>
<td>Ensure the server application is available.</td>
</tr>
<tr>
<td>61</td>
<td>ECONNREFUSED</td>
<td>Connect</td>
<td>The requested connection was refused.</td>
<td>Ensure server application is available and at specified port.</td>
</tr>
<tr>
<td>62</td>
<td>ELOOP</td>
<td>All</td>
<td>There are too many symbolic loop levels.</td>
<td>Reduce symbolic links to specified file.</td>
</tr>
<tr>
<td>63</td>
<td>ENAMETOOLONG</td>
<td>All</td>
<td>The file name is too long.</td>
<td>Reduce size of specified file name.</td>
</tr>
<tr>
<td>64</td>
<td>EHOSTDOWN</td>
<td>All</td>
<td>The host is down.</td>
<td>Restart specified host.</td>
</tr>
<tr>
<td>65</td>
<td>EHOSTUNREACH</td>
<td>All</td>
<td>There is no route to the host.</td>
<td>Set up network path to specified host and verify that host name is valid.</td>
</tr>
<tr>
<td>66</td>
<td>ENOTEMPTY</td>
<td>All</td>
<td>The directory is not empty.</td>
<td>Clear out specified directory and reissue call.</td>
</tr>
<tr>
<td>67</td>
<td>EPROCLIM</td>
<td>All</td>
<td>There are too many processes in the system.</td>
<td>Decrease the number of processes or increase the process limit.</td>
</tr>
<tr>
<td>68</td>
<td>EUSERS</td>
<td>All</td>
<td>There are too many users on the system.</td>
<td>Decrease the number of users or increase the user limit.</td>
</tr>
<tr>
<td>69</td>
<td>EDQUOT</td>
<td>All</td>
<td>The disk quota has been exceeded.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>70</td>
<td>ESTALE</td>
<td>All</td>
<td>An old NFS’ data set handle was found.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>71</td>
<td>EREMOTE</td>
<td>All</td>
<td>There are too many levels of remote in the path.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>72</td>
<td>ENOSTR</td>
<td>All</td>
<td>The device is not a stream device.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>73</td>
<td>ETIME</td>
<td>All</td>
<td>The timer has expired.</td>
<td>Increase timer values or reissue function.</td>
</tr>
<tr>
<td>74</td>
<td>ENOSR</td>
<td>All</td>
<td>There are no more stream resources.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>75</td>
<td>ENOMSG</td>
<td>All</td>
<td>There is no message of the desired type.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>76</td>
<td>EBADMSG</td>
<td>All</td>
<td>The system cannot read the message.</td>
<td>Verify that z/OS Communications Server installation was successful and that message files were properly loaded.</td>
</tr>
<tr>
<td>77</td>
<td>EIDRM</td>
<td>All</td>
<td>The identifier has been removed.</td>
<td>Call your system administrator.</td>
</tr>
</tbody>
</table>
### ERRNOs

**Table 24. Sockets ERRNOs (continued)**

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>EDEADLK</td>
<td>All</td>
<td>A deadlock condition has occurred.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>78</td>
<td>EDEADLK</td>
<td>Select Select</td>
<td>None of the sockets in the socket descriptor sets are either AF_INET or AF_IUCV sockets and there is no timeout value or no ECB specified. The select/selectex would never complete.</td>
<td>Correct the socket descriptor sets so that an AF_INET or AF_IUCV socket is specified. A timeout or ECB value can also be added to avoid the select/selectex from waiting indefinitely.</td>
</tr>
<tr>
<td>79</td>
<td>ENOLCK</td>
<td>All</td>
<td>No record locks are available.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>80</td>
<td>ENONET</td>
<td>All</td>
<td>The requested machine is not on the network.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>81</td>
<td>ERREMOTE</td>
<td>All</td>
<td>The object is remote.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>82</td>
<td>ENOLINK</td>
<td>All</td>
<td>The link has been severed.</td>
<td>Release the sockets and reinitialize the client-server connection.</td>
</tr>
<tr>
<td>83</td>
<td>EADV</td>
<td>All</td>
<td>An ADVERTISE error has occurred.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>84</td>
<td>ESRMNT</td>
<td>All</td>
<td>An SRMOUNT error has occurred.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>85</td>
<td>ECOMM</td>
<td>All</td>
<td>A communication error has occurred on a Send call.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>86</td>
<td>EPROTO</td>
<td>All</td>
<td>A protocol error has occurred.</td>
<td>Call your system administrator.</td>
</tr>
</tbody>
</table>
| 86           | EPROTO       | IOCTL (SIOCTTLSCTL requesting TLS_RESET_SESSION, TLS_RESET_CIPHER, TLS_STOP_CONNECTION, or TLS_ALLOW_HSTIMEOUT) | One of the following errors occurred:  
- A TLS_INIT_CONNECTION request has not been received for the connection  
- TLS_RESET_CIPHER or TLS_STOP_CIPHER was requested on a connection that is secured using SSL version 2.  
- TLS_ALLOW_HSTIMEOUT was requested but the policy has the HandshakeRole value client or the HandshakeTimeout is 0. | Request TTLS_INIT_CONNECTION prior to requesting TTLS_RESET_SESSION or TTLS_RESET_CIPHER. Request TTLS_RESET_CIPHER or TTLS_STOP_CIPHER only on connections secured using SSL version 3 or TLS version 1. Request TTLS_ALLOW_HSTIMEOUT only when the security type is TTLS_SEC_SERVER or higher and the HandshakeTimeout is not 0. |
<p>| 87           | EMULTIHOP    | All         | A multihop address link was attempted. | Call your system administrator. |
| 88           | EDOTDOT      | All         | A cross-mount point was detected. This is not an error. | Call your system administrator. |</p>
<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>EREMCHG</td>
<td>All</td>
<td>The remote address has changed.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>90</td>
<td>ECONNCLOSED</td>
<td>All</td>
<td>The connection was closed by a peer.</td>
<td>Check that the peer is running.</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>All</td>
<td>Socket descriptor is not in correct range. The maximum number of socket descriptors is set by MAXDESC(). The default range is 0–49.</td>
<td>Reissue function with corrected socket descriptor.</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>Bind socket</td>
<td>The socket descriptor is already being used.</td>
<td>Correct the socket descriptor.</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>Give socket</td>
<td>The socket has already been given. The socket domain is not AF_INET.</td>
<td>Correct the socket descriptor.</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>Select</td>
<td>One of the specified descriptor sets is an incorrect socket descriptor.</td>
<td>Correct the socket descriptor. Set on Select() or Selectex().</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>Takesocket</td>
<td>The socket has already been taken.</td>
<td>Correct the socket descriptor.</td>
</tr>
<tr>
<td>113</td>
<td>EBADF</td>
<td>Accept</td>
<td>A Listen() has not been issued before the Accept().</td>
<td>Issue Listen() before Accept().</td>
</tr>
<tr>
<td>121</td>
<td>EINVAL</td>
<td>All</td>
<td>An incorrect argument was specified.</td>
<td>Check and correct all function parameters.</td>
</tr>
<tr>
<td>121</td>
<td>EINVAL</td>
<td>IOCTL (SIOCSAPPLDATA)</td>
<td>The input parameter is not a correctly formatted SetApplData structure.</td>
<td>Check and correct all function parameters.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The SetAD_eye1 value is not valid.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The SetAD_ver value is not valid.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The storage pointed to by SetAD_ptr does not contain a correctly formatted SetAcontainer structure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The SetAD_eye2 value is not valid.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The SetAD_len value contains an incorrect length for the SetAD_ver version of the SetAcontainer structure.</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>ECLOSED</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>ENMELONG</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>ENOTEMPT</td>
<td>All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>E2BIG</td>
<td>All</td>
<td>The argument list is too long.</td>
<td>Eliminate excessive number of arguments.</td>
</tr>
</tbody>
</table>
### Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>156</td>
<td>EMVSINITIAL</td>
<td>All</td>
<td>Process initialization error. This indicates an z/OS UNIX process initialization failure. This is usually an indication that a proper OMVS RACF segment is not defined for the user ID associated with application. The RACF OMVS segment may not be defined or may contain errors such as an improper HOME() directory specification.</td>
<td>Attempt to initialize again. After ensuring that an OMVS Segment is defined, if the errno is still returned, call your MVS system programmer to have IBM service contacted.</td>
</tr>
<tr>
<td>157</td>
<td>EMISSED</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1002</td>
<td>EIBMSOCKOUTOF RANGE</td>
<td>Socket</td>
<td>A socket number assigned by the client interface code is out of range.</td>
<td>Check the socket descriptor parameter.</td>
</tr>
<tr>
<td>1003</td>
<td>EIBMSOCKINUSE</td>
<td>Socket</td>
<td>A socket number assigned by the client interface code is already in use.</td>
<td>Use a different socket descriptor.</td>
</tr>
<tr>
<td>1004</td>
<td>EIBMIUCVERR</td>
<td>All</td>
<td>The request failed because of an IUCV error. This error is generated by the client stub code.</td>
<td>Ensure IUCV/VMCF is functional.</td>
</tr>
<tr>
<td>1008</td>
<td>EIBMCONFLICT</td>
<td>All</td>
<td>This request conflicts with a request already queued on the same socket.</td>
<td>Cancel the existing call or wait for its completion before reissuing this call.</td>
</tr>
<tr>
<td>1009</td>
<td>EIBMCANCELLED</td>
<td>All</td>
<td>The request was canceled by the CANCEL call.</td>
<td>Informational, no action needed.</td>
</tr>
<tr>
<td>1011</td>
<td>EIBMBADTCPNAME</td>
<td>All</td>
<td>A TCP/IP name that is not valid was detected.</td>
<td>Correct the name specified in the IBM_TCPIMAGE structure.</td>
</tr>
<tr>
<td>1011</td>
<td>EIBMBADTCPNAME</td>
<td>Setibmopt</td>
<td>A TCP/IP name that is not valid was detected.</td>
<td>Correct the name specified in the IBM_TCPIMAGE structure.</td>
</tr>
<tr>
<td>1011</td>
<td>EIBMBADTCPNAME</td>
<td>INITAPI</td>
<td>A TCP/IP name that is not valid was detected.</td>
<td>Correct the name specified on the IDENT option TCPNAME field.</td>
</tr>
<tr>
<td>1012</td>
<td>EIBMBADREQUESTCODE</td>
<td>All</td>
<td>A request code that is not valid was detected.</td>
<td>Contact your system administrator.</td>
</tr>
<tr>
<td>1013</td>
<td>EIBMBADCONNECTIONSTATE</td>
<td>All</td>
<td>A connection token that is not valid was detected; bad state.</td>
<td>Verify TCP/IP is active.</td>
</tr>
<tr>
<td>1014</td>
<td>EIBMUNAUTHORIZEDCALLER</td>
<td>All</td>
<td>An unauthorized caller specified an authorized keyword.</td>
<td>Ensure user ID has authority for the specified operation.</td>
</tr>
</tbody>
</table>
## ERRNOs

### Table 24. Sockets ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1015</td>
<td>EIBMBADCONNECTIONMATCH</td>
<td>All</td>
<td>A connection token that is not valid was detected. There is no such connection.</td>
<td>Verify TCP/IP is active.</td>
</tr>
<tr>
<td>1016</td>
<td>EIBMTCPABEND</td>
<td>All</td>
<td>An abend occurred when TCP/IP was processing this request.</td>
<td>Verify that TCP/IP has restarted.</td>
</tr>
<tr>
<td>1023</td>
<td>EIBMTERMERROR</td>
<td>All</td>
<td>Encountered a terminating error while processing.</td>
<td>Call your system administrator.</td>
</tr>
<tr>
<td>1026</td>
<td>EIBMINVDELETE</td>
<td>All</td>
<td>Delete requestor did not create the connection.</td>
<td>Delete the request from the process that created it.</td>
</tr>
<tr>
<td>1027</td>
<td>EIBMINVSOCKET</td>
<td>All</td>
<td>A connection token that is not valid was detected. No such socket exists.</td>
<td>Call your system programmer.</td>
</tr>
<tr>
<td>1028</td>
<td>EIBMINVTCPCONNECTION</td>
<td>All</td>
<td>Connection terminated by TCP/IP. The token was invalidated by TCP/IP.</td>
<td>Reestablish the connection to TCP/IP.</td>
</tr>
<tr>
<td>1032</td>
<td>EIBMCALLINPROGRESS</td>
<td>All</td>
<td>Another call was already in progress.</td>
<td>Reissue after previous call has completed.</td>
</tr>
<tr>
<td>1036</td>
<td>EIBMNOACTIVETCP</td>
<td>All</td>
<td>TCP/IP is not installed or not active.</td>
<td>Correct TCP/IP name used.</td>
</tr>
<tr>
<td>1036</td>
<td>EIBMNOACTIVETCP</td>
<td>Select</td>
<td>EIBMNOACTIVETCP</td>
<td>Ensure TCP/IP is active.</td>
</tr>
<tr>
<td>1037</td>
<td>EIBMINVTSRBUSERDATA</td>
<td>All</td>
<td>The request control block contained data that is not valid.</td>
<td>No TCP/IP image was found.</td>
</tr>
<tr>
<td>1038</td>
<td>EIBMINVUSERDATA</td>
<td>All</td>
<td>The request control block contained user data that is not valid.</td>
<td>Check your function parameters and call your system programmer.</td>
</tr>
<tr>
<td>1040</td>
<td>EBMSELECTEXPOST</td>
<td>SELECTEX</td>
<td>SELECTEX passed an ECB that was already posted.</td>
<td>Check whether the user’s ECB was already posted.</td>
</tr>
<tr>
<td>1112</td>
<td>ECANCEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>EINVALDRXSOCKETCALL</td>
<td>REXX</td>
<td>A syntax error occurred in the RXSOCKET parameter list.</td>
<td>Correct the parameter list passed to the REXX socket call.</td>
</tr>
<tr>
<td>2002</td>
<td>ECONSOLEINTERRUPT</td>
<td>REXX</td>
<td>A console interrupt occurred.</td>
<td>Retry the task.</td>
</tr>
<tr>
<td>2003</td>
<td>ESUBTASKINVALID</td>
<td>REXX</td>
<td>The subtask ID is incorrect.</td>
<td>Correct the subtask ID on the INITIALIZE call.</td>
</tr>
<tr>
<td>2004</td>
<td>ESUBTASKALREADYACTIVE</td>
<td>REXX</td>
<td>The subtask is already active.</td>
<td>Only issue the INITIALIZE call once in your program.</td>
</tr>
<tr>
<td>2005</td>
<td>ESUBTASKALNOTACTIVE</td>
<td>REXX</td>
<td>The subtask is not active.</td>
<td>Issue the INITIALIZE call before any other socket call.</td>
</tr>
</tbody>
</table>
## ERRNOs

<table>
<thead>
<tr>
<th>Error number</th>
<th>Message name</th>
<th>Socket type</th>
<th>Error description</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>ESOCKNETNOTALLOCATED</td>
<td>REXX</td>
<td>The specified socket could not be allocated.</td>
<td>Increase the user storage allocation for this job.</td>
</tr>
<tr>
<td>2007</td>
<td>EMAXSOCKETSREACHED</td>
<td>REXX</td>
<td>The maximum number of sockets has been reached.</td>
<td>Increase the number of allocate sockets, or decrease the number of sockets used by your program.</td>
</tr>
<tr>
<td>2009</td>
<td>ESOCKETNOTDEFINED</td>
<td>REXX</td>
<td>The socket is not defined.</td>
<td>Issue the SOCKET call before the call that fails.</td>
</tr>
<tr>
<td>2011</td>
<td>EDOMAINSERVERFAILURE</td>
<td>REXX</td>
<td>A Domain Name Server failure occurred.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>2012</td>
<td>EINVALIDNAME</td>
<td>REXX</td>
<td>An incorrect name was received from the TCP/IP server.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>2013</td>
<td>EINVALIDCLIENTID</td>
<td>REXX</td>
<td>An incorrect clientid was received from the TCP/IP server.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>2014</td>
<td>EINVALIDFILENAME</td>
<td>REXX</td>
<td>An error occurred during NUCEXT processing.</td>
<td>Specify the correct translation table file name, or verify that the translation table is valid.</td>
</tr>
<tr>
<td>2016</td>
<td>EHOSTNOTFOUND</td>
<td>REXX</td>
<td>The host is not found.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>2017</td>
<td>EIPADDRNOTFOUND</td>
<td>REXX</td>
<td>Address not found.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>3412</td>
<td>ENODATA</td>
<td></td>
<td>Message does not exist.</td>
<td></td>
</tr>
<tr>
<td>3416</td>
<td>ELINKED</td>
<td></td>
<td>Stream is linked.</td>
<td></td>
</tr>
<tr>
<td>3419</td>
<td>EREUNITE</td>
<td></td>
<td>Recursive attempt rejected.</td>
<td></td>
</tr>
<tr>
<td>3420</td>
<td>EASYNC</td>
<td></td>
<td>Asynchronous I/O scheduled. This is a normal, internal event that is NOT returned to the user.</td>
<td></td>
</tr>
<tr>
<td>3448</td>
<td>EUNATCH</td>
<td></td>
<td>The protocol required to support the specified address family is not available.</td>
<td></td>
</tr>
<tr>
<td>3464</td>
<td>ETERM</td>
<td></td>
<td>Operation terminated.</td>
<td></td>
</tr>
<tr>
<td>3474</td>
<td>EUNKOWN</td>
<td></td>
<td>Unknown system state.</td>
<td></td>
</tr>
<tr>
<td>3495</td>
<td>EBAOBD2</td>
<td></td>
<td>You attempted to reference a object that does not exist.</td>
<td></td>
</tr>
<tr>
<td>3513</td>
<td>EOUTOFSTATE</td>
<td></td>
<td>Protocol engine has received a command that is not acceptable in its current state.</td>
<td></td>
</tr>
<tr>
<td>3412</td>
<td>ENODATA</td>
<td></td>
<td>Message does not exist.</td>
<td></td>
</tr>
<tr>
<td>3416</td>
<td>ELINKED</td>
<td></td>
<td>Stream is linked.</td>
<td></td>
</tr>
<tr>
<td>3419</td>
<td>EREUNITE</td>
<td></td>
<td>Recursive attempt rejected.</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>Asynchronous I/O scheduled. This is a normal, internal event that is NOT returned to the user.</td>
<td></td>
</tr>
<tr>
<td>3448</td>
<td>EUNATCH</td>
<td></td>
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</tr>
<tr>
<td>3464</td>
<td>ETERM</td>
<td></td>
<td>Operation terminated.</td>
<td></td>
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<tr>
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<td>You attempted to reference a object that does not exist.</td>
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<tr>
<td>3513</td>
<td>EOUTOFSTATE</td>
<td></td>
<td>Protocol engine has received a command that is not acceptable in its current state.</td>
<td></td>
</tr>
</tbody>
</table>
z/OS UNIX return codes

All return codes not listed in either "Sockets return codes (ERRNOs)" on page 835 or "Sockets extended ERRNOs" are z/OS UNIX error condition codes that are not translated to a TCP/IP errno. This is an errno that is received from z/OS UNIX. These errnos are found in the SYS1.MACLIB(BPXYERNO) and are defined in z/OS UNIX System Services Messages and Codes.

For more information about z/OS UNIX error codes, refer to z/OS UNIX System Services Messages and Codes.

Additional return codes

The following section contains the error condition codes that are returned in the ERRNO field by the API when you use the sockets extended interfaces. The RETCODE field contains a −1 when an error condition is returned.

Sockets extended ERRNOs

Table 25. Sockets extended ERRNOs

<table>
<thead>
<tr>
<th>Error code</th>
<th>Problem description</th>
<th>System action</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>10100</td>
<td>An ESTAE macro did not complete normally.</td>
<td>End the call.</td>
<td>Call your MVS system programmer.</td>
</tr>
<tr>
<td>10101</td>
<td>A STORAGE OBTAIN failed.</td>
<td>End the call.</td>
<td>Increase MVS storage in the application's address space.</td>
</tr>
<tr>
<td>10108</td>
<td>The first call issued was not a valid first call.</td>
<td>End the call.</td>
<td>For a list of valid first calls, refer to the section on special considerations in the general programming information.</td>
</tr>
<tr>
<td>10110</td>
<td>LOAD of EZBSOH03 (alias EZASOH03) failed.</td>
<td>End the call.</td>
<td>Call the IBM Software Support Center.</td>
</tr>
<tr>
<td>10154</td>
<td>Errors were found in the parameter list for an IOCTL call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the IOCTL call. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10155</td>
<td>The length parameter for an IOCTL call is less than or equal to 0.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the IOCTL call. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10156</td>
<td>The length parameter for an IOCTL call is 3200 (32 x 100).</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the IOCTL call. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10159</td>
<td>A 0 or negative data length was specified for a READ or READV call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the length in the READ call.</td>
</tr>
<tr>
<td>10161</td>
<td>The REQARG parameter in the IOCTL parameter list is 0.</td>
<td>End the call.</td>
<td>Correct the program.</td>
</tr>
<tr>
<td>10163</td>
<td>A 0 or negative data length was found for a RECV, RECVFROM, or RECVMSG call.</td>
<td>Disable the subtask for interrupts. Sever the DLC path. Return an error code to the caller.</td>
<td>Correct the data length.</td>
</tr>
</tbody>
</table>
### ERRNOs

**Table 25. Sockets extended ERRNOs (continued)**

<table>
<thead>
<tr>
<th>Error code</th>
<th>Problem description</th>
<th>System action</th>
<th>Programmer’s response</th>
</tr>
</thead>
<tbody>
<tr>
<td>10167</td>
<td>The descriptor set size for a SELECT or SELECTEX call is less than or equal to 0.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the SELECT or SELECTEX call. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10168</td>
<td>The descriptor set size in bytes for a SELECT or SELECTEX call is greater than 8192. A number greater than the maximum number of allowed sockets (65534 is the maximum) has been specified.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the descriptor set size.</td>
</tr>
<tr>
<td>10170</td>
<td>A 0 or negative data length was found for a SEND or SENDMSG call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the data length in the SEND call.</td>
</tr>
<tr>
<td>10174</td>
<td>A 0 or negative data length was found for a SENDTO call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the data length in the SENDTO call.</td>
</tr>
<tr>
<td>10178</td>
<td>The SETSOCKOPT option length is less than the minimum length.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the OPTLEN parameter.</td>
</tr>
<tr>
<td>10179</td>
<td>The SETSOCKOPT option length is greater than the maximum length.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the OPTLEN parameter.</td>
</tr>
<tr>
<td>10184</td>
<td>A data length of 0 was specified for a WRITE call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the data length in the WRITE call.</td>
</tr>
<tr>
<td>10186</td>
<td>A negative data length was specified for a WRITE or WRITEV call.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the data length in the WRITE call.</td>
</tr>
<tr>
<td>10190</td>
<td>The GETHOSTNAME option length is not in the range of 1–255.</td>
<td>Disable the subtask for interrupts. Return an error code to the caller.</td>
<td>Correct the length parameter.</td>
</tr>
<tr>
<td>10193</td>
<td>The GETSOCKOPT option length is less than the minimum or greater than the maximum length.</td>
<td>End the call.</td>
<td>Correct the length parameter.</td>
</tr>
<tr>
<td>10197</td>
<td>The application issued an INITAPI call after the connection was already established.</td>
<td>Bypass the call.</td>
<td>Correct the logic that produces the INITAPI call that is not valid.</td>
</tr>
<tr>
<td>10198</td>
<td>The maximum number of sockets specified for an INITAPI exceeds 65535.</td>
<td>Return to the user.</td>
<td>Correct the INITAPI call.</td>
</tr>
</tbody>
</table>
### ERRNOs

**Table 25. Sockets extended ERRNOs (continued)**

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Problem Description</th>
<th>System Action</th>
<th>Programmer’s Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>10200</td>
<td>The first call issued was not a valid first call.</td>
<td>End the call.</td>
<td>For a list of valid first calls, refer to the section on special considerations in the general programming information.</td>
</tr>
<tr>
<td>10202</td>
<td>The RETARG parameter in the IOCTL call is 0.</td>
<td>End the call.</td>
<td>Correct the parameter list. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10203</td>
<td>The requested socket number is a negative value.</td>
<td>End the call.</td>
<td>Correct the requested socket number.</td>
</tr>
<tr>
<td>10205</td>
<td>The requested socket number is a duplicate.</td>
<td>End the call.</td>
<td>Correct the requested socket number.</td>
</tr>
<tr>
<td>10208</td>
<td>The NAMELEN parameter for a GETHOSTBYNAME call was not specified.</td>
<td>End the call.</td>
<td>Correct the NAMELEN parameter. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10209</td>
<td>The NAME parameter on a GETHOSTBYNAME call was not specified.</td>
<td>End the call.</td>
<td>Correct the NAME parameter. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10210</td>
<td>The HOSTENT parameter on a GETHOSTBYNAME or GETHOSTBYADDR call was not specified.</td>
<td>End the call.</td>
<td>Correct the HOSTENT parameter. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10211</td>
<td>The HOSTADDR parameter on a GETHOSTBYNAME or GETHOSTBYADDR call was not specified.</td>
<td>End the call.</td>
<td>Correct the HOSTADDR parameter. You might have incorrect sequencing of socket calls.</td>
</tr>
<tr>
<td>10212</td>
<td>The resolver program failed to load correctly for a GETHOSTBYNAME or GETHOSTBYADDR call.</td>
<td>End the call.</td>
<td>Check the JOBLIB, STEPLIB, and linklib datasets and rerun the program.</td>
</tr>
<tr>
<td>10213</td>
<td>Not enough storage is available to allocate the HOSTENT structure.</td>
<td>End the call.</td>
<td>Increase the user storage allocation for this job.</td>
</tr>
<tr>
<td>10214</td>
<td>The HOSTENT structure was not returned by the resolver program.</td>
<td>End the call.</td>
<td>Ensure that the domain name server is available. This can be a nonerror condition indicating that the name or address specified in a GETHOSTBYADDR or GETHOSTBYNAME call could not be matched.</td>
</tr>
<tr>
<td>10215</td>
<td>The APITYPE parameter on an INITAPI call instruction was not 2 or 3.</td>
<td>End the call.</td>
<td>Correct the APITYPE parameter.</td>
</tr>
<tr>
<td>10218</td>
<td>The application programming interface (API) cannot locate the specified TCP/IP.</td>
<td>End the call.</td>
<td>Ensure that an API that supports the performance improvements related to CPU conservation is installed on the system and verify that a valid TCP/IP name was specified on the INITAPI call. This error call might also mean that EZASOKIN could not be loaded.</td>
</tr>
<tr>
<td>10219</td>
<td>The NS parameter is greater than the maximum socket for this connection.</td>
<td>End the call.</td>
<td>Correct the NS parameter on the ACCEPT, SOCKET or TAKESOCKET call.</td>
</tr>
</tbody>
</table>
### ERRNOs

#### Table 25. Sockets extended ERRNOs (continued)

<table>
<thead>
<tr>
<th>Error code</th>
<th>Problem description</th>
<th>System action</th>
<th>Programmer's response</th>
</tr>
</thead>
<tbody>
<tr>
<td>10221</td>
<td>The AF parameter of a SOCKET call is not AF_INET.</td>
<td>End the call.</td>
<td>Set the AF parameter equal to AF_INET.</td>
</tr>
<tr>
<td>10222</td>
<td>The SOCTYPE parameter of a SOCKET call must be stream, datagram, or raw (1, 2, or 3).</td>
<td>End the call.</td>
<td>Correct the SOCTYPE parameter.</td>
</tr>
<tr>
<td>10223</td>
<td>No ASYNC parameter specified for INITAPI with APITYPE=3 call.</td>
<td>End the call.</td>
<td>Add the ASYNC parameter to the INITAPI call.</td>
</tr>
<tr>
<td>10224</td>
<td>The IOVCNT parameter is less than or equal to 0, for a READV, RECVMSG, SENDMSG, or WRITEV call.</td>
<td>End the call.</td>
<td>Correct the IOVCNT parameter.</td>
</tr>
<tr>
<td>10225</td>
<td>The IOVCNT parameter is greater than 120, for a READV, RECVMSG, SENDMSG, or WRITEV call.</td>
<td>End the call.</td>
<td>Correct the IOVCNT parameter.</td>
</tr>
<tr>
<td>10226</td>
<td>Not valid COMMAND parameter specified for a GETIBMOPT call.</td>
<td>End the call.</td>
<td>Correct the COMMAND parameter of the GETIBMOPT call.</td>
</tr>
<tr>
<td>10229</td>
<td>A call was issued on an APITYPE=3 connection without an ECB or REQAREA parameter.</td>
<td>End the call.</td>
<td>Add an ECB or REQAREA parameter to the call.</td>
</tr>
<tr>
<td>10300</td>
<td>Termination is in progress for either the CICS transaction or the socket interface.</td>
<td>End the call.</td>
<td>None.</td>
</tr>
<tr>
<td>10330</td>
<td>A SELECT call was issued without a MAXSOC value and a TIMEOUT parameter.</td>
<td>End the call.</td>
<td>Correct the call by adding a TIMEOUT parameter.</td>
</tr>
<tr>
<td>10331</td>
<td>A call that is not valid was issued while in SRB mode.</td>
<td>End the call.</td>
<td>Get out of SRB mode and reissue the call.</td>
</tr>
<tr>
<td>10332</td>
<td>A SELECT call is invoked with a MAXSOC value greater than that which was returned in the INITAPI function (MAXSNO field).</td>
<td>End the call.</td>
<td>Correct the MAXSOC parameter and reissue the call.</td>
</tr>
<tr>
<td>10334</td>
<td>An error was detected in creating the data areas required to process the socket call.</td>
<td>End the call.</td>
<td>Call the IBM Software Support Center.</td>
</tr>
<tr>
<td>10999</td>
<td>An abend has occurred in the subtask.</td>
<td>Write message EZY1282E to the system console. End the subtask and post the TRUE ECB.</td>
<td>If the call is correct, call your system programmer.</td>
</tr>
<tr>
<td>20000</td>
<td>An unknown function code was found in the call.</td>
<td>End the call.</td>
<td>Correct the SOC-FUNCTION parameter.</td>
</tr>
<tr>
<td>20001</td>
<td>The call passed an incorrect number of parameters.</td>
<td>End the call.</td>
<td>Correct the parameter list.</td>
</tr>
<tr>
<td>20002</td>
<td>The user ID associated with the program linking EZACIC25 does not have the proper authority to execute a CICS EXTRACT EXIT.</td>
<td>End the call.</td>
<td>Start the CICS socket interface before executing this call.</td>
</tr>
</tbody>
</table>
### User abend U4093

An abend U4093 indicates that a sockets extended call that is not valid has been detected. It is issued by EZASOKET following a call to EZASOKFN if EZASOKFN has detected an error in the socket call parameter list. The registers at the time of the abend are:

- R2 contains the address of the save area containing the calling program registers.
- R11 contains the error code passed to EZASOKET by EZASOKFN.

#### Code Description

- **X’4E20’ (20000)**
  - Indicates EZASOKFN could not find the requested CALL function name.

- **X’4E21’ (20001)**
  - Indicates that EZASOKFN found an incorrect number of parameters in the parameter list for the requested function.

- R12 contains the address of the incorrect parameter list.

Figure 205 is an example of abend U4093:

```
USER COMPLETION CODE=4093
TIME=15.01.58 SEQ=00074 CPU=0000 ASID=000E
PSW AT TIME OF ERROR 078D1000 80018F14 ILC 2 INTC 0D
ACTIVE LOAD MODULE=DLSV2AS2 ADDRESS=00018670 OFFSET=000008A4
DATA AT PSW 00018F0E 00181610 0A0D4100 35185000
GPR 0-3 80000000 80000FFD 800189E4 80018DC0
GPR 4-7 000190CD 00019CE0 00018AA6 00018D18
GPR 8-11 00013780 00019378 00019088 00004E21
GPR 12-15 800187D4 0001902C 80018EF4 00004E21
```

**Figure 205. Example of abend U4093**
ERRNOs
Appendix C. Address family cross reference

This section contains AF_INET, AF_INET6, and AF_IUCV address family cross reference information for the following APIs:

- TCP/IP C socket API
- X/Open Transport Interface
- Macro API for IPv4 or IPv6 that is written in z/OS assembler language
- Call instruction API for IPv4 or IPv6 socket applications
- z/OS Communications Server socket API for REXX
- Pascal language for IPv4 socket API

Address families define different styles of addressing. All hosts in the same addressing family understand and use the same method for addressing socket endpoints. TCP/IP supports the following addressing families:

- AF_INET
- AF_INET6
- AF_IUCV

The AF_INET and AF_INET6 families both define addressing in the internet domain. The AF_IUCV family defines addressing in the IUCV domain. In the IUCV domain, address spaces can use the socket interface to communicate with other address spaces on the same host.

The INET, INET6, and IUCV column entries are:

- **yes**  The call applies to this address family.
- **no**  If you use this call with this address family, an error is returned.
- **n/a**  If you use this call with this address family, no error is returned and the call is not processed.
- **blank**  The call does not apply to this API.

**Notes:**
1. Pascal API supports only AF_INET address family.
2. XTI API supports only AF_INET address family.
3. INET6 is not supported.

*Table 26. C socket address families cross reference*

<table>
<thead>
<tr>
<th>Function</th>
<th>C SOCKETS</th>
<th>INET</th>
<th>IUCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>accept()</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>bind()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>close()</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>connect()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>endhostent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>endnetent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
Table 26. C socket address families cross reference (continued)

<table>
<thead>
<tr>
<th>Function</th>
<th>INET</th>
<th>IUCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>endprotoent()</td>
<td>yes</td>
<td>n/a</td>
</tr>
<tr>
<td>endservent()</td>
<td>yes</td>
<td>n/a</td>
</tr>
</tbody>
</table>
fcntl()                        | yes  | no   |
getclientid()                  | yes  | no   |
|getdtablesize()                | yes  | yes  |
|gethostbyaddr()                | yes  | no   |
|gethostbyname()                | yes  | n/a  |
|gethostent()                   | yes  | n/a  |
|gethostid()                    | yes  | no   |
|gethostname()                  | yes  | no   |
|getibmsockopt()                | yes  | no   |
|getnetbyaddr()                 | yes  | n/a  |
|getnetbyname()                 | yes  | n/a  |
|getnetent()                    | yes  | n/a  |
|getpeername()                  | yes  | yes  |
|getprotobynumber()             | yes  | n/a  |
|getprotoent()                  | yes  | n/a  |
|getservbyname()                | yes  | n/a  |
|getservbyport()                | yes  | n/a  |
|getservent()                   | yes  | n/a  |
|getsockname()                  | yes  | yes  |
|getsockopt()                   | yes  | no   |
givesocket()                   | yes  | no   |
|htonl()                        | yes  | n/a  |
|htons()                        | yes  | n/a  |
inet_addr()                    | yes  | n/a  |
inet_inaof()                   | yes  | n/a  |
inet_makeaddr()                | yes  | n/a  |
inet_netof()                   | yes  | n/a  |
inet_network()                 | yes  | n/a  |
inet_ntoa()                    | yes  | n/a  |
ioctl()                       | yes  | no   |
|listen()                       | yes  | yes  |
|maxdesc()                      | yes  | yes  |
|ntohl()                        | yes  | n/a  |
|nthols()                       | yes  | n/a  |
Table 26. C socket address families cross reference (continued)

<table>
<thead>
<tr>
<th>Function</th>
<th>C SOCKETS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INET</td>
<td>IUCV</td>
<td></td>
</tr>
<tr>
<td>read()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>readv()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>recv()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>recvfrom()</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>recvmsg()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>select()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>selectex()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>send()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>sendmsg()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>sendto()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>setibmqopt()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>setibmqsocket()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>sethostent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>setnetent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>setprotoent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>setservent()</td>
<td>yes</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>setsockopt()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>shutdown()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>sock_debug()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>sock_do_teststor()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>socket()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>takesocket()</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>tcperror()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>write()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>writev()</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

Note: In the following table, IUCV is not supported.

Table 27. MACRO, CALL, REXX, socket address families cross reference

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MACRO</th>
<th>CALL</th>
<th>REXX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INET</td>
<td>INET6</td>
<td>INET</td>
</tr>
<tr>
<td>ACCEPT</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>BIND</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CANCEL</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>CLOSE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CONNECT</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FCNTL</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Table 27. MACRO, CALL, REXX, socket address families cross reference (continued)

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>MACRO</th>
<th>CALL</th>
<th>REXX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INET</td>
<td>INET6</td>
<td>INET</td>
</tr>
<tr>
<td>FREEADDRINFO</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETADDRINFO</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETCLIENTID</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETDOMAINNAME</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GETHOSTBYADDR</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETHOSTBYNAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETHOSTID</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETHOSTNAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETIBMOPT</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETNAMEINFO</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETPEERNAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETPROTOBYNAME</td>
<td></td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>GETPROTOBYPNUMBER</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GETSERVBYNAMESPACE</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GETSERVBYPORT</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>GETSOCKNAME</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GETSOCKOPT see Table 28 on page 862 for exceptions.</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GIVESOCKET</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>GLOBAL</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>INITAPI</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>IOCTL see Table 28 on page 862 for exceptions.</td>
<td>yes</td>
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Table 27. MACRO, CALL, REXX, socket address families cross reference (continued)

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Table 28. MACRO, CALL, REXX, exceptions

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Appendix D. GETSOCKOPT/SETSOCKOPT command values

You can use the table below to determine the decimal or hexadecimal value associated with the GETSOCKOPT/SETSOCKOPT OPNAMES supported by the APIs discussed in this document.

The command names are shown with underscores for the assembler language. The underscores should be changed to dashes if using the COBOL programming language.

Languages that cannot easily handle binary values, such as COBOL, should use the decimal value associated with the command where necessary.

The hexadecimal value can be used in Macro, Assembler and PL/I programs.

Table 29. GETSOCKOPT/SETSOCKOPT command values for Macro, Assembler, COBOL and PL/I

<table>
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<th>Command name</th>
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<th>Hex value</th>
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<tr>
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<td>IP_ADD_SOURCE_MEMBERSHIP</td>
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<td>1048586</td>
<td>X'0010000A'</td>
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<td>X'0010000D'</td>
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Table 29. GETSOCKOPT/SETSOCKOPT command values for Macro, Assembler, COBOL and PL/I (continued)

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<th>Command name</th>
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Table 30. GETSOCKOPT/SETSOCKOPT optname value for C programs

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Appendix E. Abbreviations and acronyms

This topic lists the abbreviations and acronyms.

AIX  Advanced Interactive Executive
ANSI  American National Standards Institute
API  Application program interface
APPC  Advanced Program-to-Program Communications
APPN  Advanced Peer-to-Peer Networking®
ARP  Address Resolution Protocol
ASCII  American National Standard Code for Information Interchange
ASN.1  Abstract Syntax Notation One
AT-TLS  Application Transparent Transport Layer Security
AUI  Attachment Unit Interface
BIOS  Basic Input/Output System
BNC  Bayonet Neill-Concelman
CCITT  Comité Consultatif International Télégraphique et Téléphonique. The International Telegraph and Telephone Consultative Committee
CETI  Continuously Executing Transfer Interface
CLAW  Common Link Access to Workstation
CLIST  Command List
CMS  Conversational Monitor System
CP  Control Program
CPI  Common Programming Interface
CREN  Corporation for Research and Education Networking
CSD  Corrective Service Diskette
CTC  Channel-to-Channel
CU  Control Unit
CUA®  Common User Access®
DASD  Direct Access Storage Device
DBCS  Double Byte Character Set
DLL  Dynamic Link Library
DNS  Domain Name System
DOS  Disk Operating System
DPI  Distributed Program Interface
EBCDIC
   Extended Binary-Coded Decimal Interchange Code
EISA   Enhanced Industry Standard Adapter
ELANS  IBM Ethernet LAN Subsystem
ESCON® Enterprise Systems Connection
FAT    File Allocation Table
FDDI   Fiber Distributed Data Interface
FTAM   File Transfer Access Management
FTP    File Transfer Protocol
FTP API File Transfer Protocol Applications Programming Interface
GCS    Group Control System
GDDM® Graphical Data Display Manager
GDF    Graphics Data File
HCH”  HYPERchannel device”
HIPPI  High Performance Parallel Interface
HPFS   High Performance File System
ICAT   Installation Configuration Automation Tool
ICMP   Internet Control Message Protocol
IEEE   Institute of Electrical and Electronic Engineers
IETF   Internet Engineering Task Force
ILANS  IBM Token-Ring LAN Subsystem
IP     Internet Protocol
IPL    Initial Program Load
ISA    Industry Standard Adapter
ISDN   Integrated Services Digital Network
ISO    International Organization for Standardization
IUCV   Inter-User Communication Vehicle
JES    Job Entry Subsystem
JIS    Japanese Institute of Standards
JCL    Job Control Language
LAN    Local Area Network
LAPS   LAN Adapter Protocol Support
LCS    IBM LAN Channel Station
LPD    Line Printer Daemon
LPQ  Line Printer Query
LPR  Line Printer Client
LPRM Line Printer Remove
LPRMON Line Printer Monitor
LU Logical Unit
MAC Media Access Control
Mbps Megabits per second
MBps Megabytes per second
MCA Micro Channel® Adapter
MHS Message Handling System
MIB Management Information Base
MIH Missing Interrupt Handler
MILNET Military Network
MTU Maximum Transmission Unit
MVS Multiple Virtual Storage
MX Mail Exchange
NCP Network Control Program
NCS Network Computing System
NDIS Network Driver Interface Specification
NFS** Network File System™
NIC Network Information Center
NLS National Language Support
NSFNET National Science Foundation Network
OS/2® Operating System/2
OSF** Open Software Foundation™, Inc.
OSI Open Systems Interconnection
OSIMF/6000 Open Systems Interconnection Messaging and Filing/6000
OV/MVS OfficeVision®/MVS
OV/VM OfficeVision/VM
PAD Packet Assembly/Disassembly
PC program call
PCA Parallel Channel Adapter
PDN Public Data Network
PDU   Protocol Data Units
PING  Packet Internet Groper
PIOAM Parallel I/O Access Method
POP   Post Office Protocol
PROFS Professional Office Systems
PSCA  Personal System Channel Attach
PSDN  Packet Switching Data Network
PU    Physical Unit
PVM   Passthrough Virtual Machine
RACF  Resource Access Control Facility
RARP  Reverse Address Resolution Protocol
RExec Remote Execution
REXX  Restructured Extended Executor Language
RFC   Request For Comments
RIP   Routing Information Protocol
RISC  Reduced Instruction Set Computer
RPC   Remote procedure call
RSCS  Remote Spooling Communications Subsystem
SAA   System Application Architecture
SBCS  Single Byte Character Set
SDLC  Synchronous Data Link Control
SLIP  Serial Line Internet Protocol
SMI   Structure for Management Information
SMTP  Simple Mail Transfer Protocol
SNA   Systems Network Architecture
SNMP  Simple Network Management Protocol
SOA   Start of Authority
SPOOL Simultaneous Peripheral Operations Online
SQL   IBM Structured Query Language
TCP   Transmission Control Protocol
TCP/IP Transmission Control Protocol/Internet Protocol
TFTP  Trivial File Transfer Protocol
TSO   Time Sharing Option
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<thead>
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<th>Abbreviation</th>
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<td>Time-to-Live</td>
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<td>UDP</td>
<td>User Datagram Protocol</td>
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<td>VGA</td>
<td>Video Graphic Array</td>
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<td>VM</td>
<td>Virtual Machine</td>
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<td>VMCF</td>
<td>Virtual machine communication facility</td>
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<td>VM/SP</td>
<td>Virtual Machine/System Product</td>
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<td>VM/XA</td>
<td>Virtual Machine/Extended Architecture</td>
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<td>VTAM</td>
<td>Virtual Telecommunications Access Method</td>
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<td>WAN</td>
<td>Wide Area Network</td>
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<td>XDR</td>
<td>eXternal Data Representation</td>
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Appendix F. Related protocol specifications

This appendix lists the related protocol specifications (RFCs) for TCP/IP. The Internet Protocol suite is still evolving through requests for comments (RFC). New protocols are being designed and implemented by researchers and are brought to the attention of the Internet community in the form of RFCs. Some of these protocols are so useful that they become recommended protocols. That is, all future implementations for TCP/IP are recommended to implement these particular functions or protocols. These become the de facto standards, on which the TCP/IP protocol suite is built.

You can request RFCs through electronic mail, from the automated Network Information Center (NIC) mail server, by sending a message to service@nic.ddn.mil with a subject line of RFC nnnn for text versions or a subject line of RFC nnnn.PS for PostScript versions. To request a copy of the RFC index, send a message with a subject line of RFC INDEX.

For more information, contact nic@nic.ddn.mil or at:

Government Systems, Inc.
Attn: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021

Hard copies of all RFCs are available from the NIC, either individually or by subscription. Online copies are available at the following Web address:

http://www.rfc-editor.org/rfc.html

See "Internet drafts" on page 886 for draft RFCs implemented in this and previous Communications Server releases.

Many features of TCP/IP Services are based on the following RFCs:

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RFC 1006  ISO transport services on top of the TCP: Version 3  M.T. Rose, D.E. Cass
RFC 1009  Requirements for Internet gateways  R. Braden, J. Postel
RFC 1011  Official Internet protocols  J. Reynolds, J. Postel
RFC 1014  XDR: External Data Representation standard  Sun Microsystems
RFC 1027  Using ARP to implement transparent subnet gateways  S. Carl-Mitchell, J. Quarterman
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RFC 1033  Domain administrators operations guide  M. Lottor
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<td>1883</td>
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<td>RFC 1996</td>
<td>A Mechanism for Prompt Notification of Zone Changes (DNS NOTIFY)</td>
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**RFC 2010**  Operational Criteria for Root Name Servers  B. Manning, P. Vixie

**RFC 2011**  SNMPv2 Management Information Base for the Internet Protocol using SMIv2  K. McCloghrie, Ed.


**RFC 2013**  SNMPv2 Management Information Base for the User Datagram Protocol using SMIv2  K. McCloghrie, Ed.

**RFC 2018**  TCP Selective Acknowledgement Options  M. Mathis, J. Mahdavi, S. Floyd, A. Romanow

**RFC 2026**  The Internet Standards Process — Revision 3  S. Bradner

**RFC 2030**  Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI  D. Mills

**RFC 2033**  Local Mail Transfer Protocol  J. Myers

**RFC 2034**  SMTP Service Extension for Returning Enhanced Error Codes  N. Freed

**RFC 2040**  The RC5, RC5-CBC, RC-5-CBC-Pad, and RC5-CTS Algorithms  R. Baldwin, R. Rivest

**RFC 2045**  Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies  N. Freed, N. Borenstein

**RFC 2052**  A DNS RR for specifying the location of services (DNS SRV)  A. Gulbrandsen, P. Vixie

**RFC 2065**  Domain Name System Security Extensions  D. Eastlake 3rd, C. Kaufman

**RFC 2066**  TELNET CHARSET Option  R. Gellens

**RFC 2080**  RIPng for IPv6  G. Malkin, R. Minnear

**RFC 2096**  IP Forwarding Table MIB  F. Baker

**RFC 2104**  HMAC: Keyed-Hashing for Message Authentication  H. Krawczyk, M. Bellare, R. Canetti

**RFC 2119**  Keywords for use in RFCs to Indicate Requirement Levels  S. Bradner

**RFC 2132**  DHCP Options and BOOTP Vendor Extensions  S. Alexander, R. Droms

**RFC 2133**  Basic Socket Interface Extensions for IPv6  R. Gilligan, S. Thomson, J. Bound, W. Stevens

**RFC 2136**  Dynamic Updates in the Domain Name System (DNS UPDATE)  P. Vixie, Ed., S. Thomson, Y. Rekhter, J. Bound

**RFC 2137**  Secure Domain Name System Dynamic Update  D. Eastlake 3rd

**RFC 2163**  Using the Internet DNS to Distribute MIXER Conformant Global Address Mapping (MCGAM)  C. Allocchio

**RFC 2168**  Resolution of Uniform Resource Identifiers using the Domain Name System  R. Daniel, M. Mealling

**RFC 2178**  OSPF Version 2  J. Moy

**RFC 2181**  Clarifications to the DNS Specification  R. Elz, R. Bush
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<tr>
<td>2210</td>
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<td>RFC 2254 The String Representation of LDAP Search Filters</td>
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<td>D. Harrington, R. Presuhn, B. Wijnen</td>
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<p>| RFC 2352 | A Convention for Using Legal Names as Domain Names O. Vaughn |
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| RFC 2358 | Definitions of Managed Objects for the Ethernet-like Interface Types J. Flick, J. Johnson |
| RFC 2373 | IP Version 6 Addressing Architecture R. Hinden, S. Deering |
| RFC 2374 | An IPv6 Aggregatable Global Unicast Address Format R. Hinden, M. O'Dell, S. Deering |
| RFC 2375 | IPv6 Multicast Address Assignments R. Hinden, S. Deering |
| RFC 2376 | Protection of BGP Sessions via the TCP MD5 Signature Option A. Hefferman |
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| RFC 2401 | Security Architecture for Internet Protocol S. Kent, R. Atkinson |
| RFC 2402 | IP Authentication Header S. Kent, R. Atkinson |
| RFC 2403 | The Use of HMAC-MD5–96 within ESP and AH C. Madson, R. Glenn |
| RFC 2404 | The Use of HMAC-SHA–1–96 within ESP and AH C. Madson, R. Glenn |
| RFC 2405 | The ESP DES-CBC Cipher Algorithm With Explicit IV C. Madson, N. Doraswamy |
| RFC 2406 | IP Encapsulating Security Payload (ESP) S. Kent, R. Atkinson |
| RFC 2407 | The Internet IP Security Domain of Interpretation for ISAKMP D. Maughan, M. Schertler, M. Schneider, J. Turner |
| RFC 2409 | The Internet Key Exchange (IKE) D. Harkins, D. Carrel |
| RFC 2410 | The NULL Encryption Algorithm and Its Use With IPsec R. Glenn, S. Kent |
| RFC 2428 | FTP Extensions for IPv6 and NATs M. Allman, S. Ostermann, C. Metz |
| RFC 2445 | Internet Calendaring and Scheduling Core Object Specification (iCalendar) F. Dawson, D. Stenerson |
| RFC 2459 | Internet X.509 Public Key Infrastructure Certificate and CRL Profile R. Housley, W. Ford, W. Polk, D. Solo |
| RFC 2460 | Internet Protocol, Version 6 (IPv6) Specification S. Deering, R. Hinden |
| RFC 2462 | IPv6 Stateless Address Autoconfiguration S. Thomson, T. Narten |
| RFC 2463 | Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification A. Conta, S. Deering |
| RFC 2464 | Transmission of IPv6 Packets over Ethernet Networks M. Crawford |
| RFC 2476 | Message Submission R. Gellens, J. Klensin |</p>
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RFC 2665  Definitions of Managed Objects for the Ethernet-like Interface Types
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RFC 2671  Extension Mechanisms for DNS (EDNS0) P. Vixie
RFC 2672  Non-Terminal DNS Name Redirection M. Crawford
RFC 2675  IPv6 Jumbograms D. Borman, S. Deering, R. Hinden
RFC 2710  Multicast Listener Discovery (MLD) for IPv6 S. Deering, W. Fenner, B. Haberman
RFC 2711  IPv6 Router Alert Option C. Partridge, A. Jackson
RFC 2740  OSPF for IPv6 R. Coltun, D. Ferguson, J. Moy
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RFC 2782  A DNS RR for specifying the location of services (DNS SRV) A. Gubrandsen, P. Vixie, L. Esibov
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RFC 2845  Secret Key Transaction Authentication for DNS (TSIG) P. Vixie, O. Gudmundsson, D. Eastlake 3rd, B. Wellington
RFC 2851  Textual Conventions for Internet Network Addresses M. Daniele, B. Haberman, S. Routhier, J. Schoenwaelder
RFC 2874  DNS Extensions to Support IPv6 Address Aggregation and Renumbering M. Crawford, C. Huitema
RFC 2941  Telnet Authentication Option T. Ts’o, ed., J. Altman
RFC 2942  Telnet Authentication: Kerberos Version 5 T. Ts’o
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RFC 2953  Telnet Encryption: DES 64 bit Output Feedback T. Ts’o
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RFC 3164  The BSD Syslog Protocol C. Lonvick
RFC 3291  Textual Conventions for Internet Network Addresses M. Daniele, B. Haberman, S. Routhier, J. Schoenwaelder
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Internet drafts

Internet drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Other groups may also distribute working documents as Internet drafts. You can see Internet drafts at http://www.ietf.org/ID.html.

Several areas of IPv6 implementation include elements of the following Internet drafts and are subject to change during the RFC review process.

**Draft**  **Title and Author**

draft-bivens-sasp-02  
Server/Application State Protocol v1 A. Bivens

draft-ietf-ipngwg-icmp-v3-07  
Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification A. Conta, S. Deering

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IP Encapsulating Security Payload (ESP) S. Kent

draft-ietf-ipsec-rfc2402bis-11  
IP Authentication Header S. Kent

draft-ietf-ipsec-rfc2401bis-06  
Security Architecture for the Internet Protocol S. Kent, K. Seo

draft-ietf-ospf-ospfv3-auth-07  
Authentication/Confidentiality for OSPFv3 M. Gupta, N. Melam
Appendix G. Information APARs and technotes

This appendix lists information APARs for IP and SNA documents.

Note:

1. Information APARs contain updates to previous editions of the documents listed in Table 31 and Table 32 on page 888. Documents updated for V1R9 are complete except for the updates contained in the information APARs that might be issued after V1R9 documents went to press.

2. Information APARs are predefined for z/OS V1R9 Communications Server and might not contain updates.

3. Information APARs for z/OS documents are in the document called z/OS and z/OS.e DOC APAR and PTF ++HOLD Documentation, which can be found at http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/BOOKS/ZIDOCMST/CCONTENTS.

Information APARs for IP documents

Table 31 lists information APARs for V1R6 IP documents. For releases V1R7 and later, updates are available as technotes, which can be found at http://www.ibm.com/support/docview.wss?uid=swg21178966.

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Information APARs for SNA documents

Table 32 lists information APARs for V1R6 SNA documents. For releases V1R7 and later, updates are available as technotes, which can be found at http://www.ibm.com/support/docview.wss?uid=swg21178966.

Table 32. SNA information APARs for z/OS Communications Server

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Other information APARs

Table 33 lists information APARs not related to documents.

Table 33. Non-document information APARs

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Appendix H. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to z/OS TSO/E Primer, z/OS TSO/E User's Guide, and z/OS ISPF User's Guide Vol I for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

www.ibm.com/servers/eserver/zseries/zos/bkserv/
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z/OS Communications Server library

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Updates to documents are available on RETAIN® and in information APARs (info APARs). See Appendix G, “Information APARs and technotes,” on page 887 for a list of the documents and the info APARs associated with them.

Info APARs for z/OS documents are in the document called z/OS and z/OS.e DOC APAR and PTF ++HOLD Documentation which can be found at [http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/BOOKS/ZIDOCMST/CONTENTS](http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/BOOKS/ZIDOCMST/CONTENTS)

Planning

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<tr>
<td>z/OS Communications Server: New Function Summary</td>
<td>GC31-8771</td>
<td>This document is intended to help you plan for new IP for SNA function, whether you are migrating from a previous version or installing z/OS for the first time. It summarizes what is new in the release and identifies the suggested and required modifications needed to use the enhanced functions.</td>
</tr>
<tr>
<td>z/OS Communications Server: IPv6 Network and Application Design Guide</td>
<td>SC31-8885</td>
<td>This document is a high-level introduction to IPv6. It describes concepts of z/OS Communications Server’s support of IPv6, coexistence with IPv4, and migration issues.</td>
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Resource definition, configuration, and tuning

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<td>z/OS Communications Server: IP Configuration Guide</td>
<td>SC31-8775</td>
<td>This document describes the major concepts involved in understanding and configuring an IP network. Familiarity with the z/OS operating system, IP protocols, z/OS UNIX System Services, and IBM Time Sharing Option (TSO) is recommended. Use this document in conjunction with the z/OS Communications Server: IP Configuration Reference.</td>
</tr>
</tbody>
</table>
This document presents information for people who want to administer and maintain IP. Use this document in conjunction with the z/OS Communications Server: IP Configuration Guide. The information in this document includes:

- TCP/IP configuration data sets
- Configuration statements
- Translation tables
- SMF records
- Protocol number and port assignments

This document presents the major concepts involved in implementing an SNA network. Use this document in conjunction with the z/OS Communications Server: SNA Network Implementation Guide.

This document describes each SNA definition statement, start option, and macroinstruction for user tables. It also describes NCP definition statements that affect SNA. Use this document in conjunction with the z/OS Communications Server: SNA Network Implementation Guide.

This document contains sample definitions to help you implement SNA functions in your networks, and includes sample major node definitions.

This document is for system programmers and network administrators who need to prepare their network to route SNA, JES2, or JES3 printer output to remote printers using TCP/IP Services.

This document describes how to use TCP/IP applications. It contains requests that allow a user to log on to a remote host using Telnet, transfer data sets using FTP, send and receive electronic mail, print on remote printers, and authenticate network users.

This document describes the functions and commands helpful in configuring or monitoring your system. It contains system administrator’s commands, such as TSO NETSTAT, PING, TRACERTE and their UNIX counterparts. It also includes TSO and MVS commands commonly used during the IP configuration process.

This document serves as a reference for programmers and operators requiring detailed information about specific operator commands.

This document contains essential information about SNA and IP commands.

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<td>z/OS Communications Server: IP Configuration Reference</td>
<td>SC31-8776</td>
<td>This document presents information for people who want to administer and maintain IP. Use this document in conjunction with the z/OS Communications Server: IP Configuration Guide. The information in this document includes: TCP/IP configuration data sets, Configuration statements, Translation tables, SMF records, Protocol number and port assignments.</td>
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<tr>
<td>z/OS Communications Server: SNA Network Implementation Guide</td>
<td>SC31-8777</td>
<td>This document presents the major concepts involved in implementing an SNA network. Use this document in conjunction with the z/OS Communications Server: SNA Resource Definition Reference.</td>
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<tr>
<td>z/OS Communications Server: SNA Resource Definition Reference</td>
<td>SC31-8778</td>
<td>This document describes each SNA definition statement, start option, and macroinstruction for user tables. It also describes NCP definition statements that affect SNA. Use this document in conjunction with the z/OS Communications Server: SNA Network Implementation Guide.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Resource Definition Samples</td>
<td>SC31-8836</td>
<td>This document contains sample definitions to help you implement SNA functions in your networks, and includes sample major node definitions.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP Network Print Facility</td>
<td>SC31-8833</td>
<td>This document is for system programmers and network administrators who need to prepare their network to route SNA, JES2, or JES3 printer output to remote printers using TCP/IP Services.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP User’s Guide and Commands</td>
<td>SC31-8780</td>
<td>This document describes how to use TCP/IP applications. It contains requests that allow a user to log on to a remote host using Telnet, transfer data sets using FTP, send and receive electronic mail, print on remote printers, and authenticate network users.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP System Administrator’s Commands</td>
<td>SC31-8781</td>
<td>This document describes the functions and commands helpful in configuring or monitoring your system. It contains system administrator’s commands, such as TSO NETSTAT, PING, TRACERTE and their UNIX counterparts. It also includes TSO and MVS commands commonly used during the IP configuration process.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Operation</td>
<td>SC31-8779</td>
<td>This document serves as a reference for programmers and operators requiring detailed information about specific operator commands.</td>
</tr>
<tr>
<td>z/OS Communications Server: Quick Reference</td>
<td>SX75-0124</td>
<td>This document contains essential information about SNA and IP commands.</td>
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## Customization

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| z/OS Communications Server: SNA Customization  | SC31-6854 | This document enables you to customize SNA, and includes the following:  
• Communication network management (CNM) routing table  
• Logon-interpret routine requirements  
• Logon manager installation-wide exit routine for the CLU search exit  
• TSO/SNA installation-wide exit routines  
• SNA installation-wide exit routines |

## Writing application programs

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<tr>
<td>z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference</td>
<td>SC31-8788</td>
<td>This document describes the syntax and semantics of program source code necessary to write your own application programming interface (API) into TCP/IP. You can use this interface as the communication base for writing your own client or server application. You can also use this document to adapt your existing applications to communicate with each other using sockets over TCP/IP.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP CICS Sockets Guide</td>
<td>SC31-8807</td>
<td>This document is for programmers who want to set up, write application programs for, and diagnose problems with the socket interface for CICS using z/OS TCP/IP.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP IMS Sockets Guide</td>
<td>SC31-8830</td>
<td>This document is for programmers who want application programs that use the IMS TCP/IP application development services provided by IBM’s TCP/IP Services.</td>
</tr>
<tr>
<td>z/OS Communications Server: IP Programmer’s Guide and Reference</td>
<td>SC31-8787</td>
<td>This document describes the syntax and semantics of a set of high-level application functions that you can use to program your own applications in a TCP/IP environment. These functions provide support for application facilities, such as user authentication, distributed databases, distributed processing, network management, and device sharing. Familiarity with the z/OS operating system, TCP/IP protocols, and IBM Time Sharing Option (TSO) is recommended.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Programming</td>
<td>SC31-8829</td>
<td>This document describes how to use SNA macroinstructions to send data to and receive data from (1) a terminal in either the same or a different domain, or (2) another application program in either the same or a different domain.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Programmer’s LU 6.2 Guide</td>
<td>SC31-8811</td>
<td>This document describes how to use the SNA LU 6.2 application programming interface for host application programs. This document applies to programs that use only LU 6.2 sessions or that use LU 6.2 sessions along with other session types. (Only LU 6.2 sessions are covered in this document.)</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Programmer’s LU 6.2 Reference</td>
<td>SC31-8810</td>
<td>This document provides reference material for the SNA LU 6.2 programming interface for host application programs.</td>
</tr>
<tr>
<td>z/OS Communications Server: CSM Guide</td>
<td>SC31-8808</td>
<td>This document describes how applications use the communications storage manager.</td>
</tr>
</tbody>
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## z/OS Communications Server: CMIP Services and Topology Agent Guide

SC31-8828

This document describes the Common Management Information Protocol (CMIP) programming interface for application programmers to use in coding CMIP application programs. The document provides guide and reference information about CMIP services and the SNA topology agent.

## Diagnosis

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<tr>
<td>z/OS Communications Server: IP Diagnosis Guide</td>
<td>GC31-8782</td>
<td>This document explains how to diagnose TCP/IP problems and how to determine whether a specific problem is in the TCP/IP product code. It explains how to gather information for and describe problems to the IBM Software Support Center.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Diagnosis Vol 1, Techniques and Procedures and z/OS Communications Server: SNA Diagnosis Vol 2, FFST Dumps and the VIT</td>
<td>GC31-6850, GC31-6851</td>
<td>These documents help you identify an SNA problem, classify it, and collect information about it before you call the IBM Support Center. The information collected includes traces, dumps, and other problem documentation.</td>
</tr>
<tr>
<td>z/OS Communications Server: SNA Data Areas Volume 1 and z/OS Communications Server: SNA Data Areas Volume 2</td>
<td>GC31-6852, GC31-6853</td>
<td>These documents describe SNA data areas and can be used to read an SNA dump. They are intended for IBM programming service representatives and customer personnel who are diagnosing problems with SNA.</td>
</tr>
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## Messages and codes

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| z/OS Communications Server: SNA Messages | SC31-8790 | This document describes the ELM, IKT, IST, IUT, IVT, and USS messages. Other information in this document includes:  
  - Command and RU types in SNA messages  
  - Node and ID types in SNA messages  
  - Supplemental message-related information |
| z/OS Communications Server: IP Messages Volume 1 (EZA) | SC31-8783 | This volume contains TCP/IP messages beginning with EZA. |
| z/OS Communications Server: IP Messages Volume 2 (EZB, EZD) | SC31-8784 | This volume contains TCP/IP messages beginning with EZB or EZD. |
| z/OS Communications Server: IP Messages Volume 3 (EZY) | SC31-8785 | This volume contains TCP/IP messages beginning with EZY. |
| z/OS Communications Server: IP Messages Volume 4 (EZZ, SNM) | SC31-8786 | This volume contains TCP/IP messages beginning with EZZ and SNM. |
| z/OS Communications Server: IP and SNA Codes | SC31-8791 | This document describes codes and other information that appear in z/OS Communications Server messages. |
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