
Compaq TPU

SCTP

Installation and User's Guide

Tru64 UNIX

The SCTP Installation and User's Guide contains details on how to perform installation, configuration and troubleshooting activities and operations on the Compaq SCTP Implementation.

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Preface

The SCTP Installation and User's Guide contains detailed installation procedures related to SCTP, ensuring that users have sufficient information regarding the installation of the SCTP implementation. The user's guide sections include:

- Configuration guidelines to enable users to set up SCTP in the correct manner.
- Operating guidelines that enable users to understand the operational systems associated with the SCTP implementation and how to monitor them.
- A troubleshooting guide to aid in the event of problems arising.

Intended audience

This guide is intended for user groups requiring information on the installation and user procedures required for SCTP. It includes information useful for the configuration and operating of the SCTP environment. It is assumed that the audience has a good knowledge of the underlying protocols, stacks and operating systems, namely IP, TCP, UDP, and Compaq Tru64.

Terms and acronyms

The following terms and acronyms are used in this document.

Term	Description
IETF	Internet Engineering Task Force. Body responsible for the RFCs for SCTP
IP	Internet Protocol
MAC	Message Authentication Code
MIB	Management Information Base
MTU	Maximum Transmission Unit
PMTU-D	Path MTU Discovery
RFC	Request For Comment
RTO	Retransmission TimeOut
RTT	Round Trip Time
RTTVAR	Round Trip Time Variation
SACK	Selective Acknowledgement
SCTP	Stream Control Transmission Protocol
TCB	Transmission Control Block
TCP	Transport Control Protocol

Term	Description
TLV	Type Length Value coding format
TSN	Transmission Sequence Number
UDP	User Datagram Protocol
ULP	Upper Layer Protocol

Associated and reference documents

In addition to this guide, the SCTP documentation set includes the following books:

- SCTP Technical Description
- SCTP Application Development Guide
- SCTP Release Notes

The following documents also contain essential reference information:

- RFC2960. *Stream Control Transmission Protocol*
- draft-stewart-sctpsocket-sigtran-02. *SCTP Sockets Mapping* (superseded by draft-ietf-tsvwg-sctpsocket-01. *Sockets API Extensions for SCTP*)
- draft-ietf-sigtran-sctp-mib-02. *SCTP Management Information Base using SMIV2*
- draft-ietf-sigtran-performance-req-01. *VoIP Signaling Performance Requirements and Expectations*
- draft-ietf-sigtran-sctp-applicability-06. *Stream Control Transmission Protocol Applicability Statement*

Conventions

The following conventions are used in this guide:

boldface type	Indicates the first instance of terms being defined in text. In examples, it indicates user input.
<i>italic</i>	Is used for emphasis, for quoting document titles, and for variables.
<code>courier font</code>	Is used for code examples, file names and directory paths, command names, routine names, and syntax.
UPPERCASE lowercase	The Compaq Tru64 UNIX system differentiates between uppercase and lowercase characters. Examples, syntax descriptions, routine definitions, and literal strings that appear in text must be entered exactly as shown.

1

Introduction to Compaq SCTP

This chapter provides introductory information concerning the Stream Control Transmission Protocol (SCTP), the Compaq SCTP implementation and its API protocol mapping. It explains the relationship to IETF standard RFC2960 and summarizes the protocol features that Compaq SCTP supports.

1.1 Compaq SCTP implementation

The Compaq SCTP implementation comprises two main components: an SCTP daemon and a shareable library. See Figure 1-1 for further details. Each component has a set of defined responsibilities:

- The daemon process `sctpd` is mainly responsible for IP connectivity:
 - Receive SCTP messages over IP, verify the checksum and dispatch these messages to the correct user application according to the SCTP port number included in the message
 - Send SCTP messages over IP, on request from the user applications
 - Send ABORT when a user application dies.
- The shareable library `libsctp.so` is responsible for the provisioning of SCTP services and socket API facilities for use by one or more user applications.

1.1.1 Multiple application access

More than one application can access the SCTP services on a single Compaq Server. See Figure 1-1 for further details.

Applications communicate with the SCTP daemon through an API socket.

Typically, the type of applications that Compaq SCTP is designed for includes the transport of SS7 traffic over IP.

1.1.2 Monitoring the Compaq SCTP stack

The Compaq SCTP stack provides a means to monitor the behavior of an application that is using the Compaq SCTP API. The user connects to the Compaq SCTP daemon through a Telnet session and issues commands to display the current stack characteristics and counters.

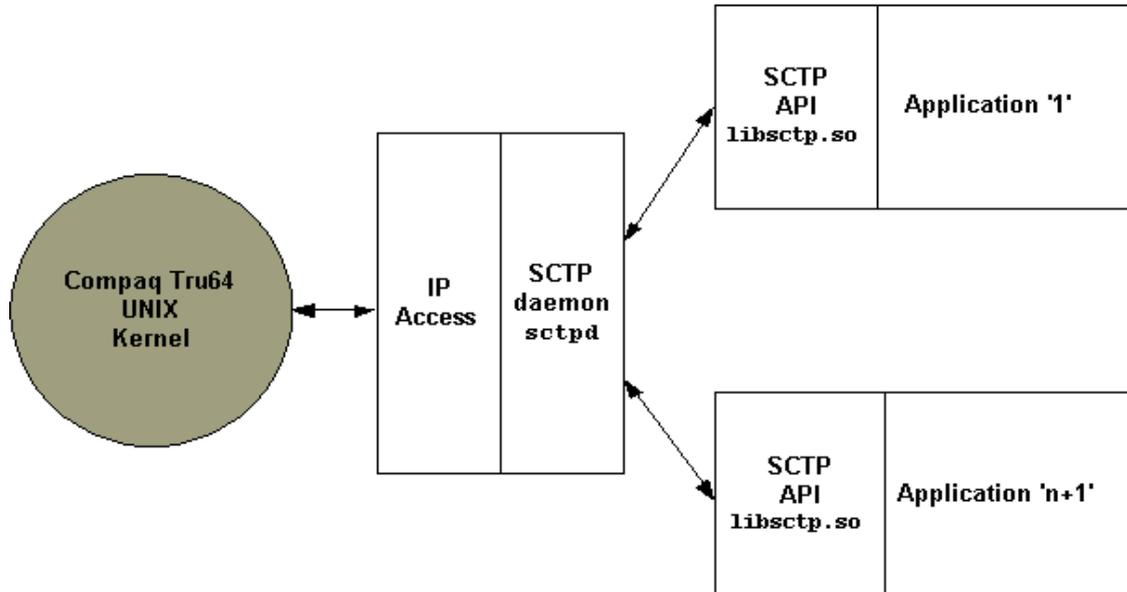


Figure 1-1 Compaq SCTP implementation components

1.2 Compaq SCTP Socket API

The Compaq SCTP implementation provides a socket API and protocol mapping that is compliant with IETF standards. This allows existing TCP or UDP applications to be easily migrated to SCTP with the minimum amount of changes.

1.2.1 Protocol mapping

The mapping of Compaq SCTP is consistent with other socket API protocol mapping. For example, UDP and TCP. Two types of interfaces are supported:

- TCP-style interface
- UDP-style interface.

1.2.1.1 TCP-style interface

This interface supports the same semantics as sockets for connection-oriented protocols, such as TCP. The purpose of defining this interface is to allow existing applications built on connection-oriented protocols to be easily ported for use with SCTP, and for developers already familiar with those semantics to easily adapt to SCTP.

1.2.1.2 UDP-style interface

This interface has a set of semantics similar to that defined for connectionless protocols, such as UDP. A UDP-style interface is more efficient than a TCP-like connection-oriented interface, since it allows access to more of the new SCTP features.

Caution

UDP-style and TCP-style programming are not compatible and cannot be merged into a single program.

1.3 Summary of features

The Compaq SCTP implementation is a reliable transport protocol that operates on top of the IP layer and is capable of offering the following services to its users:

- Acknowledged error-free non-duplicated transfer of user data
- Data fragmentation to conform to path MTU size
- Sequenced delivery of user messages within multiple streams
- Bundling of multiple data messages into a single SCTP packet
- Network-level fault tolerance through support of multi-homing at both ends of an SCTP association
- Resistance to flooding and masquerade attacks.

2

Compaq SCTP installation guidelines

This chapter describes how to install the Compaq SCTP implementation on a system running Tru64 UNIX V5.1A. Procedures are then described on how to verify that the installation has been successfully completed.

2.1 Preparing for installation

Careful preparation is important to ensure a trouble-free installation process. The following is a checklist of actions that should be carried out before you begin the installation of Compaq SCTP:

1. Ensure you have adequate hardware, a Compaq SCTP installation requires a minimum of 10,000 blocks.
2. Ensure you have the appropriate software.
3. Check that the licensing is correct for your configuration. See “2.3 Licensing” on page 2-2.
4. Ensure you have ROOT login privileges.
5. Ensure that TCP/IP networking software is correctly installed and configured.

Note

The installation procedure creates Compaq SCTP file systems in the directories:

```
/usr/opt/SCTPRD100  
/usr/opt/SCTHEADERS100  
/usr/opt/SCTLICENSE100  
/usr/opt/SCTEXAMPLE100  
/usr/opt/SCTDOC100
```

Where:

100 indicates the Compaq SCTP implementation version number, V1.0-0.

2.2 Checking the Release Notes

The Compaq SCTP implementation product provides online Release Notes. Compaq strongly recommends that you read the Release Notes before using the product. The Release Notes contain information about the product that may not be present in the published Installation and User's Guide.

2.3 Licensing

The Compaq SCTP product is licensed by means of License Keys, which are obtained through the Compaq License Key Fulfillment Web Site. Licenses are managed by FLEXlm.

2.3.1 SCTP License Key

The SCTP License Key is SCTP_TRU64.

2.3.2 Counted and Uncounted Keys

License keys can be Counted or Uncounted. They are counted by means of the tokens which are contained in the license key. If they are uncounted, there is no limitation as to their use, whereas if they are counted, their use is limited to the count authorized by the number of tokens purchased.

Table 2-1 License descriptions

SCTP Licenses	Use	Counted
SCTP_TRU64	One license token is required for each CPU present on the machine upon SCTP daemon <code>sctpd</code> startup. Processes using the SCTP API are not counted.	Yes

2.4 Installing Compaq SCTP for Tru64 UNIX

This section describes how to install Compaq SCTP for Tru64 UNIX from a CD-ROM. This procedure loads SCTP files on to a disk belonging to the system where you perform the installation. It is recommended that a backup is made of the CD-ROM contents prior to performing the installation.

The time needed to perform a Compaq SCTP installation is approximately one minute.

2.4.1 Extract the subsets

Before the SCTP subsets can be installed they must be extracted from the `SCTPKIT100.tar` file and copied to a temporary directory.

1. Place the CD in the appropriate disk drive.
2. Create a `temp` directory.
3. Copy the `SCTPKIT100.tar` file to the `temp` directory.
4. Extract the subsets from the `SCTPKIT100.tar` file into the `temp` directory by entering the following command:

```
tar -xvf SCTPKIT100.tar
```

Once the subsets have been extracted, the `temp` directory should contain five different subsets ready for installation:

- `SCTPRD100`, contains the Compaq SCTP V1.0 Product
- `SCTHEADERS100`, contains the Compaq SCTP V1.0 Header Files
- `SCTLICENSE100`, contains Compaq SCTP V1.0 License Files
- `SCTEXAMPLE100`, contains Compaq SCTP V1.0 Application Examples
- `SCTDOC100`, contains the Compaq SCTP V1.0 Documentation Set.

2.4.2 Install the subsets

The software subsets can be installed using the SysMan Menu or the `setld` utility.

1. Log in as a superuser (login name `root`) to the system where you will install the SCTP implementation. From now on you must be logged as `root` to perform the installation.
2. Go to the `temp` directory.
3. To start the installation either invoke the SysMan menu by entering the command:

```
# /usr/sbin/sysman &
```

or enter a `setld` command that requests the load option (**-l**):

```
# setld -l.
```

The installation procedure now displays the names of the SCTP subsets so that you can specify the subsets you want to load. Mandatory and optional subsets are indicated. The following instructions are displayed at this point:

```
*** Enter subset selections ***
```

```
The following subsets are mandatory and will be installed automatically  
unless you choose to exit without installing any subsets:
```

- * Compaq SCTP V1.0 Header Files
- * Compaq SCTP V1.0 License Files
- * Compaq SCTP V1.0 Product

```
The subsets listed below are optional:
```

```
There may be more optional subsets than can be presented on a single  
screen. If this is the case, you can choose subsets screen by screen  
or all at once on the last screen. All of the choices you make will  
be collected for your confirmation before any subsets are installed.
```

```
- Other:
```

- 1) Compaq SCTP V1.0 Application Examples
- 2) Compaq SCTP V1.0 Documentation Set

```
Or you may choose one of the following options:
```

- 3) ALL mandatory and all optional subsets
- 4) MANDATORY subsets only
- 5) CANCEL selections and redisplay menus
- 6) EXIT without installing any subsets

```
Estimated free disk space(MB) in root:207.0 usr:2705.1
```

```
Enter your choices or press RETURN to redisplay menus.
```

```
Choices (for example, 1 2 4-6):
```

Note

If you specify more than one number at the prompt, separate each number with a space, not a comma.

4. Choose option 3 to install all five subsets by typing **3** and press Return. The procedure displays the subsets that have been chosen for installation to allow you to verify that they are the subsets you want.

```
You are installing the following mandatory subsets:
```

```
Compaq SCTP V1.0 Header Files
Compaq SCTP V1.0 License Files
Compaq SCTP V1.0 Product
```

```
You are installing the following optional subsets:
```

```
- Other:
```

```
Compaq SCTP V1.0 Application Examples
Compaq SCTP V1.0 Documentation Set
```

```
Estimated free diskspace(MB) in root:207.0 usr:2704.3
```

```
Is this correct? (y/n): y
```

5. If the displayed subsets and components are the ones you want to load, type **y** and press Return.

If the displayed subsets and components are not the ones you intended to choose, type **n** and press Return. In this case, the subset selection menu is displayed again and you can correct your choice of optional subsets.

When the subset selection has been confirmed, the file system space will be checked to established whether there is sufficient capacity:

```
Checking file system space required to install selected subsets:
```

```
File system space checked OK.
```

With sufficient file system space available the subsets are installed. Progress messages are displayed as follows:

```
5 subsets will be installed.
```

```
Loading subset 1 of 5 ...
```

```
Compaq SCTP V1.0 Product
  Copying from . (disk)
  Verifying
```

```
Loading subset 2 of 5 ...
```

```
Compaq SCTP V1.0 Header Files
  Copying from . (disk)
  Verifying
```

```
Loading subset 3 of 5 ...
```

```
Compaq SCTP V1.0 License Files
  Copying from . (disk)
  Verifying
```

```
Loading subset 4 of 5 ...
```

```
Compaq SCTP V1.0 Application Examples
  Copying from . (disk)
  Verifying

Loading subset 5 of 5 ...

Compaq SCTP V1.0 Documentation Set
  Copying from . (disk)
  Verifying

5 of 5 subsets installed successfully.

Configuring "Compaq SCTP V1.0 Product" (SCTPRD100)

Modifying ownership of installed files...
done

Installation of Sctp (SCTPRD100) subset completed.

Configuring "Compaq SCTP V1.0 Header Files" (SCTHEADERS100)

Modifying ownership of installed files...
done

Installation of Sctp (SCTHEADERS100) subset completed.

Configuring "Compaq SCTP V1.0 License Files" (SCTLICENSE100)

Modifying ownership of installed files...
done
SCTP: start license manager

Installation of Sctp (SCTLICENSE100) subset completed.

Configuring "Compaq SCTP V1.0 Application Examples" (SCTEXAMPLE100)

Modifying ownership of installed files...
done

Installation of Sctp (SCTEXAMPLE100) subset completed.

Configuring "Compaq SCTP V1.0 Documentation Set" (SCTDOC100)
```

Note

When you see the `Verifying` message during the subset installation, the installation procedure is checking to see that the files are copied correctly; it is not an Installation Verification Procedure (IVP) message.

During the installation, if there are error messages from the `setld` utility, refer to the Diagnostics section of the `setld(8)` reference page for an explanation of the errors and the appropriate action to take.

2.4.3 Installation problems

If the installation of the SCTP subsets has been interrupted for any reason, follow this procedure:

1. Delete any SCTP subsets that have been installed.
2. After deleting all the subsets, check that the following symbolic links have also been removed from the target UNIX machine:
 - `/usr/shlib/libsctp100.so`
 - `/usr/shlib/libsctp.so`
 - `/usr/shlib/libtbx100.so`
 - `/usr/sbin/sctpd`
 - `/usr/include/sctp_api.h`
3. Manually delete any of above links, if present.
4. Attempt to re-install all the subsets again.

If you encounter problems during the installation, you should contact your Customer Support Representative.

2.5 Verifying the installation

This section describes how to check that a Compaq SCTP implementation is correctly installed.

The SCTP installation procedure creates a set of files and symbolic links in the target UNIX machine.

1. Check that these directories exist and contain files:
 - `/usr/opt/SCTPRD100`
 - `/usr/opt/SCTHEADERS100`
 - `/usr/opt/SCTLICENSE100`
 - `/usr/opt/SCTEXAMPLE100`
 - `/usr/opt/SCTDOC100`
2. Check that `/usr/sbin/sctpd.so` is present.
3. Check that `/usr/shlib/libsctp.so`, `/usr/shlib/libsctp100.so` and `/usr/shlib/libtbx100.so` are present.
4. Check that the header file `/usr/include/sctp_api.h` is present.

2.6 Using the SCTP examples

The directory `/usr/examples/sctp` contains a set of C files and Makefiles. Carefully read the README.txt file for instructions on how to compile and run the SCTP program examples.

2.7 Uninstall SCTP for Tru64 UNIX

This section describes how to uninstall SCTP for Compaq Tru64 UNIX.

2.7.1 List installed subsets

1. Log in as a superuser (login name `root`) to the system where you want to uninstall the SCTP implementation.
2. List and verify the SCTP subsets by entering a `setld` command with the `-i` option, this lists the software subsets recognized by your system together with their status (installed, incomplete, or not installed):

```
# setld -i | grep -i sctp | grep -i installed
```

A list showing all five SCTP subsets should be displayed:

SCTDOC100	installed	Compaq SCTP V1.0 Documentation Set
SCTEXAMPLE100	installed	Compaq SCTP V1.0 Application Examples
SCTHEADERS100	installed	Compaq SCTP V1.0 Header Files
SCTLICENSE100	installed	Compaq SCTP V1.0 License Files
SCTPRD100	installed	Compaq SCTP V1.0 Product

2.7.2 Uninstall procedure

The SCTP uninstall can be done using the `setld` utility and the `-d` delete option.

1. Type the following command:

```
# setld -d SCTDOC100 SCTEXAMPLE100 SCTHEADERS100 SCTLICENSE100  
SCTPRD100
```

2. Confirm the deletion of the subsets when prompted by typing:

```
# y
```

Note

If you attempt to delete an SCTP subset on which another subset depends, a warning message will be displayed prompting you for confirmation.

3

Configuration guidelines

This chapter provides information to help users configure the SCTP implementation once installation has been successfully completed.

3.1 Configuration checks

Immediately after installation or any re-install, make the following checks:

- Ensure that the `sctpd` daemon is running.
- The header file `sctp_api.h` is in `/usr/include`.
- File `libsctp.so` and `libsctp100.so` is in `/usr/shlib`.
- File `libtbx100.so` is in `/usr/shlib`.
- File `sctpd` is in `/usr/sbin`.
- Make sure that the local machine and the remote machine have the same SCTP kit installed. If not, the local and remote application may not be able to establish associations over SCTP protocol.
- Make sure that the local machine is able to reach the remote machine over the network using the `ping` command.

4

Operating guidelines

This chapter describes the operations that are possible on the Compaq SCTP implementation. Operations mainly involve monitoring applications accessing the SCTP stack and accessing system log information. The chapter describes the multi-level command menus that are available during a telnet session for application monitoring.

4.1 Compaq SCTP stack monitoring

The Compaq SCTP stack provides a means to monitor the behavior of an application that uses the Compaq SCTP API. The user can connect to a Compaq SCTP daemon through a telnet session and issue commands to display the current stack characteristics and counters.

4.1.1 Monitor menu scheme

The `sctpd` daemon presents a multi-level menu approach to monitor command selection:

- Level 1, the command menu allows access to general application statistics and Tru64 process identification
- Level 2, commands at this level enable logical connection to an application and the display of application parameters and counters
- Level 3, commands at this level present parameter and counter information for a selected association and the remote addresses.

4.2 Start and connect the monitor daemon `sctpd`

1. Start the Compaq SCTP daemon `sctpd` by entering the command:

```
$ sctpd &
```

Using standard output, the daemon displays the telnet port number that the server will use to listen:

```
SCTP INFO: The sctpd telnet server is listening on port 2000
```

When started the daemon attempts to reserve the first free telnet port, starting from port 2000.

2. Connect to the `sctpd` telnet server by entering the following command:

```
$ telnet localhost 2000
```

Once connected the system displays the following prompt message:

```
Trying 127.0.0.1
Connected to 127.0.0.1.
Escape character is '^]'.

Compaq SCTP protocol stack version V1.0
Type 'help' to get information about available commands.
>
```

From the > prompt, one of the following telnet Main Menu commands can be entered: help, stat, app or exit.

4.3 Main menu

4.3.1 Level 1: Help

Online help for sctpd level 1 commands can be accessed by entering the command:

```
> help
```

This displays the command help screen:

```
help
SCTP Telnet server main menu commands

- help | h | ?
  Display this help screen. In each menu, you can use the 'help'
  command to display contextual help information.

- stat | s
  Display general information about all applications and
  associations.

- app app_id | a app_id
  Connect to a specific application. The application identifier
  used by this command is the process ID, as it appears in the
  stat command.

- exit | e | x
  Close the telnet connection.

>
```

4.3.2 Level 1: Process and Association Statistics

Using the stat command when an SCTP application has not been started on the host:

```
> stat
```

displays the following screen:

```
> stat

PID      Local port  Asso tag   Remote port  Remote addresses
--      --         --         --          --
```

Where all statistic information fields are empty.

If an application has been started on the host, the `stat` command displays a screen containing the application's process and association details, for example:

PID	Local port	Asso tag	Remote port	Remote addresses
2450	2211	0x0e435ee5	1234	10.1.0.1 10.1.0.2

Where:

Parameter	Meaning
PID	An SCTP application is running with a Tru64 process id of 2450
Local port	This SCTP application is bound to SCTP port 2211
Asso tag	An association has been established and the association tag is 0x0e435ee5
Remote port	The association is established with a remote application bound to port 1234
Remote addresses	The remote SCTP application runs on a multi-homed host, with two IP addresses 10.1.0.1 and 10.1.0.2

4.3.3 Level 1: Connect to an Application

With the SCTP application statistics displayed it is possible to accumulate and display more detailed information concerning a particular application using the `app` command.

A connection to a specific SCTP application is made by entering the `app` command and the application's process id as the selection option:

```
> a 2450
```

A prompt is displayed, which shows the process id of the application to be monitored.

```
App 2450 >
```

Once connected and from the `App >` prompt, one of the following Application Menu commands can be entered: `help`, `attributes`, `asso`, `a` `asso tag` or `exit`.

4.4 Application menu

4.4.1 Level 2: Application Attributes and Associations Help

Online help for `sctpd` attribute and association commands can be accessed by entering the `help` command. For example:

```
App 2450> help
```

This displays the attribute and association command help screen:

```
help
SCTP Telnet server application menu commands
- help | h | ?
```

Display this help screen. In each menu, you can use the 'help' command to display contextual help information.

- attributes | attr
Display global application attributes and counters.
- asso | a | stat | s
Display statistics on associations in the current application (with more details than the 'stat' command of the root menu).
- asso asso_tag | a asso_tag
Enters the association sub-menu and access to association specific commands. The association tag can be entered in decimal or hexadecimal notation (with the '0x' prefix).
- exit | e | x
Return to root sctp menu.

App 2450 >

4.4.2 Level 2: Attributes and Counters

Entering the `attributes` command displays the application's counter parameters:

> attributes

For example:

Application parameters:

MAX ASSO IN INST:	1024	MAX INSTREAMS:	64
MAX_DEST_IN_RENDEPOINT:	64	MAX_OUTSTREAMS:	64
SEC_KEY_EXPIRY:	60 s	T1_INIT:	60 s
VALID_COOKIE_LIFE:	60 s	T2_SHUTDOWN:	60 s
MIN_RTO:	1000 ms	INIT_MAX_RETRANS:	8
MAX_RTO:	60000 ms	MAX ASSO_RETRANS:	10
INITIAL_RTO:	3000 ms	MAX_PATH_RETRANS:	5
RCVBUF:	32768 bytes	MAX_ACK_TIM:	200 ms
SNDBUF:	32768 bytes	MAX_ACK_DATA:	2 pkts
MAX_INTERFACE_MTU:	1500 bytes		

Application counters:

BAD_CHKSUM_NB:	0
OOB_NB:	0

App 2450 >

Where:

Parameter	Meaning
MAX ASSO_IN_INST	The application is able to handle a maximum of 1024 simultaneous associations.
MAX_DEST_IN_RENDPOINT	In one association, the maximum number of remote IP addresses (on a remote multi-homed host) is 64.
MAX_INSTREAMS	The application will accept a maximum of 64 inbound streams for each association.
MAX_OUTSTREAMS	The application will request 64 outbound streams for each association.
SEC_KEY_EXPIRY	The secret key expiry timer is set to 60 seconds.
VALID_COOKIE_LIFE	The cookie lifetime validity is set to 60 seconds.
T1_INIT	T1-init timer is set to 60 seconds.
T2_SHUTDOWN	T2-shutdown timer is set to 60 seconds.
MIN_RTO	Minimum RTO is set to 1000 milliseconds.
MAX_RTO	Maximum RTO is set to 60000 milliseconds.
INITIAL_RTO	Initial RTO is set to 3000 milliseconds.
INIT_MAX_RETRANS	The maximum retransmission count of INIT chunks is set to 8.
MAX ASSO_RETRANS	The maximum number of retransmission on the whole association is set to 10.
MAX_PATH_RETRANS	The maximum number of retransmission on a single path of the association is set to 5.
RCVBUF	The current number of bytes in the receive buffer is set to 32768 bytes.
SNDBUF	The current number of bytes in the send buffer is set to 32768 bytes.
MAX_INTERFACE_MTU	The maximum Message Transfer Unit of the association is set to 1500 bytes. The maximum time interval between two SACK is set to 200 milliseconds. MAX_ACK_TIM
MAX_ACK_DATA	The maximum number of messages the stack could receive before sending an acknowledgment is set to two.
BAD_CHKSUM_NB	The current number of messages received with an invalid checksum (for all the associations handled by this application) is zero (0).
OOB_NB	The current number of out-of-the-blue messages received by the application is zero (0).

4.4.3 Level 2: Summary of Associations

From the application prompt level it is possible to monitor the state of all the associations handled by a particular application using the `asso` command:

```
> asso
```

For example:

```
App 2450 > s
Proto Asso tag      Local address      Remote address      State
SCTP  0xe435ee5      10.1.0.1:2211      10.1.0.1:1234      ESTABLISHED
SCTP  0xe435ee5      10.1.0.1:2211      10.1.0.1:1234      IDLE
SCTP  0xe435ee5      10.1.0.1:2211      10.1.0.2:1234      IDLE
```

In the example above, the application with PID 2450 has one association. The association is in the ESTABLISHED state and all the PATHs in this association are in the IDLE state (that is, there is no traffic).

4.4.4 Level 2: Monitoring a Single Association

With all SCTP application associations displayed it is possible to monitor a particular association in a specific application using the `asso` command and the association tag.

```
> App 2450 > asso 0xe435ee5
```

A prompt is displayed, which shows the process id of the application and the association tag that can be monitored.

```
App 2450 / Asso 0xe435ee5:2211 >
```

From this prompt, one of the following Association Menu commands can be entered: `help`, `attributes`, `asso`, `a asso tag` or `exit`.

4.5 Association menu

4.5.1 Level 3: Association Help

Online help for `sctpd` association commands is accessed by entering the `help` command. For example:

```
App 2450 / Asso 0xe435ee5:2211 > help
```

This displays the association and association tag command help screen:

```
help
SCTP Telnet server association menu commands

- help | h | ?
  Display this help screen. In each menu, you can use the 'help'
  command to display contextual help information.

- attributes | attr | a
  Display association attributes and counters.

- dest | d
  Displays remote addresses and their attributes.

- exit | e | x
  Return to application menu.

App 2450 / Asso 0xe435ee5:2211 >
```

4.5.2 Level 3: Attributes and Counters

Entering the a command displays an association's attributes and counter parameters:

```
App 2450 / Asso 0xe435ee5:2211 > a
```

For example:

Association parameters:

```
Remote port:                1234
Association status:         ESTABLISHED
Primary destination:       10.1.0.2
Current destination:       10.1.0.2
Inbound streams:           1
Outbound streams:          1
Remote verification tag:   0x09a9345c
Association MTU:           1500
```

Association counters:

```
T1_EXPIRY_NB:              0
T2_EXPIRY_NB:              0
T3_EXPIRY_NB:              0
STALE_COOKIE_NB:          0
INVALID_COOKIE_NB:        0
BYTES_RCV_NB:              4
BYTES_SNT_NB:              6
CHNK_RCV_NB:               16
CHNK_SNT_NB:               1
UNORD_CHNK_RCV_NB:        0
UNORD_CHNK_SNT_NB:        0
INIT_CHNK_RCV_NB:         0
INIT_CHNK_SNT_NB:         1
INIT_ACK_CHNK_RCV_NB:     0
INIT_ACK_CHNK_SNT_NB:     0
COOKIE_CHNK_RCV_NB:       0
COOKIE_CHNK_SNT_NB:       1
COOKIE_ACK_CHNK_RCV_NB:   1
```

```

COOKIE_ACK_CHNK_SNT_NB: 0
DATA_CHNK_IN_NB: 1
DATA_CHNK_RCV_NB: 1
DATA_CHNK_OUT_NB: 1
DATA_CHNK_SNT_NB: 1
SACK_CHNK_RCV_NB: 1
SACK_CHNK_SNT_NB: 1
HEARTBEAT_CHNK_RCV_NB: 6
HEARTBEAT_CHNK_SNT_NB: 13
HEARTBEAT_ACK_CHNK_RCV_NB: 6
HEARTBEAT_ACK_CHNK_SNT_NB: 6
ABORT_CHNK_RCV_NB: 0
ABORT_CHNK_SNT_NB: 0
SHUTDOWN_CHNK_RCV_NB: 0
SHUTDOWN_CHNK_SNT_NB: 0
SHUTDOWN_ACK_CHNK_RCV_NB: 0
SHUTDOWN_ACK_CHNK_SNT_NB: 0
ERROR_CHNK_RCV_NB: 0
ERROR_CHNK_SNT_NB: 0

```

App 2450 / Asso 0xe435ee5:2211 >

Where:

Parameter	Meaning
Remote port	The remote port of remote application.
Association status	The current status of the association: CLOSED, ESTABLISHED, COOKIE WAIT, COOKIE ECHOED, SHUTDOWN PENDING, SHUTDOWN SENT, SHUT- DOWN RECEIVED, SHUTDOWN ACK SENT
Primary destination	In a multi-homed association, there is always a remote destination (a single IP address) of choice to send data to (when the destination is available). Such a destination is called the "primary destination". In the Compaq SCTP stack, the IP address of the current primary destination is displayed here.
Current destination	This is the address of the remote IP destina- tion used to send data to. In general, 'cur- rent destination is the same as primary destination', but when the 'primary destina- tion' fails, the traffic is diverted to another remote destination (in a multi-homed asso- ciation).
Inbound streams	The maximum number of streams used to receive messages.
Outbound streams	The maximum number of streams used to send messages.

Parameter	Meaning
Remote verification tag	The verification tag set by the remote stack in each SCTP header.
Association MTU	The smallest MTU value. In a multi-homed association, a Path MTU is "computed/discovered" for each path. The association MTU is taken as the smallest of these MTU values.
T1_EXPIRY_NB	The total number of times the T1-init timer has expired since the beginning of the association.
T2_EXPIRY_NB	The total number of the T2-shutdown timer has expired since the beginning of the association.
T3_EXPIRY_NB	The total number of the T2-rec timer has expired since the beginning of the association.
STALE_COOKIE_NB	The number of cookies (COOKIE_ECHO chunks) that have been received too late.
INVALID_COOKIE_NB	The number of cookies (COOKIE_ECHO) that have been received and that are invalid (they do not correspond to the cookie sent previously in the INIT_ACK chunk).
BYTES_RCV_NB	Number of bytes (of payload DATA) received since the beginning of the association.
BYTES_SNT_NB	Number of bytes (of payload DATA) received since the beginning of the association.
CHNK_RCV_NB	The number of chunks received since the beginning of the association.
CHNK_SNT_NB	The number of chunks sent since the beginning of the association.
UNORD_CHNK_RCV_NB	The number of unordered chunks received.
UNORD_CHNK_SNT_NB	The number of unordered chunks transmitted.
INIT_CHNK_RCV_NB	The number of INIT chunks received.
INIT_CHNK_SNT_NB	The number of INIT chunks sent.
INIT_ACK_CHNK_RCV_NB	The number of INIT_ACK chunks received.
INIT_ACK_CHNK_SNT_NB	The number of INIT_ACK chunks sent.
COOKIE_CHNK_RCV_NB	The number of COOKIE chunks received.
COOKIE_CHNK_SNT_NB	The number of COOKIE chunks sent.

Parameter	Meaning
COOKIE_ACK_CHNK_RCV_NB	The number of COOKIE_ACK chunks received.
COOKIE_ACK_CHNK_SNT_NB	The number of COOKIE_ACK chunks sent
DATA_CHNK_IN_NB	The total number of DATA chunks received.
DATA_CHNK_RCV_NB	The total number of non-duplicated DATA chunks received.
DATA_CHNK_OUT_NB	The total number of DATA chunks transmitted (first transmission and retransmissions if any).
DATA_CHNK_SNT_NB	The number of DATA chunks transmitted (excluding retransmissions).
SACK_CHNK_RCV_NB	The number of SACK chunks received.
SACK_CHNK_SNT_NB	The number of SACK chunks sent.
HEARTBEAT_CHNK_RCV_NB	The number of HEARTBEAT chunks received.
HEARTBEAT_CHNK_SNT_NB	The number of HEARTBEAT chunks sent.
HEARTBEAT_ACK_CHNK_RCV_NB	The number of HEARTBEAT_ACK chunks received.
HEARTBEAT_ACK_CHNK_SNT_NB	The number of HEARTBEAT_ACK chunks sent.
ABORT_CHNK_RCV_NB	The number of ABORT chunks received.
ABORT_CHNK_SNT_NB	The number of ABORT chunks sent.
SHUTDOWN_CHNK_RCV_NB	The number of SHUTDOWN chunks received.
SHUTDOWN_CHNK_SNT_NB	The number of SHUTDOWN chunks sent.
SHUTDOWN_ACK_CHNK_RCV_NB	The number of SHUTDOWN_ACK chunks received.
SHUTDOWN_ACK_CHNK_SNT_NB	The number of SHUTDOWN_ACK chunks sent.
ERROR_CHNK_RCV_NB	The number of ERROR chunks received.
ERROR_CHNK_SNT_NB	The number of ERROR chunks sent

4.5.3 Level 3: Remote Addresses

The remote or destination IP addresses of a particular association are monitored by entering the `dest` command:

```
App 2450 / Asso 0xe435ee5:2211 > dest
```

For example:

```
Remote-address  State    Mtu   Rto   Srtt  Cwnd   Ss-thr  In-flt  T3-exp  HB-int
10.1.0.1        INACT   1500  3000  0     1500   3000   0       0       30000
10.1.0.2        IDLE   PC 1500  1000  0     3000   3000   0       0       30000
App 2450 / Asso 0xe435ee5:2211 >
```

Where, for each remote destination IP address:

Parameter	Meaning
Remote-address	The association's destination IP address.
State	The state of the remote address ACTIVE, INACTIVE or IDLE.
Mtu	The current Message Transfer Unit of the remote address in bytes.
Rto	The current Retransmission TimeOut of the remote address in milliseconds.
Srtt	The current Smoothed Round Trip Time of the remote address in milliseconds.
Cwnd	The current Congestion Window of the remote address in bytes.
SS-thr	The current Slow Start Threshold of the remote address in bytes.
In-flt	The current number of In-flight Messages, concerning the remote address.
T3-exp	The current number of T3 timer expiries, concerning the remote address
HB-int	The current Heartbeat interval in milliseconds

4.6 Logging syslog messages

Messages are logged by SCTP using the `syslog` utility and written to the `/var/adm/syslog.dated/DATE/user.log` file. Refer to the Tru64 UNIX `syslogd(8)` reference page for a complete description of the `syslog` utility. Messages are logged by SCTP in a particular format and by type. See "user.log messages" on page 5-3.

5

Troubleshooting

This chapter provides useful pointers to solving some of the more likely SCTP errors. While it is not feasible to cover every possible error scenario that may occur, a number of the more common ones are described.

5.1 Recommended approach

The approach to adopt when troubleshooting the Compaq SCTP implementation is to view the various components as a complete logical entity, comprising hardware, software and server elements. In other words first create the 'big' picture, then try to isolate the problem down to the component or problem area using a process of elimination and lots of patience.

5.2 Troubleshooting resources

The Compaq SCTP implementation and Tru64 UNIX includes a number of resources that can assist you when troubleshooting, we have covered some of these in preceding chapters, the `sctpd` daemon is such a resource. Here is a list of some others:

- this Installation and User's guide
- IETF documentation (see "Associated and reference documents" in the Preface)
- Tru64 UNIX reference documentation
- System log files.

The Compaq SCTP implementation comprises two main components: an SCTP daemon and a shareable library. See the SCTP Technical Description for a more detailed look at the product and its component parts.

5.3 SCTP application errors

Problems can occur with applications not starting or responding to call functions.

5.3.1 Application does not start

Symptoms

An SCTP application does not start, the first `socket` call returns `EPROTONOSUPPORT`.

Explanation

The SCTP application tries to connect the `sctpd` daemon and fails.

User Action

1. Check that the `sctpd` daemon is running by entering the command:

```
$ ps -ae | grep sctpd
```
2. If the process is not running, you must start it by entering the command:

```
$ /usr/bin/sctpd &
```
3. If the problem persists, you must delete everything under the file directory `/tmp/tbx` by entering the command:

```
$ rm -r /tmp/tbx
```
4. Restart the `sctpd` daemon.

5.3.2 Application cannot be bound

Symptoms

An SCTP application cannot be bound on a chosen port.

Explanation

Two applications cannot be bound on the same port on the same machine.

User Action

1. Check that the port is not use by an another application.
2. Choose another port for the application.

5.3.3 UDP-style application cannot be associated with a peer

Symptoms

An SCTP application cannot receive or send messages over the UDP-style interface.

Explanation

The `sendmsg` or `recvmsg` calls return an error and are permanently blocked.

User Action

Set the `sctp_recvassocevent` event using the `setsockopt` function:

```
Int VI_on = 1;
Int VI_len = sizeof(VI_on);

sctp_setsockopt(VI_socket_id,
                IPPROTO_SCTP,
                SCTP_RECVASSOCEVENT,
                &VI_on,
                VI_len);
```

5.3.4 Application cannot send data

Symptoms

An SCTP application is not able to send data to a peer.

Explanation

The `sendmsg` function always returns an error, and, with a UDP-style interface, irrespective of the `sctp_rcvassocrevnt` event being set.

User Action

1. Check that an SCTP application is running on the peer machine.
2. In TCP-style, check that the association has been established.
3. Check that an application is bound on the correct port on the remote machine.
4. Check the IP address of the remote machine.
5. Check that the remote machine can be reached over the network, using the `ping` command for example.

5.3.5 Local application remains blocked when sending data

Symptoms

The local application becomes blocked immediately after sending some user messages.

Explanation

The `sendmsg` function has sent some data to the peer, but now it is blocked and no new data are sent to peer.

User Action

Check that the peer uses the `recv`, `recvmsg` or `recvfrom` functions to retrieve received messages from SCTP stack. If not, the received messages are queued in the SCTP API queue where they wait to be delivered to the user. The advertised remote window value `arwnd` (see *RFC2960, Stream Control Transmission Protocol, section 6.1* for information about this value) is closed and no more data can be sent while the peer does not retrieve the data.

5.4 user.log messages

The following example illustrates a typical `user.log` message sequence.

Extract 1

In Extract 1 the `sctpd` daemon has been started on July 12 at 11:36:28, on a machine named Clown, and has the pid: 91900. SCTP INFO indicates that the message contains user information, which notifies the user that the telnet server is listening on port 2000.

```
Jul 12 11:36:28 clown sctp [91900]: SCTP INFO: The sctpd telnet
server is listening on port 2000
```

Extract 2

An application with pid 122531 has been started on perth on July 12 at 14:47:16. The application's port and association tag is monitored.

```
telnet clown 2000
Escape character is '^'.
Compaq SCTP protocol stack version SCTPv100(Tru64 51 12-Jul-2001
14:08:20).
Type 'help' to get information about available commands.
```

```
> s
PID          Local port  Asso tag    Remote port  Remote addresses
122531       8           0x243043b5  7            10.1.0.3
                                     10.1.0.2
                                     10.1.0.1
```

Extract 3

Here an SCTP user information message allows a user to retrieve application information. Using telnet on port 2677:

```
>
Jul 12 14:47:16 perth sctp [122531]: SCTP INFO: Application 122531
telnet port: 2677
```

...application information is displayed as follows:

```
telnet perth 2677
Trying 10.0.0.1...
Connected to 10.0.0.1.
Escape character is '^]'.
App 122531 > s
Proto Asso tag    Local address          Remote address          State
SCTP  0x243043b5                ESTABLISHED
SCTP  0x243043b5  10.0.0.2:8
SCTP  0x243043b5  10.0.0.3:8
SCTP  0x243043b5  10.0.0.1:8
SCTP  0x243043b5                10.1.0.3:7             IDLE
SCTP  0x243043b5                10.1.0.2:7             ACTIVE
SCTP  0x243043b5                10.1.0.1:7             IDLE
App 122531 >
```

Extract 4

The entry in this extract contains protocol information showing that the maximum retransmission for destination 10.1.1.3 on port 7 has been exceeded.

```
Jul  9 18:06:51 clown sctp [72796]: SCTP PROTOCOL INFO: Retransmit
count exceeded for destination [addr:port] 10.1.1.3:7
```

Extract 5

In this extract, protocol information is given showing that the application with tag 0x86b3df42 and pid 72796 has no more available destinations. The peer does not respond to the heartbeat.

```
Jul  9 18:06:51 clown sctp [72796]: SCTP PROTOCOL INFO: No more
available destination for association [tag] 0x86b3df42
```

5.4.1 Messages and message types available in user.log

The `user.log` file can contain the following types of message, most of which are self-explanatory:

Internal stack error messages:

"Memory overflow"	"Critical section error"
"Control block not empty, cannot delete"	"Invalid parameter"
"Null pointer"	"Element already exists"
"Invalid lock status"	"Delete error"
"Database not initialized"	"Timer subsystem init error"
"Managment subsystem init error"	"Invalid timer cancel"
"Unsupported address family"	"Cannot initialize SCTP database"
"Cannot initialize IP layer"	"Cannot register port number"
"Surveillance mechanism error"	"Socket call error"
"Write error"	"Shared memory error"
"function returned: failure!"	"Timer not canceled"
"Wait failed"	

User information or user error messages:

"The SCTP daemon or an SCTP application is already running"

"The sctpd telnet server is listening on port <n>"

"The sctp daemon could not register its signal handler"

"The sctp daemon is exiting (caught signal <signal>)"

"Unable to start the telnet server"

"Application <name> telnet port: <n> "

"Cannot read the SCTP `config` file"

"No daemon configuration file, using default parameters"

"Inconsistency detected"

"Cannot send data while performing a shutdown"

"Unable to access the IP layer, check sctp daemon has administrator privileges"

Protocol error or protocol information messages:

"Retransmit count exceeded for destination [addr:port]"	"Retransmit count exceeded for association [tag] "
"No more available destination for association [tag]"	"Out-of-order SACK received"
"Bad chunk type"	"Data not available"
"Invalid received cookie"	"Invalid cumulative TSN in received Shutdown chunk"
"Bad received chunk"	"Maximum inbound streams number exceeded"
"Maximum outbound streams number exceeded"	"Current destination address is not ACTIVE"
"Path MTU too small"	"Bad packet: DATA before CONTROL Chunk"
"Bad packet: INIT, INIT_ACK SHUTDOWN_COMPLETE chunk not alone"	"Bad packet: Unknown chunk type"
"Bad packet: Unknown parameter type"	"Bad packet: No Padding"
"Bad packet: Invalid Checksum"	"Bad packet: Invalid SCTP packet len"
"Bad packet: Invalid SCTP packet, no user data"	"OOTB chunk received"
"Aborting: received chunk with no data"	"Max number of SCTP applications reached"

Internal management error messages:

"Mgt attribute ID already defined"
"Mgt attribute ID too big"

Management user errors messages:

"Function '<x>' called with invalid management attribute ID = <y>"
"In function '<x>', attribute <y> is not a <z> attribute"
"<n> management attribute(s) are not defined"
"Attribute <y> has an invalid type in function '<x>'"
"Attribute <y> is not settable in function '<x>'"
"Value <v>, is not in range [<n1>,<n2>] for attribute <y> in function <x>"
"No range test for this type"
"Invalid value for attribute <y> in function <x>"

API generic user error messages:

"Invalid parameter <p> in function <x>"
"Invalid IPv4 address argument in function <x>"
"Invalid instance ID <n> in function <x>"
"Invalid asso ID <n> in function <x>"
"Invalid destination ID in function <x>"

Database specific error messages:

"Maximum number of associations (<n>) reached for endpoint <e>"
"Maximum number of destinations (<n>) reached for association <a>"

Security error warning messages:

"Unable to start the security key timer, security key generation disabled"

Daemon configuration messages:

"Daemon: max number of applications set to <n>"
"Daemon: max message size set to <n>"
"Daemon: number of shared memory slots set to <n>"

Path MTU discovery messages:

"Invalid port in ICMP DTB message: <n>."

"Invalid remote address and port in ICMP DTB message: <address>:<port>."

"Invalid router MTU size <n> in ICMP DTB message from route <port>:<port>."

"Unsupported ICMP message received."

"The system returned an invalid Interface MTU value."

"Remote address <n>:<n> is unavailable."

"Remote address <n>:<n> is available."