



Dialogic[®] SS7 Protocols
SCTP Programmer's Manual

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Revision History

Issue	Date	Description
4	February 2008	Document rebranded and reformatted.
3	October 2006	Support for native SCTP interface layer.
2	September 2003	Additional configuration module options added (CRC32).
1	June 2002	Raised to issue 1.

Note: The latest release issue of this guide can be found at:
<http://www.dialogic.com/support/helpweb/signaling>

1 Introduction

The suite of SCTP modules (SCTP, SCTPD and SCTPN) provides access to a software implementation of the Stream Control Transmission Protocol (SCTP).

In addition to the protocol-related functions, the modules contain a number of features to assist you in the development of your application. These features include the ability to trace any primitive message received by, or issued from, the SCTP modules to a management module where it can be recorded or presented to you. In this way, you can debug your application without needing to gain detailed knowledge of the internal working of the SCTP module.

This manual is intended for use by systems integrators and application programmers who will need to use the SCTP modules, but do not need to know the detail of the internal operation of the modules.

There are two separate implementations that provide Stream Control Transmission Protocol (SCTP) services. Both implementations provide the same message interface to other modules through the message passing environment. Both implementations cannot be run concurrently on the same host.

This manual gives an overview of the operation of the SCTP modules and details the structure of all messages which can be sent to, or issued by, the modules and also describes the configuration parameters.

1.1 SCTP and SCTPD Modules

The SCTP module is a software implementation of the Stream Control Transmission Protocol (SCTP) as specified in RFC2960 and includes the checksum change required in RFC3309.

The current SCTP implementation provides you with functionality to implement up to 32 separate associations, each with up to 128 input and output streams. Each association can be configured with up to 4 network addresses to provide multi-homing capabilities.

The SCTP module requires services provided by the SCTPD module, which must also be running. It is suitable for use under Windows, Linux, Solaris 8 and Solaris 9. For Solaris 10, the SCTPN module should be used instead.

1.2 SCTPN Module

The SCTPN module is an interface layer to the SCTP stack that is built into Solaris 10. The SCTPN module provides a GCT message interface compatible with the SCTP module.

The module itself imposes no hard limits on the number of associations and streams which can be used, and these limits are therefore bounded by the available resources and limitations of the operating system's SCTP stack.

Note: The SCTPN module does not require the SCTPD module and the SCTPD module must **not** be running.

1.3 Compatibility

The following table shows the compatibility of each implementation with various operating systems. This table is not intended to be exhaustive.

	SCTP / SCTPD	SCTPN
Windows	✓	✗
Linux	✓	✗
32-bit Solaris 8	✓	✗
32-bit Solaris 9	✓	✗
32-bit Solaris 10	✗	✓
64-bit Solaris 8	✓	✗
64-bit Solaris 9	✓	✗
64-bit Solaris 10	✗	✓

1.4 Abbreviations

IETF	Internet Engineering Task Force.
RFC	Request for Comments.
SCTP	Stream Control Transmission Protocol.

1.5 Related Documentation

- [1] [*RFC 2960 - Stream Control Transmission Protocol*](#)
- [2] [*Software Environment Programmer's Manual*](#)
- [3] [*RFC 3309 - Stream Control Transmission Protocol Checksum Change*](#)

1.6 Feature Overview

Key features of the SCTP module include:

- Implementation of RFC 2960.
- Configuration options on a per association basis.
- Message-oriented interface.
- Selectable (RFC2960 / RFC3309) module checksum algorithm.

2 General Description

2.1 Module Overview

The SCTP module is an implementation of the Stream Control Transmission Protocol as defined in RFC 2960, and the additional checksum change specified in RFC 3309.

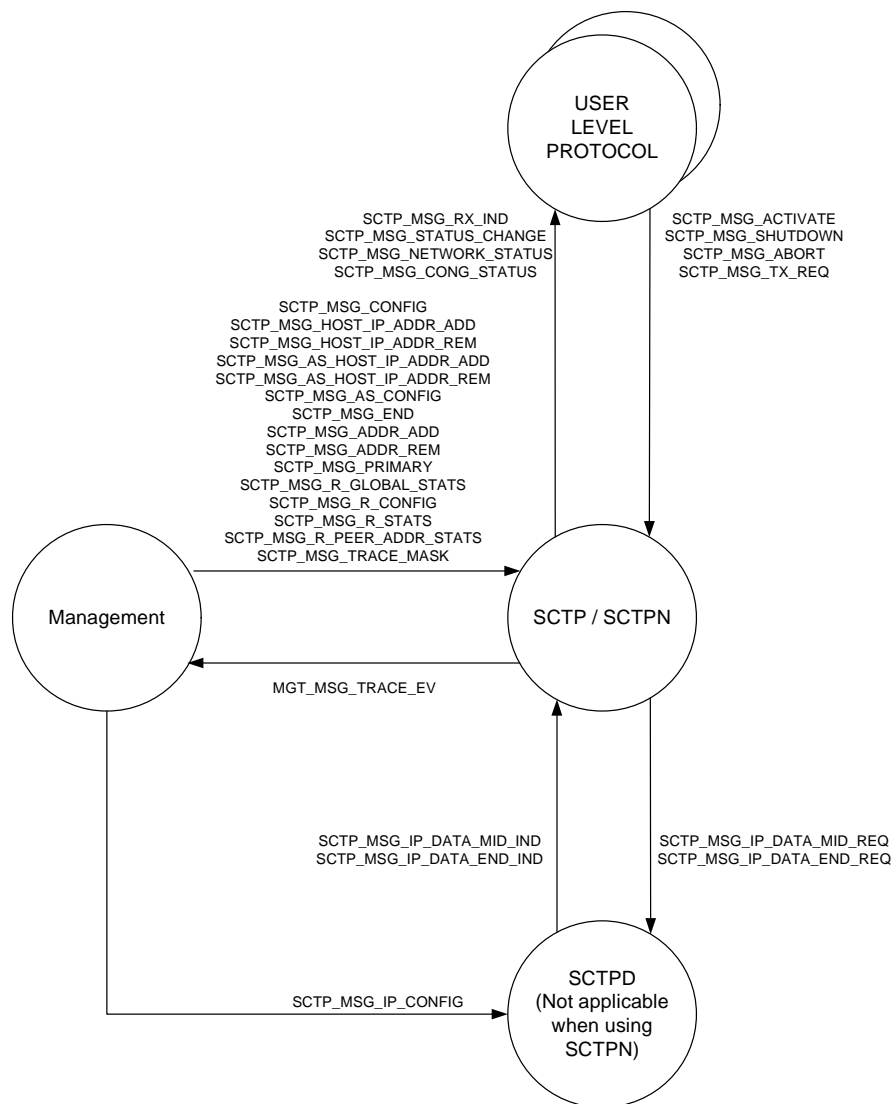
Each association is uniquely identified by an association identifier **assoc_id**. Assoc_ids range from 0 to one less than the number of associations supported.

2.2 Module Configuration

The module is configured for operation in conjunction with a number of user part modules, which lie above the SCTP module in the protocol stack, and a network interface module that lies below the SCTP module in the protocol stack.

Management functionality should be provided by a management module, which configures the SCTP module and handles the recording or presenting of trace messages and event indications to you.

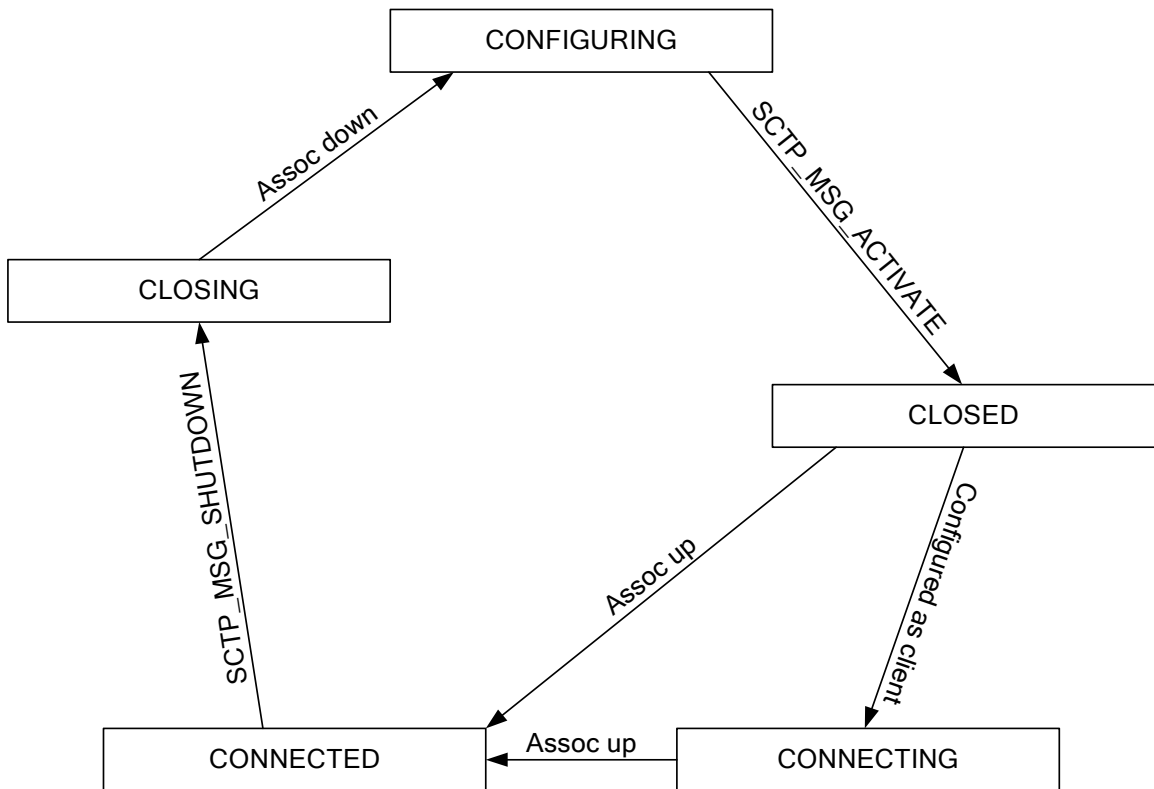
Figure 1. Module Configuration



2.3 Association State Transitions

A simplified state transition diagram for the SCTP module is detailed below.

Figure 2. Associated State Transitions



3 Internal Data Structures

This chapter describes the internal data structures used by the SCTP module. This description is intended to assist you in understanding the operation of the module. It is not necessary to acquire detailed knowledge of these structures in order to use the module.

3.1 Global Data Structure

The entire data storage used by the module is contained in a single contiguous data structure. This structure contains global configuration settings, per association storage and statistics storage all relating to operation of the SCTP protocol. It also contains internal event queues, timer control structures and internal buffers for message processing.

3.2 Association Data Structure

Each circuit group has a data structure within the global data structure, which contains the user supplied configuration parameters for the association (e.g. host and peer ports and addresses).

3.3 Per Peer Address Data Structure

Each association stores data and statistics with respect to each address supplied by its peer during association initialization.

4 Interface to System Services

4.1 System Functions

In addition to the primitive interface and the management interface to the Sctp module (which are described in later sections) the module requires a few basic system services to be supplied by the underlying operating system. This functionality is usually supplied by the appropriate Development package and is detailed in the *Software Environment Programmer's Manual*.

4.2 Timer Operation

In order to provide internal implementation of the Sctp protocol timers the Sctp module needs to receive a periodic timer tick message. This is usually achieved using the Timer module supplied in the Development Package.

The format of these messages is described in the *Software Environment Programmer's Manual*.

Note: The Sctp module does not require timer ticks.

5 SCTP Management Interface

The management layer communicates with the SCTP module using the following primitives.

Primitive	Description
SCTP_MSG_CONFIG	Configure global options within the SCTP module.
SCTP_MSG_HOST_IP_ADDR_ADD	Add an IP address to the list of valid IP addresses available for the host.
SCTP_MSG_HOST_IP_ADDR_REM	Remove a IP address from the list of valid IP addresses available for the host.
SCTP_MSG_AS_CONFIG	Configure association.
SCTP_MSG_AS_ADDR_ADD	Add a peer network address to an association.
SCTP_MSG_AS_ADDR_REM	Remove a peer address from an association.
SCTP_MSG_AS_PRIMARY	Designate a peer address as the primary address.
SCTP_MSG_TRACE_MASK	Define which events generate trace messages to the trace module.
SCTP_MSG_R_GLOBAL_STATS	Read the global statistics for the SCTP module.
SCTP_MSG_R_STATS	Read the statistics for a particular association.
SCTP_MSG_R_AS_PEER_ADDR_STATS	Read the statistics for a particular peer network address for a particular association.

5.1 Module Configuration Request

Synopsis

Configure system parameters for the SCTP module.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_CONFIG (0x7282)
id	0
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	20

Parameter Area		
Offset	Size	Name
0	1	mngt_id
1	1	trace_id
2	1	ip_id
3	2	max_assocs
5	2	max_i_streams
7	2	max_o_streams
9	2	ms_per_tick
11	2	options
13	7	reserved

Parameters

mngt_id

Module ID of the management module.

trace_id

Module ID of the message trace module.

ip_id

Module ID of the IP daemon.

Note: This parameter is ignored when using the SCTPN module.

max_assocs

Maximum number of associations the module will be required to handle.

max_i_streams

Maximum number of input streams for each association the module must be able to handle.

max_o_streams

Maximum number of output streams for each association the module must be able to handle.

ms_per_tick

Number of milliseconds between each system tick message.

options

Bitmap of options.

Option	Value	Description
SCTP_CFG_OPT_CRC32	0x0001	Module will use CRC32 as the checksum.
SCTP_CFG_OPT_NO_ABORT_INIT	0x0002	Module will ignore rather than abort incoming connection attempts for none present SCTP ports.

By default, the SCTP module will use Adler32 (RFC2960) checksums.

Note: When using the SCTPN module the SCTP_CFG_OPT_CRC32 must be set as Adler32 is not supported; the SCTP_CFG_OPT_NO_ABORT_INIT option must not be set when.

reserved

Reserved space. This must be set to zero.

Description

First message sent to the SCTP module to start the module and configure general parameters.

The module sending the message should request a response and check the returned status to ensure the configuration message has been accepted by SCTP.

5.2 Add Host Network Address Request

Synopsis

Add an IP network address to the list of those available for SCTP.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_HOST_IP_ADDR_ADD (0x7283)
id	0
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	17

Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

Description

Sent to the SCTP module to add a network address to the list of host network addresses supplied by SCTP, during association initialization.

The module sending the message should request a response and check the returned status to ensure the IP address has been accepted by SCTP.

Added addresses will only be available for use by associations that are initiated after the address has been added.

Added addresses will not be available for use by restarted associations.

Addresses added are NOT checked for validity on the host.

5.3 Remove Host Network Address Request

Synopsis

Remove an IP network address from the list of those available for SCTP.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_HOST_IP_ADDR_REM (0x7284)
id	0
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	17

Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

Description

Sent to the SCTP module to remove a network address from the list of host network addresses supplied by SCTP, during association initialization.

The module sending the message should request a response and check the returned status to ensure the IP address has been removed by SCTP.

The removed IP address will still be used by currently active associations until such time as they are shut down.

5.4 Configure Association Request

Synopsis

Configure an association for use by SCTP.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_AS_CONFIG (0x7286)
id	Association ID
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	80

Parameter Area		
Offset	Size	Name
0	2	peer_port
2	2	host_port
4	2	max_i_streams
6	2	max_o_streams
8	4	rto_min
12	4	rto_max
16	4	rto_init
20	4	cookie_life
24	4	heartbeat
28	2	max_retx_init
30	2	max_retx_cookie
32	2	max_retx_shutdown
34	2	max_retx_heartbeat
36	2	max_retx_data
38	4	T1_init
42	4	T2_init
46	2	cong_abate
48	2	cong_onset
50	2	cong_discard
52	4	rx_window
56	2	options
58	22	Reserved for expansion

Parameters

peer_port

SCTP port of peer (zero to allow connection from any peer port).

host_port

SCTP port of host (zero to allow connection to any host port).

max_i_streams

Association-specific maximum number of SCTP streams that the peer can request for data transmission to the host.

max_o_streams

Association-specific maximum number of SCTP streams that the host will request for data transfer to the peer.

rto_min

Minimum RTO in milliseconds.

rto_max

Maximum RTO in milliseconds.

rto_init

Initial RTO in milliseconds.

cookie_life

Cookie lifetime in milliseconds.

heartbeat

Minimum time between heartbeats in milliseconds.

max_retx_init

Maximum number of times an INIT message is re-transmitted before the association attempt is aborted.

max_retx_cookie

Maximum number of times a COOKIE_ECHO message is re-transmitted before the association attempt is aborted.

max_retx_shutdown

Maximum number of times a SHUTDOWN message is re-transmitted before the association is closed.

max_retx_heartbeat

Maximum number of times a HEARTBEAT message is lost before the network address marked failed.

max_retx_data

Maximum number of times a data chunk will be retransmitted before the association is aborted.

T1_init

Starting timeout of an INIT chunk.

T2_init

Starting timeout of a SHUTDOWN chunk.

Note: This parameter is not supported by the SCTPN module.

cong_abate

Number of memory buffers in the transmission queues that indicate the abatement of congestion.

cong_onset

Number of memory buffers in the transmission queues that indicate the onset of congestion.

cong_discard

Number of memory buffers in the transmission queues that indicate the discarding of messages due to congestion.

rx_window

The size of the associations receive window, in octets.

options

Bitmap of options.

Value	Description
SCTP_AS_CNF_OPT_CLIENT	Association will be a client and will initiate the connection
SCTP_AS_CNF_OPT_SERVER	Association will be a server and will await a connection
SCTP_AS_CNF_OPT_NO_RESTART	Association will ABORT if a restart is detected
SCTP_AS_CNF_OPT_KEEP_ALIVE	Association will not shutdown on excess heartbeat loss
SCTP_AS_CNF_OPT_FULL_CFG	Association must be fully configured with all the peer's network addresses

Description

Sent by the user module to configure the parameters of an SCTP association.

The module sending the message should request a response and check the returned status to ensure the SCTP configuration has been accepted by SCTP.

An association can only be configured when it is in the configuring state.

5.5 Add Peer Network Address Request

Synopsis

Add an IP network address to those available on which to contact the peer.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_ADDR_ADD (0x7287)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Non zero on error	
err_info	0	
len	17	
Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

ip_type & ip_addr

The IP address format and the IP address. Refer to [Section 10 on page 57](#).

Description

Sent to the SCTP module to add a network address to the list of valid peer IP addresses for this association.

The module sending the message should request a response and check the returned status to ensure the IP address has been added by SCTP.

Addresses can only be added when the association is in the Configuration State.

For a server application, the IP addresses configured are the addresses from which SCTP will accept association creation requests. Wildcard addresses (consisting of a zero IP address) are valid only if no other addresses have been specified.

For a client application, the IP addresses configured are the addresses that SCTP uses when attempting to create an association. Wildcard addresses are NOT valid.

If the association has been configured with the `SCTP_AS_CNF_OPT_FULL_CFG` flag, the host **MUST** supply all the IP network addresses of the peer; otherwise the association initiation will fail.

5.6 Remove Peer Network Address Request

Synopsis

Remove an IP network address from those available to contact the peer on.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_ADDR_REM (0x7288)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Non zero on error	
err_info	0	
len	17	
Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

Description

Sent to the SCTP module to remove a network address from the list of valid peer IP addresses for this association.

The module sending the message should request a response and check the returned status to ensure the IP address has been removed by SCTP.

Addresses can only be removed when the association is in the Configuration State.

5.7 Set Primary Address Request

Synopsis

Indicate the primary address of the peer.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_PRIMARY (0x7289)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Non zero on error	
err_info	0	
len	17	
Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

Description

Configure the association to use the indicated address as the primary destination address of the association.

An address will be accepted but not used if it is currently not reachable.

Until the primary address is selected via this message, the first peer address present in the SCTP association initialization message will be used.

5.8 Global Statistics Request

Synopsis

Retrieve global statistical information for the module.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_R_GLOBAL_STATS (0x6290)	
id	0	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Reset Flag	
err_info	0	
len	46	
Parameter Area		
Offset	Size	Name
0	2	est_current
2	4	est_client
6	4	est_server
10	4	aborted
14	4	shutdown
18	4	OOB
22	4	chunks_tx
26	4	chunks_rx
30	4	chunks_retx
34	4	chunks_unorder_tx
38	4	chunks_unorder_rx
42	4	bad_checksum

Parameters

Reset Flag

Reserved for future use. Set to zero.

est_current

Number of associations currently in either ESTABLISHED or SHUTDOWN_RECEIVED states.

est_client

Total number of associations established from this host.

est_server

Total number of associations established from a peer.

aborted

Total number of associations ended by ABORT.

shutdown

Total number of associations ended gracefully.

OOB

Total number of out of the blue packets received.

Note: This parameter is not supported by the SCTPN module.

chunks_tx

Total number of chunks transmitted (not re-transmits).

chunks_rx

Total number of chunks received.

chunks_retx

Total number of chunks re-transmitted.

Note: This parameter is not supported by the SCTPN module.

chunks_unorder_tx

Total number of unordered chunks sent.

chunks_unorder_rx

Total number of unordered chunks received.

bad_checksum

Total number of chunks that failed the checksum.

Note: This parameter is not supported by the SCTPN module.

Description

If the statistics are not read before their maximum values are reached, then the counts will wrap.

5.9 Read Association Configuration Request

Synopsis

Read configuration options for an individual association.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_R_CONFIG (0x6291)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	85	
Parameter Area		
Offset	Size	Name
0	80	Parameters as defined for SCTP_ASSOC_CONFIG
80	1	state
81	2	i_streams
83	2	o_streams

Parameters

state

Current state of the association.

Status	Description
CONFIGURING	Association is being configured.
CLOSED	Association is active but unused.
COOKIE_WAIT	Association has attempted to initially contact the peer.
COOKIE_ECHOED	Association peer has responded and we are waiting for confirmation of the established state.
ESTABLISHED	Association is available for data transfer.
SHUTDOWN_PENDING	Host has indicated an association should be gracefully closed.
SHUTDOWN_SENT	Host is attempting to gracefully close an association.

Status	Description
SHUTDOWN_RECEIVED	Peer has indicated an association should be gracefully closed.
SHUTDOWN_ACK_SENT	Association is shutting down.

Note: The COOKIE_ECHOED, SHUTDOWN_ACK_SENT, SHUTDOWN_RECEIVED and SHUTDOWN_SENT status values are never returned by the SCTPN module.

i_streams

Number of input streams in the current association (contains valid value only for associations in the ESTABLISHED state).

o_streams

Number of output streams in the current association (contains valid value only for associations in the ESTABLISHED state).

Description

Retrieves the parameters used to configure the association.

5.10 Read Association Statistics Request

Synopsis

Gets association statistical information for the association.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_R_STATS (0x6292)
id	Association ID
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Reset Flag
err_info	0
len	49

Parameter Area		
Offset	Size	Name
0	4	est_client
4	4	est_server
8	4	aborted
12	4	shutdown
16	4	chunks_tx
20	4	chunks_rx
24	4	chunks_retx.
28	4	chunks_unordered_tx
32	4	chunks_unordered_rx
36	2	t1_expires.
38	2	t2_expires.
40	1	peer_addr
41	4	period
45	4	time_oos

Parameters

est_client

Total number of associations established from this host on this association.

est_server

Total number of associations established from a peer on this association.

aborted

Total number of associations ended by ABORT on this association.

shutdown

Total number of associations ended gracefully on this association.

chunks_tx

Total number of chunks transmitted (not re-transmits) on this association.

chunks_rx

Total number of chunks received on this association.

chunks_retx

Total number of chunks retransmitted on this association.

Note: This parameter is not supported by the SCTPN module.

chunks_unordered_tx

Total number of unordered chunks sent on this association.

chunks_unordered_rx

Total number of unordered chunks received on this association.

t1_expires

Number of times T1 expired during INIT phases on this association.

Note: This parameter is not supported by the SCTPN module.

t2_expires

Number of times T2 expired during SHUTDOWN phases on this association.

Note: This parameter is not supported by the SCTPN module.

peer_addr

Number of peer network addresses present for this association (set to zero in associations **not** in the ESTABLISHED state).

period

Number of timer ticks that have passed since the statistics were last reset.

time_oos

Number of timer ticks that the association has been out of service since the last reset.

Description

If the statistics are not read before their maximum values are reached, then the counts will wrap.

5.11 Read Association Peer Address Statistics

Synopsis

Retrieve statistical information for a network address within an established association.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_R_PEER_ADDR_STATS (0x6293)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Non zero on error	
err_info	0	
len	31	
Parameter Area		
Offset	Size	Name
0	1	addr_num (Input)
1	1	ip_type
2	16	ip_addr
18	1	status
19	4	rto
23	4	lost_heartbeat
27	4	lost_data

Parameters

addr_num

Supplied by the originating module to specify the number of the network addresses that statistics are to be read.

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

status

Address status.

Status	Description
INACTIVE	Network address has been marked inactive.
ACTIVE	Network address has been marked as available for data transfer.

rto

Current RTO for the interface.

lost_heartbeat

Number of heartbeat messages lost on the interface.

Note: This parameter is not supported by the SCTPN module.

lost_data

Number of data chunks lost on the interface.

Note: This parameter is not supported by the SCTPN module.

Description

Information is reset when the association transitions into the established state.

Addresses that have not been configured result in a returned address type of ADR_NONE.

6 User Layer Interface to SCTP

The user layer protocol communicates with the Stream Control Transmission Protocol (SCTP) module using the following primitives, based on those present in RFC2960.

AS_ACTIVATE	Make an association available for client or server connections.
AS_SHUTDOWN	Shutdown a currently active association.
AS_ABORT	Abort a currently active association.
AS_DATA_REQ	Send a packet of data to a peer.

6.1 SCTP Status Codes

The following status codes will be returned within requested confirmation messages from SCTP.

Mnemonic	Value	Description
none	0	Success.
SCTPE_BAD_ID	1	Inappropriate or invalid id in request message.
SCTPE_BAD_MSG	5	Inappropriate or unrecognized message type.
SCTPE_BAD_PARAM	6	Invalid parameters contained in message.

6.2 Association Activate Request

Synopsis

Move the association from the Configuration State into the active state.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_ACTIVATE (0x728a)
id	Association ID
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	0

Description

The association is moved from the configuration state into the active state, allowing the association to accept incoming or start outgoing connection procedures with its peer.

The module sending the message should request a response and check that all configuration information was accepted and that the activation has succeeded.

At least **one** peer IP address must be configured prior to activation.

Once the association has been activated, if the host port is zero it is configured to an ephemeral port.

If the association has been configured with a peer port (set to non zero), the association will attempt to initiate an association with its peer. This will be indicated to you by the reception of an association status change message detailing a state of CONNECTING.

If the association has been configured without a peer port (set to zero), the activated association will await an incoming association from the configured peer.

Established associations will be indicated to you via the association status message detailing a state of CONNECTED.

6.3 Association Shutdown Request

Synopsis

Attempt to shutdown an association after all outstanding data has been acknowledged.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_SHUTDOWN (0x728b)
id	Association ID
src	Originating Module ID
dst	SCTP Module
rsp_req	Used to request a confirmation
hclass	0
status	Non zero on error
err_info	0
len	0

Description

Once shutdown starts, the status of the connection will be indicated to the user via the SCTP_MSG_ASSOC_STATUS message.

Once you have successfully requested that the association be shutdown, all further attempts to send data on this association will be rejected.

Once the shutdown has completed, SCTP will send you an association status message with a status of CLOSED and will re-enter the un-configured state.

6.4 Association Abort Request**Synopsis**

Initiates the termination of an association with the loss of all outstanding data.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_ABORT (0x728c)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	Non zero on error	
err_info	0	
len	2	
Parameter Area		
Offset	Size	Name
0	2	error

Parameters**error**

Error code sent to the peer to indicate the reason for the abort. See [RFC2960 section 3.3.10](#) for a detailed description of error codes.

Note: This parameter is not supported by the SCTPN module.

Description

Once an association is aborted, then no new data will be accepted for transmission and all outstanding data will be lost.

Once the association has shutdown, then it will send you an association status message with a status of closed and will re-enter the un-configured state.

6.5 Association Data Transfer Request

Synopsis

Queue a data packet for transmission on an association.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_TX_REQ (0xc280)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	data len + 8	
Parameter Area		
Offset	Size	Name
0	data len	data
data len	2	flags
data len + 2	2	stream
data len + 4	4	ppid

Parameters

data

Octets of data for transmission.

flags

SCTP transmission flags.

Status	Description
SCTP_UNBUNDLED	Do not bundle the packet for first transmission.
SCTP_UNORDERED	Use un-sequenced delivery

Note: The SCTP_UNBUNDLED flag is not supported by the SCTPN module.

stream

SCTP stream number for transmission.

ppid

SCTP Payload Protocol Identifier.

Description

Data packets with more than 300 octets are not supported.

Data packets will be rejected if the association is not currently established or an invalid stream ID is used.

If a response message has been requested, it is returned when either the packet is rejected (see above) or the packet has been queued for transmission. There is no method to determine when its peer has acknowledged a specific data packet.

If you attempt to send data faster than the peer will accept, SCTP will buffer the data. If the amount of data exceeds a predetermined amount, you will be notified by a congestion status message indicating that congestion has occurred. Once the amount of data is dropped to a lower predetermined level, then a second congestion status message is sent to you indicating congestion has abated. If you continue to send data after being notified congestion has occurred and a second level is passed, you will be informed that the data sent is being discarded.

7 SCTP Interface to User Layer

The Stream Control Transmission Protocol (SCTP) module communicates with the user layer protocol using the following primitives, based on those present in RFC2960.

AS_DATA_IND	A packet of data has been received from the peer.
AS_STATUS_CHANGE	A change in the status of the association has occurred.
AS_NETWORK_STATUS	A change in the status of a peer address has occurred.
AS_CONG_STATUE	A change in the congestion status has occurred.

7.1 Association Data Transfer Indication

Synopsis

Indicates the arrival of a data packet from the peer.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_RX_IND (0x8281)	
id	Association ID	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	0	
hclass	0	
status	0	
err_info	0	
len	data len + 8	
Parameter Area		
Offset	Size	Name
0	data len	data
data len	2	flags
data len + 2	2	stream
data len + 4	4	ppid

Parameters

data

Actual octets of data received.

flags

Combinable SCTP transmission flags.

Status	Description
SCTP_UNORDERED	Packet used un-sequenced delivery

stream

SCTP stream number for transmission.

ppid

SCTP Payload Protocol Identifier.

Description

In the event of a data chunk of more than 300 octets being received from its peer, SCTP will acknowledge the packet as normal. However, the packet will then be discarded (you will never see the packet) and a management message will be generated.

7.2 Association Status Change

Synopsis

A change in the association status has occurred.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_STATUS_CHANGE (0x028d)	
id	Association ID	
src	Originating Module ID	
dst	User Application	
rsp_req	0	
hclass	0	
status	status	
err_info	0	
len	4	
Parameter Area		
Offset	Size	Name
0	2	i_streams
2	2	o_streams

Parameters

status

Status	Description
STATUS_CLOSED	Association has entered the closed state.
STATUS_CONNECTING	Association is attempting to connect to a peer.
STATUS_CONNECTED	Association is available for data transfer.
STATUS_CLOSING	Association is attempting a graceful shutdown.
STATUS_RESTART	The peer has restarted the association. Data queued by the association before it was restarted will be lost.

i_streams

Number of SCTP streams allocated for peer-to-host data transfer.

o_streams

Number of SCTP streams allocated for host-to-peer data transfer.

Description

Sent to your application to indicate a change in state of the association.

7.3 Association Network Status

Synopsis

Indicates a status change has occurred on a network address within the association.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_NETWORK_STATUS (0x028e)
id	Association ID
src	Originating Module ID
dst	User Application
rsp_req	0
hclass	0
status	status
err_info	0
len	17

Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr

Parameters

status

Status	Description
ADDRESS_INACTIVE	Network address has been marked inactive.
ADDRESS_ACTIVE	Network address has been marked as available for data transfer.

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

Description

This indicates that either a network address that was previously available has now been marked as inactive, or vice versa. The definition of an inactive address is one that has failed to respond to a configurable number of sequential heartbeat requests.

7.4 Association Congestion Status

Synopsis

Indicates a status change has occurred with regards to transmit congestion on an association.

Message Format

Message Header	
Field Name	Meaning
type	SCTP_MSG_CONG_STATUS (0x028f)
id	Association ID
src	Originating Module ID
dst	User Application
rsp_req	0
hclass	0
status	status
err_info	0
len	0

Parameters

status

Status	Description
SCTP_TX_CONG_ABATE	Transmission queue is free to accept more messages
SCTP_TX_CONG_ONSET	Transmission queue is experiencing congestion
SCTP_TX_CONG_DISCARD	Transmission queue has been filled to capacity and has started to discard messages queued for transmission

Description

Sent to you to indicate the level of congestion on the association has changed.

If you receive an SCTP_TX_CONG_ONSET message you should reduce the rate at which messages are sent to SCTP. If the congestion clears then an SCTP_TX_CONG_ABATE message is sent and you can continue as before. However if the level of congestion rises after a SCTP_TX_CONG_ONSET message has been sent, the system will send you an SCTP_TX_CONG_DISCARD message. At this point, SCTP will discard any data messages sent by you until the level of congestion has dropped to a safe level, at which time an SCTP_TX_CONG_ABATE message will be sent.

8 SCTP Trace Messages

8.1 Trace Mask Configuration Request

Synopsis

Configure SCTP to trace the specified messages and events.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_TRACE_MASK (0x5285)	
id	0	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	12	
Parameter Area		
Offset	Size	Name
0	4	op_evt_mask
4	4	ip_evt_mask
8	4	reserved

Parameters

op_evt_mask

The output event mask. This is a 32 bit value with bits set to 1 to cause a trace message to be sent to the system management module whenever a message is issued by SCTP for the event indicated.

Bit Number	Mnemonic	Description
0	DATA_IND	SCTP_MSG_RX_IND
1	STATUS_CHG	SCTP_MSG_STATUS_CHANGE
2	NET_CHG	SCTP_MSG_NETWORK_STATUS
3	CONG_CHG	SCTP_MSG_CONG_STATUS
4	DATA_REQ	SCTP_MSG_IP_DATA_XXX_REQ
5-31	Reserved	Reserved - Should be set to zero.

Note: The DATA_REQ bit is not supported by the SCTPN module.

ip_evt_mask

The input event mask. This is a 32 bit value with bits set to 1 to cause a trace message to be sent to the system management module whenever a message is received by SCTP for the event indicated.

Bit Number	Mnemonic	Description
0	ACT_ASSOC	SCTP_MSG_ACTIVATE
1	SHUT_REQ	SCTP_MSG_SHUTDOWN
2	ABORT_REQ	SCTP_MSG_ABORT
3	DATA_REQ	SCTP_MSG_TX_REQ
4	PRI_ADDR	SCTP_MSG_PRIMARY
5-31	Reserved	Reserved - Should be set to zero

reserved

Currently reserved. MUST be set to zero.

Description

Can be used to debug user-level applications by detailing the exact information exchanged on the USER/SCTP interface.

8.2 Trace Event Indication

Synopsis

Message sent to the trace module containing the message to be traced.

Message Format

Message Header	
Field Name	Meaning
type	MGT_MSG_TRACE_EV (0x0003)
id	0
src	Originating Module ID
dst	Management Module ID
rsp_req	Used to request a confirmation
hclass	0
status	0
err_info	0
len	18 + data len

Parameter Area		
Offset	Size	Name
0	1	src_id
1	1	dst_id
2	2	id
4	2	type
6	2	status
8	4	timestamp
12	4	p_msg
16	2	length
18	data len	data

Parameters

src_id

Source module identifier of the traced message.

dst_id

Destination module identifier of the traced message.

id

Message identifier of the traced message.

type

Type of the traced message.

status

Status id of the traced message.

timestamp

Timestamp for the traced message.

p_msg

Pointer to the traced message.

length

Length of the traced message.

data

Data from the parameter area of the traced message.

Description

Used by SCTP to inform the trace entity of various message events. Notification of message can be enabled or disabled using the set trace mask message.

9 SCTP to SCTPD Interface

The following are used by the message-based interface between SCTP and the SCTP daemon SCTPD. Except for the configuration message, these messages are internal to SCTP / SCTPD and are shown here for reference only. These messages are not used by the SCTPN module.

9.1 SCTPD Configuration Request

Synopsis

Sent to the SCTP module at startup to configure various parameters.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_IP_CONFIG (0x7295)	
id	0	
src	Originating Module ID	
dst	IP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	2	
Parameter Area		
Offset	Size	Name
0	1	mngt_id
1	1	trace_id
2	1	sctp_id

Parameters

mngt_id

Module ID of the management module.

trace_id

Module ID of the message trace module.

sctp_id

Module ID of the SCTP module.

Description

The module sending the message should request a response and check the returned status to ensure the configuration message has been accepted by SCTPD.

9.2 IP Data Transmission Request

Synopsis

Request sending data via IP.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_IP_DATA_MID_REQ (0x7296) SCTP_MSG_IP_DATA_END_REQ (0x7297)	
id	0	
src	Originating Module ID	
dst	Module_id of SCTPD module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	17 + data len	
Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr
17	data len	data

Parameters

ip_type & ip_addr

The IP address format and IP address. Refer to [Section 10 on page 57](#).

data

Data to be transmitted via IP.

Description

Used by SCTP to transfer data to the network layer of the underlying operating system.

The network layer buffers all the SCTP_MSG_IP_DATA_MID_REQ information until a SCTP_MSG_IP_DATA_END_REQ message is received. At this point all the data is sent via the IP network to the network address supplied in the final message.

9.3 IP Data Reception Indication**Synopsis**

Indicates reception of a data packet from IP.

Message Format

Message Header		
Field Name	Meaning	
type	SCTP_MSG_IP_DATA_MID_IND (0x7298) SCTP_MSG_IP_DATA_END_IND (0x7299)	
id	0	
src	Originating Module ID	
dst	SCTP Module	
rsp_req	Used to request a confirmation	
hclass	0	
status	0	
err_info	0	
len	17 + data len	
Parameter Area		
Offset	Size	Name
0	1	ip_type
1	16	ip_addr
17	data len	data

Parameters**ip_type & ip_addr**

The IP address format and IP address. Refer to [Section 10 on page 57](#).

data

Data to be transmitted via IP.

Description

Used by the network layer to transfer data to SCTP.

SCTP buffers all the SCTP_MSG_IP_DATA_MID_IND information until a SCTP_MSG_IP_DATA_END_IND message is received. At this point, all the data is processed.

10 Network Address Representation

The SCTP module is designed to facilitate future support for IPv6 addresses. Currently only IPv4 addresses are supported, but the interface to the module is designed to accommodate IPv6 addresses in the future.

10.1 Network Address Structure for an invalid address

Invalid / not present network addresses will be represented in the following way:

Address Type ADR_NONE
Address Value Undefined.

10.2 Network Address Structure for Internet Protocol Version 4

IPv4 network addresses will be represented in the following way:

Address Type ADR_IPV4
Address Value 16 octets containing the following:

- Octet 0 MSB of network address
- ...
- Octet 3 LSB of network address
- Octet 4 undefined
- ...
- Octet 15 undefined

11 Module Command Line Interface

11.1 SCTP

```
sctp [-v -m<module_id> -b<buffers>]
```

Where:

- **-v** displays the module version and command line option information.
- **-m<module_id>** sets to configure the module id to be used by the module.
- **-b<buffers>** sets the number of message buffers sctp should use.

11.2 SCTPD

```
sctpd [-v -m<module_id>]
```

Where:

- **-v** displays the module version and command line option information.
- **-m<module_id>** sets to configure the module id to be used by the module.

11.3 SCTPN

```
sctpn [-v -m<module_id>]
```

Where:

- **-v** displays the module version and command line option information.
- **-m<module_id>** sets to configure the module id to be used.

12 Example SCTP Message Flows

The following diagrams show the flow of messages between the user application and SCTP module for the following general situations.

Note For simplicity AS_NETWORK_STATUS messages are not shown.

Figure 3. Example SCTP Message Flows: Configure as Client and Connect to Peer Server

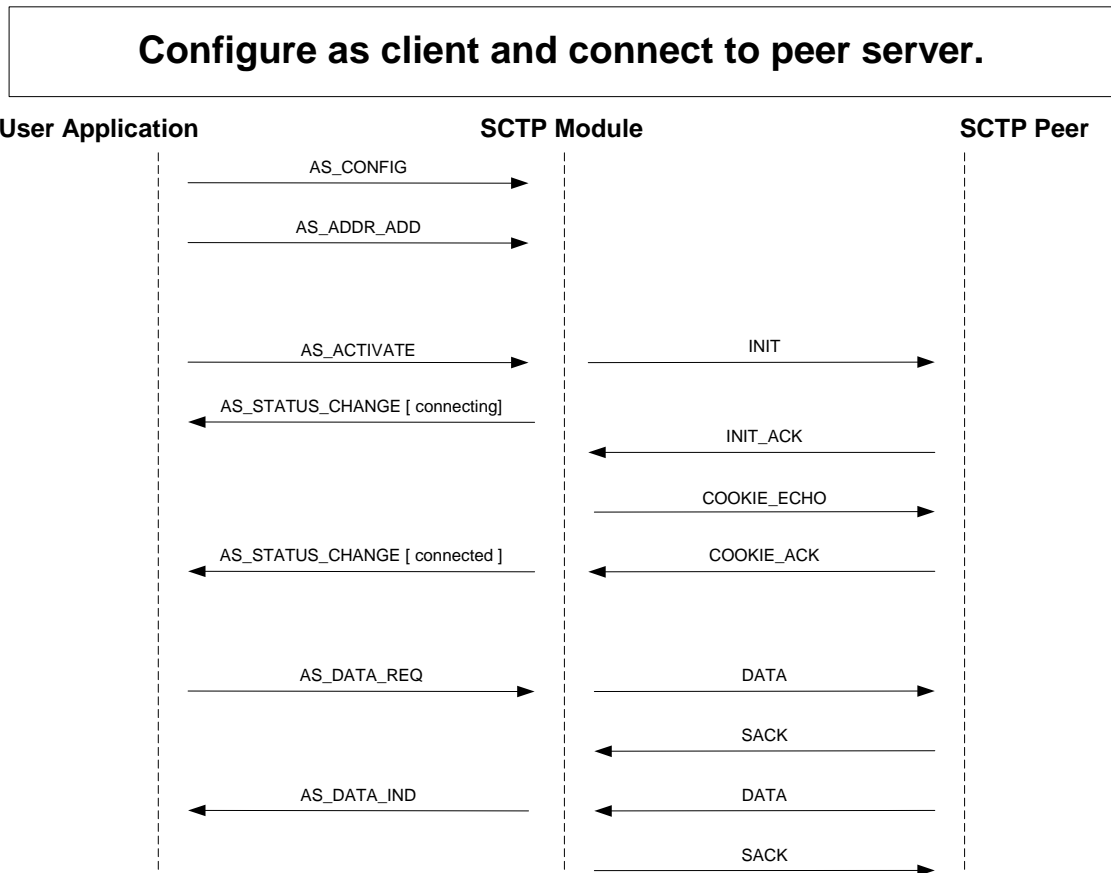


Figure 4. Example SCTP Message Flows: Configure as Server and Connect from Peer Client

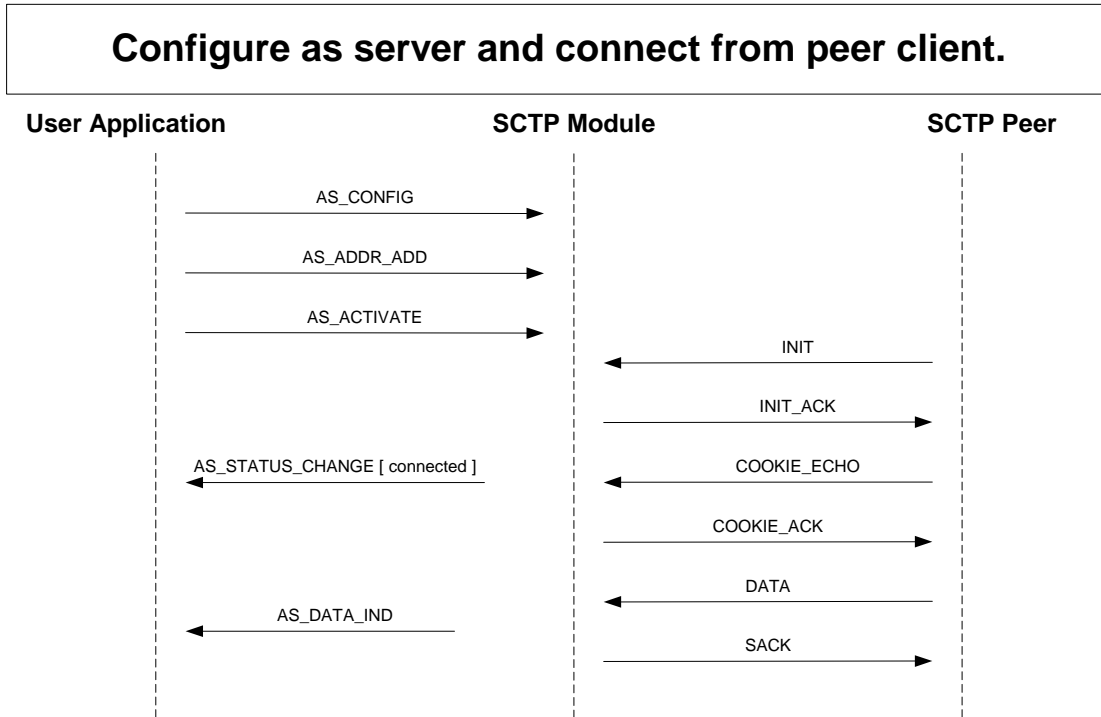


Figure 5. Example SCTP Message Flows: Association Shutdown by User Application

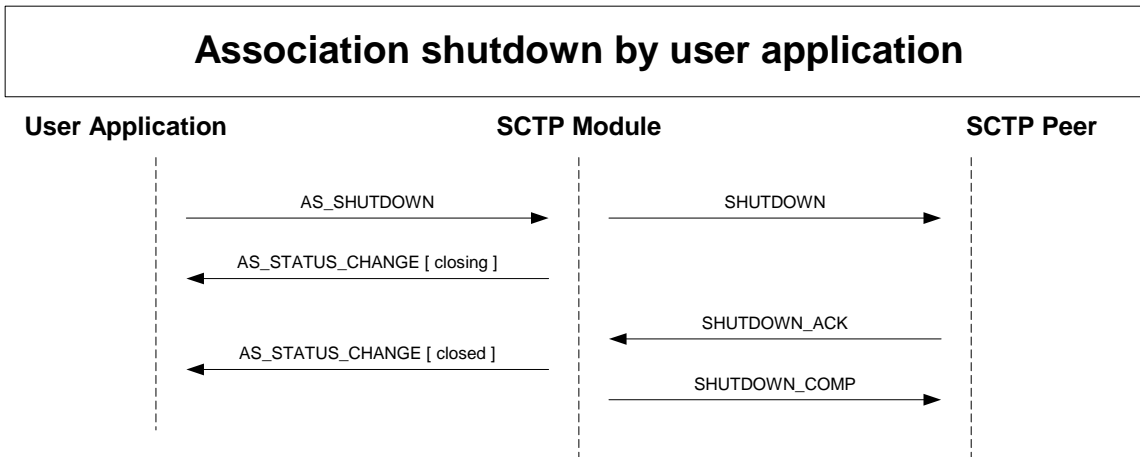
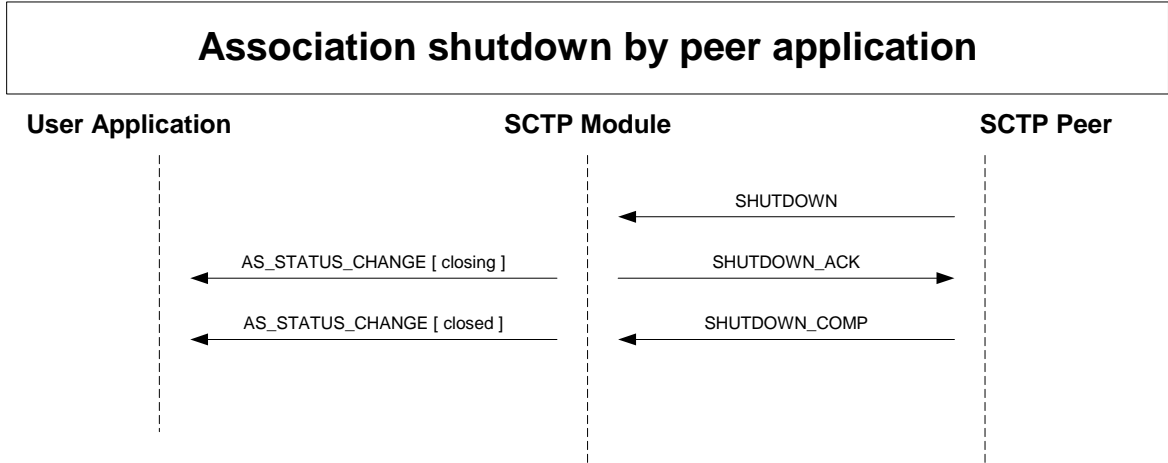


Figure 6. Example SCTP Message Flows: Association Shutdown by Peer Application



Appendix A

A.1 Message Type Table

The following table lists, by message type, all the messages described in this manual.

Message Type	Mnemonic	Description
0x028d	SCTP_MSG_STATUS_CHANGE	Indicates the association has changed state
0x028e	SCTP_MSG_NETWORK_STATUS	Indicates a network address has changed state
0x028f	SCTP_MSG_CONG_STATUS	Indicates the congestion status of an association has changed
0x5285	SCTP_MSG_TRACE_MASK	Set trace options for the SCTP module
0x6290	SCTP_MSG_R_GLOBAL_STATS	Reads the global statistics for the SCTP module
0x6291	SCTP_MSG_R_CONFIG	Reads the configuration for an association
0x6292	SCTP_MSG_R_STATS	Read the per association statistics
0x6293	SCTP_MSG_R_PEER_ADDR_STATS	Read the statistics on an associations network interface
0x7282	SCTP_MSG_CONFIG	Configure the SCTP module
0x7283	SCTP_MSG_HOST_IP_ADDR_ADD	Add an IP address for the host
0x7284	SCTP_MSG_HOST_IP_ADDR_REM	Remove an IP address from the host
0x7286	SCTP_MSG_AS_CONFIG	Configure an SCTP association
0x7287	SCTP_MSG_ADDR_ADD	Add a peer IP address to an association
0x7288	SCTP_MSG_ADDR_REM	Remove a peer address from an association
0x7289	SCTP_MSG_PRIMARY	Designate a peer IP address as the primary
0x728a	SCTP_MSG_ACTIVATE	Attempt activation of an SCTP association
0x728b	SCTP_MSG_SHUTDOWN	Shutdown an association after all data has been transferred
0x728c	SCTP_MSG_ABORT	Abort an association losing all data currently in transit
0x7295	SCTP_MSG_IP_CONFIG	Configure the IP daemon
0x7296	SCTP_MSG_IP_DATA_MID_REQ	Data transmission request with more data packet fragments to follow
0x7297	SCTP_MSG_IP_DATA_END_REQ	Data transmission request marking the end of the data packet
0x7298	SCTP_MSG_IP_DATA_MID_IND	Indicates the reception of a data packet with more fragments to follow
0x7299	SCTP_MSG_IP_DATA_END_IND	Indicates the end of a received data packet
0x8281	SCTP_MSG_RX_IND	Indication of data reception
0xc280	SCTP_MSG_TX_REQ	Request data transmission