

Intel[®] NetStructure[™] SS7 Protocols SCTP Programmer's Manual

Document Reference: U01STN

Disclaimer

The product may contain design defects or errors known as errata, which may cause the product to deviate from published specifications.

Information in this document is provided in connection with Intel® products. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Intel's Terms and Conditions of Sale for such products, Intel assumes no liability whatsoever, and Intel disclaims any express or implied warranty, relating to sale and/or use of Intel products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright or other intellectual property right. Intel products are not designed, intended or authorized for use in any medical, life saving, or life sustaining applications or for any other application in which the failure of the Intel product could create a situation where personal injury or death may occur. Intel may make changes to specifications and product descriptions at any time, without notice.

Intel and Intel NetStructure are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

* Other names and brands may be claimed as the property of others.

Copyright © 1993-2003 Intel Corporation. All rights reserved. No part of this document may be copied, or reproduced in any form, or by any means without prior written consent of Intel.

REVISION HISTORY

ISSUE	DATE	BY	CHANGES
1	14-Jun-02	IDP	Raised to issue 1.
2	10-Sep-03	IDP	Additional configuration module options added (CRC32).

CONTENTS

1.	INTRODUCTION.....	6
2.	ABBREVIATIONS	6
3.	RELATED DOCUMENTATION.....	6
4.	FEATURE OVERVIEW	7
5.	GENERAL DESCRIPTION	8
5.1	Module Overview	8
5.2	Module Configuration.....	8
5.3	Association State Transitions	9
6.	INTERNAL DATA STRUCTURES	10
6.1	Global Data Structure	10
6.2	Association Data Structure	10
6.3	Per Peer Address Data Structure	10
7.	INTERFACE TO SYSTEM SERVICES.....	11
7.1	System Functions	11
7.2	Timer Operation	11
8.	SCTP MANAGEMENT INTERFACE	12
8.1	Module Configuration Request	12
8.2	Add Host Network Address Request	12
8.3	Remove Host Network Address Request	12
8.4	Configure Association Request	12
8.5	Add Peer Network Address Request.....	12
8.6	Remove Peer Network Address Request.....	12
8.7	Set Primary Address Request	12
8.8	Global Statistics Request.....	12
8.9	Read Association Configuration Request.....	12
8.10	Read Association Statistics Request.....	12
8.11	Read Association Peer Address Statistics	12
9.	USER LAYER INTERFACE TO SCTP	12
9.1	SCTP Status Codes.....	12
9.2	Association Activate Request	12
9.3	Association Shutdown Request	12
9.4	Association Abort Request	12
9.5	Association Data Transfer Request.....	12
10.	SCTP INTERFACE TO USER LAYER	12
10.1	Association Data Transfer Indication	12
10.2	Association Status Change.....	12
10.3	Association Network Status	12
10.4	Association Congestion Status	12
11.	SCTP TRACE MESSAGES	12
11.1	Trace Mask Configuration Request	12
11.2	Trace Event Indication	12
12.	SCTP TO SCTPD INTERFACE.....	12
12.1	SCTPD Configuration Request.....	12
12.2	IP Data Transmission Request	12
12.3	IP Data Reception Indication	12
13.	NETWORK ADDRESS REPRESENTATION	12

13.1	Network Address Structure for an invalid address	12
13.2	Network Address Structure for Internet Protocol Version 4.....	12
14.	MODULE COMMAND LINE INTERFACE	12
14.1	SCTP	12
14.2	SCTPD.....	12
15.	EXAMPLE SCTP MESSAGE FLOWS.....	12
16.	APPENDIX A.....	12
16.1	Message Type Table	12

1. INTRODUCTION

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.

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

The current SCTP implementation provides the user with functionality to implement upto 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 multihoming capabilities.

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

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

2. ABBREVIATIONS

- IETF Internet Engineering Task Fork
- RFC Released for Comment.
- SCTP Stream Control Transport Protocol

3. RELATED DOCUMENTATION

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

4. **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.

5. GENERAL DESCRIPTION

5.1 Module Overview

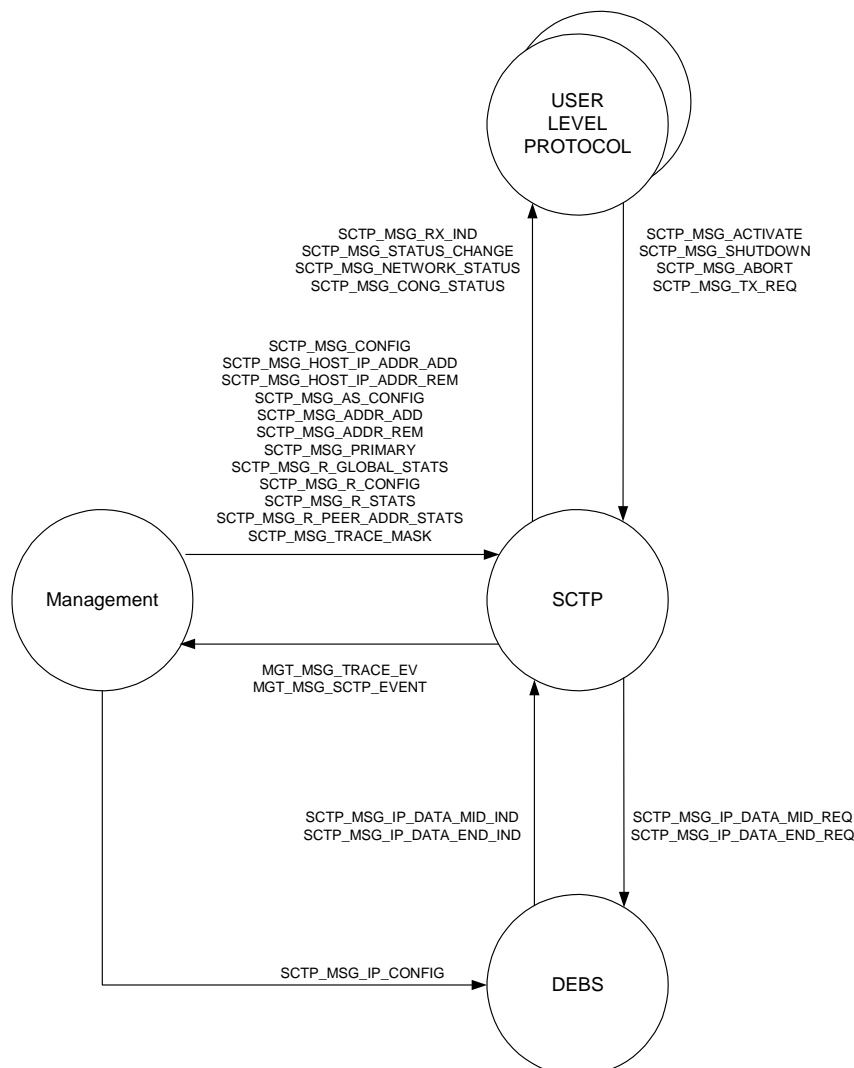
The SCTP module is an implementation of the Stream Control Transmission Protocol as defined in RFC 2960 and the additional checksum change specified in RFC 3309.

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

5.2 Module Configuration

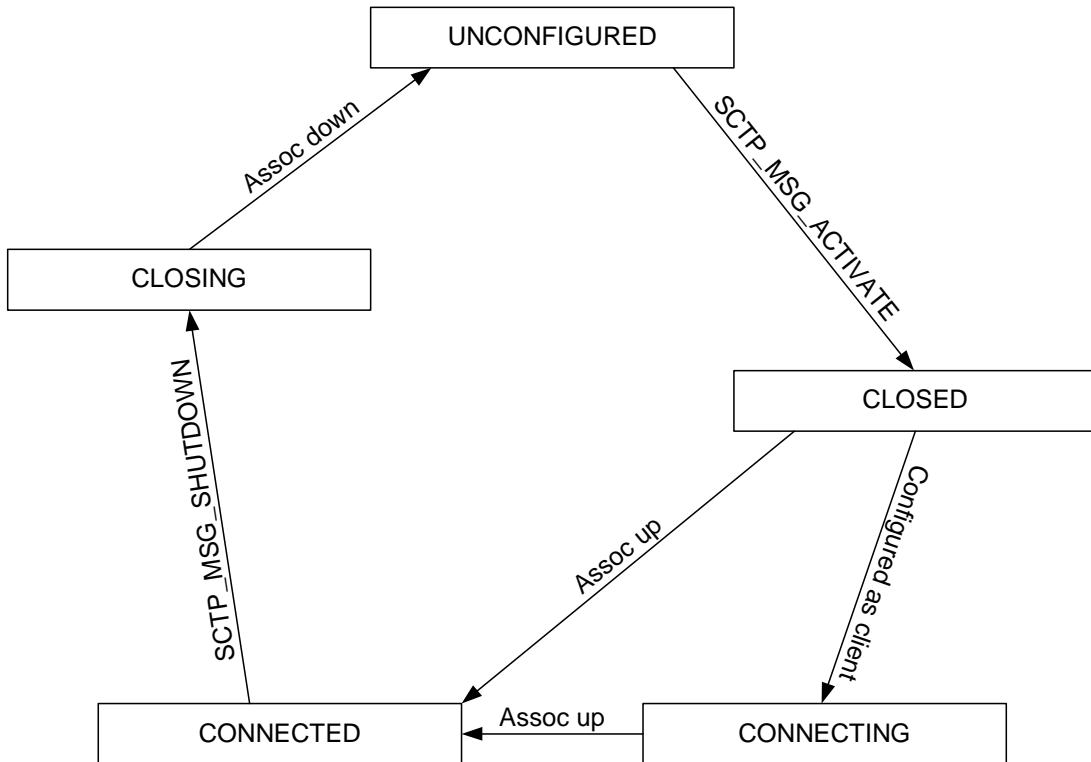
The module is configured for operation in conjunction with a number of user part modules, which lie above the SCTP module in the protocol stack, and a network interface module that lies below the SCTP module in the protocol stack.

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



5.3 Association State Transitions

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



6. INTERNAL DATA STRUCTURES

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

6.1 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.

6.2 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).

6.3 Per Peer Address Data Structure

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

7. INTERFACE TO SYSTEM SERVICES

7.1 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 [2].

7.2 Timer Operation

In order to provide internal implementation of the SCTP protocol timers the 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 [2].

8. SCTP MANAGEMENT INTERFACE

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

CONFIG	Configure global options within the SCTP module
HOST_IP_ADDR_ADD	Add an IP address to the list of valid IP addresses available for the host.
HOST_IP_ADDR_REM	Remove a IP address from the list of valid IP addresses available for the host.
AS_CONFIG	Configure association.
AS_ADDR_ADD	Add a peer network address to an association.
AS_ADDR_REM	Remove a peer address from an association.
AS_PRIMARY	Designate a peer address as the primary address.
TRACE_MASK	Define which events generate trace messages to the trace module.
R_GLOBAL_STATS	Read the global statistics for the SCTP module.
R_AS_STATS	Read the statistics for a particular association.
R_AS_PEER_ADDR_STATS	Read the statistics for a particular peer network address for a particular association.

8.1 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.

max_assocs

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

max_i_streams

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

max_o_streams

Maximum number of output streams for each associations 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_CNF_OPT_CRC32	0x0001	Module will use CRC32 as the checksum
SCTP_CNF_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.

reserved

Reserved space. 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.

8.2 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 13.

Description

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

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.

8.3 Remove Host Network Address Request

Synopsis

Remove 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_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 13.

Description

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

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

Removed IP address will still be used by currently active associations until such time as they are restarted.

8.4 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 the peer may request for data transmission to the host.

max_o_streams

Association specific maximum number of SCTP streams 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 retransmitted before the association attempt is aborted.

max_retx_cookie

Maximum number of times a COOKIE_ECHO message is retransmitted before the association attempt is aborted.

max_retx_shutdown

Maximum number of times a SHUTDOWN message is retransmitted 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.

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 peers network addresses

Description

Send 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.

Association can only be configured when the association is in the unconfigured state.

8.5 Add Peer Network Address Request

Synopsis

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

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 IP address. Refer to section 13.

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 which 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 or the association initiation will fail.

8.6 Remove Peer Network Address Request

Synopsis

Remove an IP network address to 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 13.

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.

8.7 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 13.

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 the address is currently not reachable.

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

8.8 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.

chunks_tx

Total number of chunks transmitted (Not Retransmits)

chunks_rx

Total number of chunks received.

chunks_retx

Total number of chunks retransmitted.

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.

period

Reserved for future use.

Description

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

8.9 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
SHUTDOWN_RECEIVED	Peer has indicated an association should be gracefully closed
SHUTDOWN_ACK_SENT	Association is shutting down

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.

8.10 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 Retransmits) on this association.

chunks_rx

Total number of chunks received on this association.

chunks_retx

Total number of chunks retransmitted on this association.

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.

t2_expires

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

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 the counts will wrap.

8.11 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 address that statistics are to be read.

ip_type & ip_addr

The IP address format and IP address. Refer to section 13.

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.

lost_data

Number of data chunks lost on the interface.

Description

Information is reset when association transitions into the established state.

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

9. 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.

9.1 **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 unrecognised message type
SCTPE_BAD_PARAM	6	Invalid parameters contained in message

9.2 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 all configuration information was accepted and 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 and will be indicated to the user 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 the user via the association status message detailing a state of CONNECTED.

9.3 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 the user has 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 the user an association status message with a status of CLOSED and will re-enter the unconfigured state.

9.4 Association Abort Request

Synopsis

Initiates the abortion 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 detailed description of error codes.

Description

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

Once the association has shutdown it will send the user an association status message with a status of closed and will re-enter the unconfigured state.

9.5 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 unsequenced delivery

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. The user has no method to determine when its peer has acknowledged a specific data packet.

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

10. SCTP INTERFACE TO USER LAYER

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.

10.1 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 unsequenced 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 (the user will never see the packet) and a management message will be generated.

10.2 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 the user application to indicate a change in state of the association.

10.3 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 13.

Description

Indicates to the user that either a network address that was previous available has now being marked as inactive or visa versa. The definition of an inactive address is one that has failed to respond to a configurable number of sequential heartbeat requests.

10.4 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 the user to indicate the level of congestion on the association has changed.

If the user receives an SCTP_TX_CONG_ONSET message they 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 the user can continue as before. However if the level of congestion rises after a SCTP_TX_CONG_ONSET message has been sent, the system may send the user an SCTP_TX_CONG_DISCARD message. At this point, SCTP will discard any data messages sent by the user until the level of congestion has dropped to a safe level and an SCTP_TX_CONG_ABATE message will be sent.

11. SCTP TRACE MESSAGES

11.1 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:

See below.

op_evt_mask

The output event mask. This is a 32bit 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

ip_evt_mask

The input event mask. This is a 32bit 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.

11.2 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_id of the traced message.

dst_id

Destination module_id of the traced message.

id

Message id 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.

12. 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.

12.1 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.

12.2 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 13.

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.

12.3 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 13.

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.

13. NETWORK ADDRESS REPRESENTATION

The SCTP module is designed to facilitate future support for IP V6 addresses. Currently only IPV4 addresses are supported but the interface to the module is designed to accommodate V6 addresses in the future.

13.1 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.

13.2 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

14. MODULE COMMAND LINE INTERFACE

14.1 SCTP

sctp V1.00

Copyright (C) 2000-2001 DataKinetics Ltd. All rights reserved.

Syntax: sctp [-v -m<module_id> -b<buffers>]
-v : display version (without running)
-m : module_id (default 0xed)
-b : buffers (default 8000)

Example sctp -m0xdf -b5000

14.2 SCTPD

sctpd V1.00

Copyright (C) 2000-2002 DataKinetics Ltd. All rights reserved.

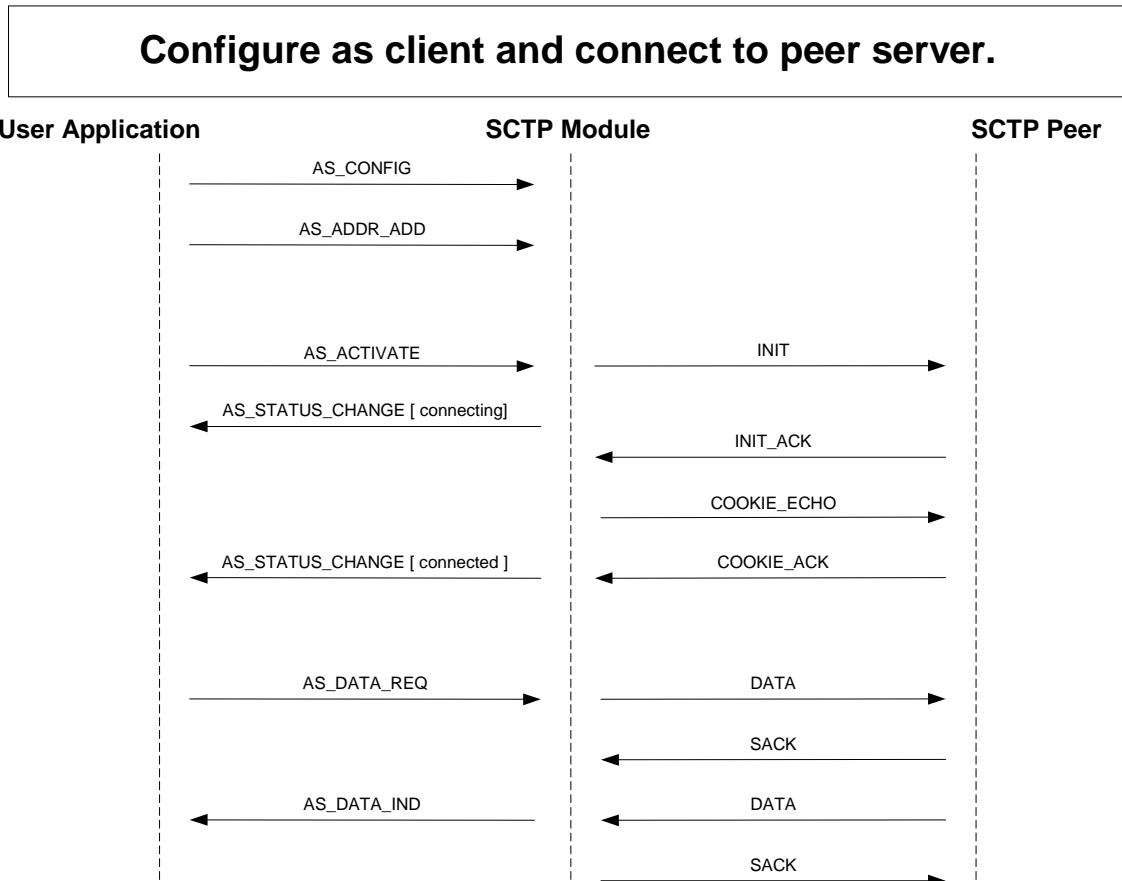
Syntax: sctpd [-v -m<module_id>]
-v : display version (without running)
-m : module_id (default 0xee)

Example sctpd -m0xdf

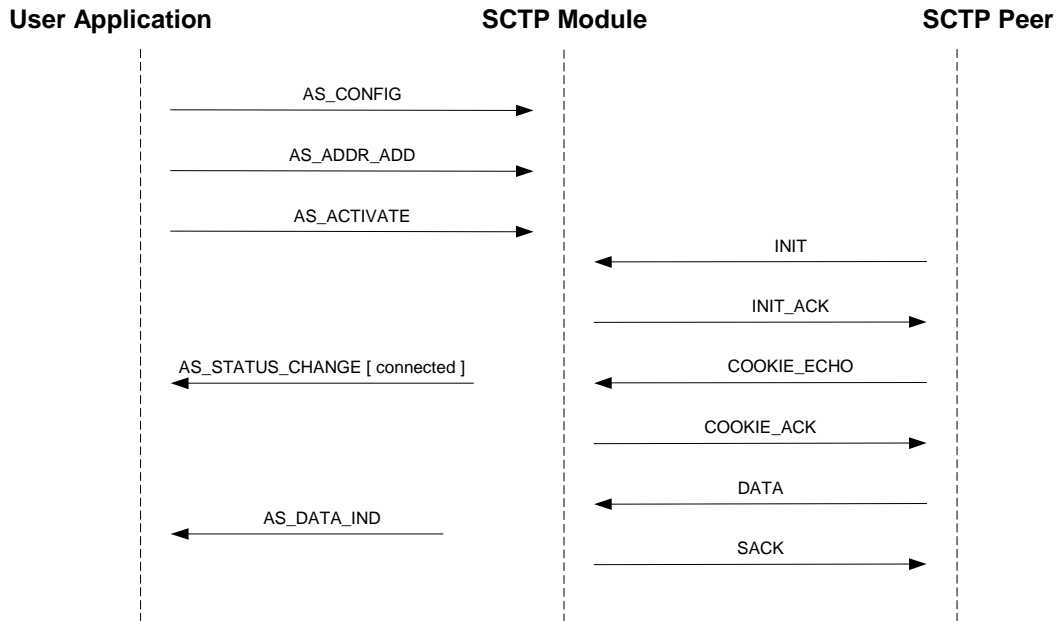
15. EXAMPLE SCTP MESSAGE FLOWS

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

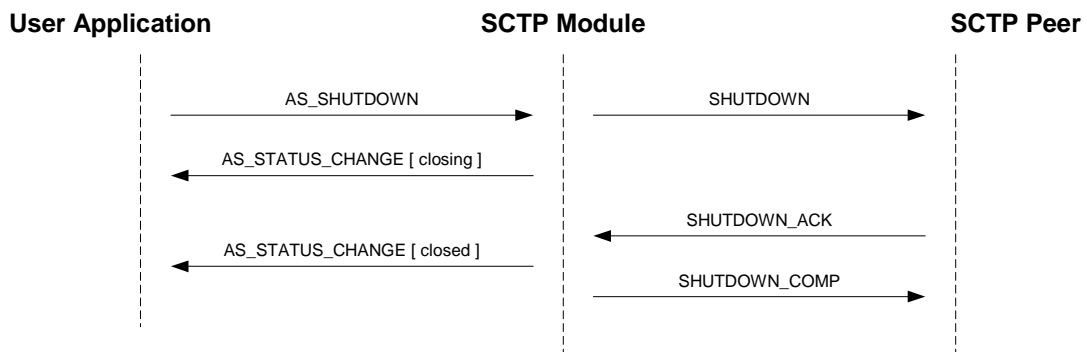
Note - For simplicity AS_NETWORK_STATUS messages are not shown.



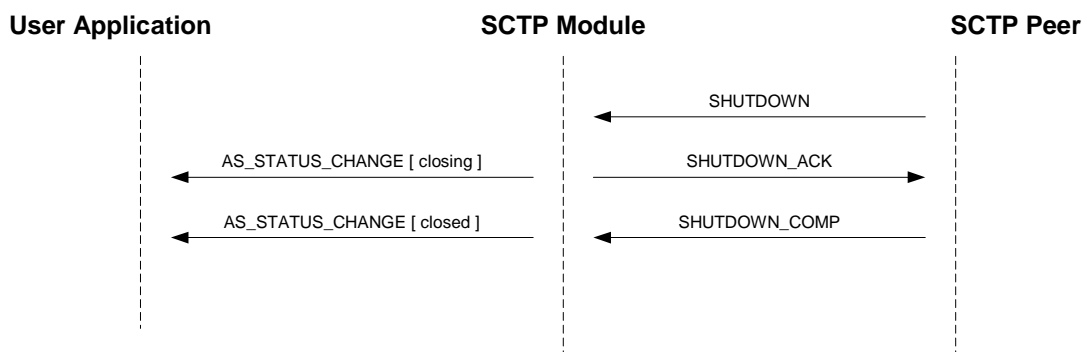
Configure as server and connect from peer client.



Association shutdown by user application



Association shutdown by peer application



16. APPENDIX A

16.1 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