Stream Control Transmission Protocol (SCTP Session Setup, Release and IP Address Reconfiguration)

SCTP Network			EventStudio System Designer 2.5
SCTP Endpoint A	SCTP Endpoint B		
IP Address A	IP Address B 1	IP Address B 2	08-Mar-06 07:22 (Page 1)

This sequence diagram was generated with EventStudio System Designer 2.5 (http://www.EventHelix.com/EventStudio).
The diagram is based on an Ethereal capture obtained from: http://wiki.ethereal.com/SampleCaptures.

Stream Control Transmission Protocol (SCTP) is a relatively new transport layer in the IP Protocol Stack.
SCTP belongs to the SIGTRAN protocol family and has been used as the transport layer for carrying telecom signaling over IP.

SCTP provides a reliable transport service that operates at message level (unlike TCP that provides a byte stream interface with no message boundaries).

SCTP allows multiple message streams to be exchanged on a single SCTP connection. Data from multiple streams can be sent in a single SCTP message as chunks. Selective acknowledgements are supported at individual chunk level.

Recent additions to the SCTP protocol allow dynamic configuration of the IP addresses. Similar to SS7, SCTP can be switched over from one link to another. SCTP supports a make-before-break changeover, i.e. the packet stream is moved before removing the link that needs to be taken out of service.

In this sequence diagram we will be examining some of the features of SCTP.
(1) SCTP Connection establishment.
(2) SCTP data exchange and selective acknowledgement.
(3) Addition of a new IP address to an SCTP connection.
(4) Switching over to the new IP address.
(5) Removing the old IP address.
(6) SCTP connection release.

Setting up the SCTP connection.

1:INIT Chunk
Initiate tag: 0x71b81d1f,
Advertised receiver window credit (a _rwnd): 109568,
Number of outbound streams: 10,
Number of inbound streams: 65535,
Initial TSN: 2702200202

An association setup request is received in the closed state. The server analyzes the received INIT chunk and generates all the values needed at its side to enter an established association, and generates a secure hash of these values and a secret key (e.g. with the MD5 or SHA-1 algorithms).

2:INIT_ACK Chunk
Initiate tag: 0x48e63127,
Advertised receiver window credit (a _rwnd): 109568,
Number of outbound streams: 10,
Number of inbound streams: 10,
Initial TSN: 4194126429,
Parameter type: State cookie (0x0007),
Parameter type: ECN (0x8000),
Parameter type: Forward TSN supported (0xc000)

The secure hash values and a message authentication code (MAC) are stored in a COOKIE parameter. This information is sent by in the INIT-ACK message.

3:COOKIE_ECHO Chunk

SCTP Endpoint B copies the COOKIE into the COOKIE-ECHO message.

Unpack the data and perform an integrity check with MAC

SCTP End Point A validates the COOKIE-ECHO by checking it against the included MAC,

Initiate the SCTP connection

The COOKIE-ECHO validation had passed, so an SCTP instance is created.

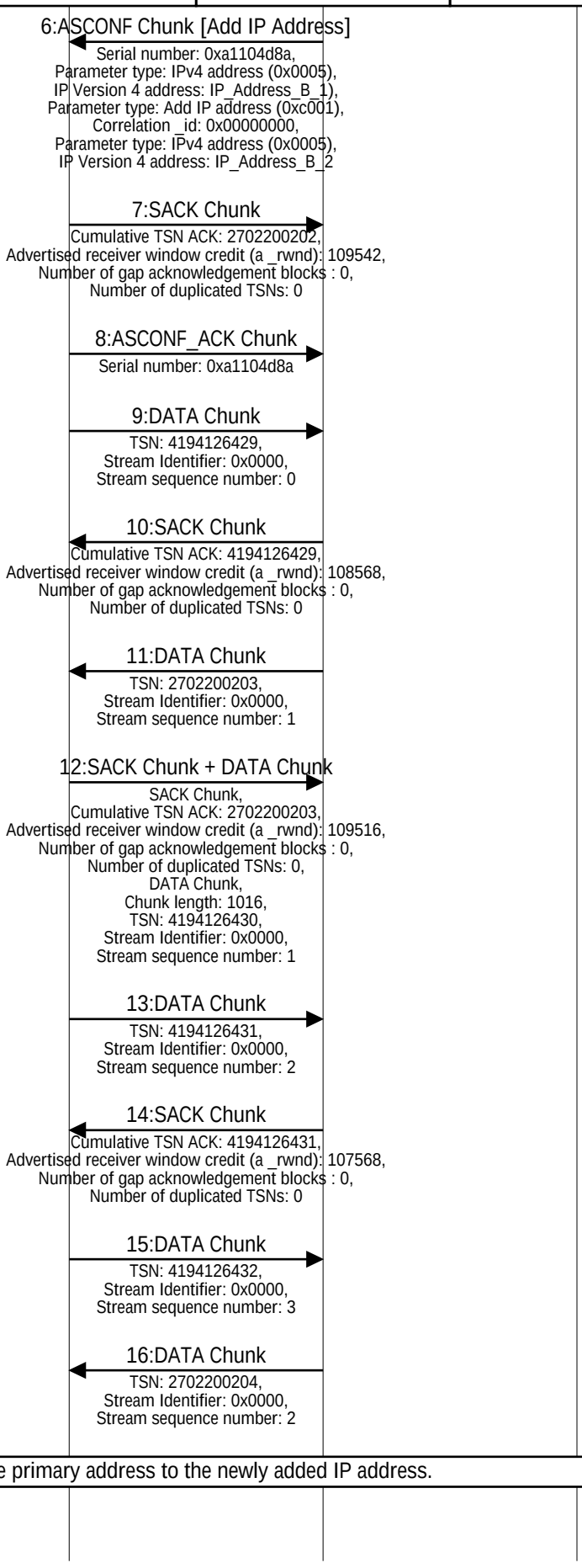
4:COOKIE_ACK Chunk

SCTP Endpoint A replies with a COOKIE-ACK, indicating that the COOKIE-ECHO has been accepted.

5:DATA Chunk
TSN: 2702200202,
Stream Identifier: 0x0000,
Stream sequence number: 0

Endpoint B sends stream data using the DATA chunk. The Transport Sequence Number (TSN) is assigned to the chunk. The acknowledgements sent from the receiver to the sender are based on these sequence numbers.

Addition of a new IP address



SCTP Endpoint B sends an Address configuration change chunk (ASCONF) with an "Add IP Address" indication for IP_Address_B_2.

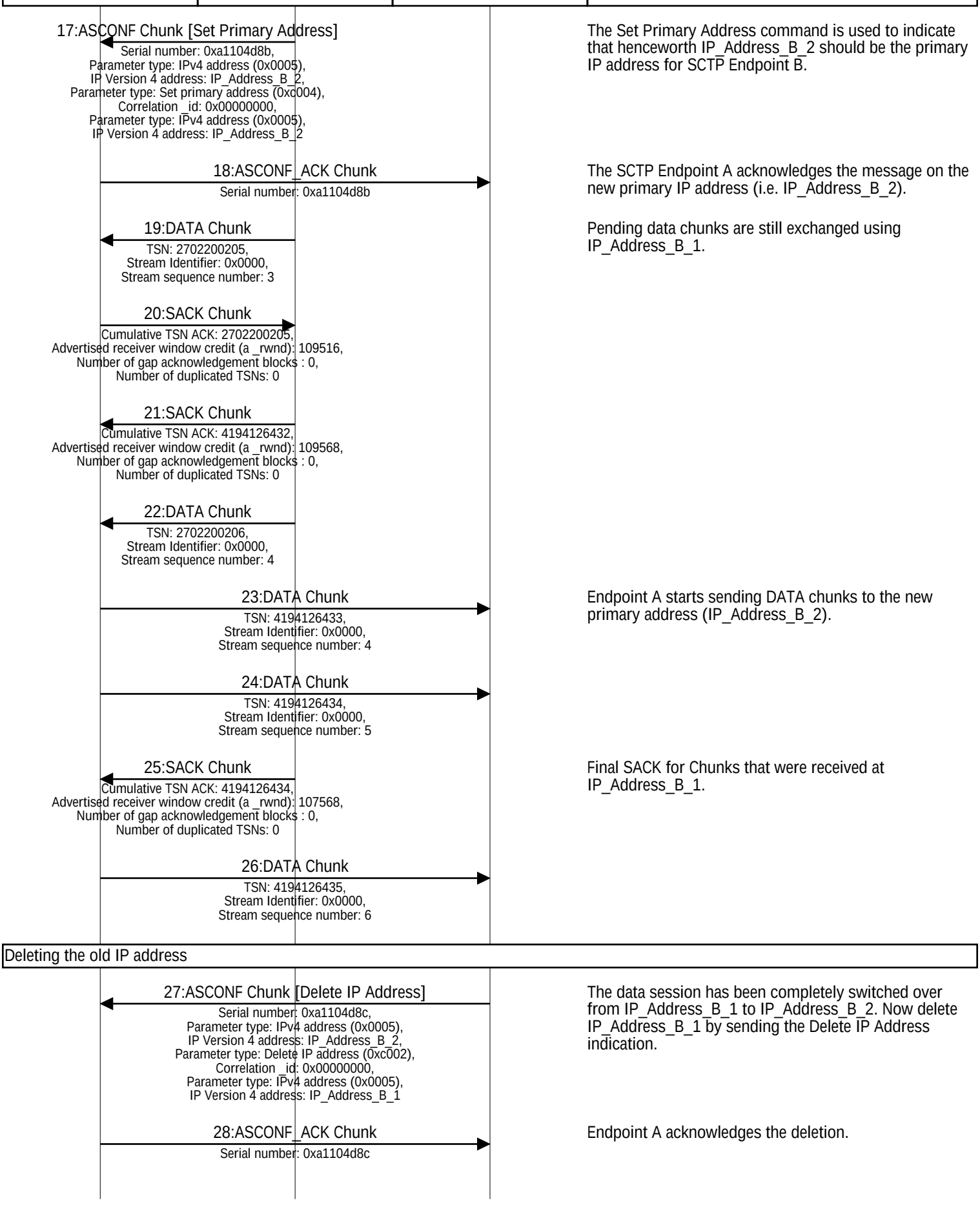
SCTP Endpoint A acknowledges the data by sending a Cumulative TSN ACK. SCTP supports a powerful selective acknowledgement interface. Gaps in received sequence numbers can be signaled efficiently.

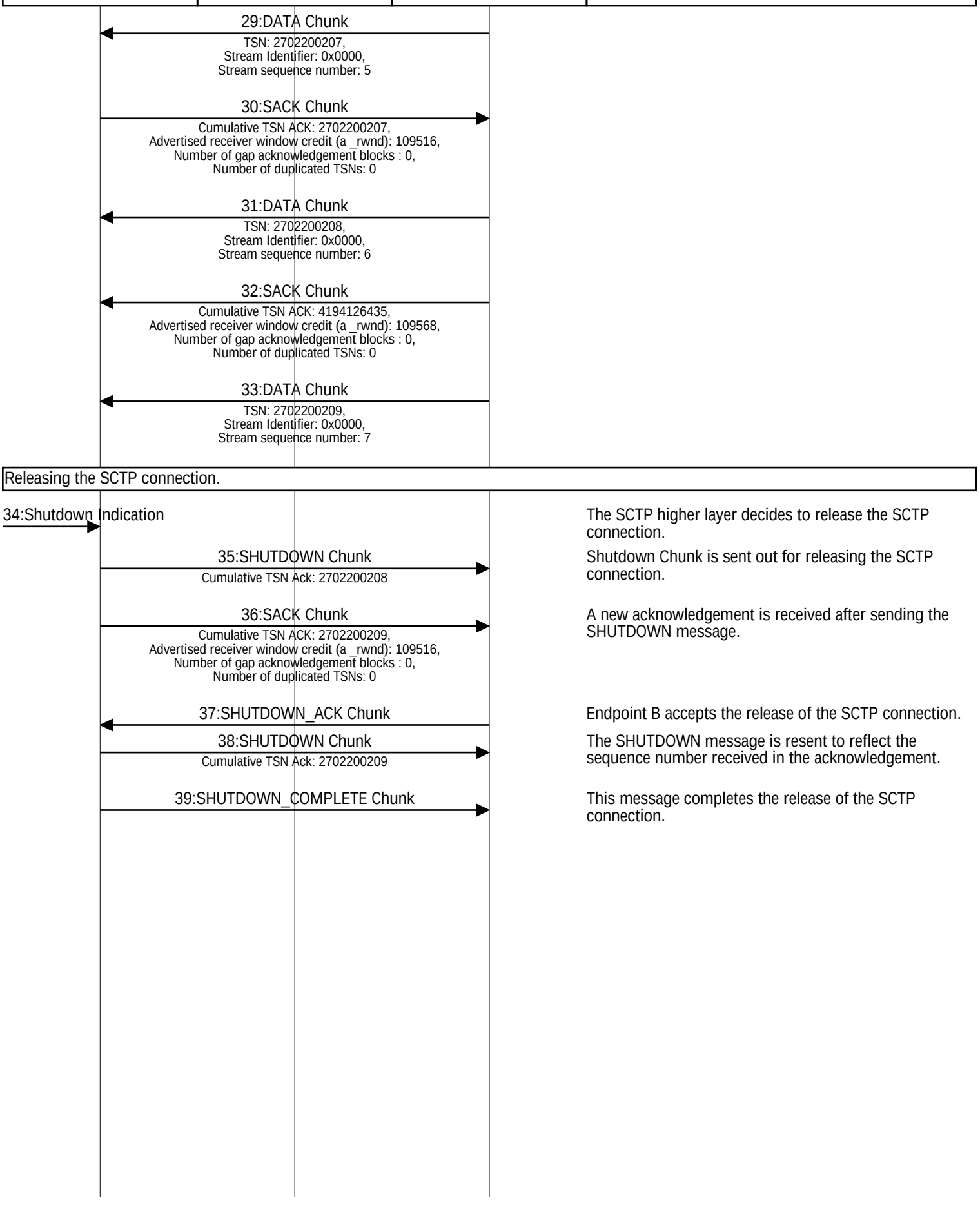
The SCTP Endpoint A acknowledges the addip request. The ack is sent within the Address Configuration Ack (ASCONF_ACK) chunk.

A new IP address has been added but this has no impact on the data communication.

A message containing the SACK and the DATA chunk.

Set the primary address to the newly added IP address.


17:ASCONF Chunk [Set Primary Address]
Serial number: 0xa1104d8b,
Parameter type: IPv4 address (0x0005),
IP Version 4 address: IP_Address_B_2,
Parameter type: Set primary address (0xc004),
Correlation _id: 0x00000000,
Parameter type: IPv4 address (0x0005),
IP Version 4 address: IP_Address_B_2
The Set Primary Address command is used to indicate that henceworth IP_Address_B_2 should be the primary IP address for SCTP Endpoint B.
18:ASCONF_ACK Chunk
Serial number: 0xa1104d8b
The SCTP Endpoint A acknowledges the message on the new primary IP address (i.e. IP_Address_B_2).
19:DATA Chunk
TSN: 2702200205,
Stream Identifier: 0x0000,
Stream sequence number: 3
Pending data chunks are still exchanged using IP_Address_B_1.
20:SACK Chunk
Cumulative TSN ACK: 2702200205,
Advertised receiver window credit (a _rwnd): 109516,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
21:SACK Chunk
Cumulative TSN ACK: 4194126432,
Advertised receiver window credit (a _rwnd): 109568,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
22:DATA Chunk
TSN: 2702200206,
Stream Identifier: 0x0000,
Stream sequence number: 4
23:DATA Chunk
TSN: 4194126433,
Stream Identifier: 0x0000,
Stream sequence number: 4
Endpoint A starts sending DATA chunks to the new primary address (IP_Address_B_2).
24:DATA Chunk
TSN: 4194126434,
Stream Identifier: 0x0000,
Stream sequence number: 5
25:SACK Chunk
Cumulative TSN ACK: 4194126434,
Advertised receiver window credit (a _rwnd): 107568,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
Final SACK for Chunks that were received at IP_Address_B_1.
26:DATA Chunk
TSN: 4194126435,
Stream Identifier: 0x0000,
Stream sequence number: 6
Deleting the old IP address
27:ASCONF Chunk [Delete IP Address]
Serial number: 0xa1104d8c,
Parameter type: IPv4 address (0x0005),
IP Version 4 address: IP_Address_B_2,
Parameter type: Delete IP address (0xc002),
Correlation _id: 0x00000000,
Parameter type: IPv4 address (0x0005),
IP Version 4 address: IP_Address_B_1
The data session has been completely switched over from IP_Address_B_1 to IP_Address_B_2. Now delete IP_Address_B_1 by sending the Delete IP Address indication.
28:ASCONF_ACK Chunk
Serial number: 0xa1104d8c
Endpoint A acknowledges the deletion.


29:DATA Chunk
TSN: 2702200207,
Stream Identifier: 0x0000,
Stream sequence number: 5
30:SACK Chunk
Cumulative TSN ACK: 2702200207,
Advertised receiver window credit (a _rwnd): 109516,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
31:DATA Chunk
TSN: 2702200208,
Stream Identifier: 0x0000,
Stream sequence number: 6
32:SACK Chunk
Cumulative TSN ACK: 4194126435,
Advertised receiver window credit (a _rwnd): 109568,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
33:DATA Chunk
TSN: 2702200209,
Stream Identifier: 0x0000,
Stream sequence number: 7
Releasing the SCTP connection.
34:Shutdown Indication
The SCTP higher layer decides to release the SCTP connection.
35:SHUTDOWN Chunk
Cumulative TSN Ack: 2702200208
Shutdown Chunk is sent out for releasing the SCTP connection.
36:SACK Chunk
Cumulative TSN ACK: 2702200209,
Advertised receiver window credit (a _rwnd): 109516,
Number of gap acknowledgement blocks : 0,
Number of duplicated TSNs: 0
A new acknowledgement is received after sending the SHUTDOWN message.
37:SHUTDOWN_ACK Chunk
Endpoint B accepts the release of the SCTP connection.
38:SHUTDOWN Chunk
Cumulative TSN Ack: 2702200209
The SHUTDOWN message is resent to reflect the sequence number received in the acknowledgement.
39:SHUTDOWN_COMPLETE Chunk
This message completes the release of the SCTP connection.