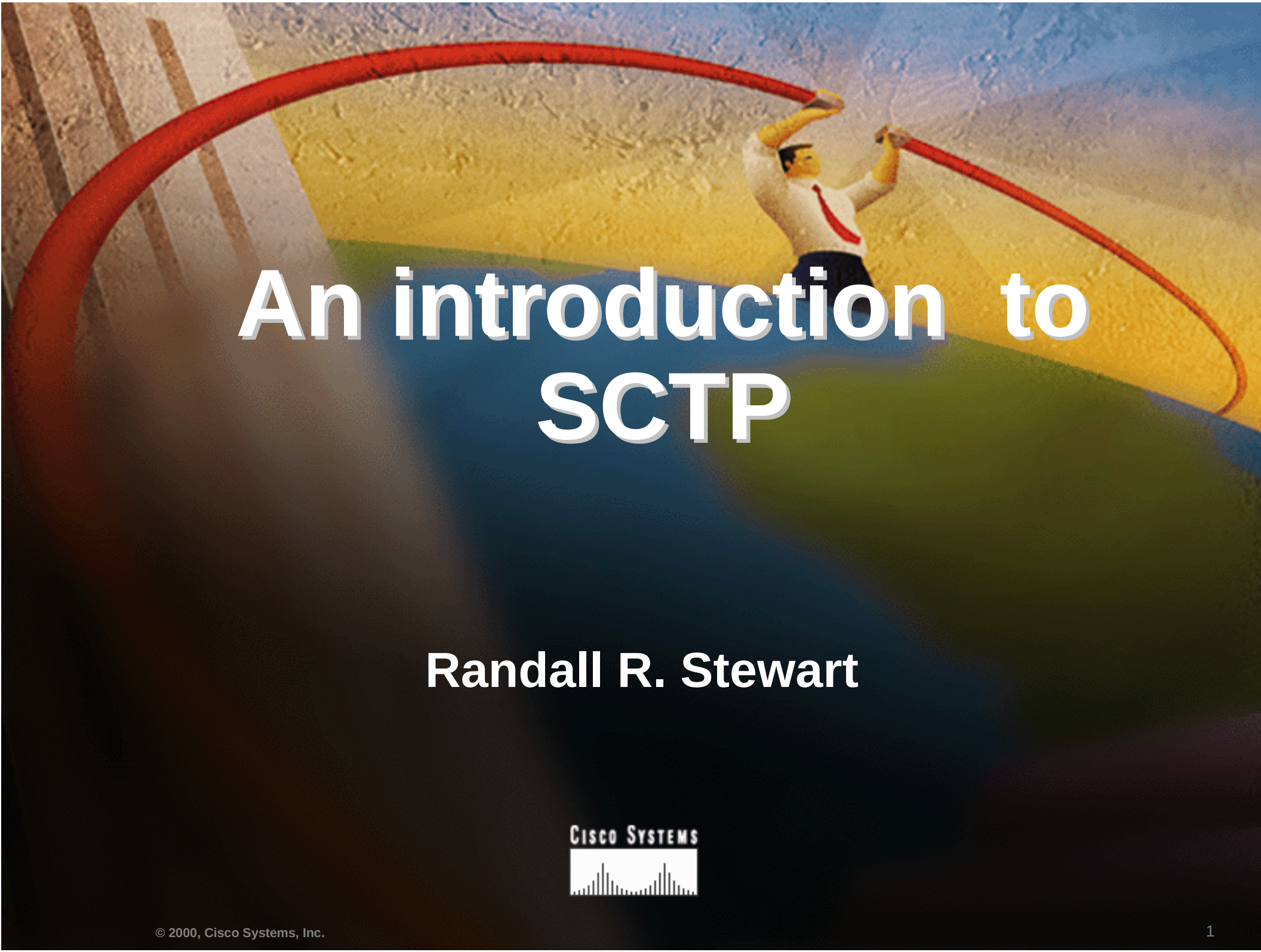


An introduction to SCTP

Randall R. Stewart

Cisco Systems

Stream Control Transmission Protocol (SCTP)

- What is it?
- What new features does it offer?
- What was it designed for?
- Functional details of how it works?

What Is It?

- **It is a new IETF transport protocol for reliable message-oriented data transfer.**
- **It can be used anyplace TCP would be used.**

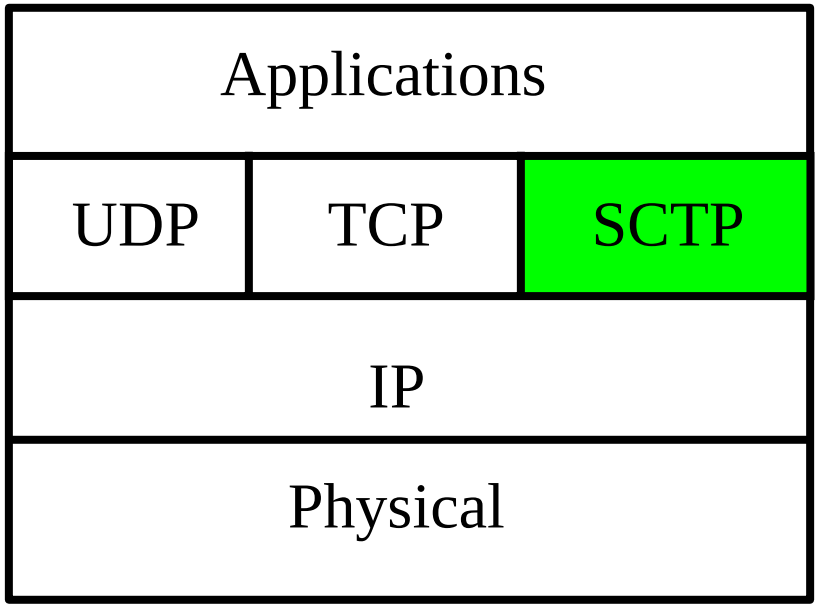
How Is It Different Than TCP?

- **Message boundaries are preserved.**
- **Multi-stream capable, a way to escape "head-of-line” blocking.**
- **Directly support for multi-homing.**
- **SACK is built into the protocol.**
- **Heartbeat/keep-alive mechanisms are integral part of the protocol.**

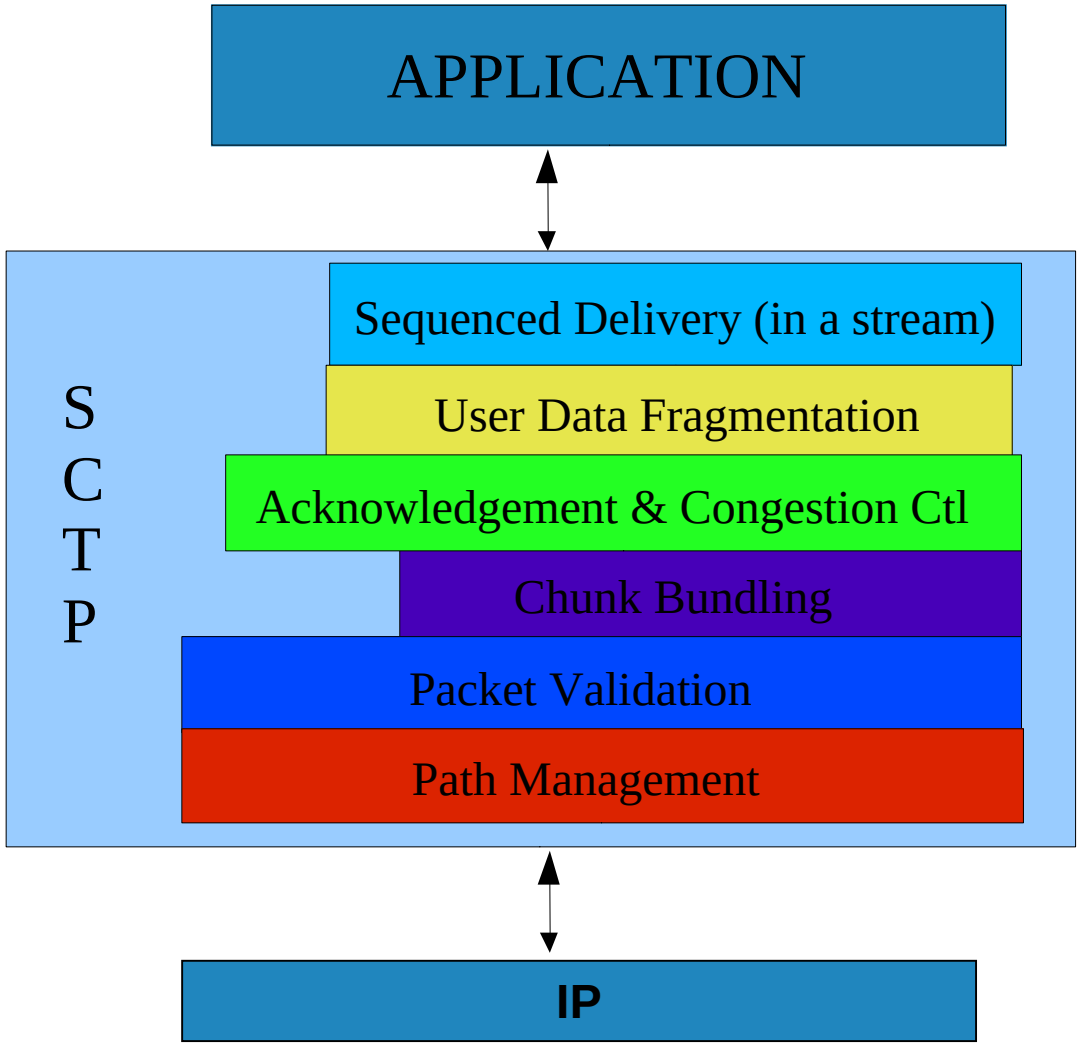
How Is It Different Than TCP? (Cont.)

- **Un-ordered delivery as an option.**
- **Message time-to-live option.**
- **Security cookie mechanism to protect against "SYN" attack.**
- **Path MTU discovery built-in.**
- **Better extensibility.**

New IP Stack Model With SCTP



The Sub-layers Within



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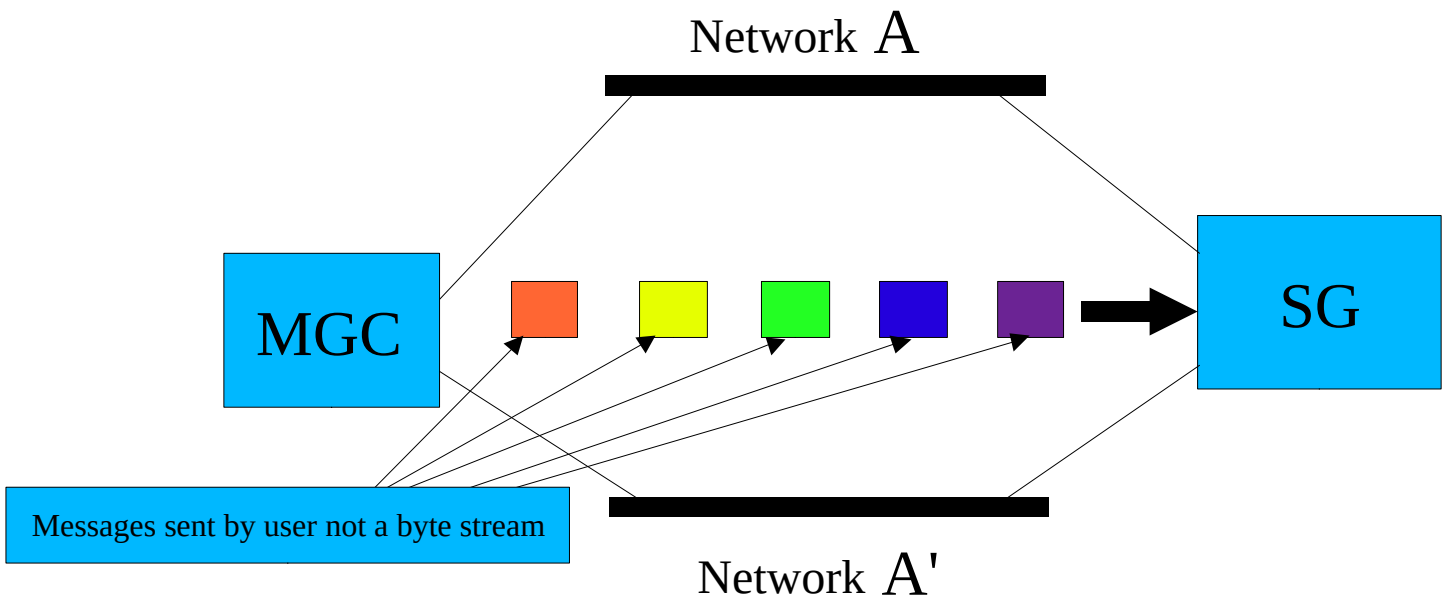
New Feature 1 - Message Boundaries Intact



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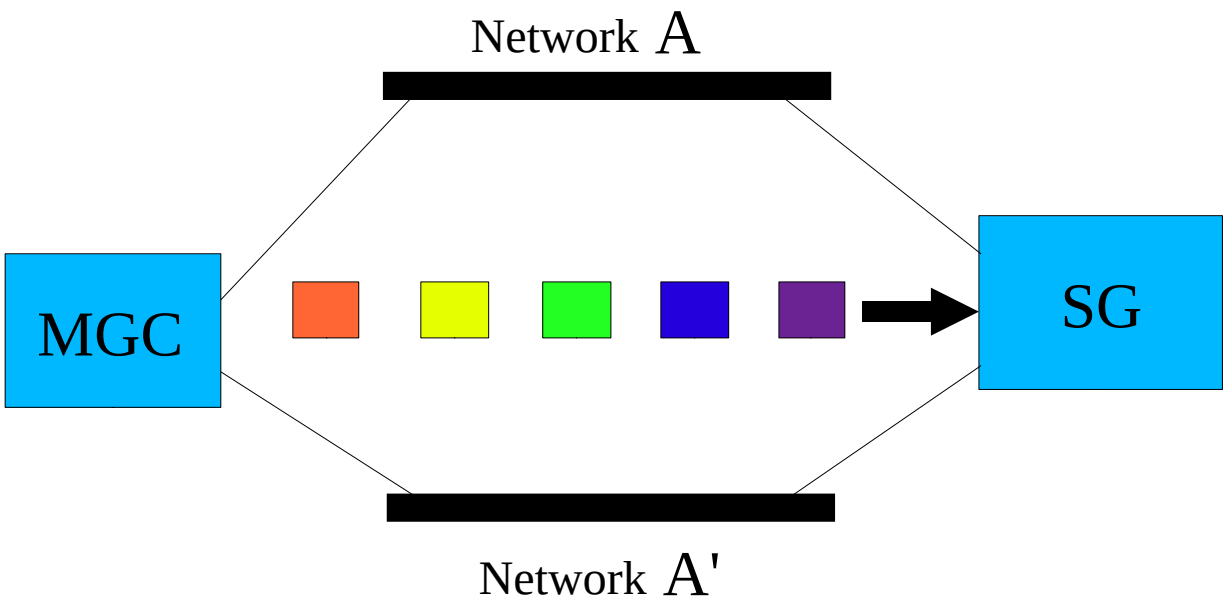
New Feature 2 - No Head-of-line Blocking



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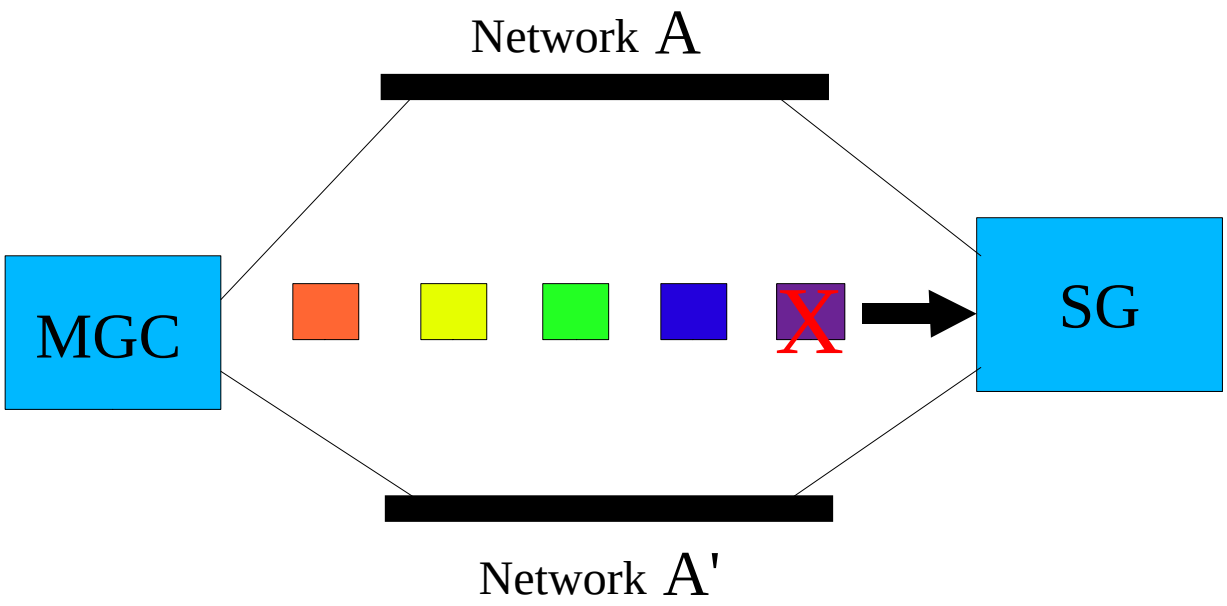
New Feature 2 - No Head-of-line Blocking (Cont.)



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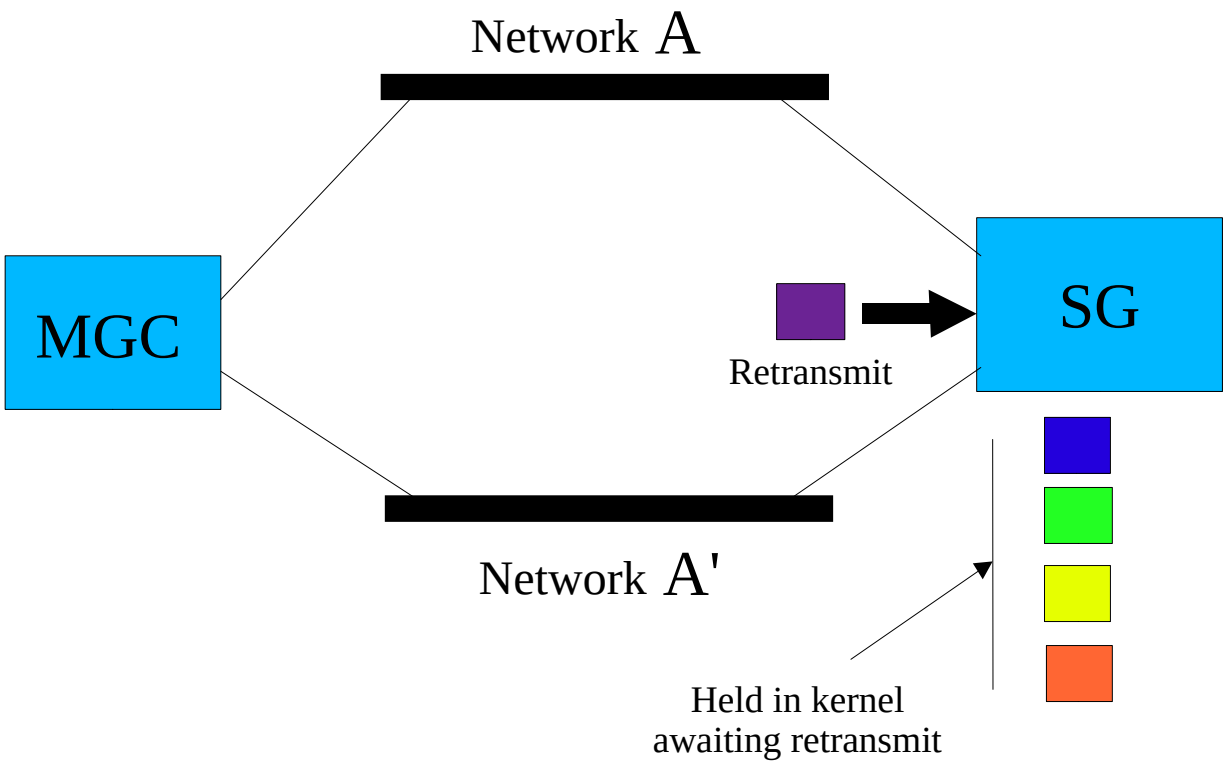
New Feature 2 - No Head-of-line Blocking (Cont.)



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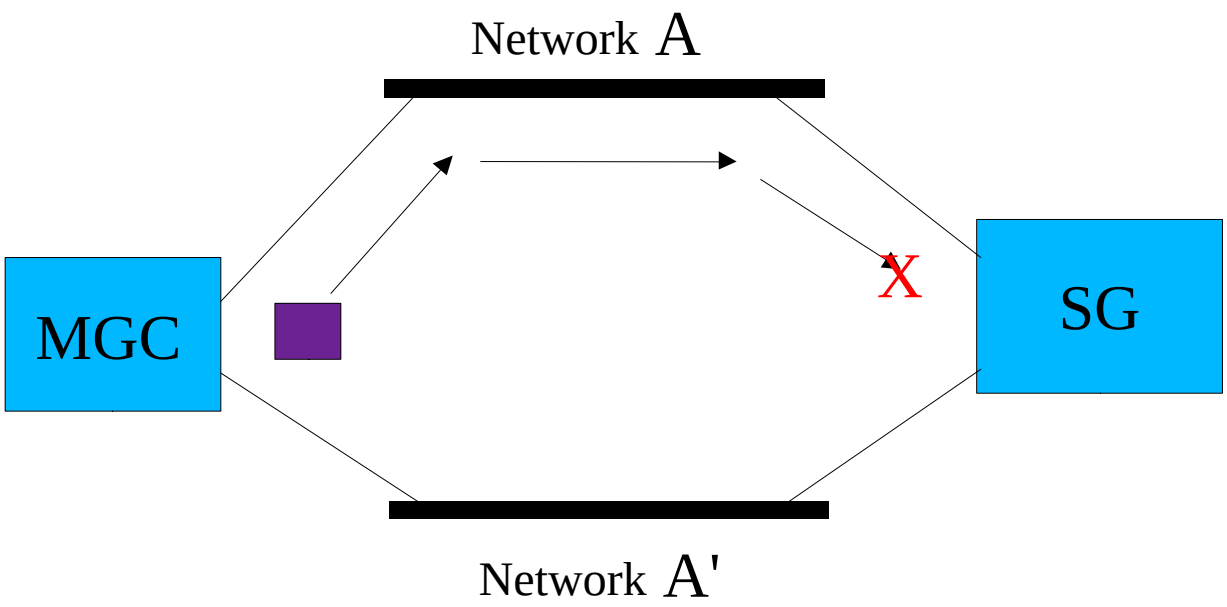
New Feature 3 - Multi-homing Support



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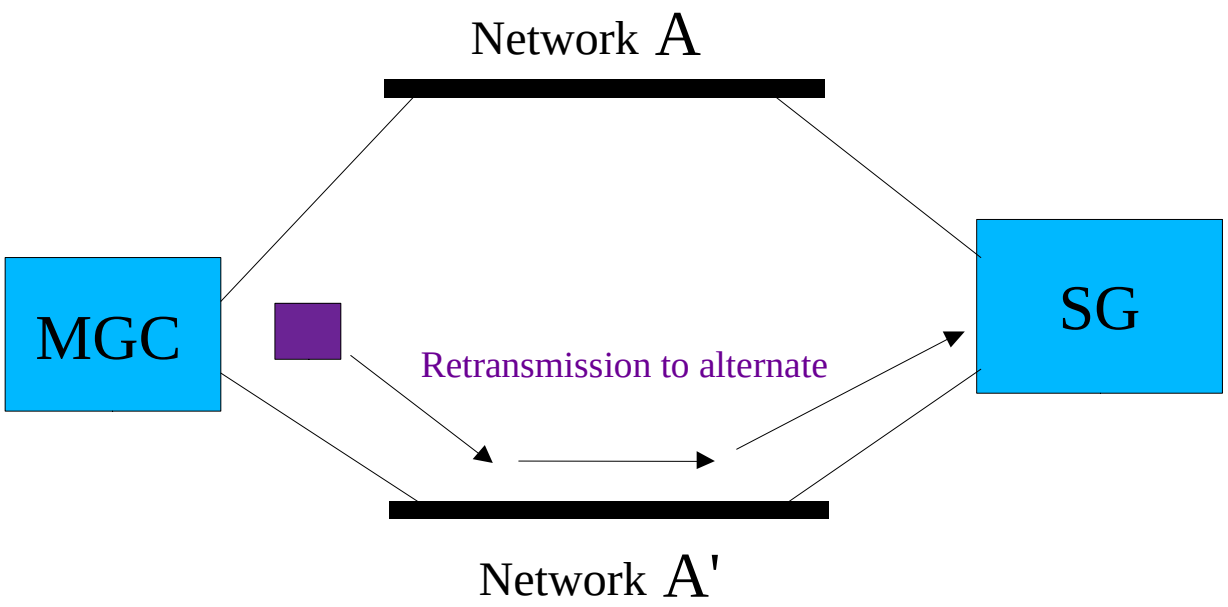
New Feature 3 - Multi-homing Support (Cont.)



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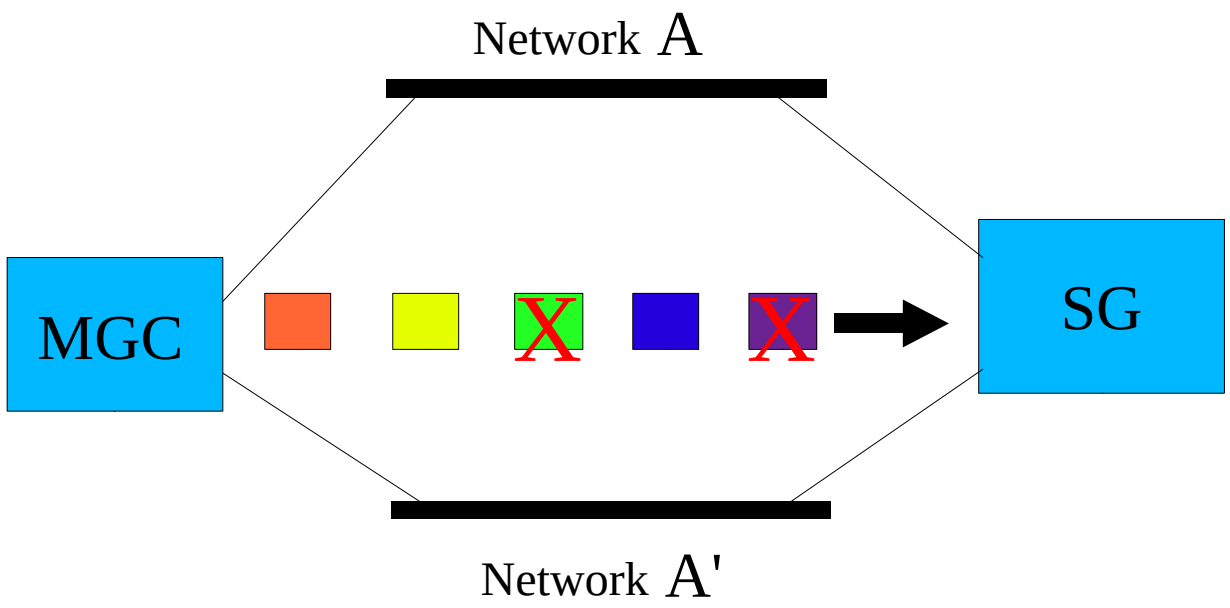
New Feature 4 - SACK Built Into the Protocol



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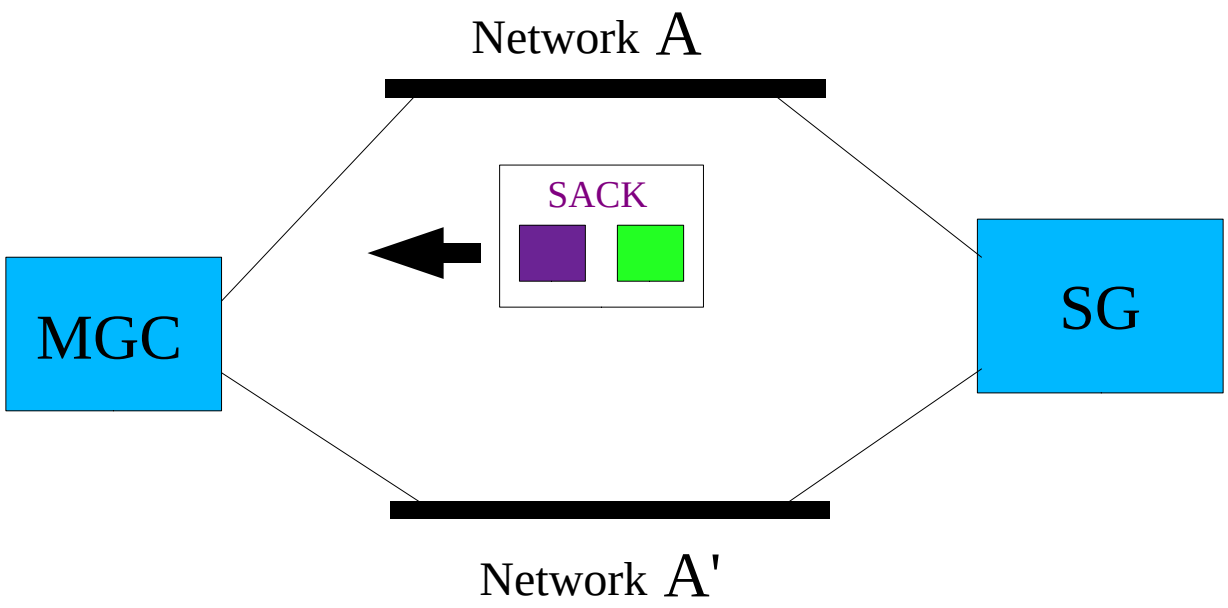
New Feature 4 - SACK Built Into the Protocol (Cont.)



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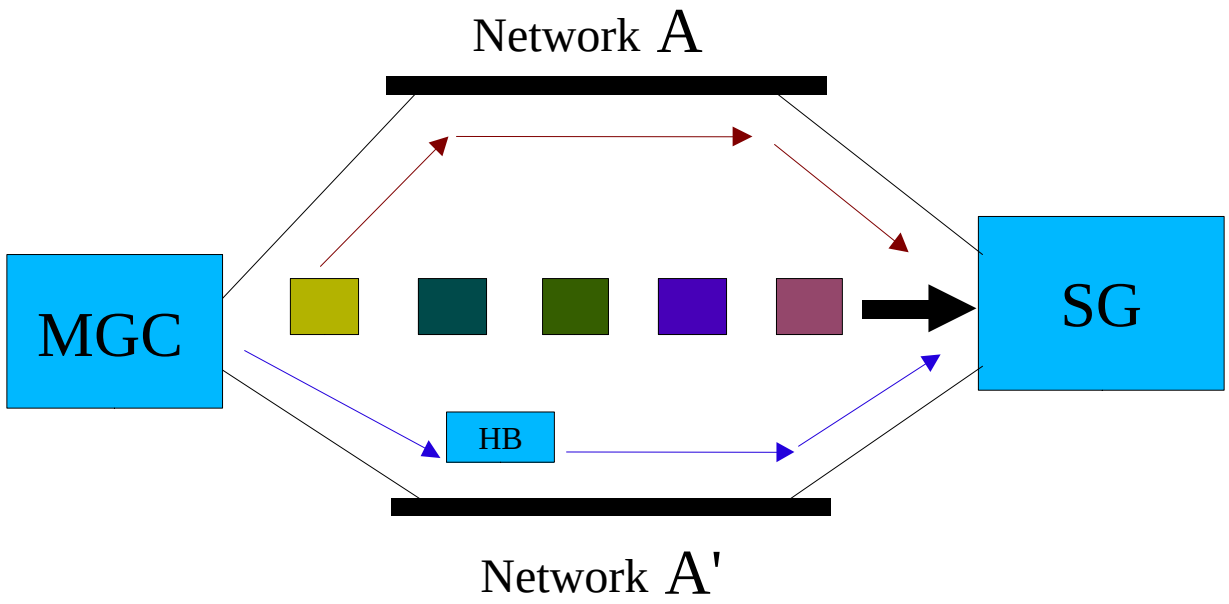
New Feature 5 - Heartbeat



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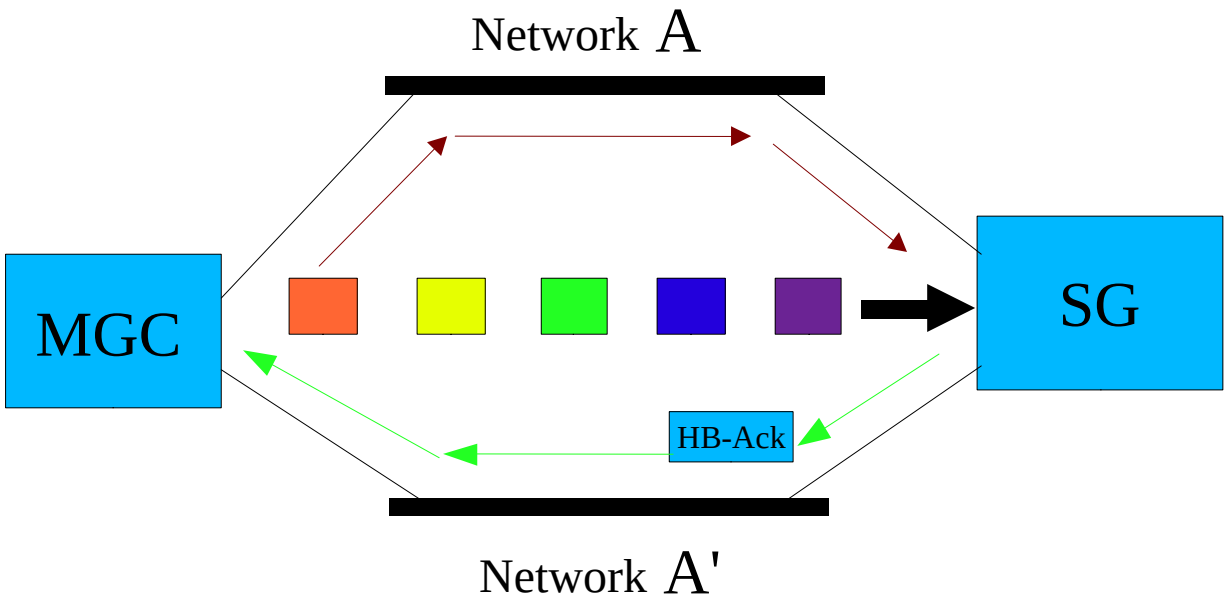
New Feature 5 – Heartbeat (Cont.)



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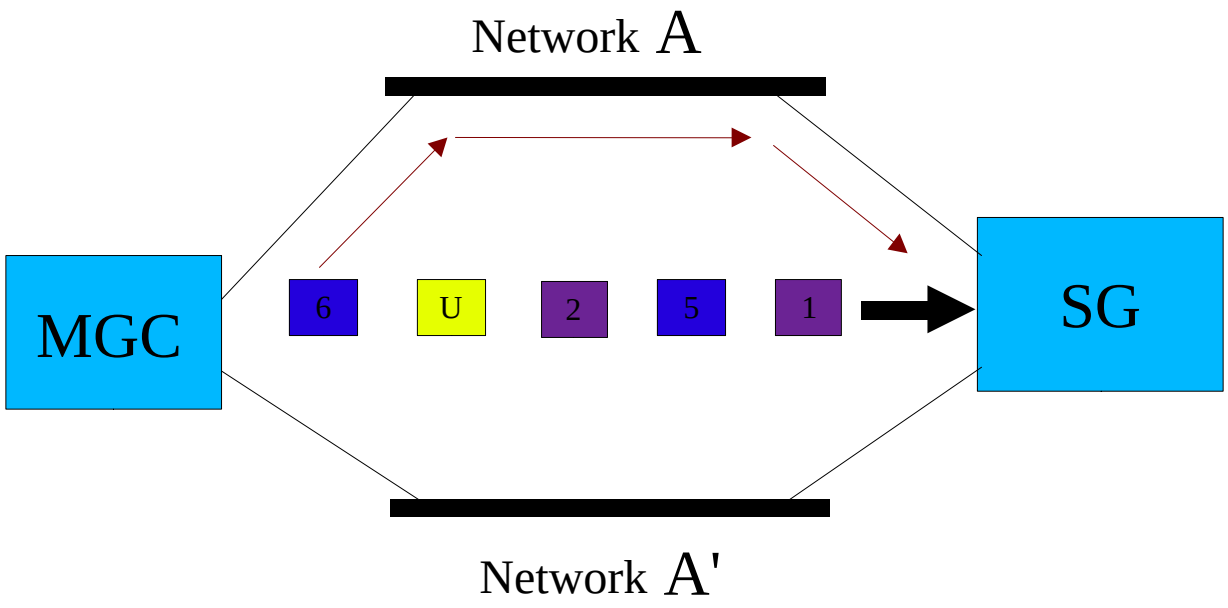
New Feature 6 - Unordered Delivery



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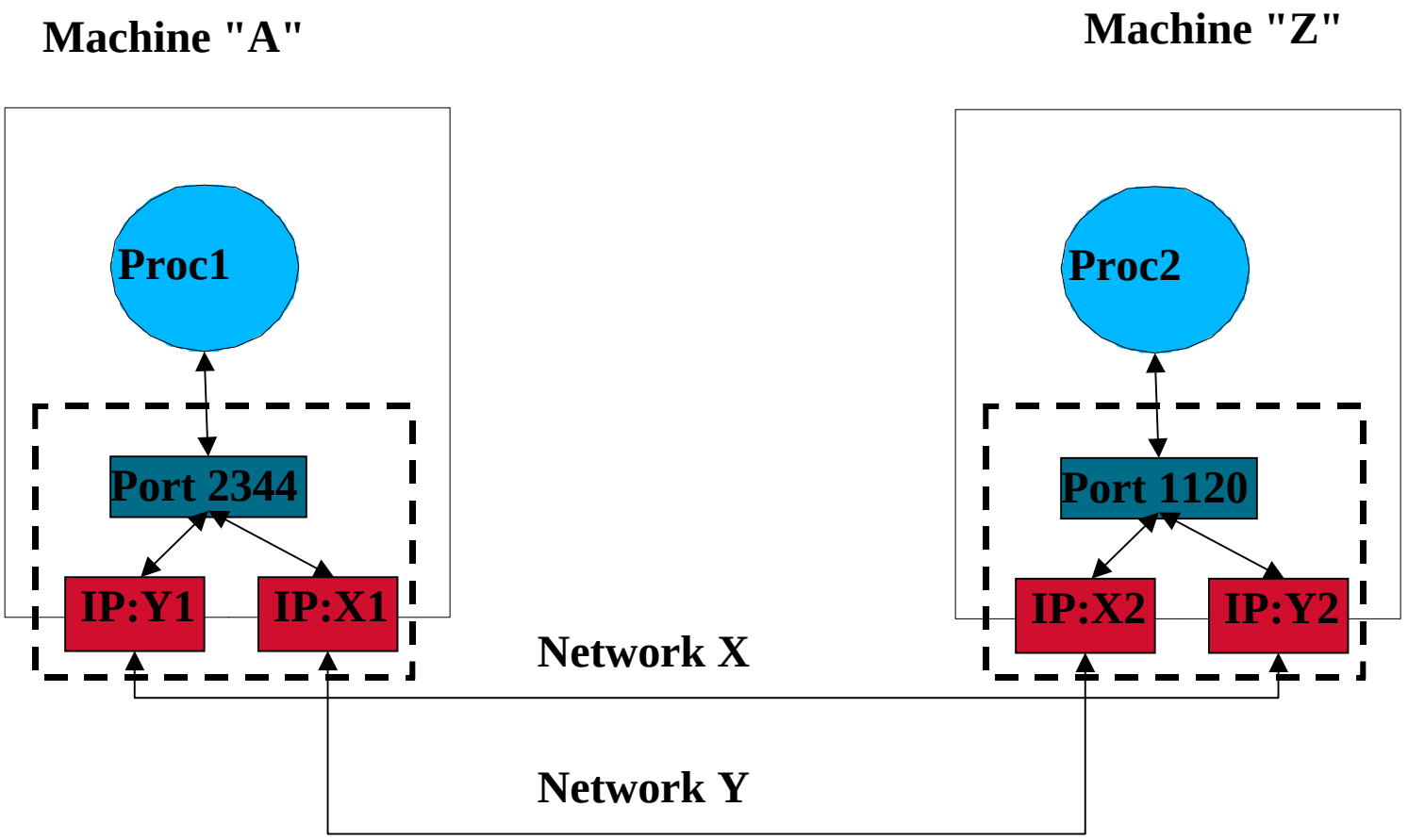
What Are Transport Address, Endpoint, and Association?

- Transport Address --- a combination of an SCTP port and an IP address.
- Endpoint --- a sender/receiver of SCTP packets, can be represented as a list of transport addresses sharing the same SCTP port.
- Association --- a relationship or conversation between two endpoints.

A Tail of 2 Processes



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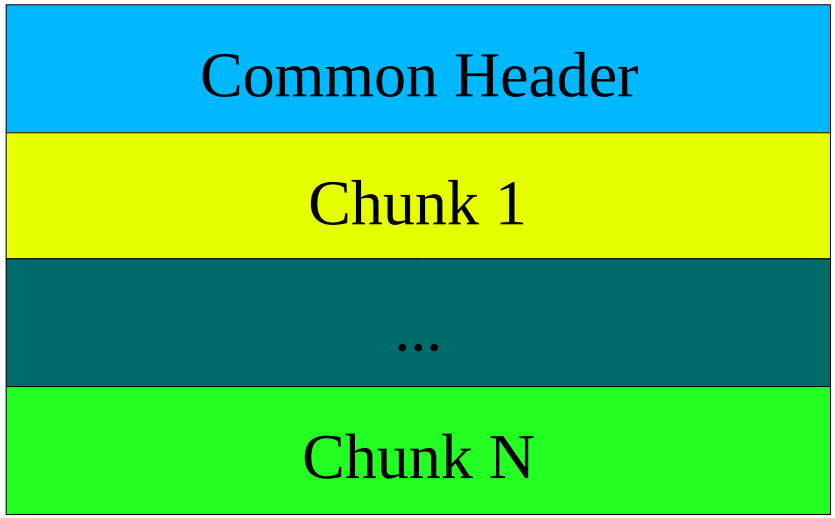
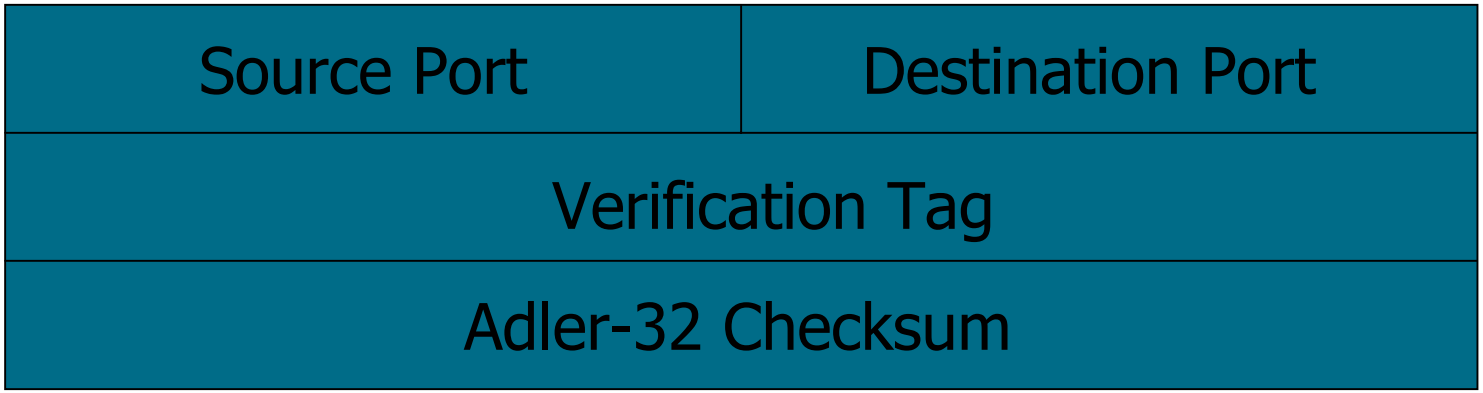
Basic SCTP Packet Format



SCTP is comprised of a common header and some number of CHUNKS

Basic SCTP Packet Format (Cont.)

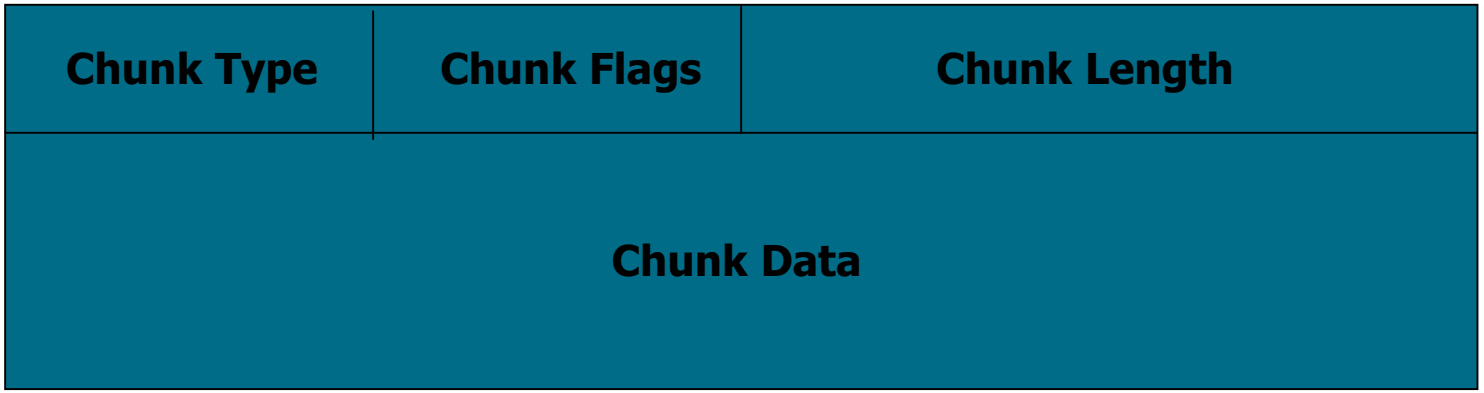


SCTP common header

Basic SCTP Packet Format (Cont.)

- Each Chunk has its own chunk data structure defined.
- Chunk flags have specific definition for different chunk type.
- We will look at the specifics of each chunk at the time we examine the use of the chunk.

Basic SCTP Packet Format (Cont.)



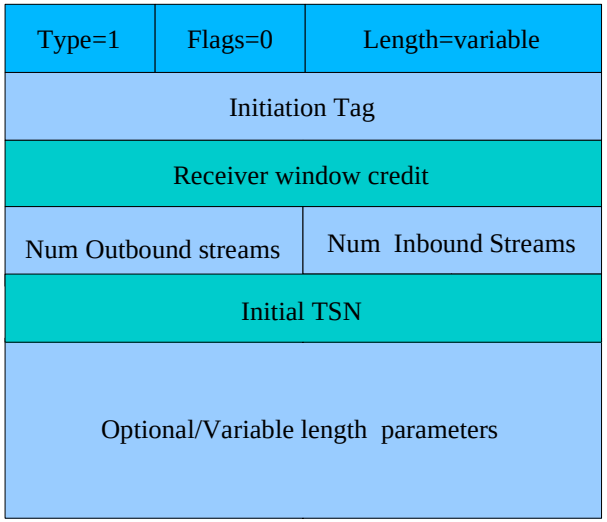
An SCTP chunk

Chunks Used by SCTP to Operate: Control Chunks

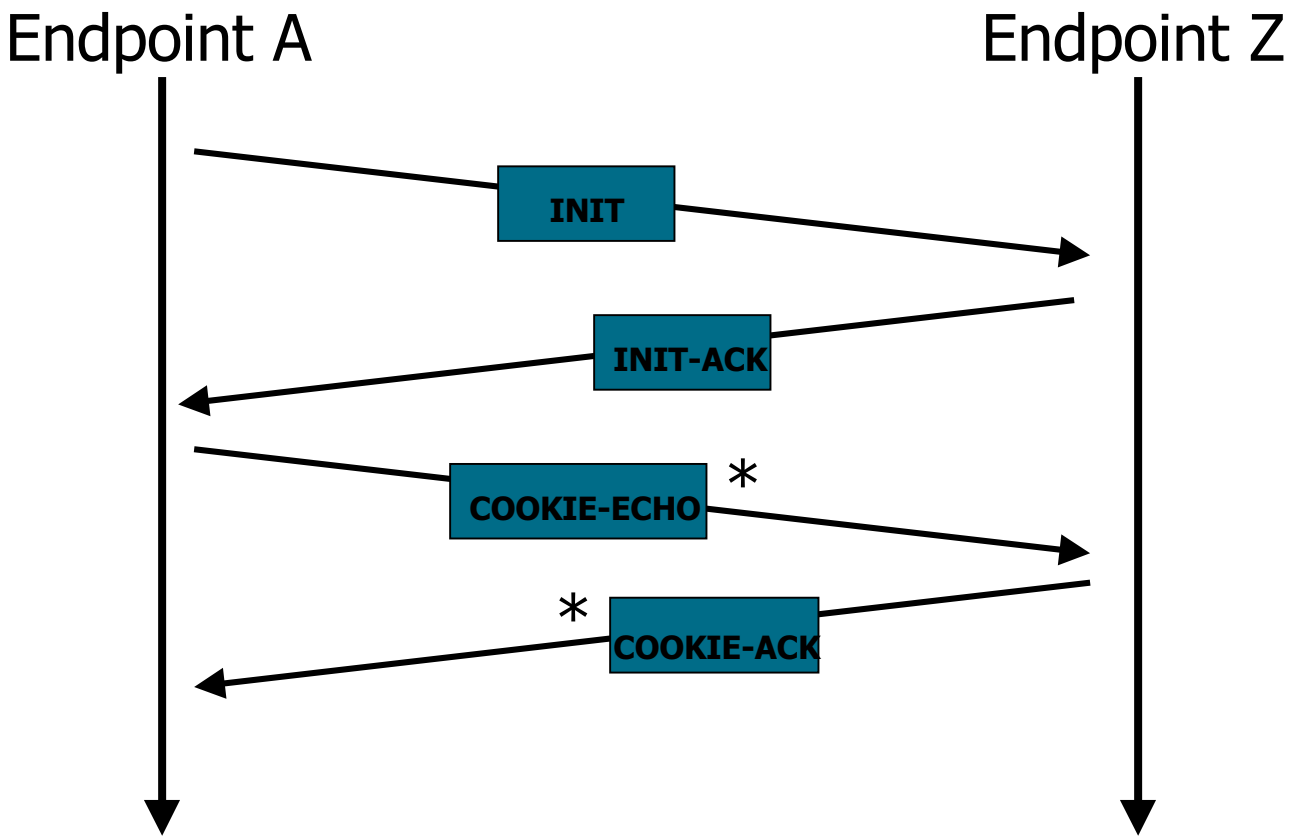
- Initiation (INIT)
- Initiation Acknowledgement (INIT ACK)
- Selective Acknowledgement (SACK)
- Heartbeat Request (HEARTBEAT)
- Heartbeat Acknowledgement (HEARTBEAT ACK)
- Abort (ABORT)
- Shutdown (SHUTDOWN)
- Shutdown Acknowledgement (SHUTDOWN ACK)
- Operation Error (ERROR)
- State Cookie (COOKIE ECHO)
- Cookie Acknowledgement (COOKIE ACK)
- Explicit Congestion Notification Echo (ECNE)
- Congestion Window Reduced (CWR)
- Shutdown Complete (SHUTDOWN COMPLETE)

Basic Initiation (or Set-up)

When an endpoint wishes to set-up an association with a peer endpoint, it creates an initiation chunk and sends it to the peer.



Basic Association Initiation Sequence



* -- User data can be attached

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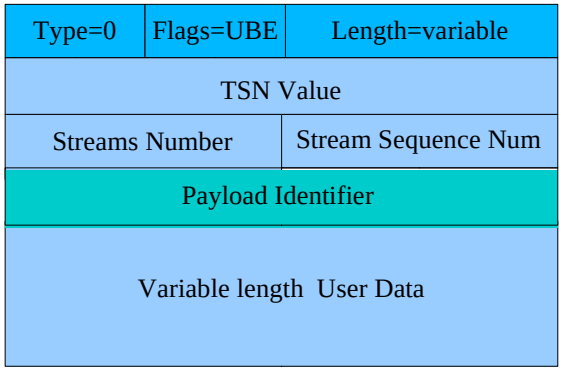
Basic SCTP DATA Chunk



Flag Bits UBE are used to indicate:

U – Unordered Data

B – Beginning of Fragmented Message

E – End of Fragmented Message

A user message that fits in one chunk would have both the B and E bits set.

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Handle Lost Packet

When a packet is lost, retransmission will occur in one of two ways:

- **When repeated sacks occur reporting the missing packet (via holes) 4 times. Or,**
- **When a time-out occurs on the packet.**
- **The receiver will help speed things up by sacking every packet when a hole exists.**

Handle Lost Packet (Cont.)

- **A SACK describes all received pieces, as well as painting a picture for the sender of what is missing and what is duplicated.**

Type=3	Flags=0	Length=variable
Cumulative TSN		
Receiver window credit		
Num of Fragments=N	Num of Dup=M	
Gap Ack Bloc #1 start	Gap Ack Bloc #1 end	
Gap Ack Bloc #N start	Gap Ack Bloc #N end	
Duplicate TSN #1		
Duplicate TSN #M		

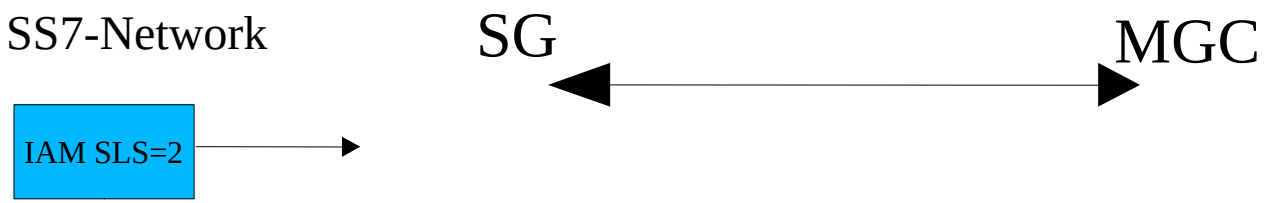
Handle Lost Packet (Cont.)

- **Cumulative TSN is the highest consecutive TSN received (no gaps).**
- **All gaps/fragments reports describe what has been received.**
- **All gap/fragments numbers are offsets from the cumulative TSN.**
- **Retransmissions are made to alternate destinations if possible.**

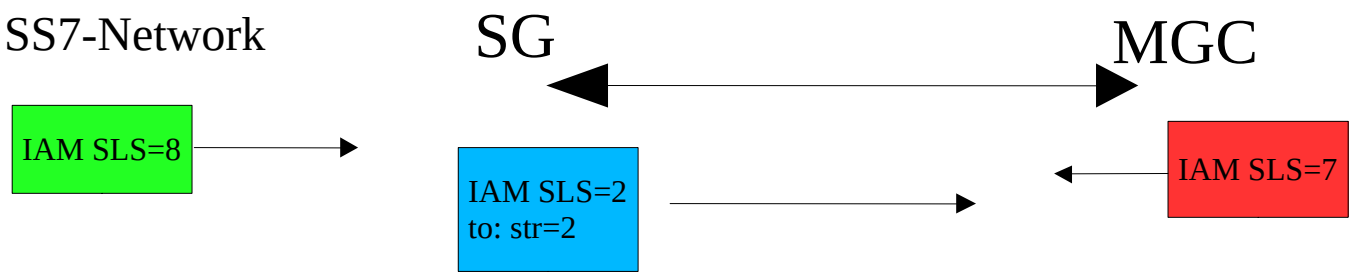
How Streams Are Used

- **Streams are used to provide a non-head-of-line blocking discipline.**
- **Common uses would be to route a given SLS from an SS7 link set for ISUP over independent streams.**
- **Another possible use is to route each call reference number over a modulo of the number of streams.**

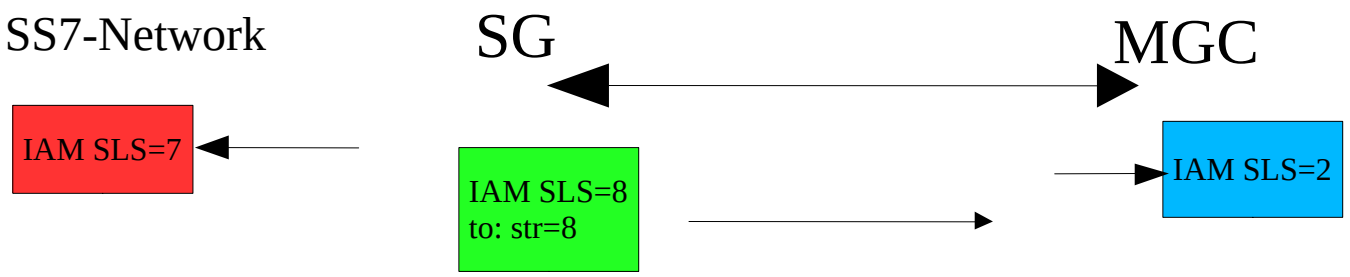
An ISUP Example



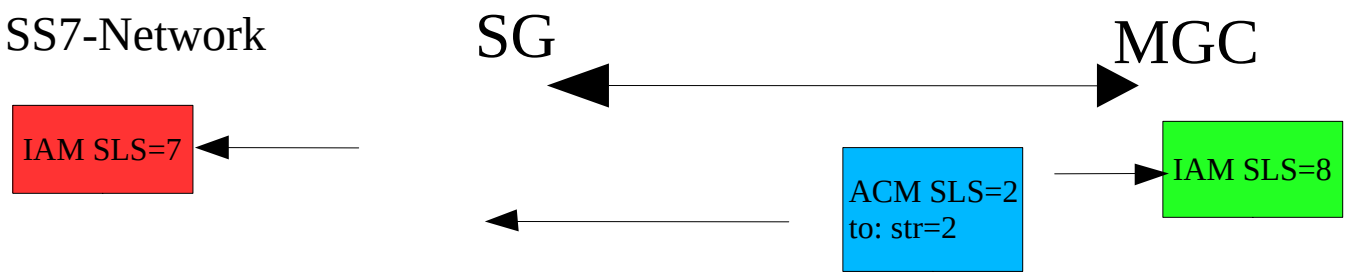
An ISUP Example



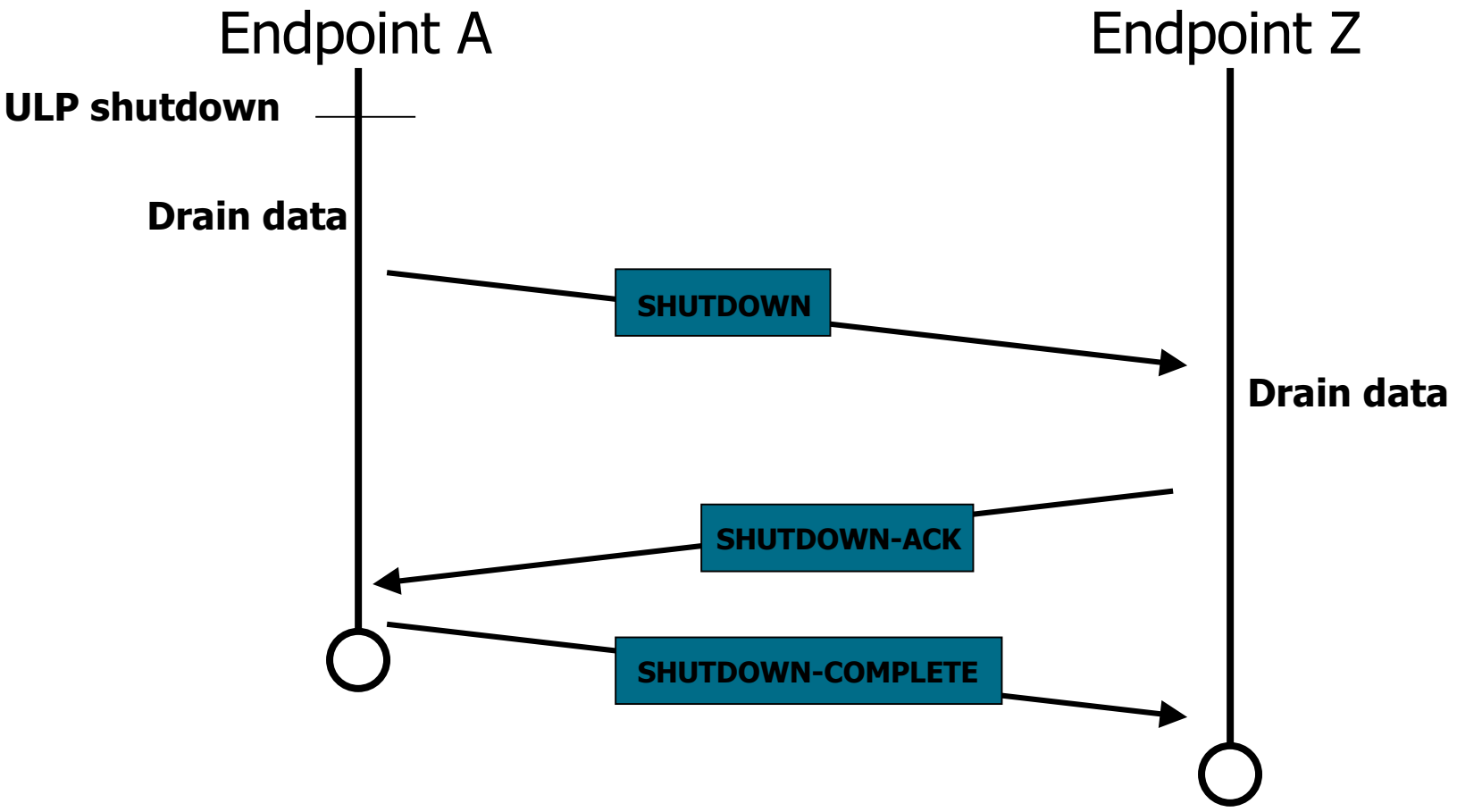
An ISUP Example



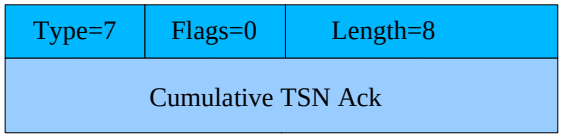
An ISUP Example



Basic Association Shutdown Sequence



The SHUTDOWN Chunks



The Shutdown Chunk includes the Cumulative TSN.

The Shutdown Ack confirms the sender has drained all data.

The Shutdown Complete finalizes the association tear down