SCTP (Stream Control Transmission Protocol)
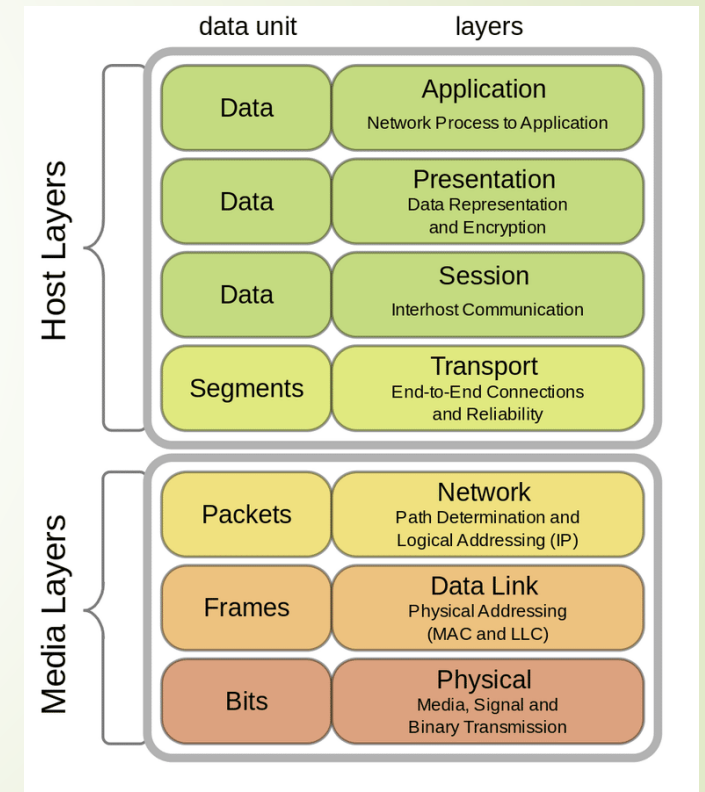
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Agenda

- What is SCTP
- SCTP vs TCP
- SCTP Header
- SCTP Flow
- SCTP MultiStreaming
- SCTP MultiHoming

OSI Model

- **Open Systems Interconnection Model**

- characterizes and standardizes the communication functions

- a layer serves the layer above it and is served by the layer below it

- Transport Layer Protocols
  - UDP
  - TCP
  - SCTP

data unit	layers	
Host Layers	Data	Application — Network Process to Application
	Data	Presentation — Data Representation and Encryption
	Data	Session — Interhost Communication
	Segments	Transport — End-to-End Connections and Reliability
Media Layers	Packets	Network — Path Determination and Logical Addressing (IP)
	Frames	Data Link — Physical Addressing (MAC and LLC)
	Bits	Physical — Media, Signal and Binary Transmission

What is SCTP ?

- *Stream Control Transmission Protocol (SCTP):A Reference Guide* by <u>Randall R. Stewart</u> and <u>Qiaobing Xie</u>: " ***SCTP is considered by many to be the TCP of the future....more robust and secure...the technology of choice for building next-generation commercial grade infrastructures for telecommunications and e-commerce.*** "

- IETF Signaling Transport (SIGTRAN) Working Group

- Protocol Number 132

  - TCP 6, UDP 17

- RFC 2960 Stream Control Transmission Protocol (updated by RFC 3309 and obsoleted by RFC 4960)

SCTP like TCP

- uses a checksum and sequence number(Transmission Sequence Number)
- is connection oriented
- implements tcp-like mechanisms of:
  - reliable transmission
  - ordered delivery
  - flow and congestion control follow TCP algorithms
  - slowstart
  - fast recovery
  - fast retransmit--upon receiving 4 consecutive SACKs
  - delayed acks
  - SACK
  - ssthresh, RTO, CWND, etc.

SCTP unlike TCP

- uses a 32 bit checksum as opposed to a 16 bit checksum
- can have several streams within an association
- defines a stream as a sequence of messages(chunks)--not bytes--there are presently 13 chunk types defined
- a packet includes a common header plus one or more chunks which can be control or data
- uses 4 messages in setting up an association and data may be sent with 3 & 4
- uses 3 messages for shutdown--there are no half-open connections
- can use multi-homed endpoints for redundancy
- employs a signed cookie mechanism specifically to guard against SYN flooding
- uses a Verification Tag as a protection against blind masquerade attacks and stale packets from a previous association
- supports in-order and order-of-arrival delivery on a per datagram basis
- IP multicast and broadcast are NOT supported
- Sack messages may carry a larger number of SACK blocks than TCP's 3 or 4

SCTP BONUS ??

- MULTI-STREAMING
  - can have several streams within an association
- MULTI-HOMING
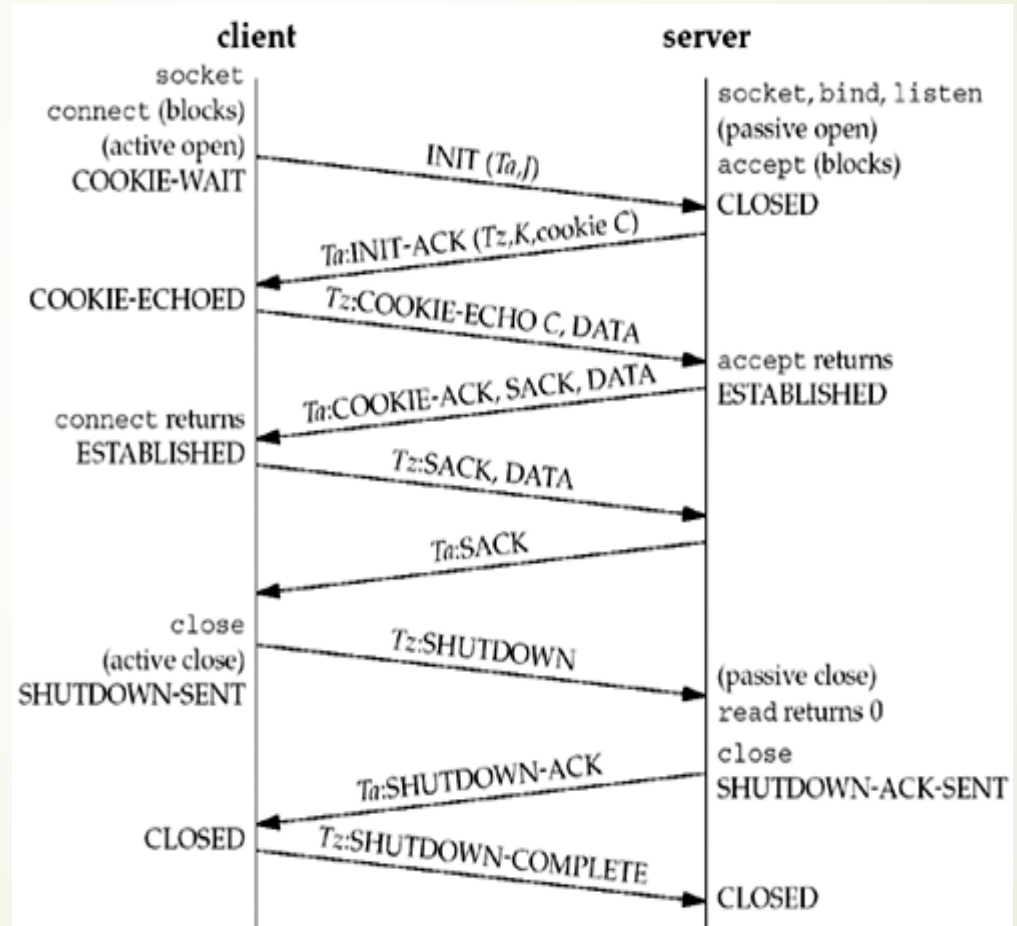 - can use multi-homed endpoints for redundancy
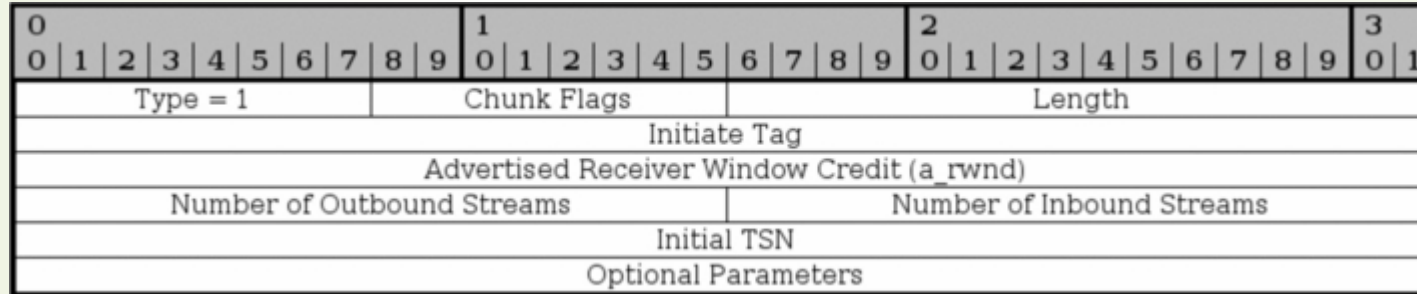
SCTP Header over IP

| Bits	0–7	8–15	16–23	24–31
+0	Source port		Destination port	
32	Verification tag			
64	Checksum			
96	Chunk 1 type	Chunk 1 flags	Chunk 1 length	
128	Chunk 1 data			
…	…			
…	Chunk N type	Chunk N flags	Chunk N length	
…	Chunk N data			

SCTP Flow

SCTP Init Chunk

SCTP Init Ack Chunk

SCTP MultiStreaming

- SCTP association has a single port (or one local port and one remote port) but may use many streams

- the capability of SCTP to transmit several independent streams of chunks in parallel

- for example transmitting web pages
  - Images, Style sheet, Javascript, etc

- messages which don't require in sequence delivery may be sent on different streams and thus avoid unnecessary head of line blocking

- all messages for a particular call will be delivered in sequence but retransmission of a message for one call need not delay delivery of messages for another call

- use of streams allows this to be achieved without the creation of new associations which would typically require considerable system resources for tx and rx buffers in addition to association establishment costs

SCTP MultiStreaming (cont.)
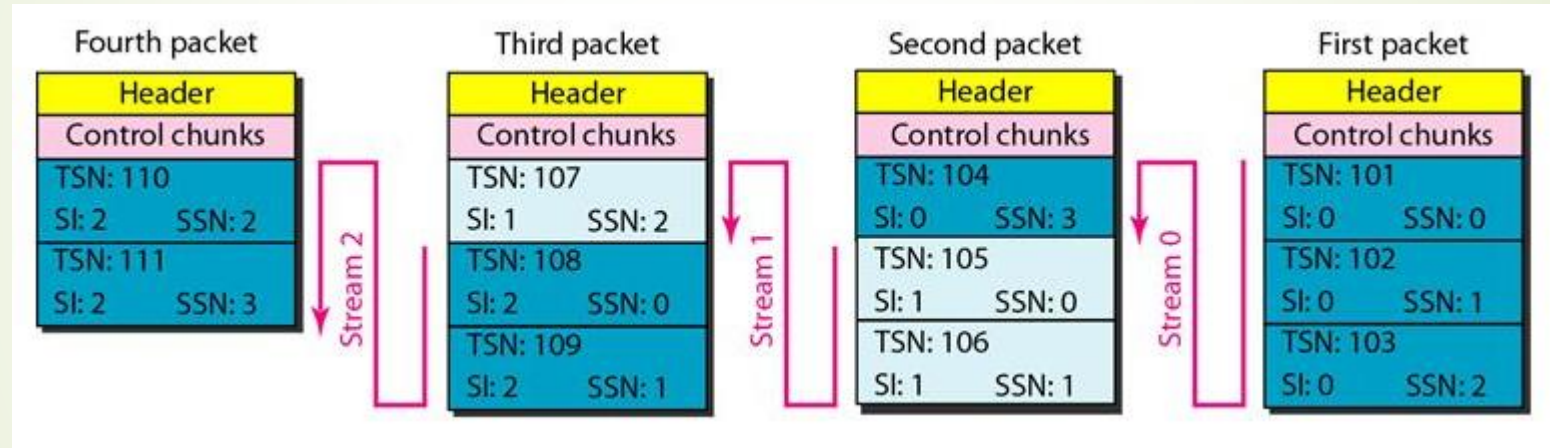
SCTP Multihoming
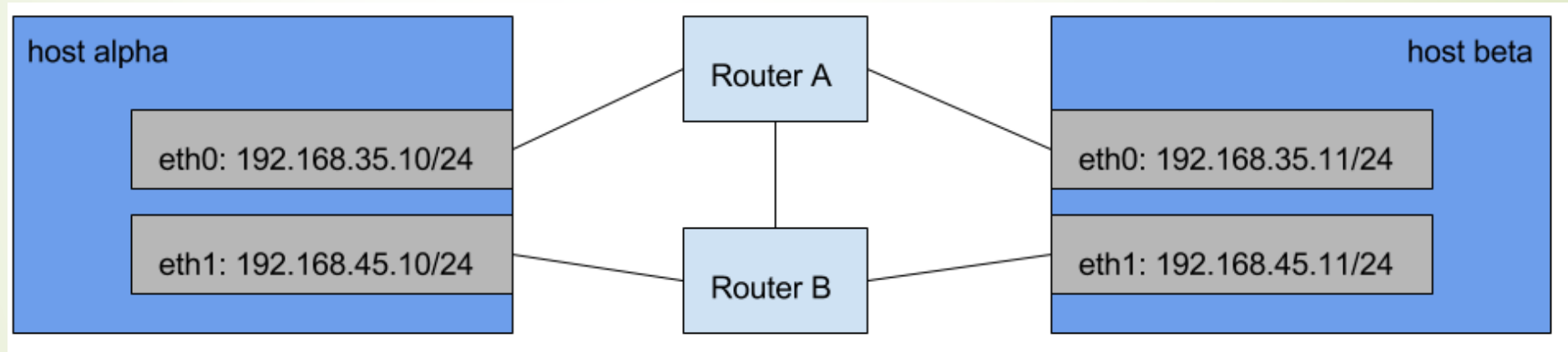
SCTP Init Chunk with Optinal Params

+	Bits 0 - 7	8 - 15	16 - 31
0	Chunk type = 1	Chunk flags	Chunk length
32	Initiate tag		
64	Advertised receiver window credit		
96	# of outbound streams		# of inbound streams
128	Initial TSN		
160	Parameter type = 5		Parameter length = 8
192	IPv4 address of sending endpoint		
224	Parameter type = 6		Parameter length = 20
256	IPv6 address of sending endpoint		
288			
320			
352			
384	Parameter type = 9		Parameter length = 8
416	Suggested cookie life-span increment (milliseconds)		
448	Parameter type = 11		Parameter length
480	Null-terminated host name		
512	Parameter type = 12		Parameter length
544	Address type #1		Address type #2
576	Address type #3		...
608	Parameter type = 32768		Parameter length
640	Explicit congestion notification (reserved)		

SCTP Multihoming (cont.)

- An SCTP endpoint is considered multi-homed if there are more than one transport address that can be used as a destination address to reach that endpoint.

- Obtaining peer's IP addresses
  - INIT and INIT-ACK packets

- Path verification
  - After the association is established, each endpoint knows the IP addresses of its peer
  - The verification of each address is done with a HEARTBEAT, sent to it

- After all IP addresses are derived, one of them is selected as a **PRIMARY**

SCTP Flow with Multihoming

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.35.11	192.168.35.10	SCTP	100	INIT
2	0.000061000	192.168.35.10	192.168.35.11	SCTP	356	INIT_ACK
3	0.000317000	192.168.35.11	192.168.35.10	SCTP	312	COOKIE_ECHO
4	0.000362000	192.168.35.10	192.168.35.11	SCTP	52	COOKIE_ACK
5	3.001509000	192.168.35.11	192.168.35.10	SCTP	72	DATA
6	3.001547000	192.168.35.10	192.168.35.11	SCTP	64	SACK
7	3.001638000	192.168.35.10	192.168.35.11	SCTP	68	DATA
8	3.001714000	192.168.35.11	192.168.35.10	SCTP	64	SACK
9	4.211177000	192.168.45.10	192.168.45.11	SCTP	100	HEARTBEAT
10	4.211422000	192.168.45.11	192.168.45.10	SCTP	100	HEARTBEAT_ACK
11	6.001983000	192.168.35.11	192.168.35.10	SCTP	72	DATA
12	6.002107000	192.168.35.10	192.168.35.11	SCTP	84	SACK DATA
13	6.200309000	192.168.35.11	192.168.35.10	SCTP	64	SACK
14	9.002442000	192.168.35.11	192.168.35.10	SCTP	72	DATA
15	9.002539000	192.168.35.10	192.168.35.11	SCTP	84	SACK DATA
16	9.187182000	192.168.45.10	192.168.45.11	SCTP	100	HEARTBEAT
17	9.187438000	192.168.45.11	192.168.45.10	SCTP	100	HEARTBEAT_ACK
18	9.199481000	192.168.35.11	192.168.35.10	SCTP	64	SACK
19	12.003572000	192.168.35.11	192.168.35.10	SCTP	72	DATA
20	12.003700000	192.168.35.10	192.168.35.11	SCTP	84	SACK DATA
21	12.200113000	192.168.35.11	192.168.35.10	SCTP	64	SACK
22	14.019184000	192.168.45.10	192.168.45.11	SCTP	100	HEARTBEAT
23	14.019432000	192.168.45.11	192.168.45.10	SCTP	100	HEARTBEAT_ACK
24	15.003612000	192.168.35.11	192.168.35.10	SCTP	72	DATA
25	15.003709000	192.168.35.10	192.168.35.11	SCTP	84	SACK DATA
26	15.003997000	192.168.35.11	192.168.35.10	SCTP	62	SHUTDOWN
27	15.004020000	192.168.35.10	192.168.35.11	SCTP	52	SHUTDOWN_ACK
28	15.004121000	192.168.35.11	192.168.35.10	SCTP	62	SHUTDOWN_COMPLETE

Further Reading and Researches

- RFC 4960

- http://www.ibm.com/developerworks/library/l-sctp/

- http://duepublico.uni-duisburg-essen.de/servlets/DerivateServlet/Derivate-29737/Dre2012_final.pdf

- Most of the researches on Multi-homing

  - Use all paths actively, concurrent data transfer

  - Ex. Reasearch : 'Concurrent Multi-path Data Transfer Using Modified SCTP' Murat Akzeybek and Ensar Gul, IEEE International Conference on Communication, Networks and Satellite (COMNETSAT 2013), Yogyakarta, Indonesia, 3-5 December 2013.

  - Ex. Usage: Modeo Live (http://www.modeo.tv/)

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- https://en.wikipedia.org/wiki/OSI_model

- https://www.lifewire.com/open-systems-interconnection-model-816290

- http://www.csm.ornl.gov/~dunigan/netperf/sctp.html

- http://www.masterraghu.com/subjects/np/introduction/unix_network_programming_v1.3/ch02lev1sec8.html

- http://stackoverflow.com/questions/15617621/how-is-multistreaming-in-sctp-different-from-opening-multiple-connections-in-tcp

- http://petanode.com/blog/posts/multi-homing-in-sctp.html

- http://www.myreadingroom.co.in/notes-and-studymaterial/68-dcn/855-sctp-features.html

- https://en.wikipedia.org/wiki/SCTP_packet_structure

- http://security.maruhn.com/iptables-tutorial/x1736.html

ÖNEMLİ

Bu projeler lisansüstü öğrencilerinin hazırladığı çalışmalar olup tüm sorumluluk hazırlayan öğrencilere aittir. Öğrenciler hazırladığı projeye göre not almışlardır.