SCTP and its Support in Wireshark

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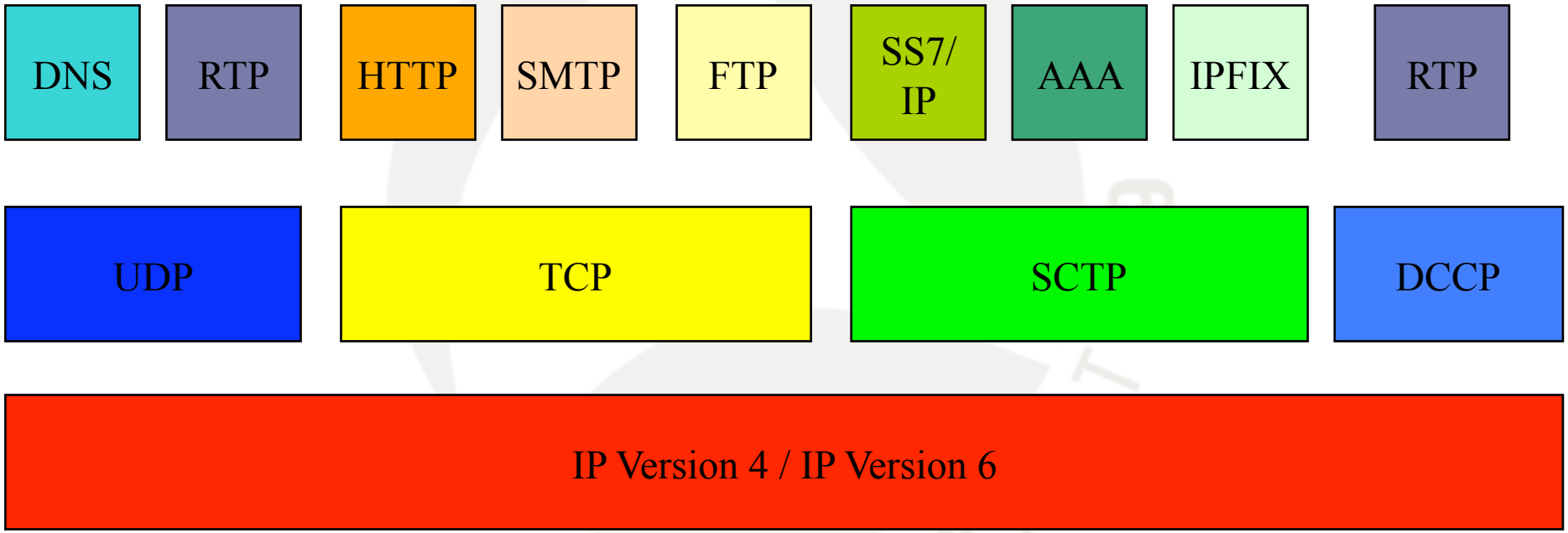
Outline

- History of SCTP.
- Introduction to SCTP.
- Services provided by SCTP.
- SCTP support in Wireshark.
- Conclusion.

The IP Protocol Suite



Why was SCTP developed?

- In 1999 the IETF (SIGTRAN working group) started to work on SS7/IP.
- Neither UDP not TCP provided the necessary network fault tolerance:
  - Head of line blocking when packets are lost.
  - Switch to an alternate path when a path fails.
- So a new transport protocol was developed for SIGTRAN: *Simple Control Transmission Protocol* (SCTP). But the name was changed…

Where is SCTP used?

- Telephony signaling networks, especially UMTS.
- Diameter (successor of Radius).
- IPFIX (successor of NetFlow).
- Ongoing research:
  - MPI
  - HTTP/SCTP
  - Network file systems
  - SSH, DNS

Implementations

- Part of FreeBSD 7.0 and higher.
- Part of all recent 2.6 kernels.
- Part of Solaris 10.
- Kernel extension for Mac OS X (Tiger and Leopard) available from http://sctp.fh-muenster.de.
- For FreeBSD, Linux, Solaris, Mac OS X, HP-UX and Windows: sctplib (userland library) available from http://www.sctp.de.
- Several commercial implementations.

Features of SCTP: Base Protocol

- Packet oriented.
- Connection oriented.
- Reliable Transport.
- Flow and congestion control.
- Supports multiple unidirectional streams .
- Supports multihoming (IPv4 and/or IPv6).
- Supports bundling of multiple user messages.
- Fragmentation and reassembly.

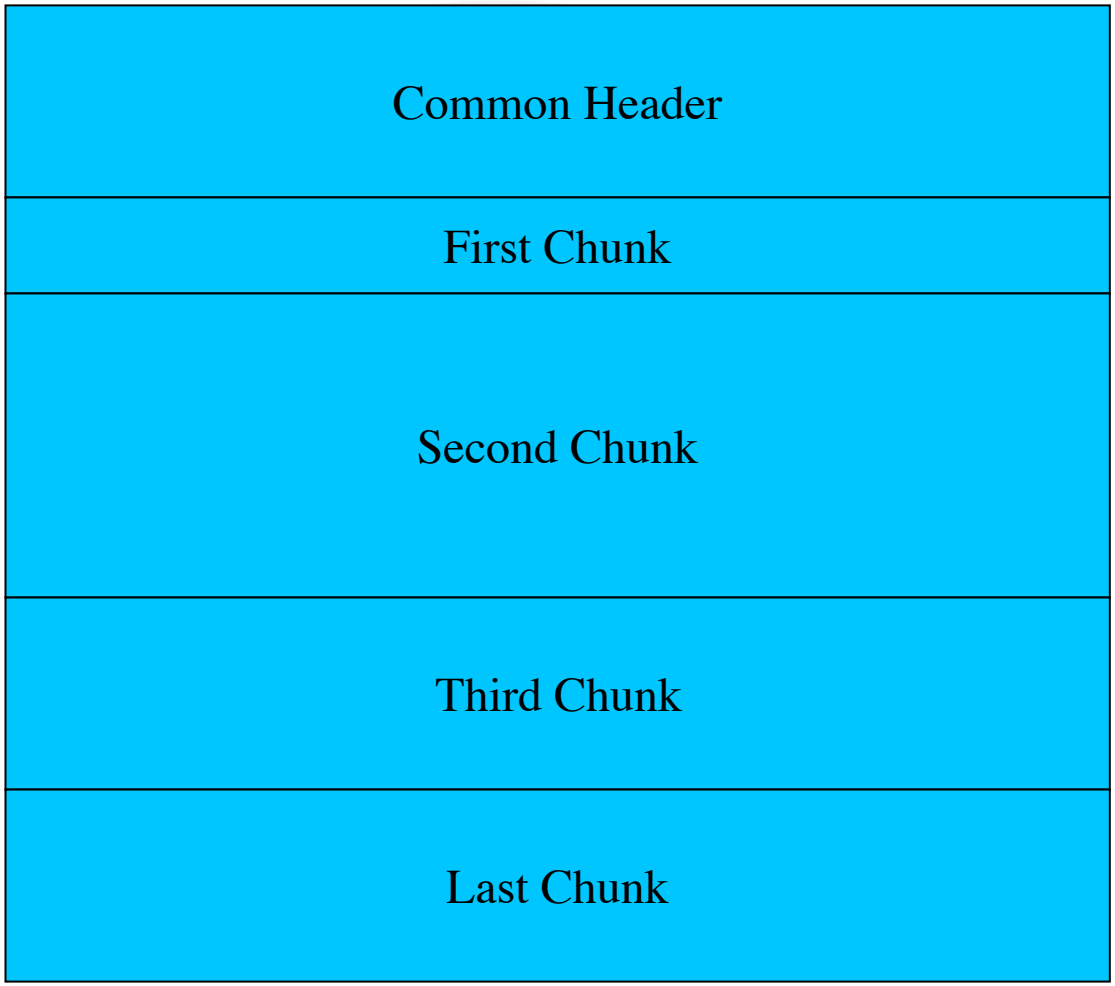
Features of SCTP: Protocol Extensions

- User controlled partial reliability.
- Support for SCTP-AUTH.
- Dynamic reconfiguration of addresses during the lifetime of an association.
- Dynamic reconfiguration of Streams.
- Advanced path MTU discovery.

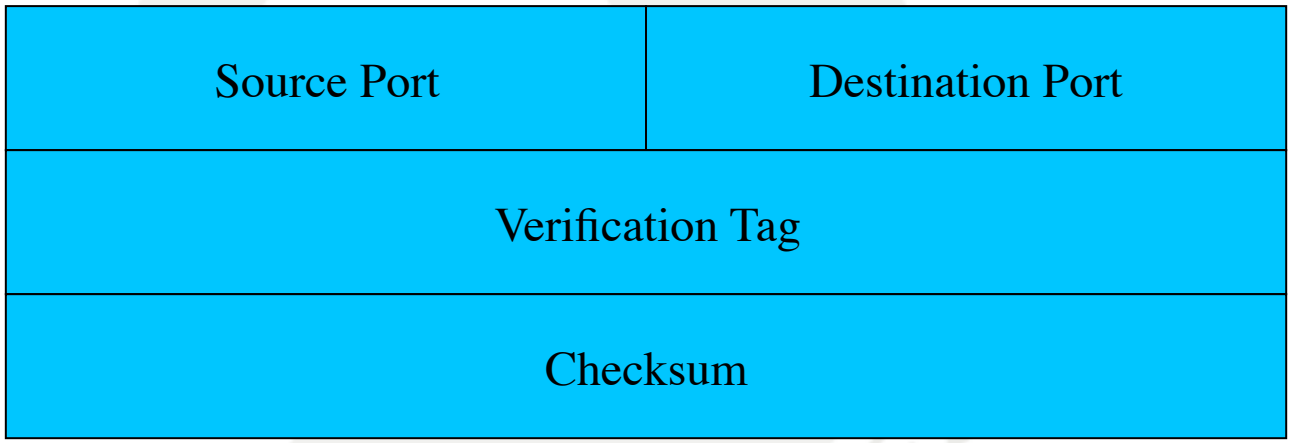
SCTP Terminology

- An SCTP connection is called an association.
- SCTP uses the same port number concept as TCP and UDP do.
- An SCTP endpoint can be identified (at a certain point of time) by a pair of a list of IP-addresses and a port number.

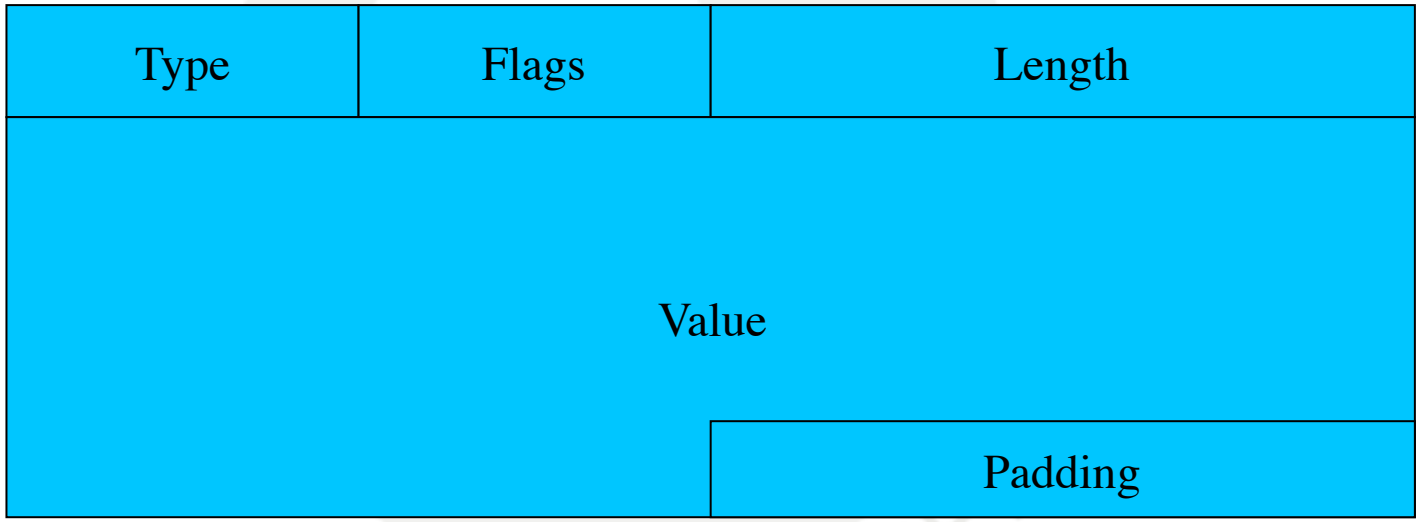
SCTP Message Format



SCTP Common Header Format



SCTP Chunk Format



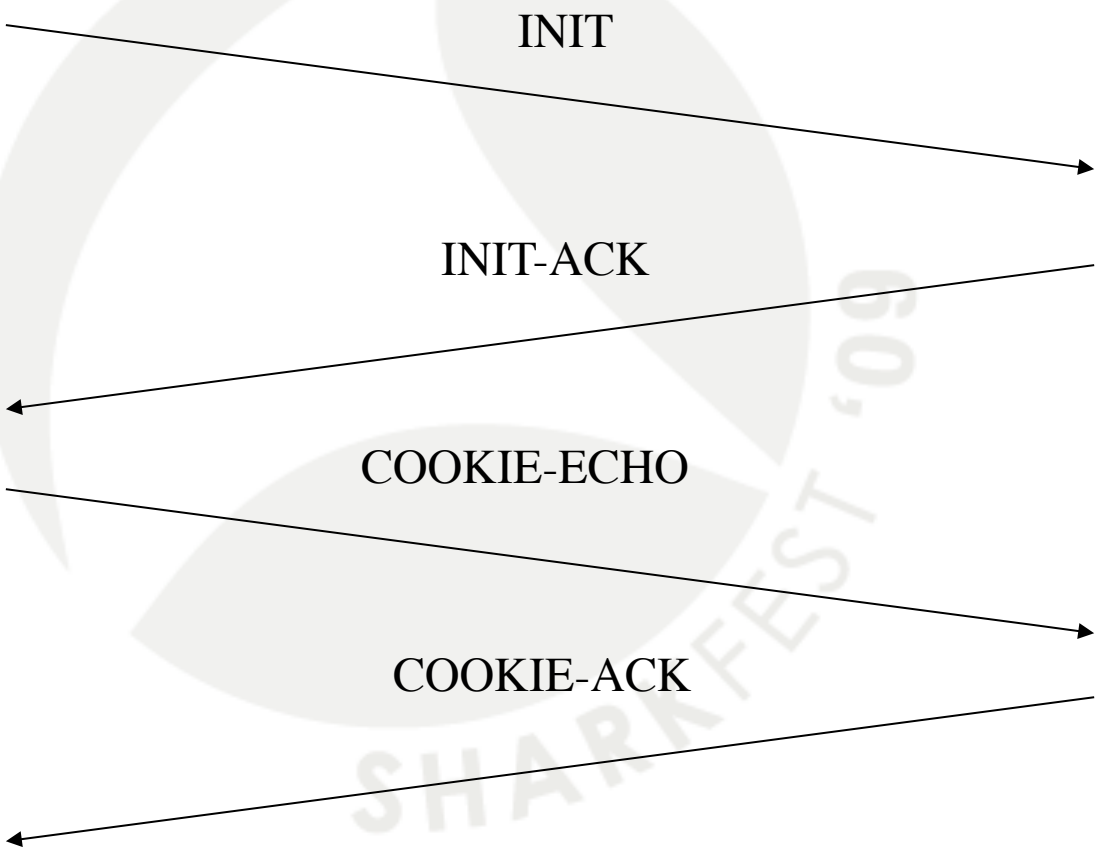
SCTP Chunk Types

- INIT, INIT-ACK, COOKIE-ECHO, COOKIE-ACK.
- DATA, SACK.
- SHUTDOWN, SHUTDOWN-ACK, SHUTDOWN-COMPLETE.
- HEARTBEAT, HEARTBEAT-ACK.
- ERROR, ABORT.
- FORWARD-TSN.
- ASCONF, ASCONF-ACK.
- AUTH.

Association Setup

- Peer to peer model (including client/server).
- Four way handshake is used.
- Important parameters exchanged:
  - Verification tag.
  - Maximum receiver window.
  - Number of streams.
  - IP addresses (IPv4 and/or IPv6).
- Cookie-based mechanism.

Message Flow



The Verification Tag

- 32-bit random number.
- Chosen by each end-point.
- The protection against blind attackers is based on the verification tag.
- Stays the same during the lifetime of an association.
- Some implementations use it for looking up the association.
- If a packet is received with a wrong verification tag it is silently discarded.

Multihoming

- Every IP address of the peer is considered as a path.
- All paths are continuously supervised and initially confirmed.
- One path, the so called primary path, is used for initial data transmission.
- In the case of (timer based) retransmissions an alternate path is used.
- Loadsharing is subject of ongoing research.

Partial In-sequence Delivery

- A lot of applications do not require all data to be delivered in sequence.
- Therefore SCTP supports the streams concept. Only data sent within the same stream is delivered in sequence relative to that stream.
- This minimizes the impact of head of line blocking in case of message loss.
- In addition: Unordered delivery in each stream.

Partial Reliability

- The sender has the capability of notifying the receiver that a particular DATA chunk will never arrive at the receiver.
- PR-SCTP is a general concept.
- Applications:
  - Data may have a limited life time.
  - Data may have one of several priorities and share a resource.
  - Data may only be transmitted a limited number of times.

Dynamic Address Reconfiguration

- Reliable systems must be reconfigured without interruption of the service.
- ADDIP allows to delete and add IP-addresses during the lifetime of an association.
- Security is based on SCTP-AUTH.
- IP-addresses are transported inside ASCONF chunks.
- For example, it supports IPv6 renumbering.

Wireshark Support

- SCTP Base protocol and all extensions (I'm aware of) are supported.
- Configurable via Edit->Preferences->Protocols->SCTP.
- Associations based analysis even if initial handshake is not included in the capture file.
- Graphical analysis.

An Example: basic_sctp.pcap

- Shows
  - the association setup.
  - the association teardown.
  - a simple exchange of user data.
  - a lot of parameters in the INIT and INIT-ACK chunk.

Dissecting Upper Layers

- All SIGTRAN protocols, a lot of SS7 protocols.
- Upper layers are detected by
  - looking at the payload protocol identifier.
  - looking at the smaller port number
  - looking at the larger port number
  - heuristic dissectors (precedence configurable)
- Dissection of upper layers can be switched of.
- Can manually be selected: Analyze->Decode As

Reassembly

- Needs to be enabled in the protocol preferences.
- Is required to dissect upper layer protocols when the user message is fragmented.
- Is demoed by using frag_sctp.pcap.

TSN analysis

- Needs to be enabled in the protocol preferences.
- For a DATA chunk shows in which frame it is acknowledged.
- For a SACK chunk shows which DATA chunk it acknowledges and in which frame they are.
- Show the round trip time (RTT).
- Is demoed using basic_sctp.pcap.

Association analysis

- Much more complex than for UDP or TCP.
- Based on the handshake messages, if available, and makes used of verification tag based heuristics.
- Can be used to analyze the particular association or show all associations.
- Demoed by using multi_sctp.pcap.

Graphical Analysis

- Can draw TSN over time per association including acknowledgements.
- Can draw bytes over time per association.
- You can zoom in.
- Very useful to get an overview.
- Demoed by using data_sctp.pcap.

Capturing on Multiple Interfaces

- Currently only supported by the any interface on Linux platforms.
- Needs multiple instances of dumpcap and post-processing with mergecap.
- An alternative: using a switch with port mirroring.
- … there is room for improvement.

Conclusion

- SCTP is a very powerful transport protocol available on (almost) all Unix like platforms.
- Wireshark provides excellent support for SCTP.
- Support for capturing on multiple interfaces will be improved…

Questions and/or Suggestions?