# SCTP/SIGTRAN & SS7 Overview

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**Michael Tüxen**
Wireshark Core Developer

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# Outline

- Signaling System Number 7 (SS7).
- SS7 over IP.
- SIGTRAN Protocol Suite.
- Stream Control Transmission Protocol (SCTP).

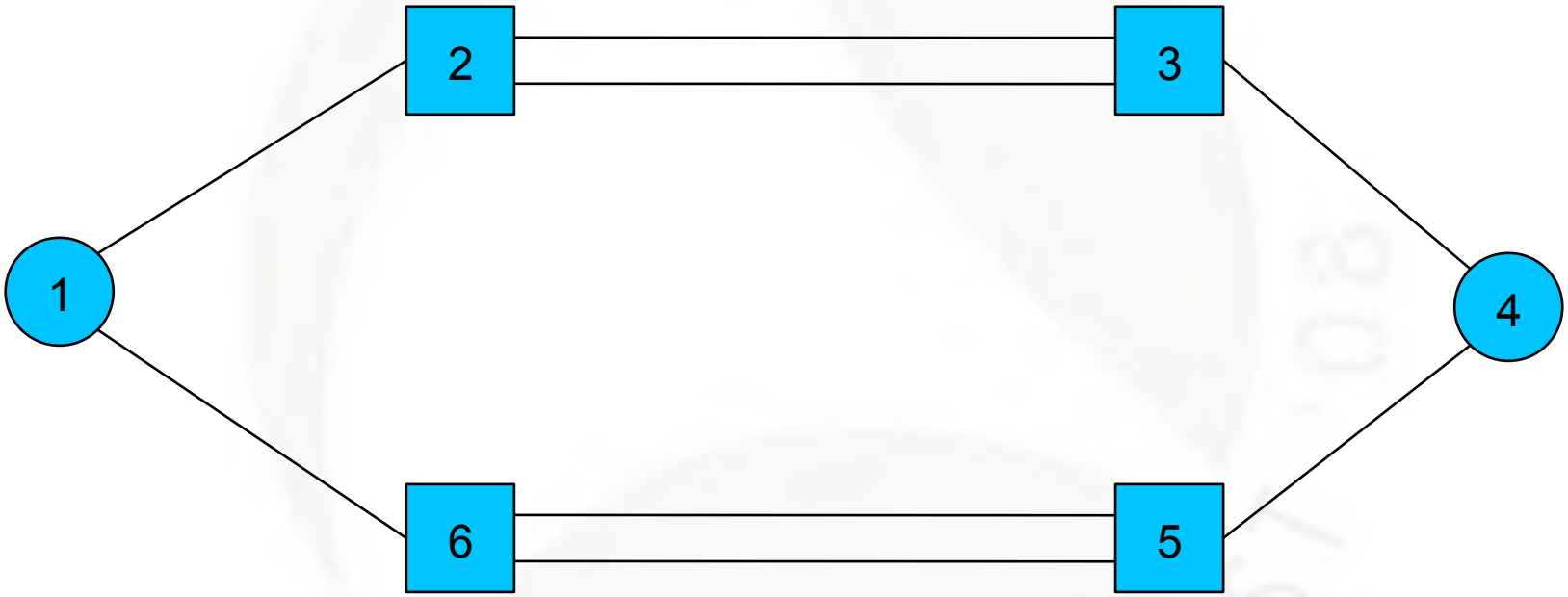
# Signaling System Number 7

- A protocol suite used for classical telephony signaling.
- Standardized by the ITU and country specific variants by local standards bodies.
- It uses four levels:
  - MTP 1
  - MTP 2
  - MTP 3
  - User Parts

# Some SS7 concepts

- Nodes are addressed by point codes.
- Links have limited bandwidth, typically 56/64 kbit/sec.
- Two adjacent nodes are connected by at most 16 links.
- Loadsharing is done based on SLS.
- Each MSU contains OPC, DPC, SLS.
- Defined failover proceduces.

# Example SS7 network



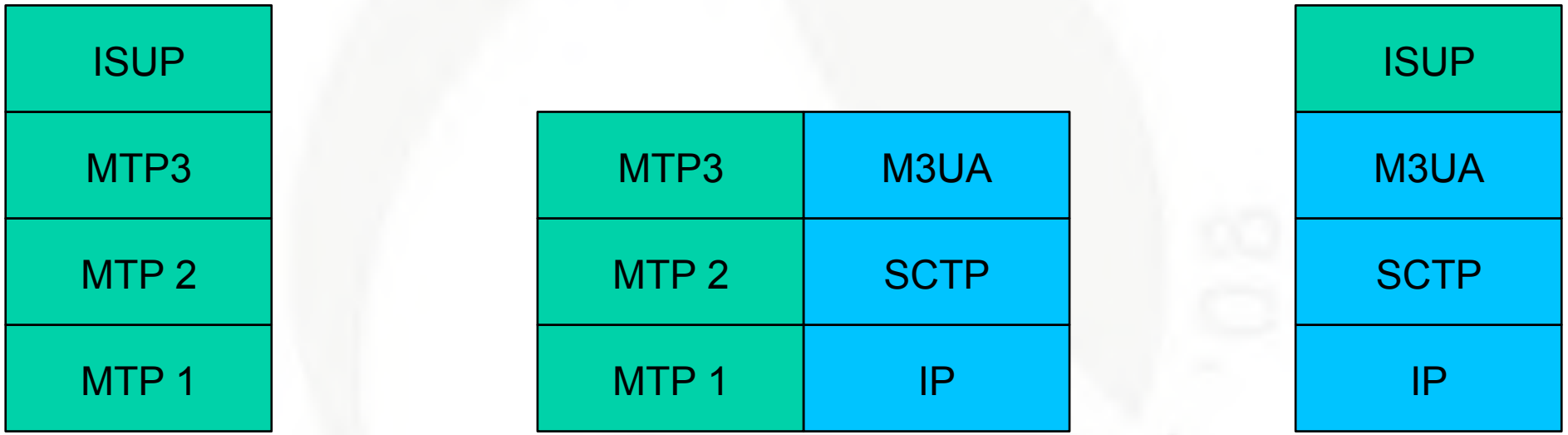
# SS7 and Wireshark

- Wireshark supports a lot of SS7 protocols.
- Different protocol versions are supported:
  - ANSI
  - ITU
  - Japanese
  - Chinese
- The version is selected in Edit/Preferences/MTP3, even for SS7 protocols other than MTP3.

# SS7 over IP

- Integrate IP-based nodes into the SS7 network.
- No special hardware requirements for the IP-based nodes.
- Interworking at different protocol layers.
- A common transport protocol is used.
- Similar performance requirements as the classical SS7 network:
  - Minimize end-to-end delay.
  - Short failover time in case of network failures.

# M3UA example




SS7-based node

Signaling Gateway

IP-based node

# SIGTRAN Protocols

- Several protocols are specified:
  - M2UA
  - M3UA
  - SUA
  - M2PA
  - IUA
- All protocols are supported by Wireshark (some in different versions depending on deployment)
- Some fields are affected by the SS7 preferences.

# SIGTRAN Protocol Concepts

- All *UA are asymmetric.
- M2PA is something like a symmetric IP-based MTP-2 link.
- The *UA use a cluster concept to handle host failures with similar messages.
- M3UA is the protocol mostly deployed.
- All adaptation layers use the same transport protocol for reliable message transfer.

# Stream Control Transmission Protocol

- Supports unicast
- Packet oriented
- Connection oriented
- Reliable Transport
- Flow and congestion control
- Supports multiple streams
- Supports multihoming
- Supports bundling of multiple user messages.
- Fragmentation and reassembly.

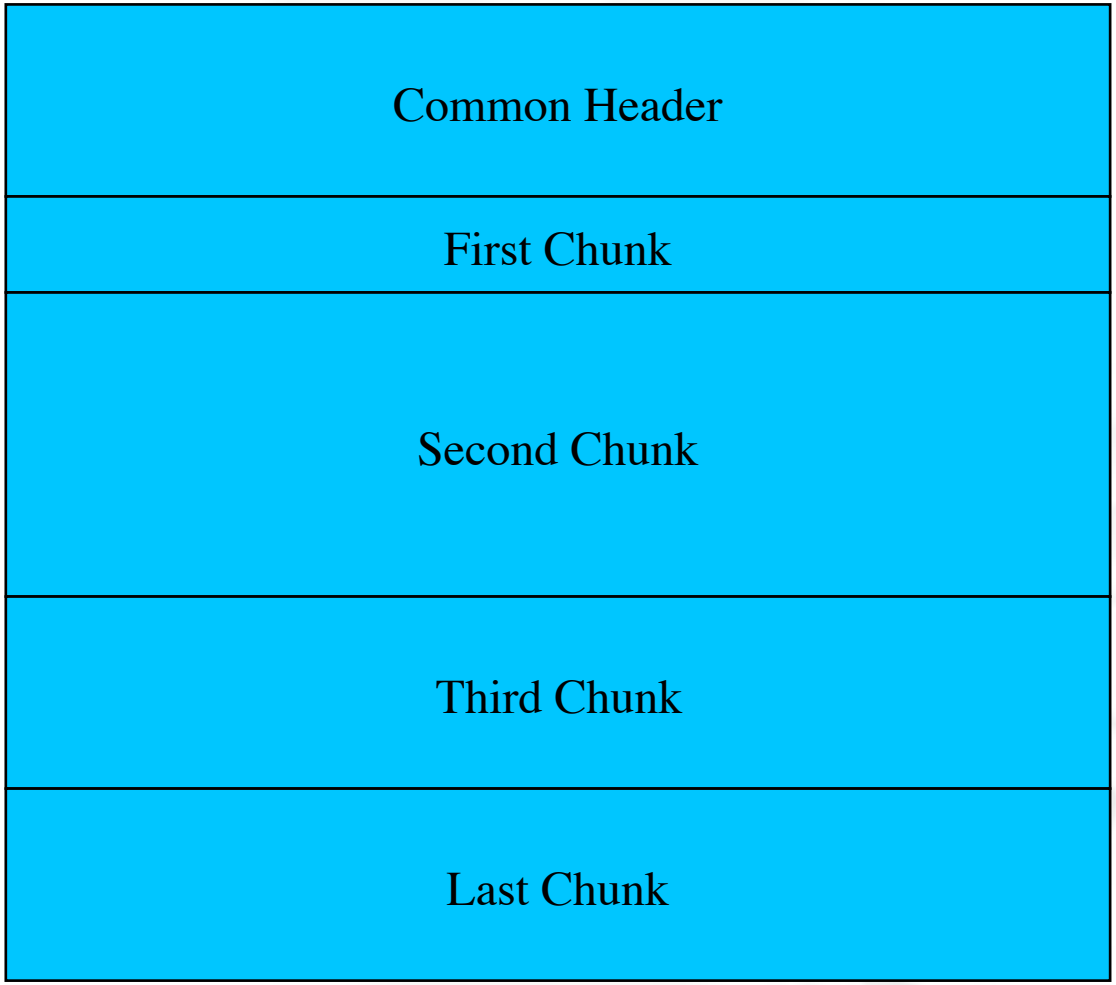
# SCTP Terminology

- An SCTP connection is called an association.
- SCTP uses the port number concept of TCP and UDP.
- An SCTP endpoint can be identified by a pair of a list of IP-addresses and a port number.

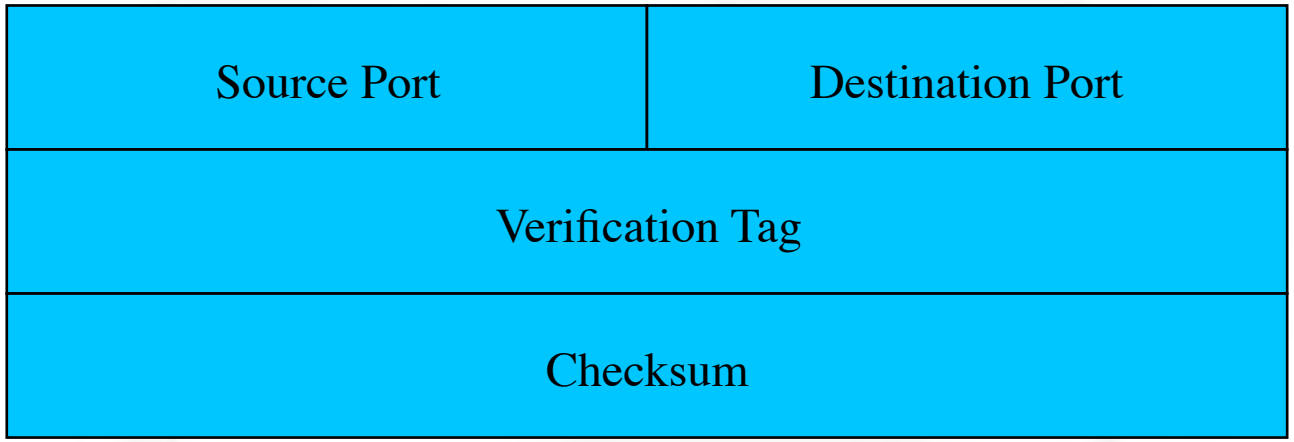
# Availability of Implementations

- Integrated in FreeBSD 7.
- For Linux: Part of 2.6 kernels and even back-ported to 2.4 kernels.
- Integrated in Solaris 10.
- For BSD Unix, Linux, Solaris, Mac OS X, HP-UX and Windows: sctplib (userland library).
- Several commercial implementations.
- Integrated in almost all SS7 nodes.

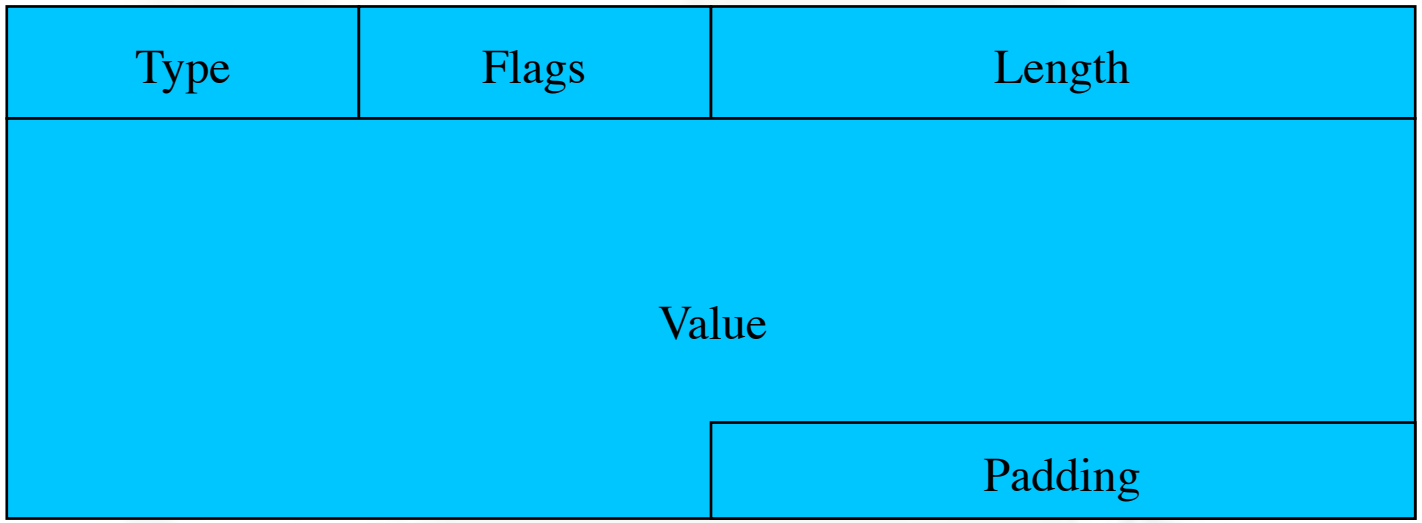
# SCTP Message Format



# SCTP Common Header Format



# SCTP Chunk Format



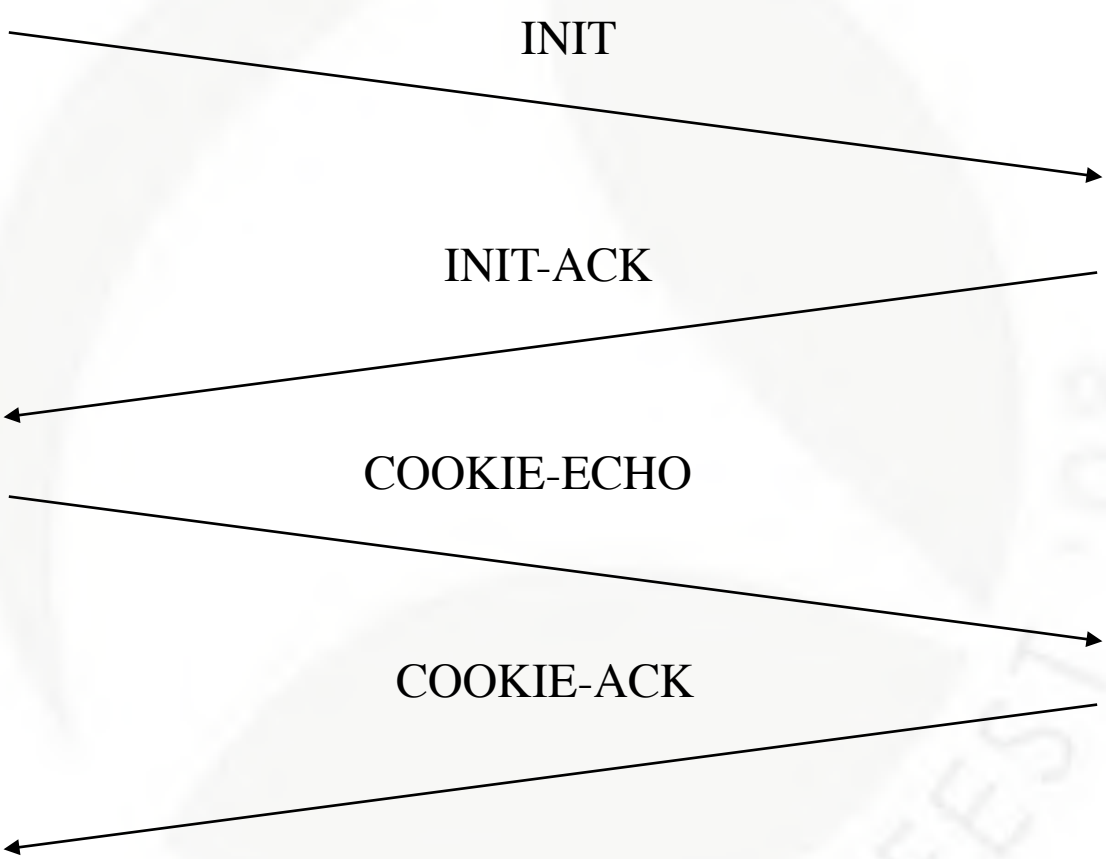
# SCTP Chunk Types

- 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.
- Four way handshake is used.
- Verification tags are exchanged.
- Maximal receiver window is exchanged.
- The number of streams are negotiated and can be different in each direction.
- The IP addresses of each endpoint are exchanged.
- The procedure is protected against ‚blind attacks‘.

# Message Flow



# The Role of the Verification Tag

- It is a 32-bit random number.
- It is chosen by each end-point.
- The protection against blind attackers is based on the verification tag.
- It 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.

# Support of 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 not part of RFC 4960 but 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.

# 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.
- An extension of the protocol.

# Address Reconfigration

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

# Wireshark Support for SCTP

- SCTP is supported including all standardized extensions.
- Finding all packets of an SCTP association is harder than finding packets of a TCP connection.
- A verification tag based heuristic is used for association analysis.
- Graphing capabilities.
- Payload detected by payload protocol identifier and port numbers.
- Reassembly.

# Conclusion

- SS7 can be transported over IP.
- SCTP is a generic transport protocol having a lot of interesting features.
- Wireshark
  - supports these protocols.
  - Has excellent support for SCTP.