Harman International

Understanding IEEE 1722
AVB Transport Protocol - AVBTP

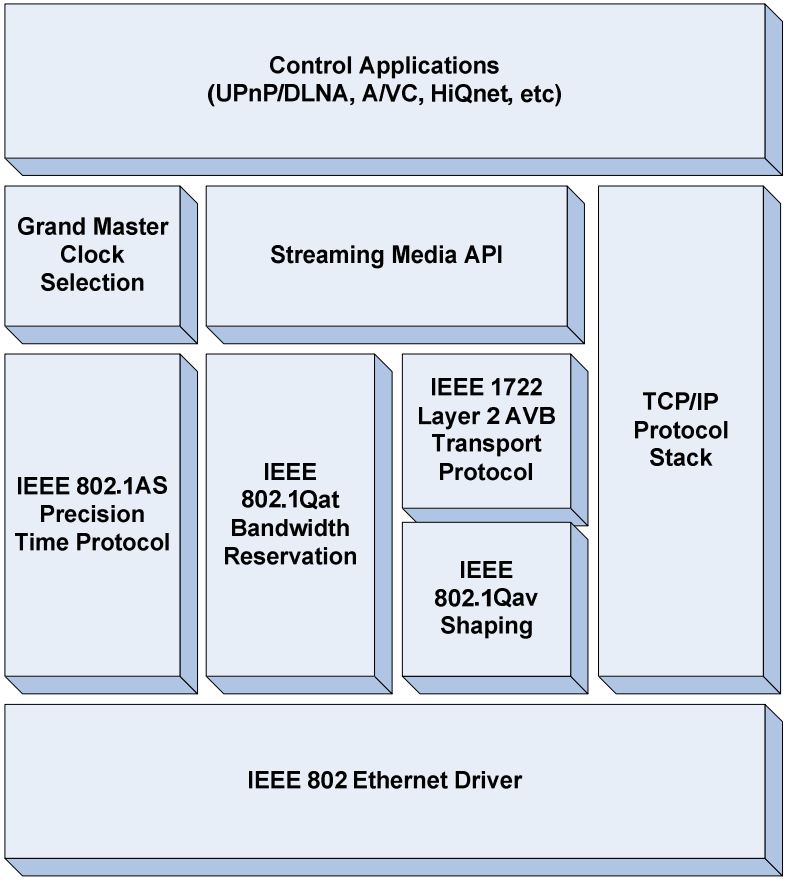
Robert Boatright
Chair, IEEE 1722

rboatright@harman.com
9 March 2009

What is the purpose of the AVB Transport Protocol?

- **IEEE 1722 enables interoperable streaming by defining:**
  - Media formats and encapsulations
    - Raw & compressed audio/video formats
    - Bridging IEEE 1394 LANs over AVB networks
  - Media synchronization mechanisms
    - Media clock reconstruction/synchronization
    - Latency normalization and optimization
  - Multicast address assignment
    - Assigning AVB Stream ID
    - Media clock master

Where does the transport protocol fit?



AVBTP packet components

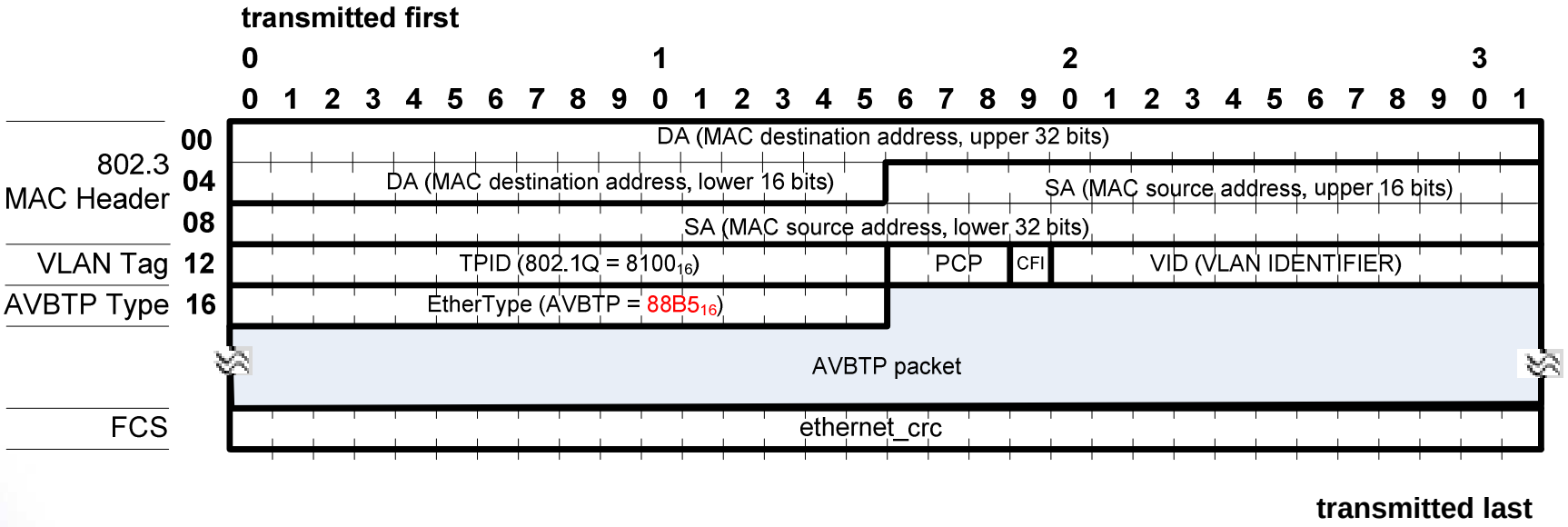
- Ethernet header

  plus

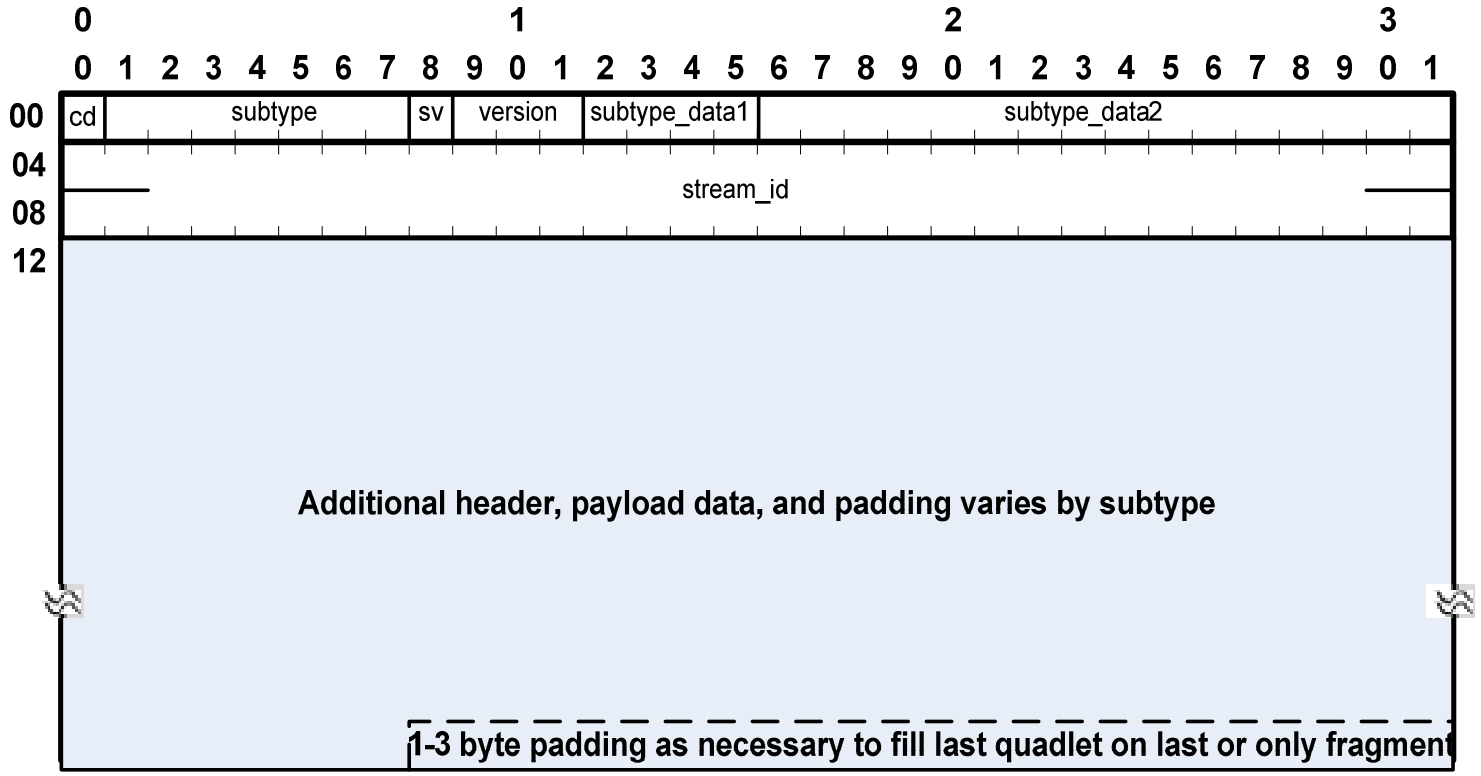
- Common frame header
  - Control frames
    - Common control frame header
    - Protocol-specific headers & payload

      or
  - Streaming frames
    - Common stream data header
    - Streaming data headers & payload

AVBTP packets encapsulated within Ethernet header

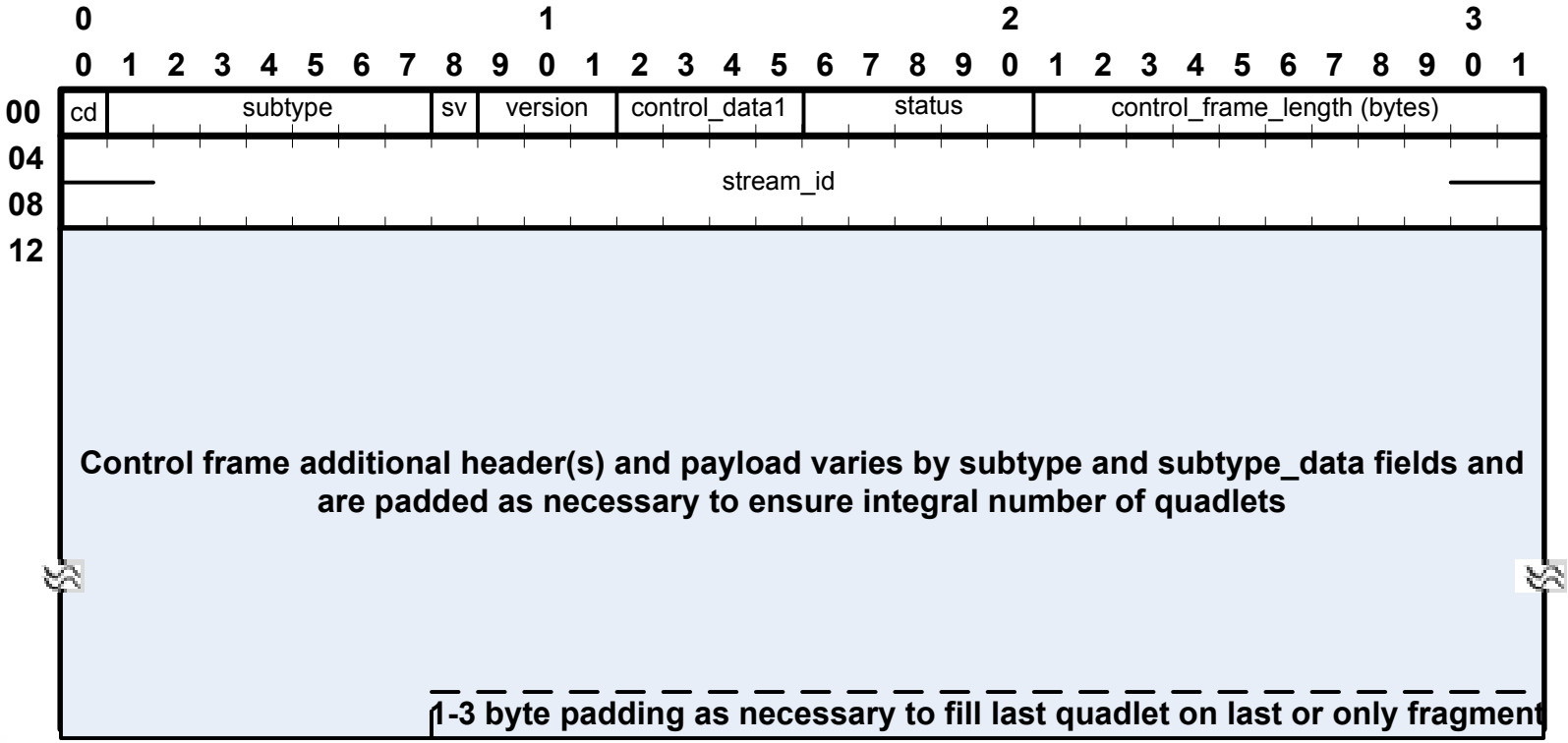


AVBTP frame common header fields



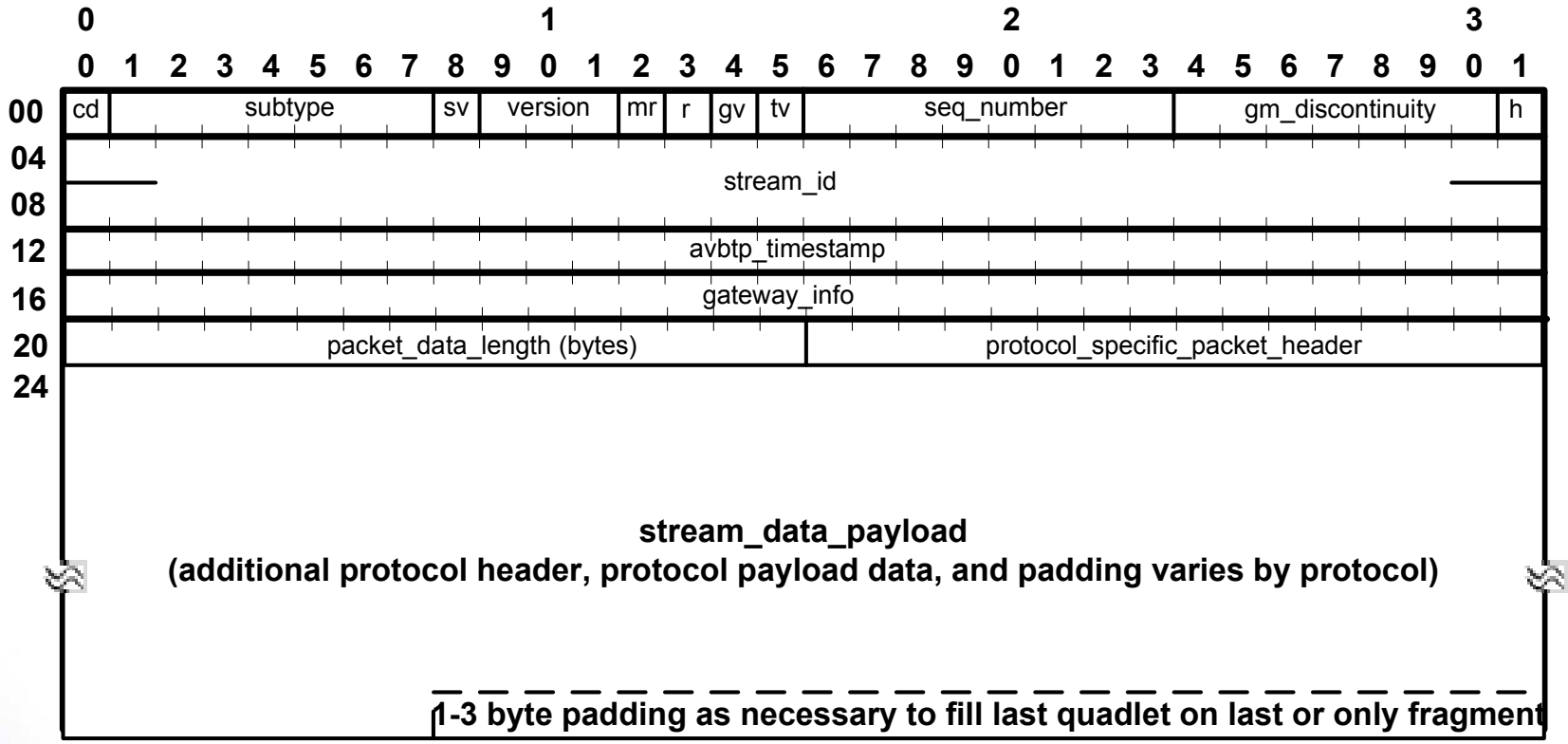
cd: control or data packet
subtype: protocol type
sv: stream_id valid
version: revision of p1722 standard
subtype_data1/2: protocol specific info
stream_id: IEEE 802.1Qat stream ID

Command/control packet header (cd=1)



control_data1: protocol-specific data
status: status flags, values, etc
control_frame_length: length in bytes of control payload

AVBTP common stream data header



mr: media engine restart
r: reserved
gv: gateway_info field valid
tv: avbtp timestamp valid
seq_number: sequence number
gm_discontinuity: grandmaster discontinuity
h: holdover

AVBTP subtype field specifies streaming protocol

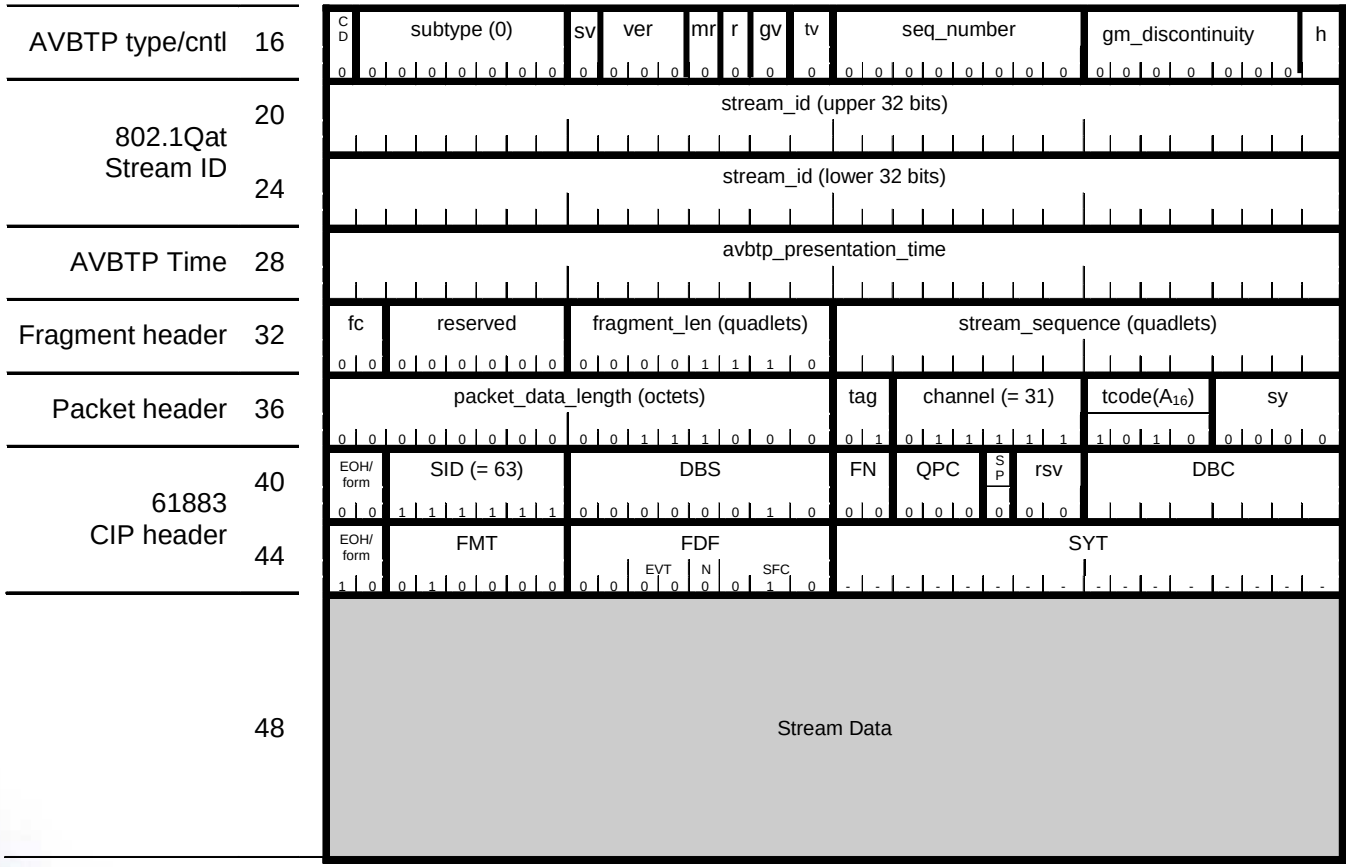
Hex Value	Function	Meaning
00_{16}	61883/IIDC	61883/IIDC over AVBTP
00_{16}-$7E_{16}$	-	Rsvd – future protocols
$7F_{16}$	Proprietary	Proprietary/experimental

Identify registration authority to administer future assignments?

Support for raw & compressed audio/video i.e. Firewire

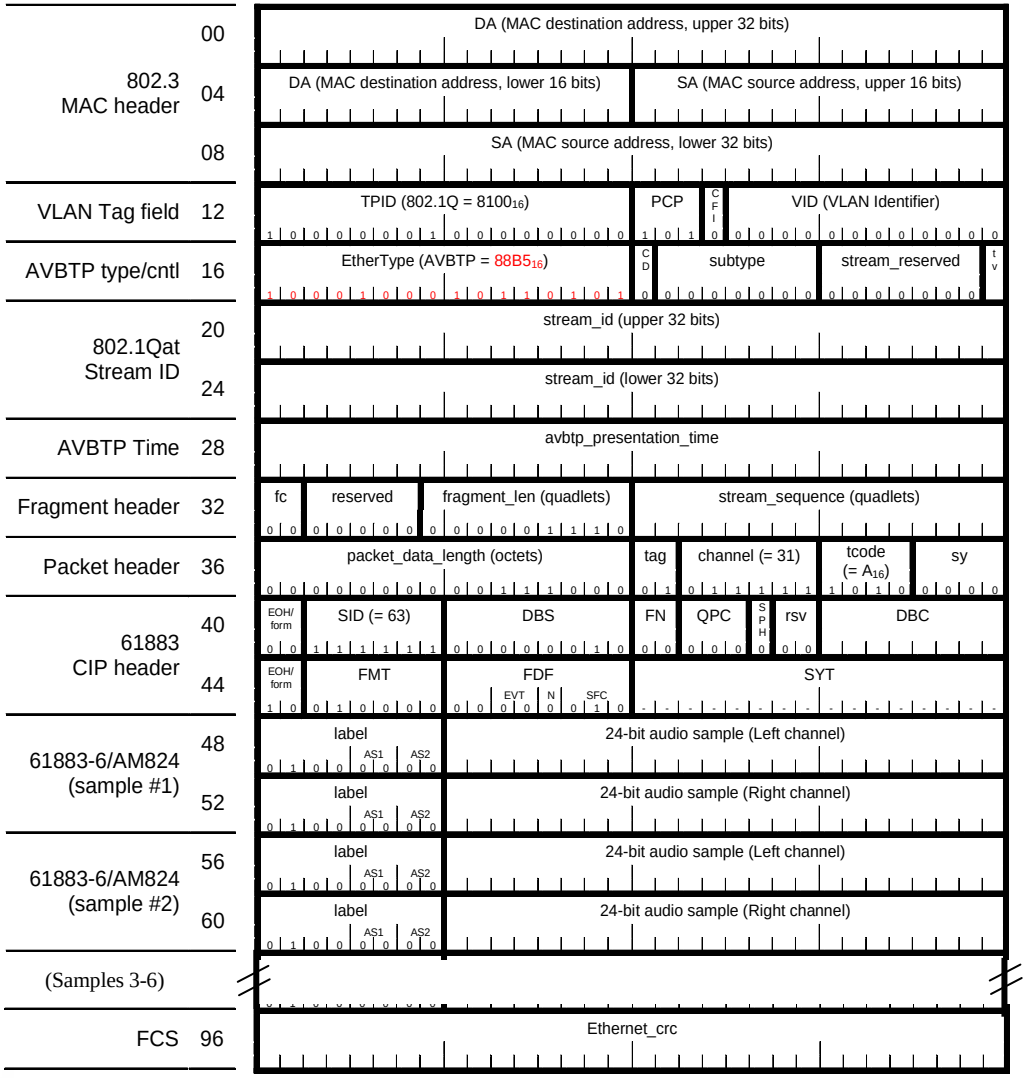
- Formats based on IEC 61883 parts 1-8[1]
  - **61883-2 SD-DVCR**
  - **61883-4 MPEG2-TS Compressed Video**
  - **61883-6 Uncompressed Audio**
  - **61883-7 Satellite TV MPEG**
  - **61883-8 Bt.601/656 Video**
  - **IIDC Uncompressed Industrial Cameras**

61883-*n* header/streams encapsulated in 1722 packets



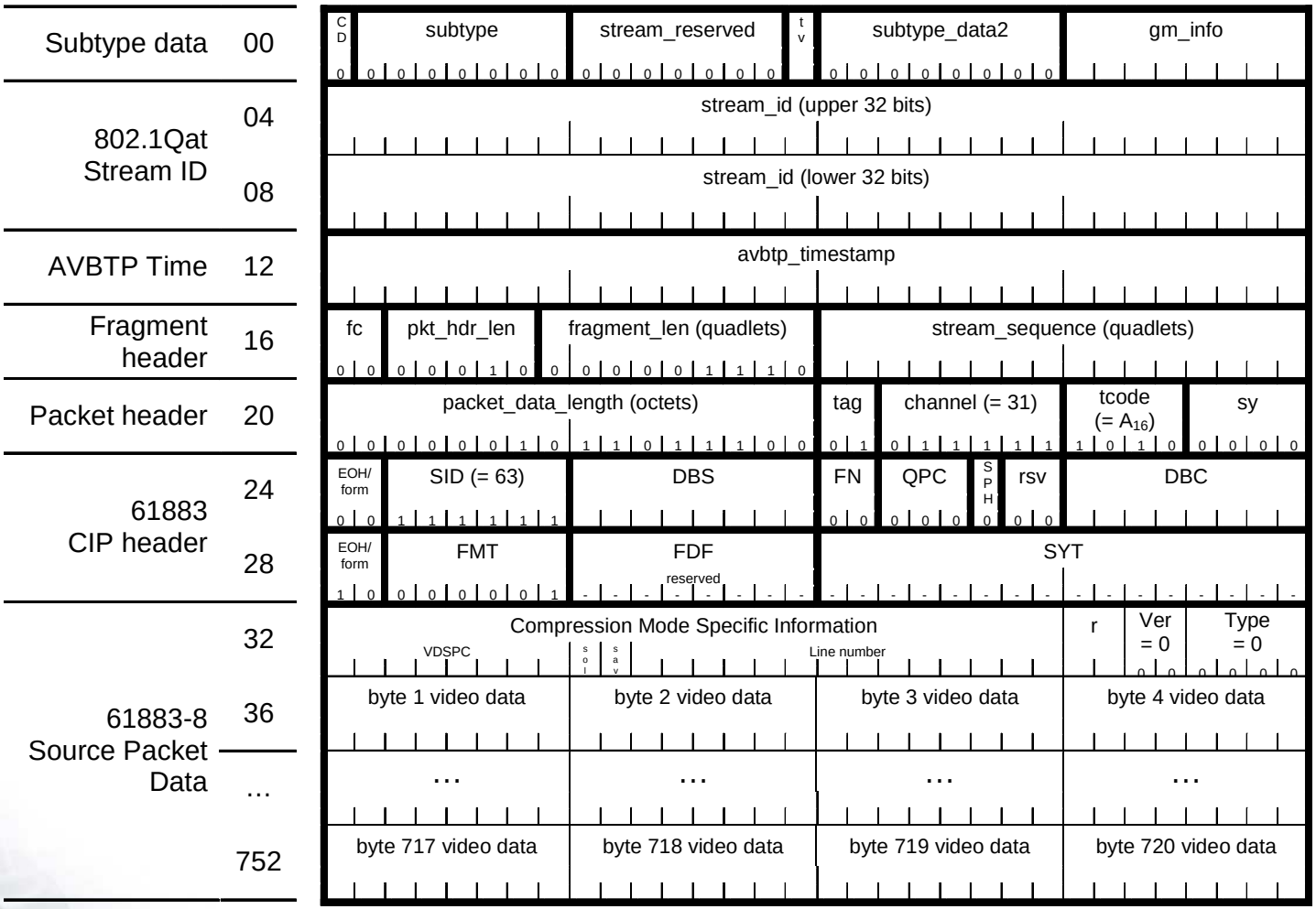
Example 61883-6 audio packet

P1722 packet format for 61883-6/AM824 (Multi-bit linear audio) 48kHz stereo stream



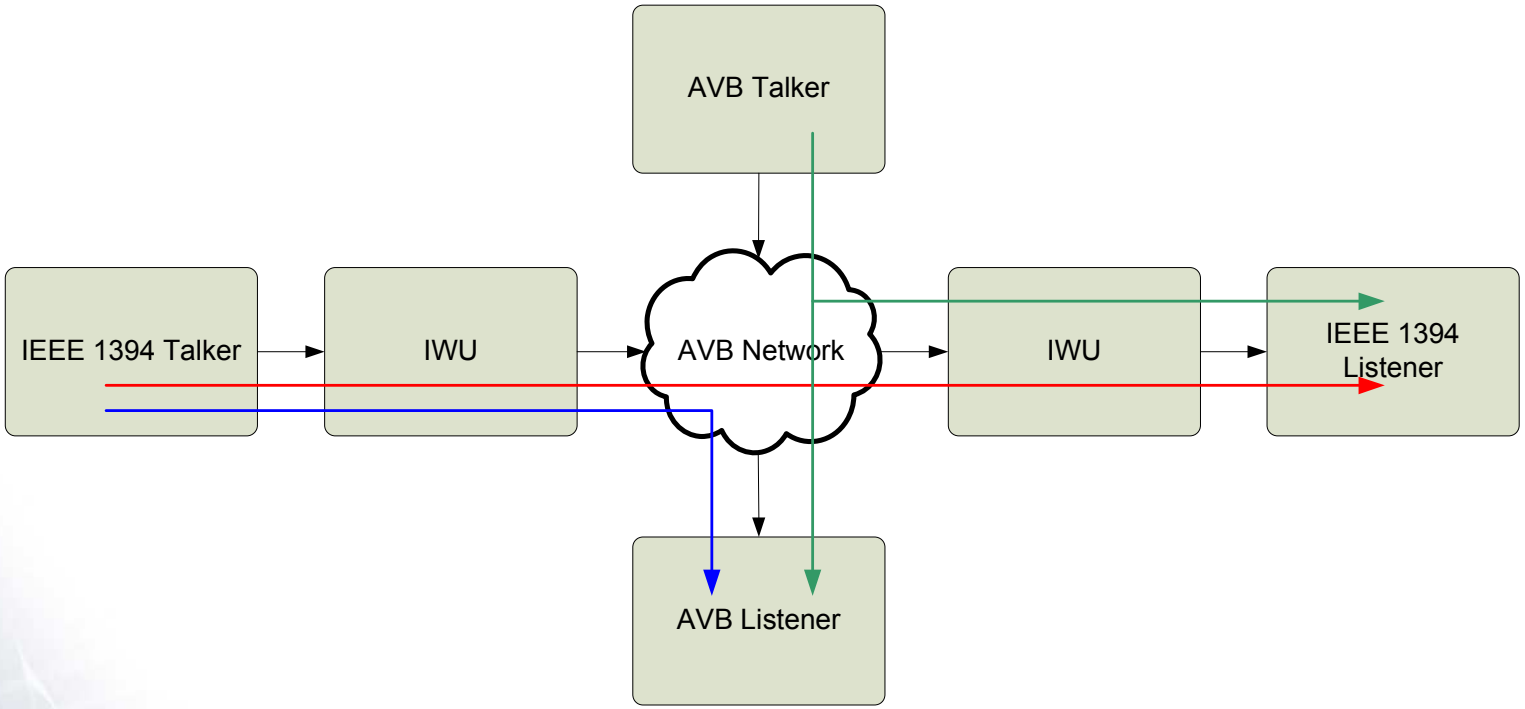
Example 61883-8 video packet

P1722 packet format for 61883-8, Source Packet Type=0 (video data)



Bridging IEEE 1394 LANs

- "Interworking Units" bridge 61883 between Firewire and AVB LANs

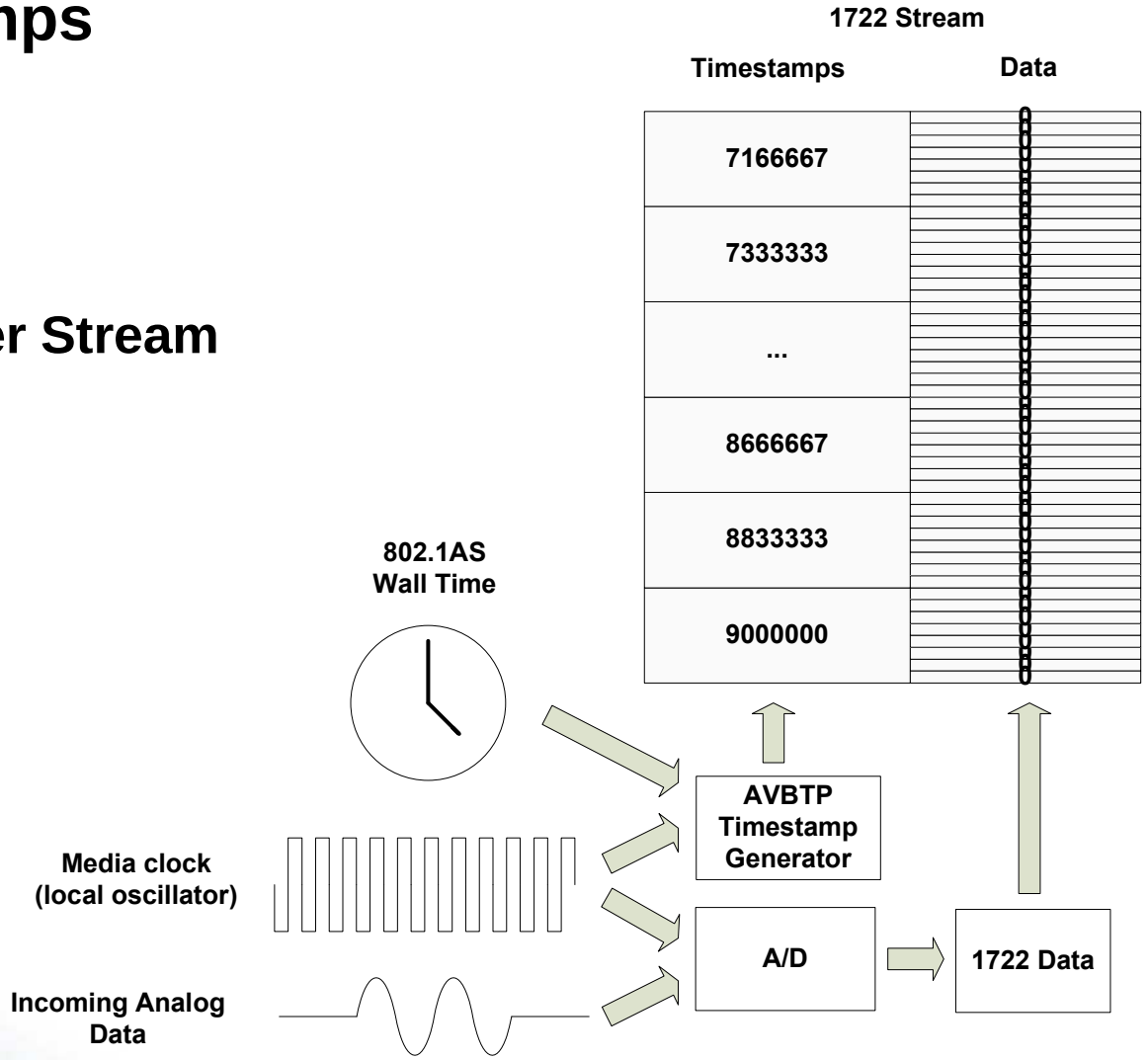


Synchronization mechanisms

- Media clock reconstruction
- Media clock master selection/management
- Presentation Time
- Latency normalization

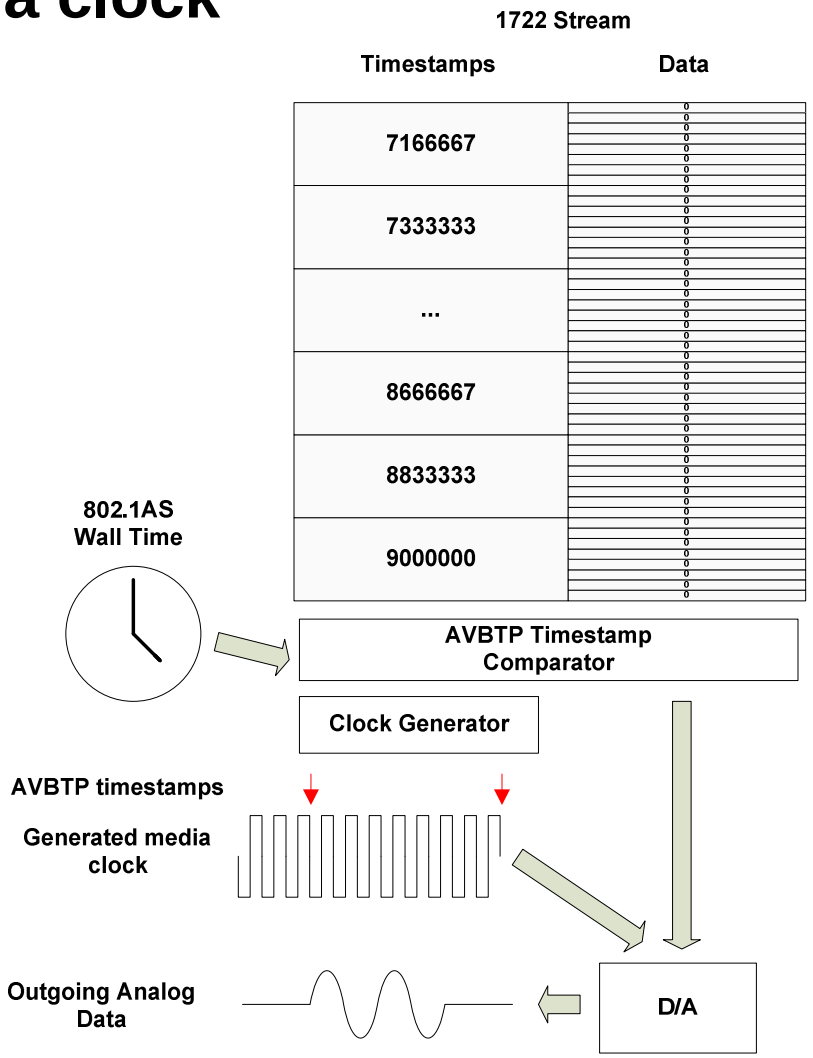
Media clock info embedded in talker's presentation timestamps

Talker Stream

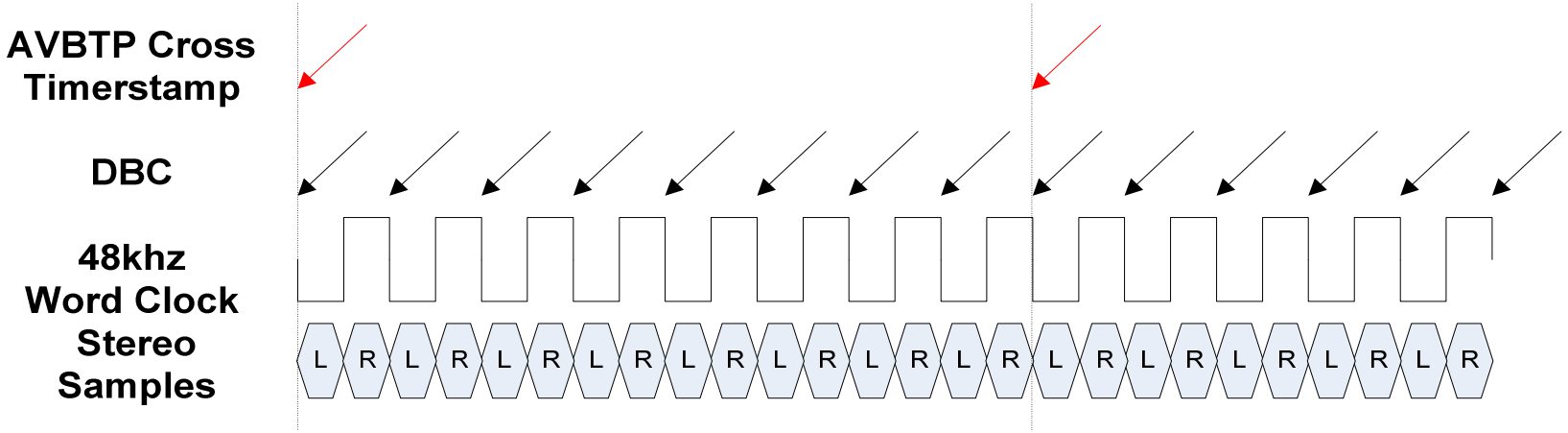


Presentation Time Stamps and 802.1AS wall time used to recreate media clock

Incoming Stream



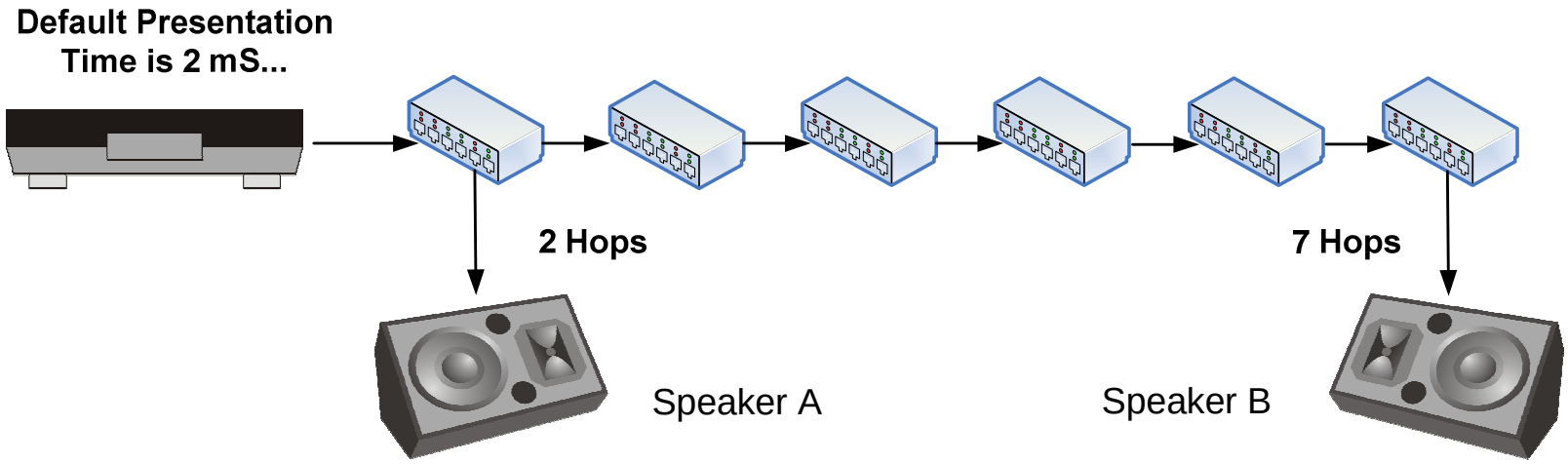
Media clocks are derived from cross-timestamping



A/V stream media clock management[2]

- 256 addresses for unique media clocks
  - Located at top of p1722 MAAP OUI range
- Each address identifies a unique A/V media clock source
  - Specified on per stream basis i.e.
    - 48 kHz audio word clock
    - 44.1 kHz audio word clock
    - Video genlock source
    - Etc
- Globally pre-assigned or dynamically negotiated?

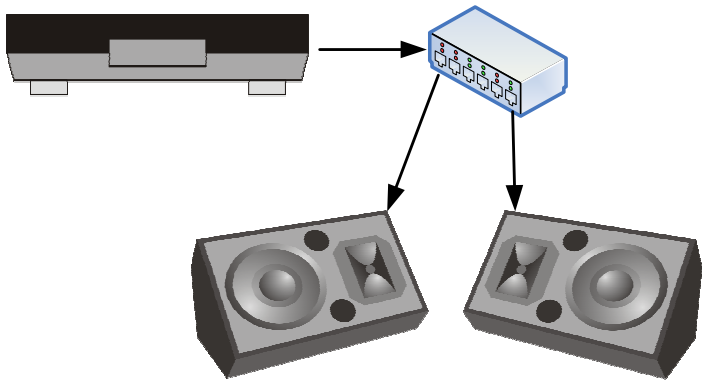
Latency Normalization



Speaker A buffers audio until Speaker B receives audio and presentation time is reached

Default Presentation Time is 2 ms…

… but Presentation Time
can be dialed down



2 Hops

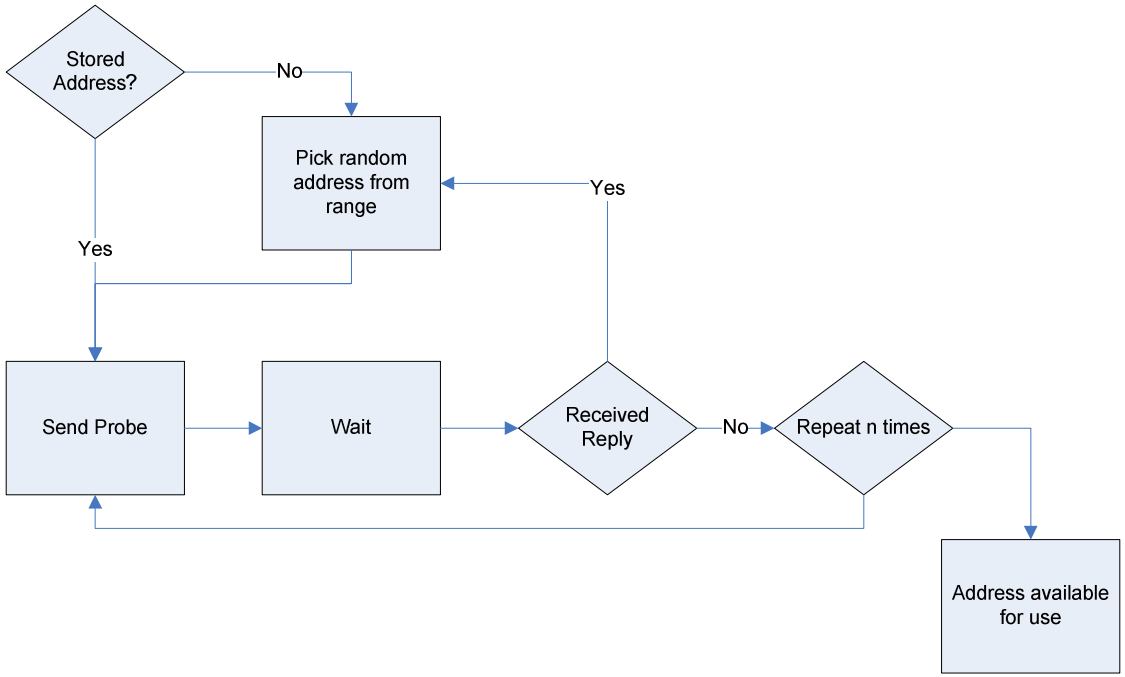
Talker is responsible for setting delay…

Multicast Address Allocation Protocol[3]

- Stream Addresses must be unique
- Stream Addresses also needed above Layer 2 i.e. IP, RTP, UDP…
- IP Streams
  - Need to use IPv4/IPv6 multicast addresses
  - Established Multicast infrastructure
  - Unique layer 2 multicast not guaranteed
  - Mapping from IP to layer 2 is not reversible
- Layer 2 Streams
  - No current method for dynamic Multicast Allocation
  - Vendors could assign additional MAC addresses to devices

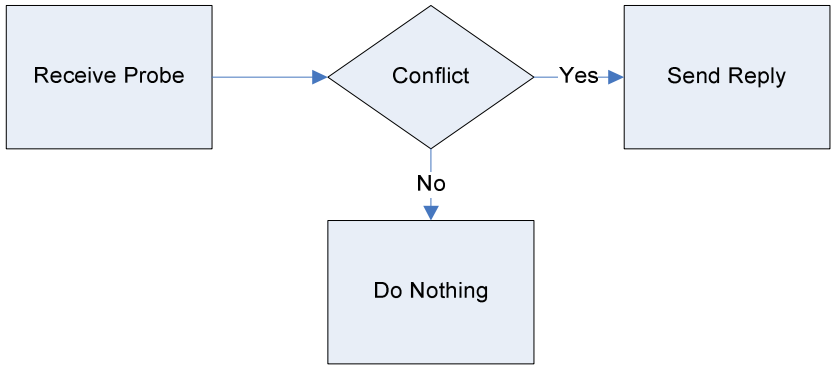
Address Acquisition Algorithm

- Pick random Stream Address(es)
- Probe
- Watch for Reply

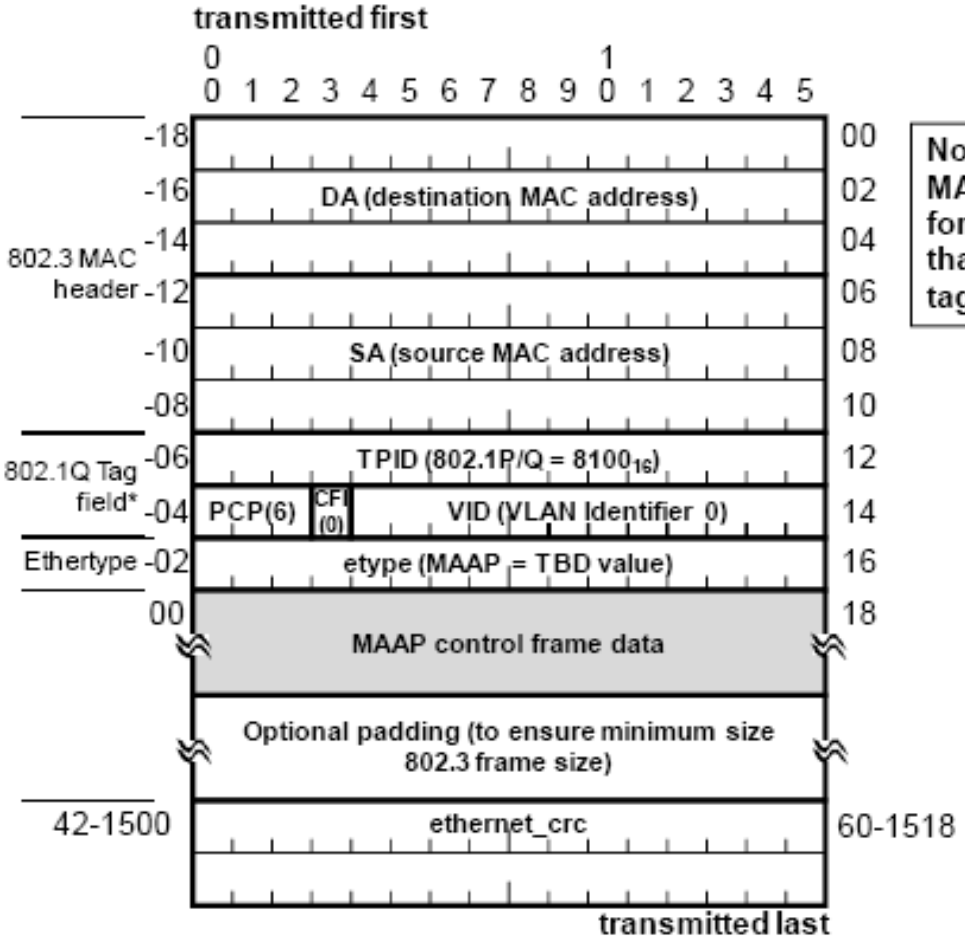


Address Defense Algorithm

- Watch for Probe packets
- If a conflict, send a Reply

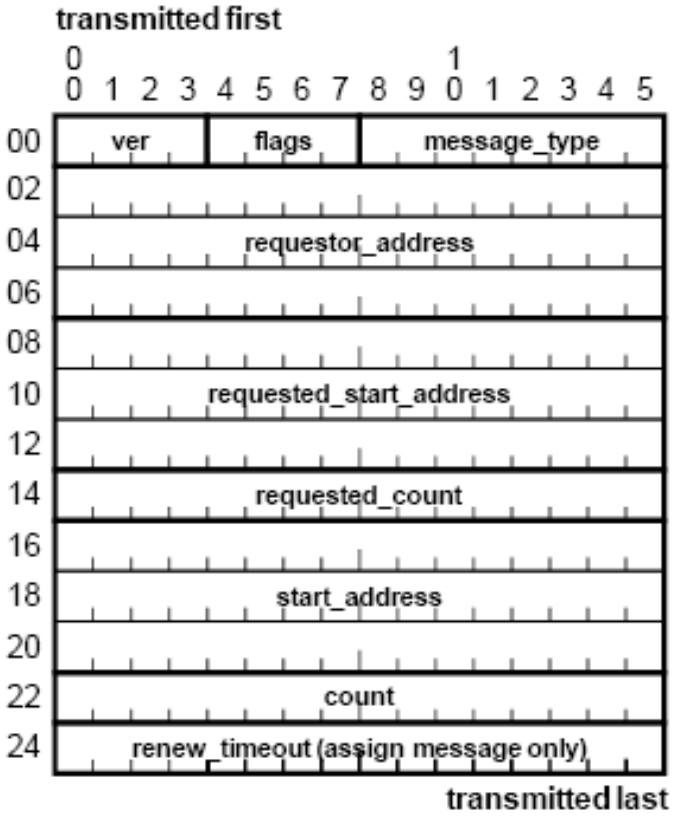


MAAP Control Frame



Note: A sending device may send MAAP frames in an untagged format but it is recommended that MAAP frames be 802.1Q tagged with PCP value set to 6.

MAAP frame format

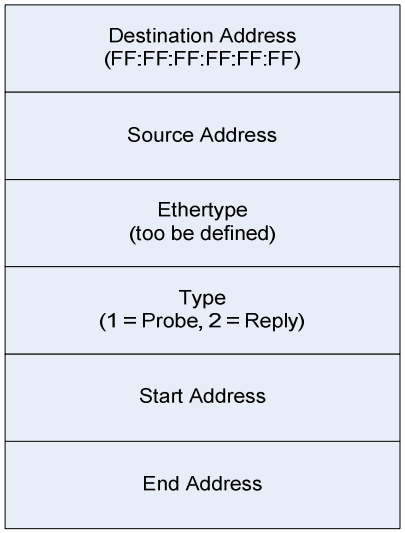


MAAP message types

Value (decimal)	FUNCTION	Meaning
0	--	Reserved
1	MAAP_PROBE	Probe MAC address(es) frame
2	MAAP_DEFEND	Defend address(es) response frame
3	MAAP_ANNOUNCE	Announce MAC address(es) acquired frame
4	MAAP_RELEASE	Release MAC acquired address(es)
5	MAAP_ASSIGN	Assign MAC address(es) command
6	MAAP_UNASSIGN	Unassign MAC address(es) command

Address Acquisition Packet

- Protocol allows for a single address or a range to be requested
- Reply packets should contain only the conflicting addresses



256 MAAP addresses reserved for media clocks

Value (hex)	FUNCTION	Meaning
00_{16} to $0F_{16}$	--	Reserved
10_{16}	MAAP_DEF_AUDIO	Default Audio Clock
11_{16}	MAAP_DEF_VIDEO	Default Video Clock
12_{16} to FF_{16}	--	Reserved

Identify Registration Authority to administer MAAP Media Clock addresses?

What's left to finish IEEE 1722?

- **Define Maximum Holdover Time**
  - Get from 802.1AS maximum convergence time amount or formula
- **Finish Media Clock Master algorithm**
  - Negotiate clock addresses or pre-assigned?
- **Latency**
  - Define Class B latency guarantees
  - Define latency measurement points
- **RAC requests**
  - AVBTP Ethertype, MAAP Ethertype & OUI
- **Define ext. variable interface**
- **Resolve Editor's Notes, inconsistencies, editorial errors, etc**
- **Draft version/comment iterations as necessary**
  - Aiming to start ratification process in CY2009

More info…

- Website
  - http://grouper.ieee.org/groups/1722/
- Email reflector
  - subscribe avbtp **<FirstName> <LastName>** to ListServ@ieee.org
- Weekly phone conferences
  - The AVB L2 Transport Protocol Working Group holds weekly phone conferences on Mondays at 2:00 p.m. Pacific/Los Angeles time.
  - Phone bridge: +1.866.888.5021 or +1.630.693.2119, Access code: 8451103#
- Face-to-face meetings every two months
  - Next meeting April 23, 2009 hosted by Xilinx in San Jose, California
  - Send RSVP to rboatright@harman.com

References

1. IEC 61883 Parts 1-8, 2003-2008
2. Media Clock Distribution in a 1722 Network, Dave Olsen, Oct. 2008
   http://grouper.ieee.org/groups/1722/contributions/avbtp-dolsen-Media-Clock-Distribution-v2.pdf
3. Stream Address Allocation in Ethernet AVB, Dave Olsen, Mar. 2007
   http://www.ieee802.org/1/files/public/docs2007/avb-do-stream-address-allocation-0307.pdf


AKG
AUDIOACCESS
BECKER
BSS AUDIO
crown
dbx
PROFESSIONAL PRODUCTS
DigiTech
harman/kardon
Infinity
JBL
lexicon
mark levinson
QNX
QNX SOFTWARE SYSTEMS
REVEL
Soundcraft
STUDER
professional audio equipment
Harman International
Premium Solutions for Audio and Infotainment