AES-X242 and S-ADM

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AES Project AES-X242 – "Streaming audio metadata over IP networks"

Audio metadata for AES67

- Separate RTP stream for metadata associated with PCM essence in AES67

- Intended to support broader AES67 user base, not just broadcast applications

- Format agnostic, open to any kind of audio metadata

- ITU-R BS.2125 (Serial ADM) a primary format for requirements

End to end perspective – "Microphone to Speaker" metadata

mixing
console

emission
coder
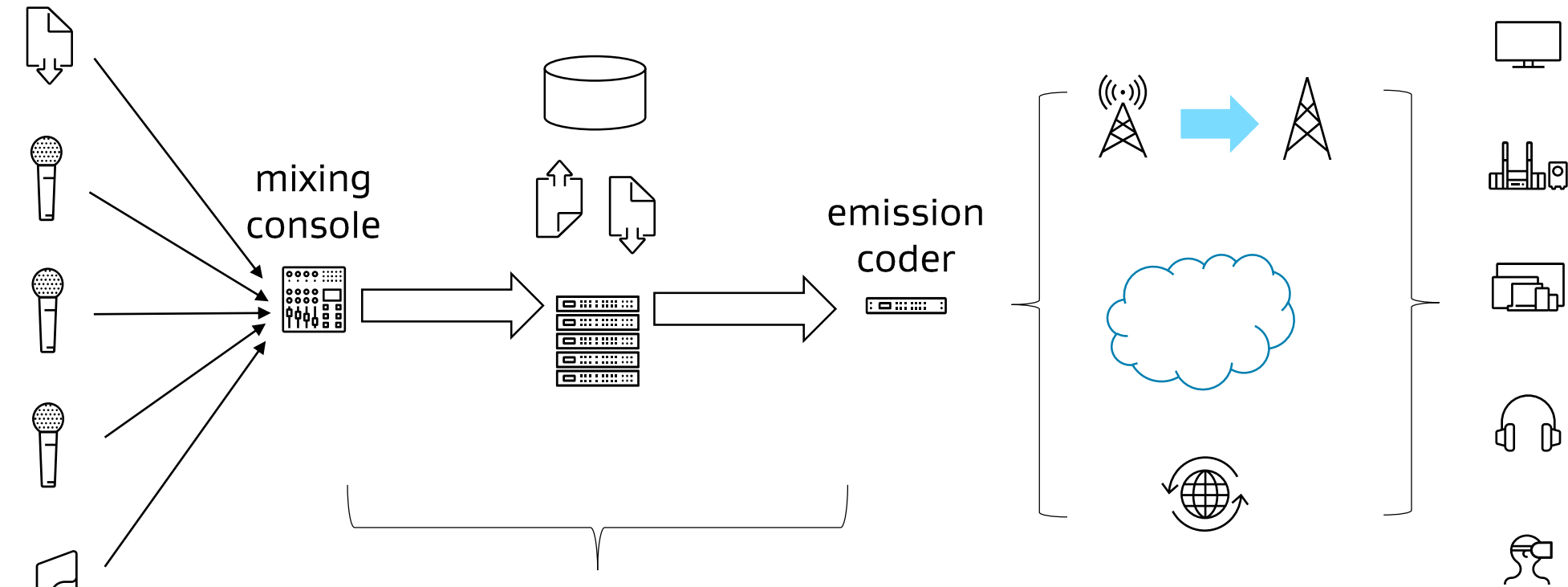
Audio Metadata in Live Production

Audio Metadata in Legacy/"Non-IP" Live Production (Broadcast)

Live production currently channel based in practice

- 2.0 or 5.1 most common

Limited support for audio metadata, especially dynamic (time varying) metadata

- But generally sufficient for current production practices

Historically a lack of standards defining audio metadata and transport of metadata for live production
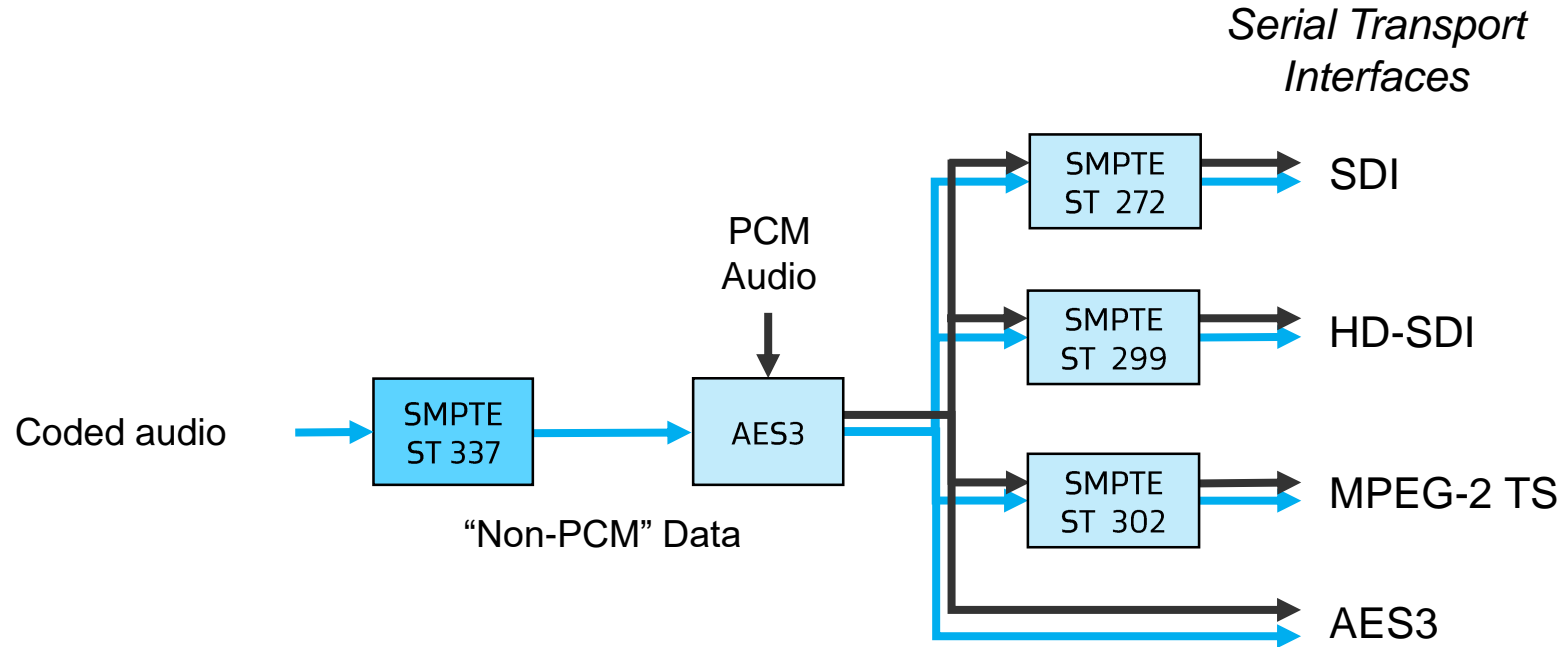
- AES41, RDD6, ST 2020, . . .

SMPTE ST 337 – "Non-PCM data in AES3" in common use for 20+ years

- Includes formats for compressed audio with included metadata (e.g. Dolby E)

Until recently limited support for > 5.1 and new immersive formats (e.g. object based audio)

- Recent trials have demonstrated new capabilities

SMPTE ST 337 – "Non-PCM data in AES3"

Builds on existing standards

Non–PCM data can be carried with PCM data (per track usage)

Requirements for Live Metadata Transport

Functional –latency, switching, synchronization, . . .

Expandable – new evolving metadata

Open –standard and non-standard/private data

Bandwidth – average and burst data rates

File Interchange – seamless/virtualized

Present/Future – SDI/AES3 to IP to Cloud based systems

Standards – interoperability; build on existing standards

Enable innovative new services

Extensible Metadata Format (EMDF)

Standards based: defined in ETSI TS 103 190-1 (AC-4)

A payload based format for transporting audio metadata with coded audio (emission)

- Related metadata grouped together for transport (e.g. loudness)
- Only transmit payloads that are needed at a given time
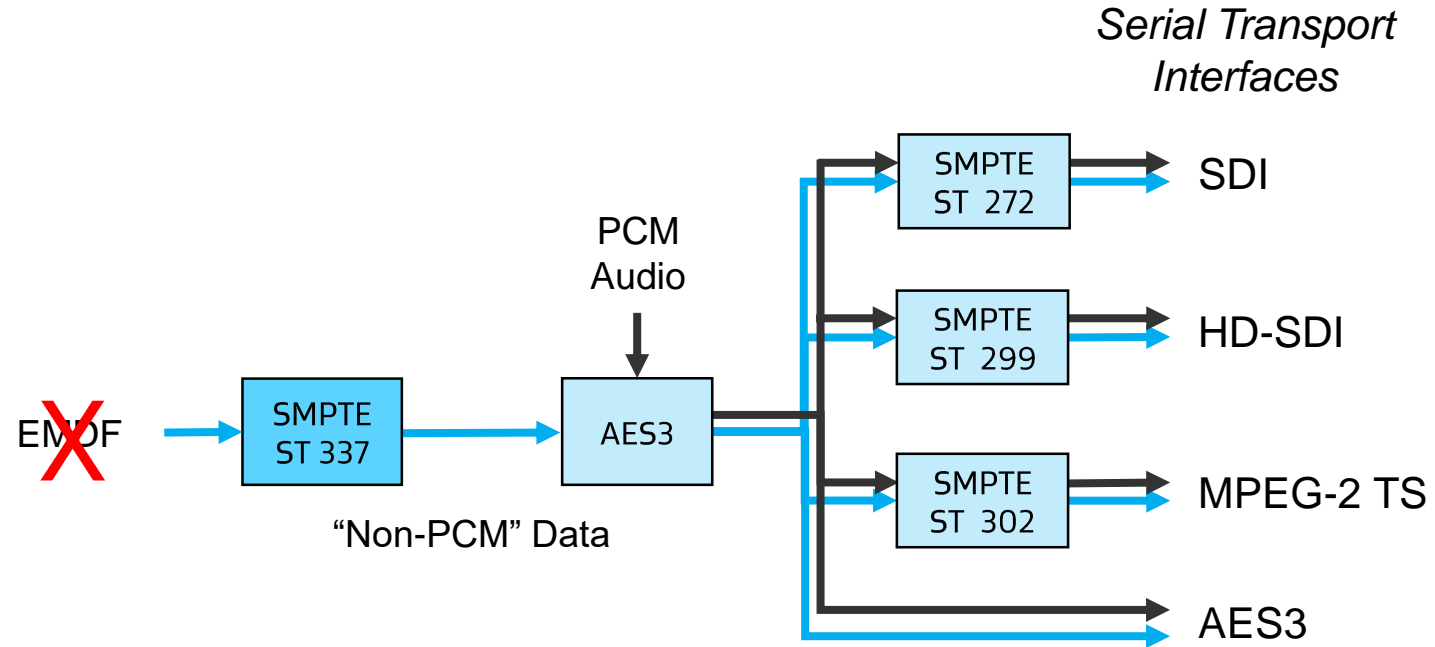
Supports live *dynamic* metadata

Extensible to support new payloads

Open registry (EMDF-RA.ORG)

Allows metadata to *evolve* over time

Can this model be applied to live production?

EMDF in SMPTE ST 337 ?

Serial Transport Interfaces

EMDF intended for emission application – not fully suited for production

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SMPTE ST 2109 – Audio Metadata over AES3

Defines *format agnostic* transport of audio metadata in AES3 via ST337

- Does not define metadata, only transport
- Supports payload model similar to EMDF

Uses Key–Length–Value (KLV) defined in SMPTE ST 336 and existing ST 338 data type for KLV (SMPTE ST 355)
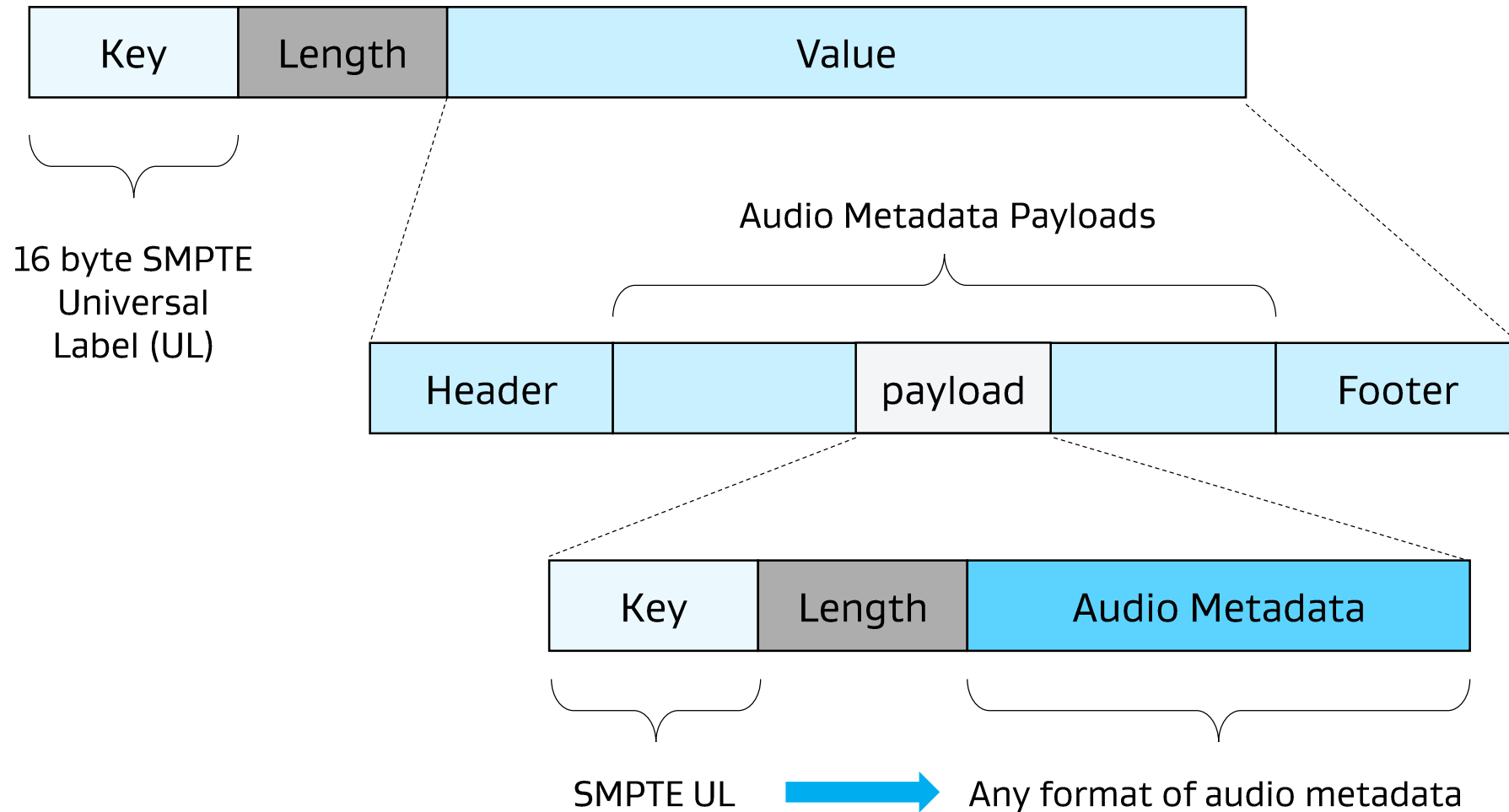
KLV used as audio metadata *wrapper for transport*

Metadata is NOT required to be in KLV format – it can be any format (including S-ADM)

Utilizes existing SMPTE Metadata Dictionary and associated standards for registration of metadata payloads

Sample accurate transport of live dynamic audio metadata

Published 2019

SMPTE ST 2109 Container

Key	Length	Value

16 byte SMPTE
Universal
Label (UL)

Audio Metadata Payloads

Header		payload		Footer

Key	Length	Audio Metadata

SMPTE UL → Any format of audio metadata

SMPTE ST 2109 Features

Supports standard/public and non-standard/private metadata

Dynamic mapping of payload tags for non-registered data (private and experimental ULs)

Optional bitstream error detection

Timing fields to offset time references

- Per container or per payload

All payloads optional – only use payloads that are needed

Multiple payloads with different metadata formats can be sent in same container

RDD 49 – Professional Metadata (PMD)

SMPTE RDD 49 (PMD) defines a payload based audio metadata format optimized for ST 2109

Encodes metadata in an efficient binary format

- Needed for data rate restrictions with Dolby E applications, but suitable for PCM as well

Not a standard but published as an open specification

RDD 49 requires ST 2109 but *ST 2109 does not require RDD 49*

ST 2109 defines transport while RDD 49 defines metadata

SMPTE ST 2116 – Serial ADM over AES3

Transport of ITU-R BS.2125 audio metadata in AES3 via ST 337

- Separate ST 337 data type – not ST 2109

Audio Definition Model (ADM) BS.2076 data formatted for serial interchange

Restricts ST 337 usage to S-ADM only – no metadata outside S-ADM structure supported

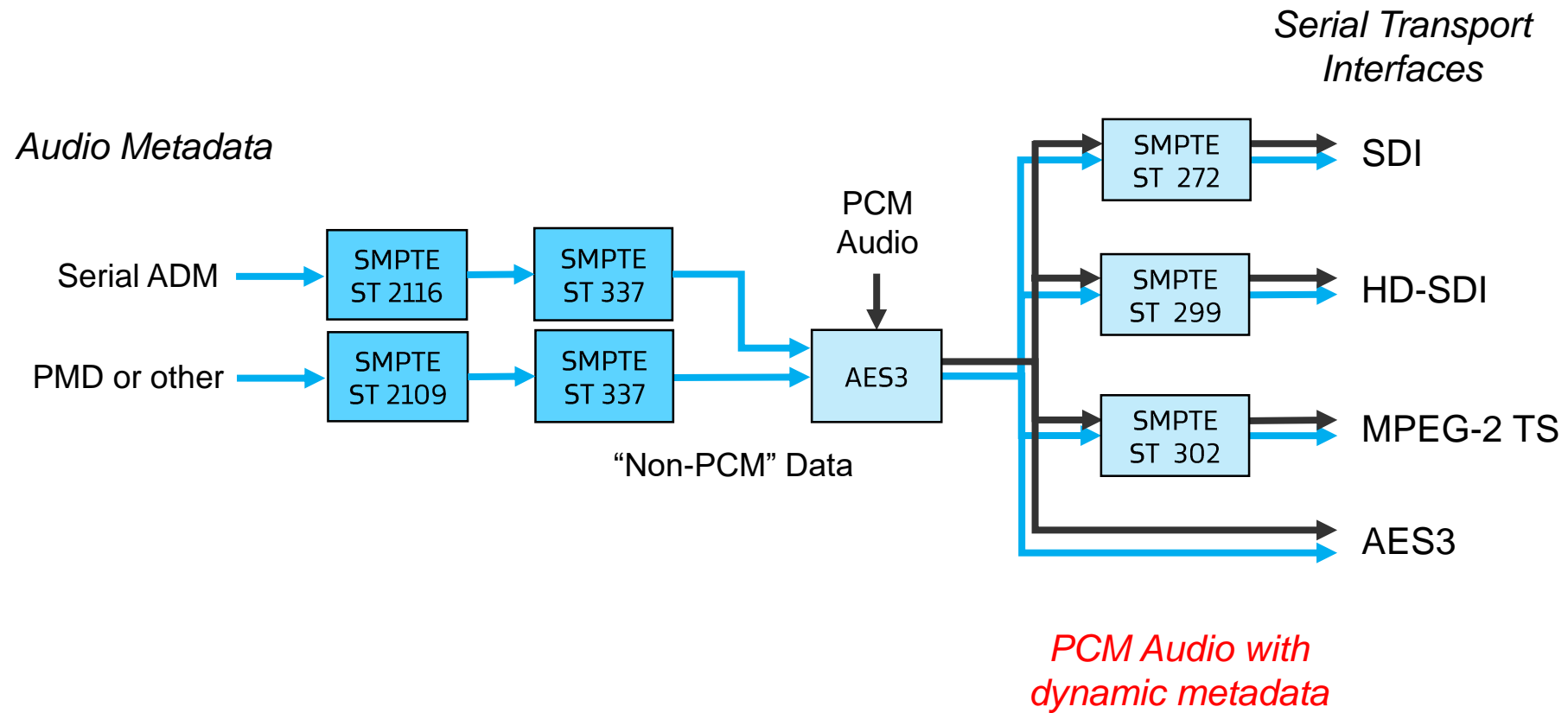- Can send in separate AES3 channel though

Requires ST 337 subframe mode (1 AES3 channel)

Specifies multiple AES3 channels for multi-track modes

Currently supports native and GZIP representations

In SMPTE publication queue (2019 publication expected)

Audio Metadata in Legacy/"Non-IP" Interfaces

Serial Transport Interfaces

Audio Metadata

Serial ADM → SMPTE ST 2116 → SMPTE ST 337

PMD or other → SMPTE ST 2109 → SMPTE ST 337

PCM Audio → AES3

"Non-PCM" Data

SMPTE ST 272 → SDI

SMPTE ST 299 → HD-SDI

SMPTE ST 302 → MPEG-2 TS

AES3

PCM Audio with dynamic metadata

Serial ADM in SMPTE ST 2109

ST 2109 Key	Length	Value

S-ADM Tag	Length	S-ADM

SMPTE UL ➡ A format of S-ADM data (e.g. GZIP)
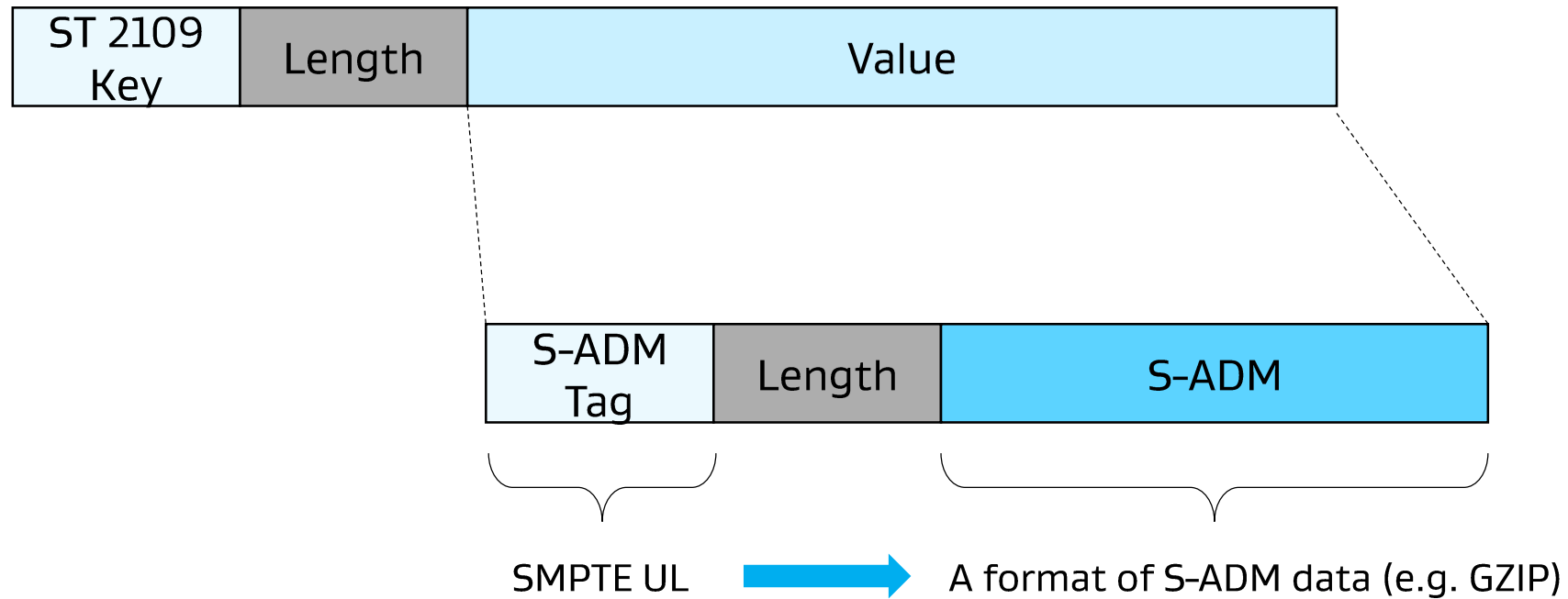
S-ADM can be carried in a single ST 2109 payload
No other ST 2109 payloads are required

Audio/Video over IP (AVoIP)

AES67 – Audio over IP Interoperability

- PCM Audio only; no support for "non-PCM" data

SMPTE ST 2022-6 – Transport of High Bit Rate Media Signals over IP Networks (HBRMT)

- Includes SDI audio (embedded in ancillary space)

## SMPTE ST 2110 Series – Professional Media Over Managed IP Networks

SMPTE ST 2110–30 – PCM Digital Audio

- Based on AES67
- As with AES67 transports PCM Audio only; no support for "non–PCM" data

SMPTE ST 2110–31 – AES3 Transparent Transport

- Based on RAVENNA AM824
- Carries full AES3 signal with channel status/user data
- Supports "non–PCM" data; carriage of coded audio a primary application

Audio Metadata over IP with AES3
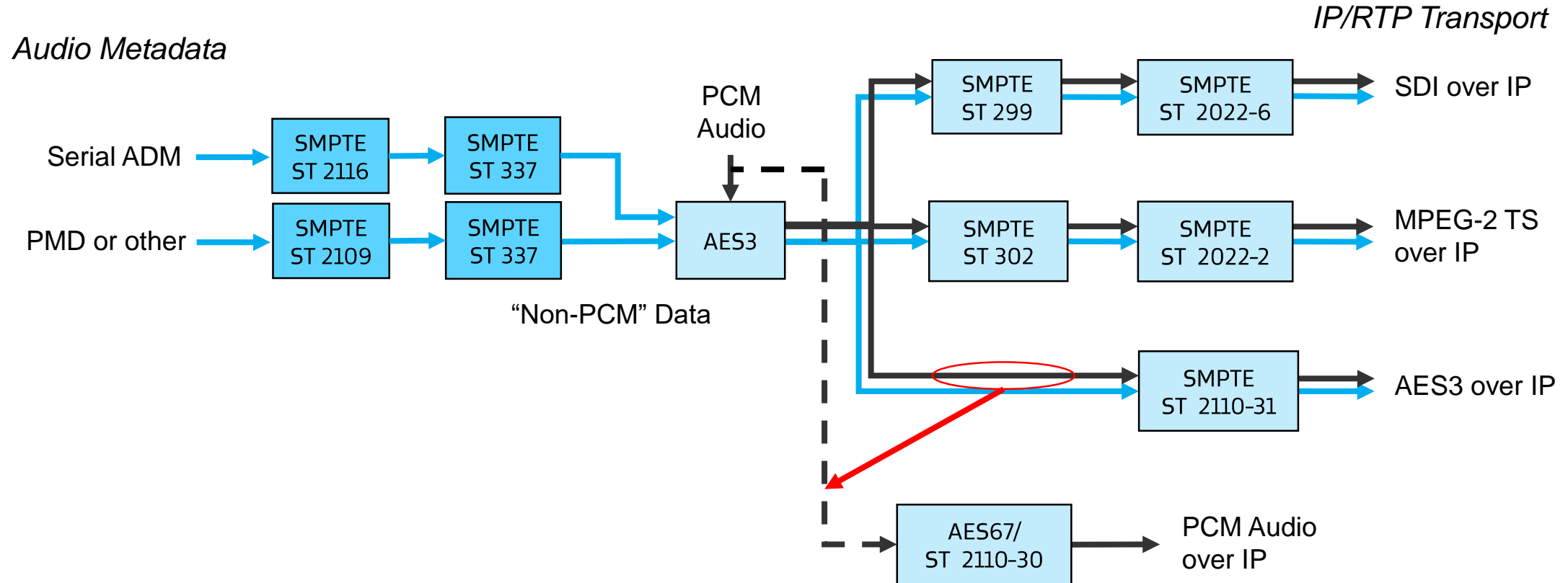
Limitations of AM824/ST 2110-31 for Audio Metadata

Requires constant bit rate AES3 pairs
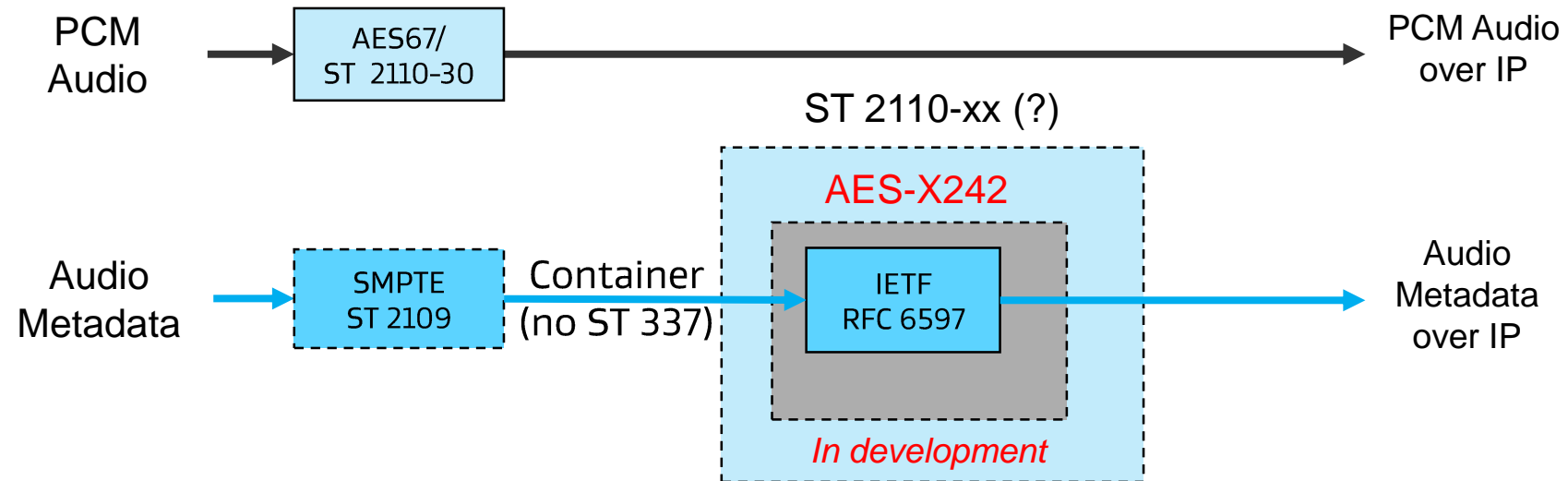
- Multiples of ~3 Mbps

Average bit rate may be much less than 3 Mbps

Burst bit rate may require additional 3 Mbps

Legacy tunneling format not ideally suited for IP transport

- Brings legacy issues (lack of signaling, bit depth, etc.)

AES-X242 – IP Audio with Native Metadata (as proposed)

PCM
Audio

**AES67/
ST 2110-30**

PCM Audio
over IP

ST 2110-xx (?)

AES-X242

Audio
Metadata

**SMPTE
ST 2109**

Container
(no ST 337)

**IETF
RFC 6597**

Audio
Metadata
over IP

In development

- Map ST 2109 containers *directly* to RTP
- Free of legacy constraints with AES3/ST337 tunneling
- Full metadata support for NGA and advanced audio applications

AES Project AES-X242 – "Streaming audio metadata over IP networks"

http://www.aes.org/standards/meetings/init-projects/aes-x242-init.cfm

- To define a standardized method for transporting metadata associated with audio in an AES67 stream. The audio metadata shall be transported in a separate stream that is sent in parallel to AES67 streams rather than part of the AES67 stream. The standard shall define synchronization between the audio metadata transport and the associated AES67 transport. The transmission method shall be low latency and have a level of network performance equivalent to AES67. Within the scope is formatting of the streaming audio metadata for transport. Suggested is an open standards based framework that supports both static and dynamic, time synchronous metadata that is optimized for live workflow applications. The standard shall consider all use cases for metadata associated with AES67, support existing AES audio metadata standards, and be extensible for future metadata requirements. The standard will consider binding between the audio metadata transport and the associated AES67 transport.

Audio metadata for AES67

- Targeted for audio metadata interface, similar to AES67 for PCM audio interchange
- Project initiated in AES to support wider AES67 applications, not restricted to ST 2110
- Helpful in broadcast production not utilizing ST 2110

Work started in AES SC-02-12-R in 2017

- Currently in committee working draft state
- Draft publication targeted for 2020

SMPTE ST 2110-40 – Ancillary Data over IP
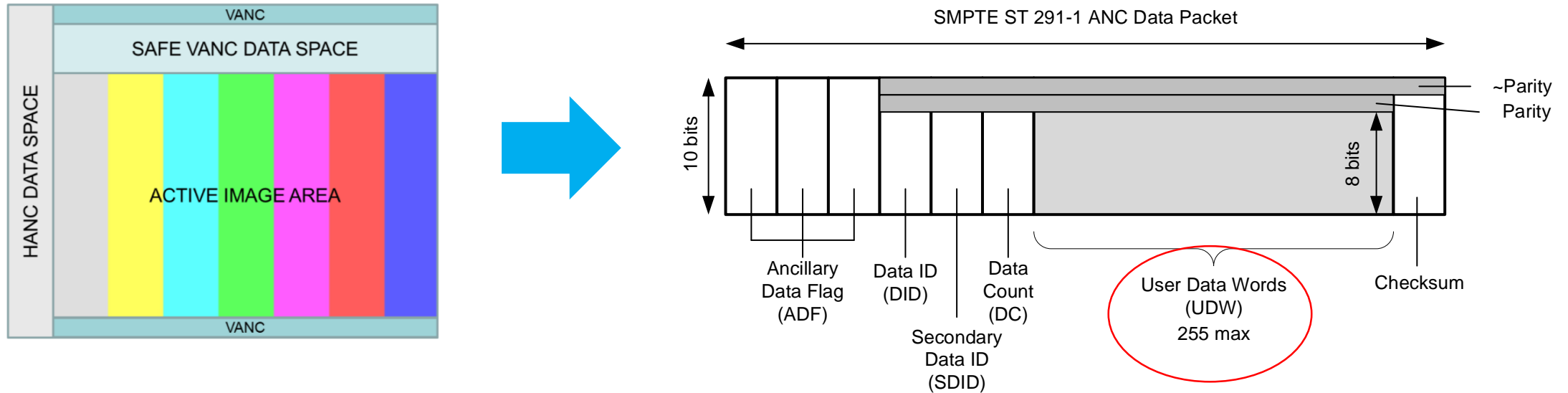
References IETF RFC 8331 *RTP Payload for SMPTE ST 291-1 Ancillary Data*

Specific for transport of ST 291-1 ANC data packets

Open to arbitrary data but subject to restrictions of ANC packet structure

32NF-60 Studio Video over IP (SVIP): ST 2110-41 "Fast Metadata"

https://kws.smpte.org/higherlogic/ws/public/projects/558/details

- Problem to be solved:: In the ST 2110 suite, there is provision for carriage of legacy ST 291 ANC metadata. This legacy SDI-centric method is described in ST 2110-40 and provides an excellent bridge to IP for SDI services. In the IP-centric future, there will undoubtedly be new metadata requirements which will have no relevance or application in the SDI domain and additionally may not be appropriate for efficiently wrapping in legacy ST 291 SDI ANC packets for IP transport with 2110-40. This project will create a new transport method for arbitrary metadata using RTP packets in the same manner as the other 2110 standards. This method will not be strictly tied to any type or form of metadata. Use of the 2110 synchronization mechanism will permit transmission in association with a 2110 essence stream. . .

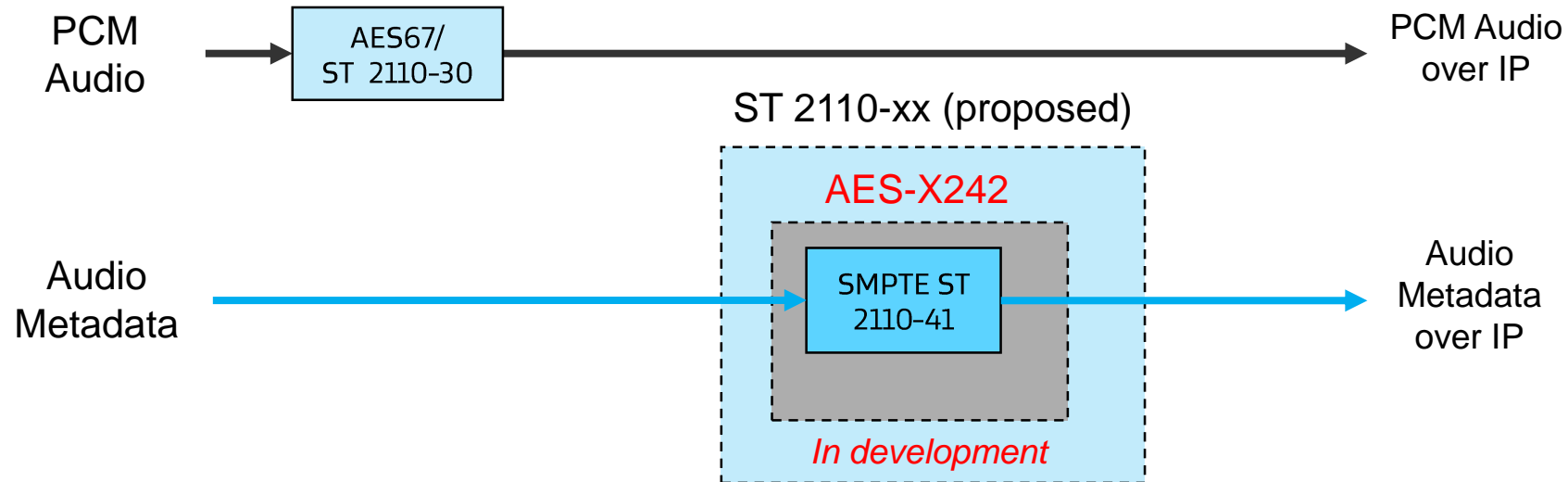- Similar application in legacy vs. IP metadata transport

Transmission of arbitrary metadata with limitations of ANC packet structure

Shares many common requirements with AES-X242 project

AES-X242 limited to audio metadata

ST 2110-41 open to "any" metadata

AES-X242 – IP Audio with Native Metadata (option with ST 2110-41)

PCM
Audio
→ AES67/ ST 2110-30 → PCM Audio over IP

ST 2110-xx (proposed)

AES-X242

Audio
Metadata
→ SMPTE ST 2110-41 → Audio Metadata over IP

In development

- AES/SMPTE liaison to investigate "harmonization" of AES-X242 and ST 2110-41
  - i.e. share common RTP streaming format
- Still free of legacy constraints with AES3/ST337 tunneling
- *Both standards under active development – participation encouraged!*

AES-X242 Use Cases and Requirements

Live Broadcast

- RDD 49 (PMD) and Serial ADM

Music and Film Production

- MIDI, OSC-like protocols

Live Sound

Radio

Audio Streaming

General Transport

. . .

AES-X242 Open Issues

Decision on harmonization with SMPTE ST 2110-41 (FMX)

- If using ST 2110-41 require ST 2109 container or make optional?

Packet time or repetition rate signaling

Sender timing and receiver buffer

Use case profiles?

Latency modes

Association with AES67 stream(s)

Validation of use cases against specification

AES SC-02-12-R – Task group on Streaming audio metadata over IP

Task group to develop AES-X242 standard

SC-02-12-R seeking user input on AES-X242 use cases and requirements

AES-X242 development and interop testing needed

Input and participation encouraged!

Standards relevant to Audio Metadata over IP

SMPTE

- ST 2109 – Audio Metadata in AES3
- RDD 49 – Professional Metadata (PMD)
- ST 2116 – Serial ADM in AES3 (*publication queue*)
- ST 2110-30 – PCM Audio over IP
- ST 2110-31 – AES3 over IP
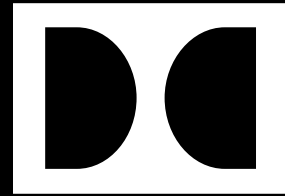- ST 2110-41 – Fast Metadata (*in development*)

AES

- AES67 – Audio over IP Interoperability
- AES-X242 – Audio Metadata over IP (*in development*)

ITU
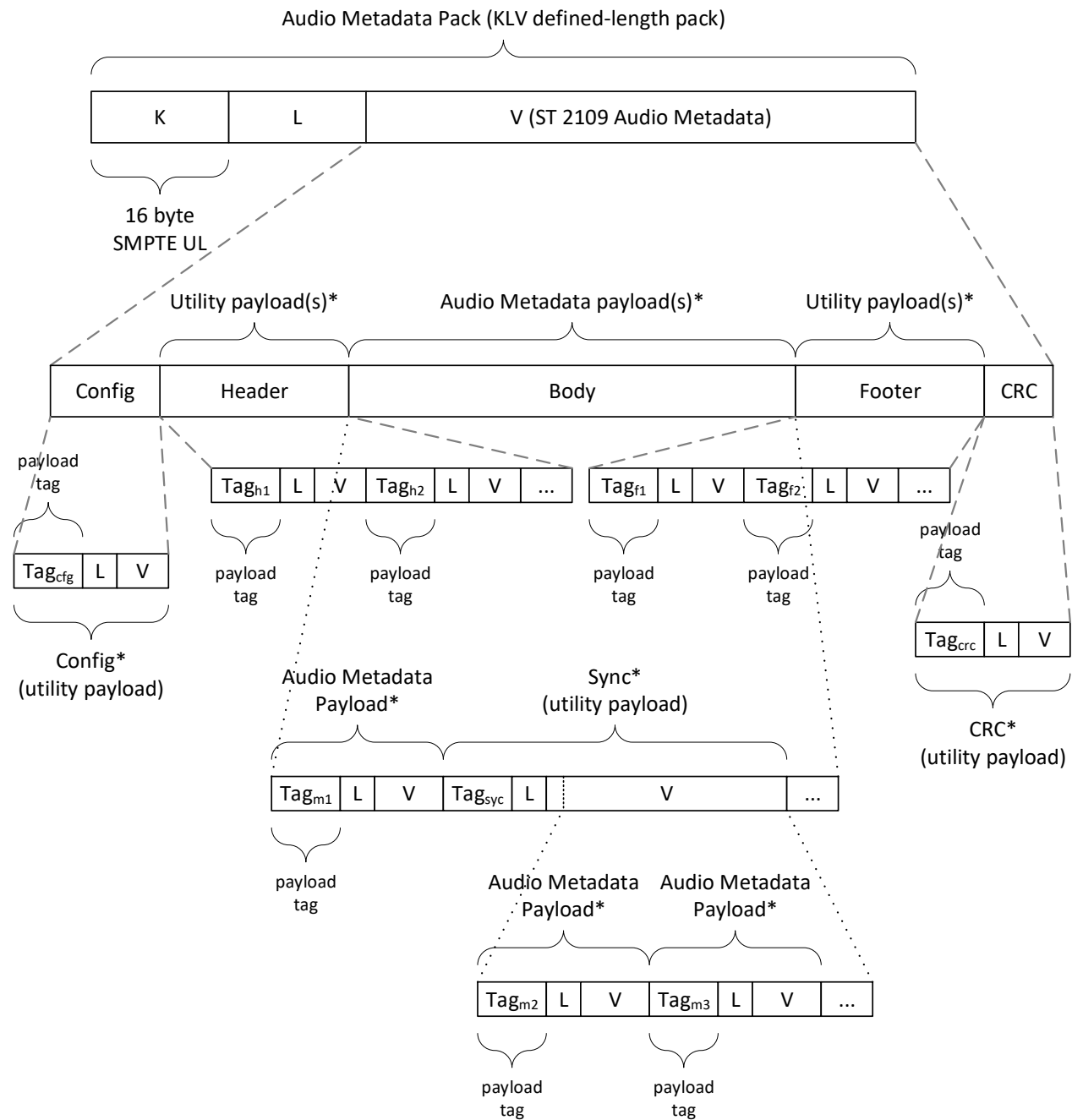
- ITU-R BS.2125-0 – Serial ADM (Audio Definition Model)

Thank you

Kent Terry

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SMPTE ST 2109 Container

Audio Metadata Pack (KLV defined-length pack)

K	L	V (ST 2109 Audio Metadata)

16 byte
SMPTE UL

Utility payload(s)*   Audio Metadata payload(s)*   Utility payload(s)*

Config	Header	Body	Footer	CRC

payload tag

Tag$_{h1}$	L	V	Tag$_{h2}$	L	V	...

Tag$_{f1}$	L	V	Tag$_{f2}$	L	V	...

payload tag

Tag$_{cfg}$	L	V

Config*
(utility payload)

payload tag

payload tag

payload tag

payload tag

payload tag

Tag$_{crc}$	L	V

CRC*
(utility payload)

Audio Metadata Payload*   Sync* (utility payload)

Tag$_{m1}$	L	V	Tag$_{syc}$	L	V	...

payload tag

Audio Metadata Payload*   Audio Metadata Payload*

Tag$_{m2}$	L	V	Tag$_{m3}$	L	V	...

payload tag

payload tag

SMPTE ST 2109 Payload

ST 2109 Payload

Payload Tag	Payload Length	Payload Value

ASN.1 OID
BER coded

ASN.1 BER
short or
long
coded

SMPTE UL defines contents

Payload Tag defined in ST 2109
Administrative Register or
Config Payload

SMPTE UL associated with
Payload Tag

SMPTE ST 2109 Config Payload