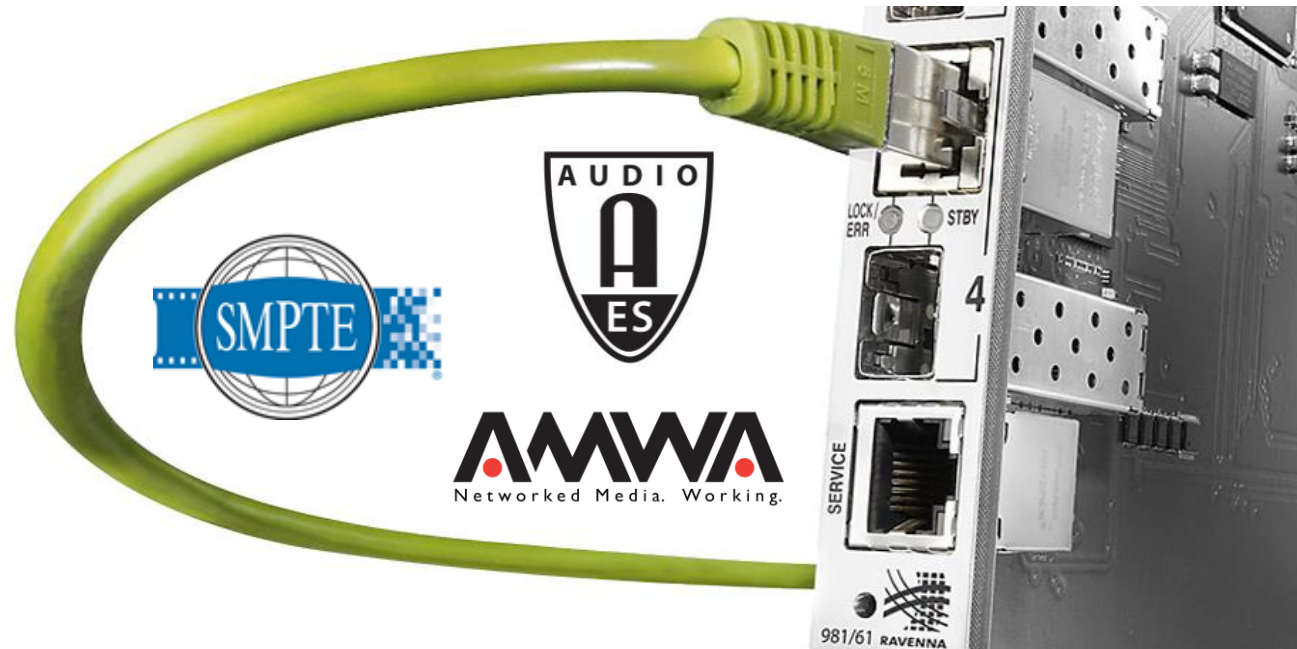


Overview on current SDO Activities



- Andreas Hildebrand –
RAVENNA Technology Evangelist
ALC NetworX, Munich



Andreas Hildebrand, RAVENNA Technology Evangelist

- more than 25 years in the professional audio / broadcasting industry
- graduate diploma in computer science
- R&D, project & product management experience
- member of AES67 TG and ST2110 DG



ALC NetworkX GmbH, Munich / Germany

- established 2008
- R&D center
- developing & promoting RAVENNA
- Partnerships with > 40 manufacturers



RAVENNA

- IP media networking technology
- designed to meet requirements of professional audio / broadcasting applications
- open technology approach, license-free
- fully AES67/ST2110-compliant (*built-in*)



Relevant Standards

⇒ **AES67**

- defines high-performance AoIP interoperability

⇒ **SMPTE ST 2110 (SMPTE ST 2059)**

- defines elementary essence data transport on managed IP networks

⇒ **AMWA NMOS**

- defines upper layer operational & management functionalities

⇒ **AES70**

- defines device control & connection management

⇒ **AES X242**

- defines real-time audio meta data transport over IP





AES67

What was the original goal?

- “Provide a method to connect disparate Audio-over-IP systems to achieve workaround-free networked audio interoperability”

What is AES67?

- Interoperability Standard for high performance Audio-over-IP networks
- Based on existing protocols and trusted IT standards
 - This ensures compatibility with existing network infrastructure
 - Allows coexistence with other IT data
 - High adoption rate by all major solution providers

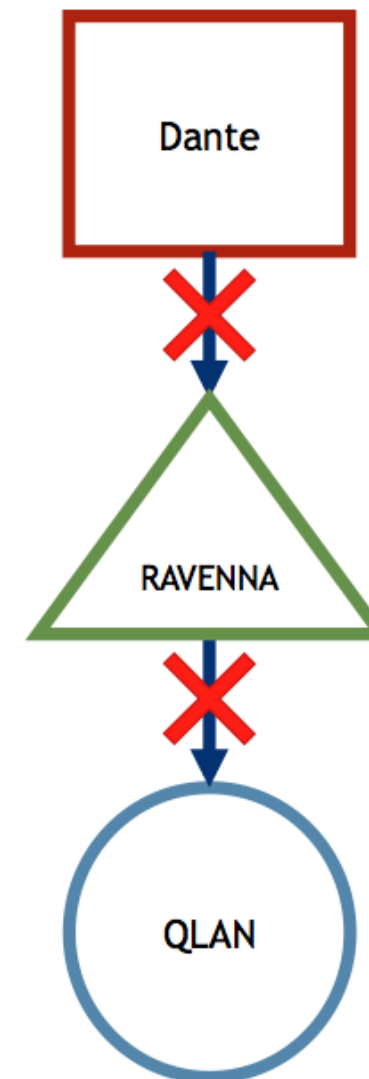


AES67

AES67

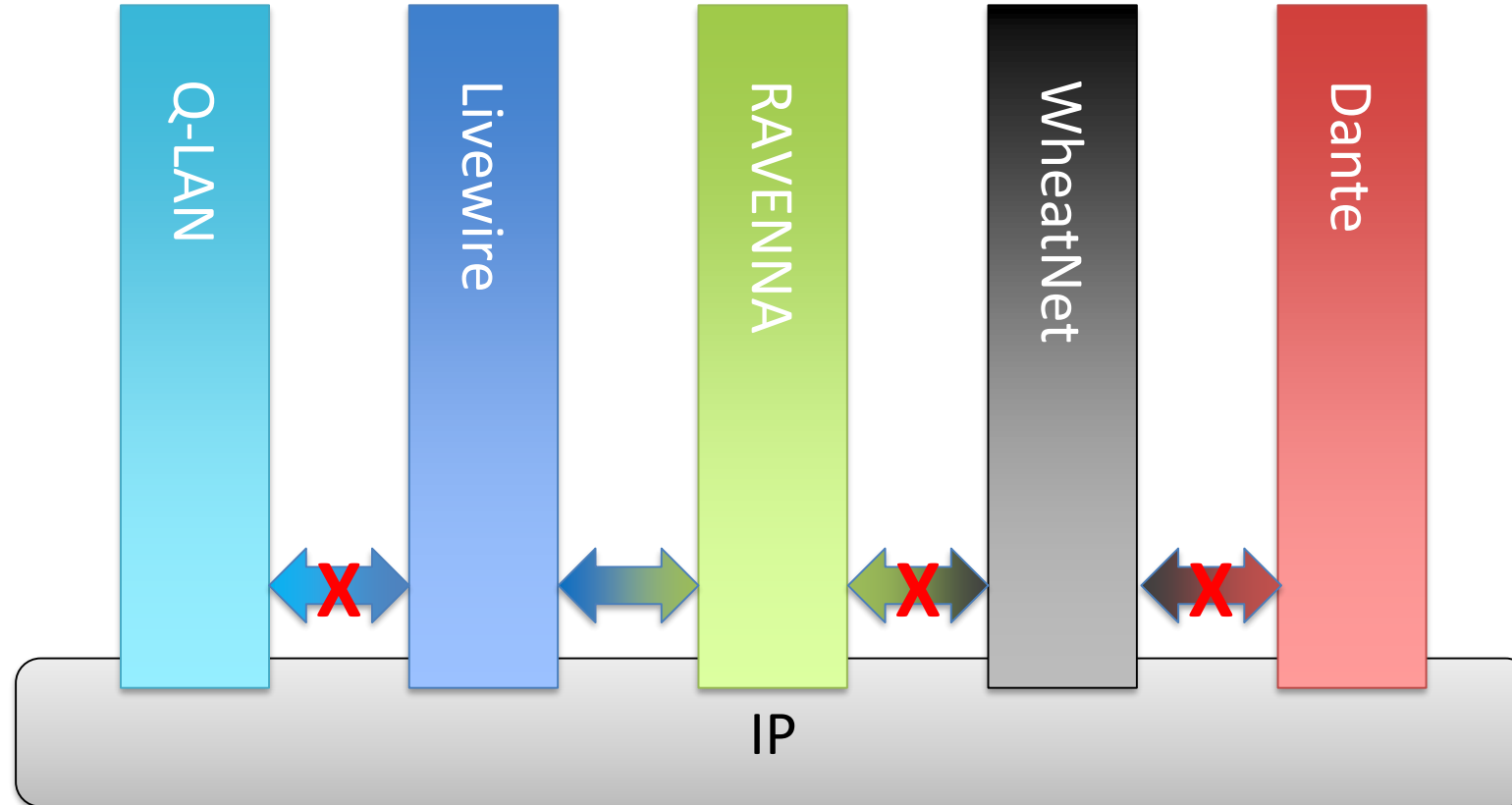
Problem Statement

- Audio-over-IP (aka Networked Audio) provides simpler and better connection between audio equipment
- Coupled with many advantages, one clear challenge presented itself: **Compatibility**
- While each Audio-over-IP solution offered in-system connectivity, there was no standard to provide inter-system connectivity



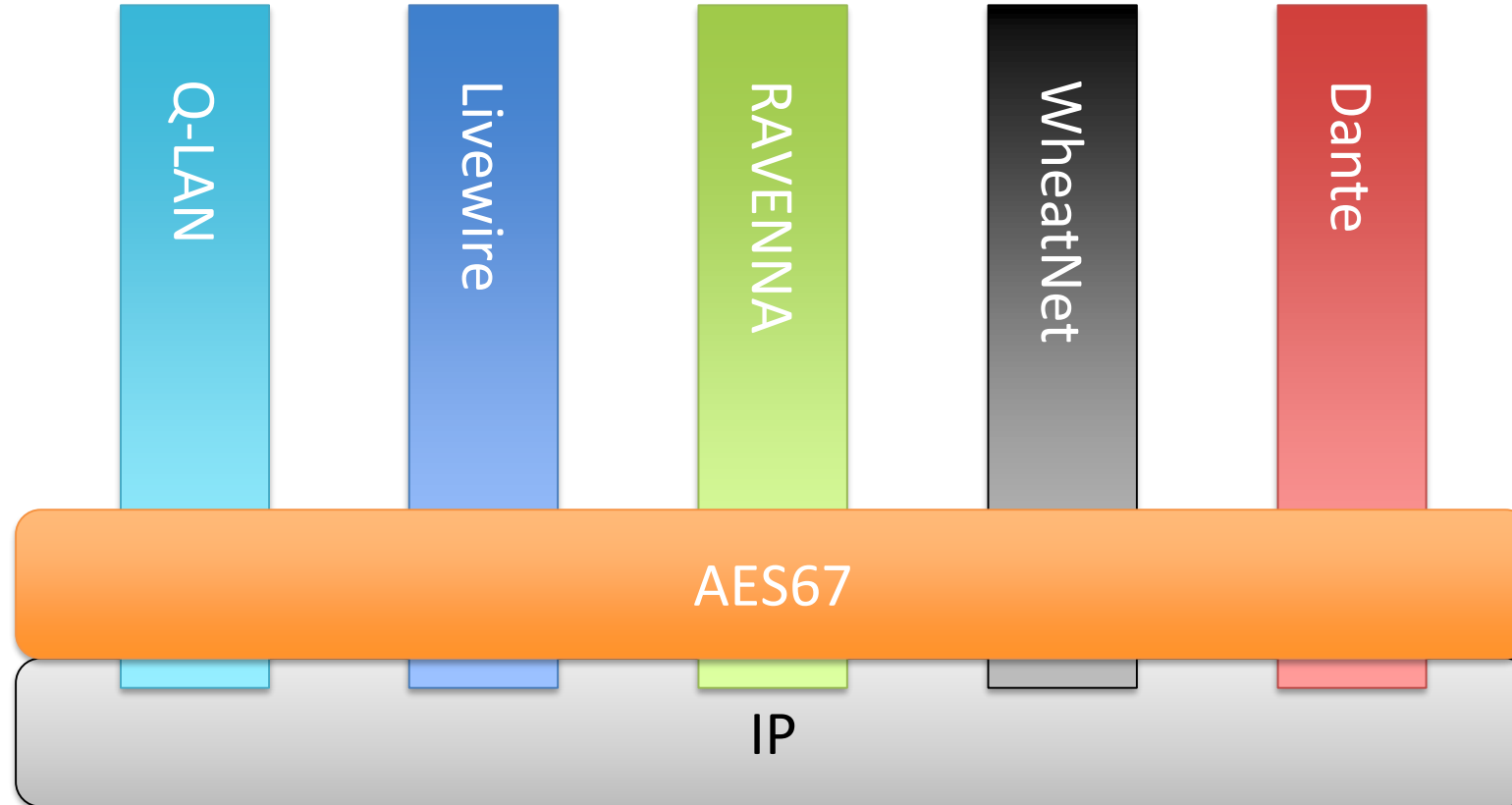


Overview on current SDO Activities





Overview on current SDO Activities



AES67



AES67 - Status

2013 – initial publication

- 3 years of work
- 100+ participants (manufacturers, consultants, system integrators, end users)

2015 – first revision

- Corrigendum & clarifications
- Backward compatibility (no new requirements)

2018 – second revision

- Further clarifications
- Backward compatibility (no new requirements)
- PICS added

Current status

- Task Group is working on further topics (multicast addressing, SDP, homologation w/ ST 2110 etc.)
- Interested parties are invited to join SC-02-12-M (Thu, 1p)



AES67



Further Work in AES Task Groups

AES70 – Open Control Architecture

- Initially published in 2017
- AES70-2018 – improvements + additions (i.e. CM3, web sockets / UDP support, Task mechanism etc.)
- Current work: further improvements, AES70 for AES67 Connection Management, NMOS convergence

X238 – Requirements for Media Network Directories and Directory Services

- setting forth technical recommendations for media network directories and directory-related services
- Covering: Registration, query, and administration protocols; security mechanisms; directory data model; query language and related semantics; scalability strategies

X242 – Streaming audio metadata over IP

- Defining a transport mechanism for real-time audio meta data associated with an AES67 audio stream
- Synchronization, RTP payload format (but agnostic to actual payload data), association & alignment w/ AES67 streams
- Seeking alignment / coordination w/ SMPTE ST 2110-41 (“Transport of Extensible Fast Metadata”)



SMPTE ST 2110 – Professional Media over Managed IP Networks



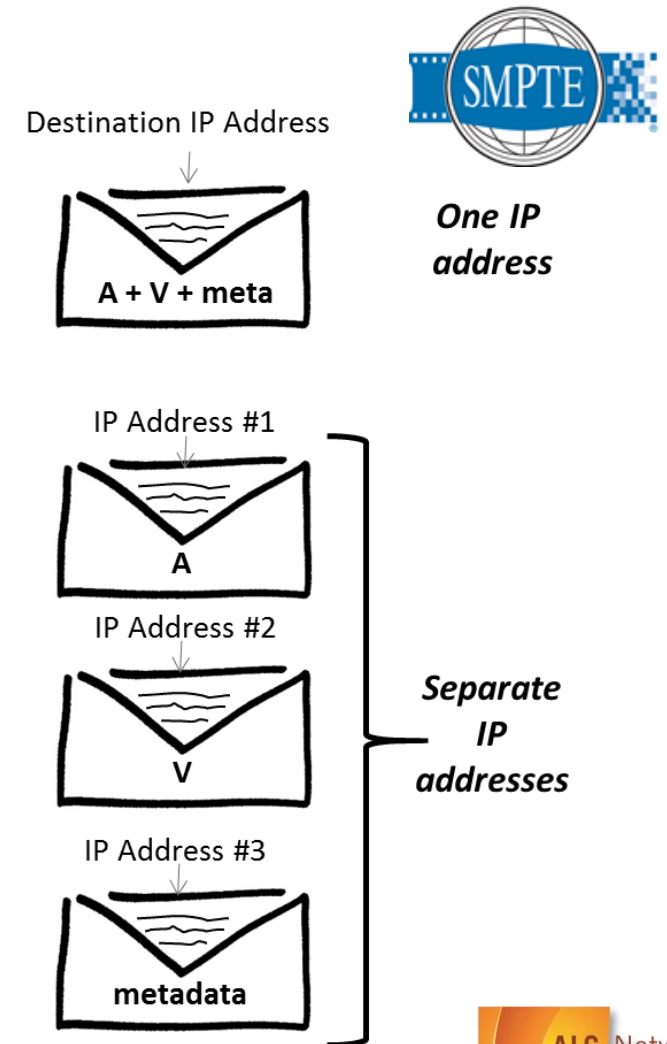
The SMPTE ST 2110 standards suite specifies

- the transport, synchronization and description of
 - separate elementary essence streams (video, audio, ancillary data)
 - over managed IP networks (at any speed, from 1GbE to 100 GbE and beyond)
 - for real-time production, playout and other professional media applications.

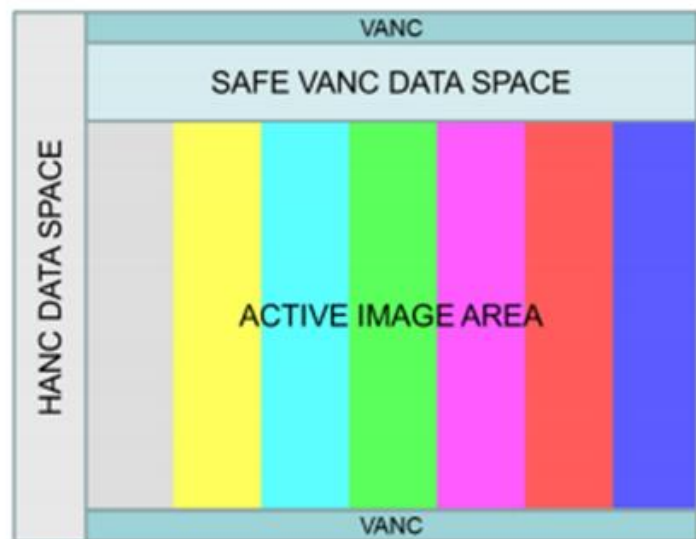


Two Fundamental Approaches to IP Transport

- **Bundled** (Audio, Video, Metadata together)
 - Audio/Video/Metadata/Sync travel **coherently**
 - Requires extra work to “unpack” separate essences
- **Essence-based** (Audio, Video, Metadata separate)
 - Ideal for **Studio/Production** workflows
 - Individual essence kept in sync using PTP timing



The Bundled Approach: SMPTE ST 2022-6

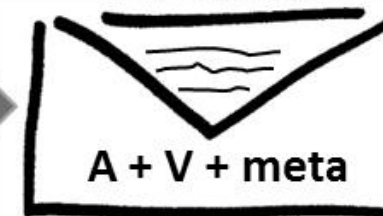


SDI Raster

IP Packetization of SDI Raster
Method: **SMPTE ST 2022-6**

- Audio (from HANC)
- Video (from active area)
- Metadata (from VANC)
- Sync/Timing (from frame)

One Destination
IP Address



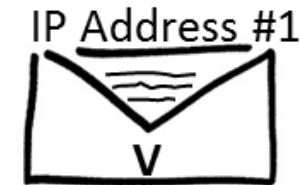
Published beginning in 2012

The Essence-based Approach: SMPTE ST 2110



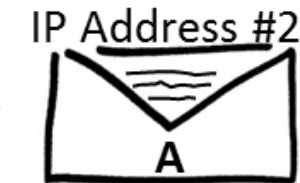
Active Video

IP Packetization of Active Video
Method: SMPTE ST 2110-20



Audio

IP Packetization of Audio Channels
Method: SMPTE ST 2110-30



Metadata

IP Packetization of ANC Data
Method: SMPTE ST 2110-40



Published in 2017



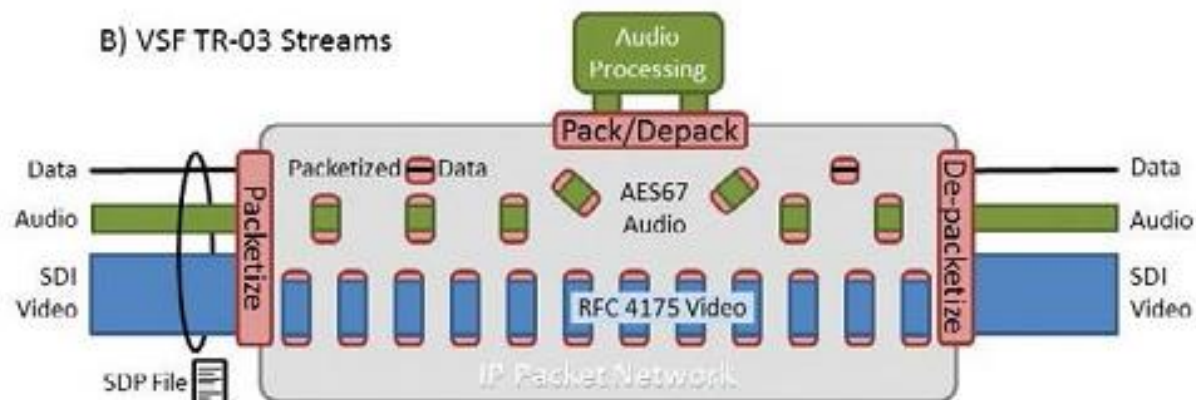
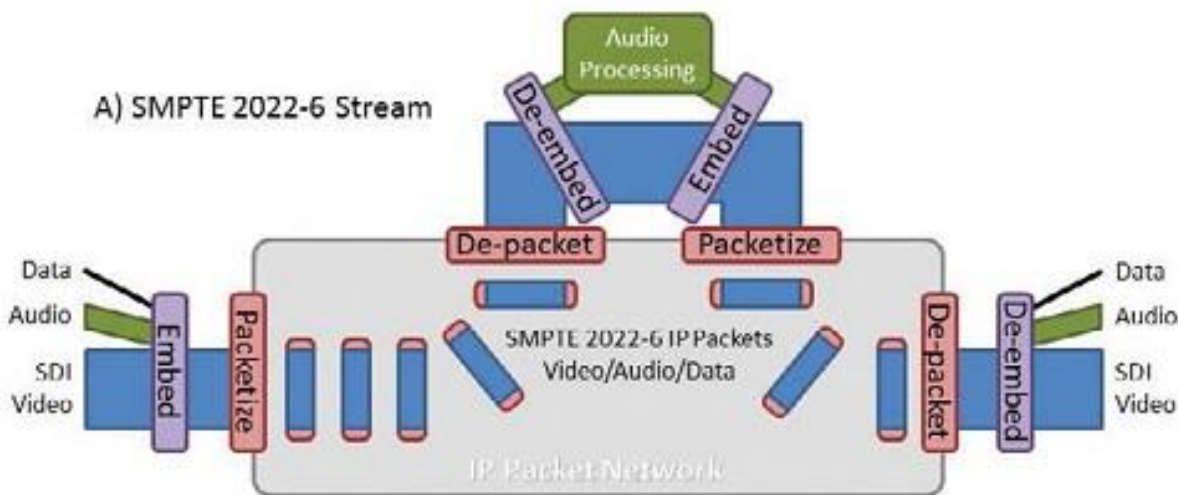
Bundled vs. Essence-based Approach



ST 2022-6



ST 2110





The SMPTE ST 2110 Suite of Standards

Document structure (published):

- 2110-10: System Timing & Definitions
 - defines transport layer and synchronization (SMPTE2059, clocks, RTP, SDP etc.)
- 2110-20: Uncompressed Active Video
 - defines payload format for raw video (RFC4175, RTP, SDP, constraints)
- 2110-21: Traffic Shaping and Delivery Timing for Uncompressed Active Video
 - defines timing model for senders and receivers (traffic shaping requirements)





The SMPTE ST 2110 Suite of Standards

Document structure (published):

- 2110-30: PCM Digital Audio
 - defines payload format for linear audio (AES67, constraints)
- 2110-31: AES3 Transparent Transport
 - defines payload format for non-linear audio (RAVENNA AM824)
- 2110-40: Transport of SMPTE Ancillary Data
 - defines RTP payload format for SDI ancillary data (new IETF draft)



SMPTE ST 2110-30 Linear PCM Audio



Specifies the payload format for PCM digital audio streams

- Uncompressed Linear PCM Audio only
- Based on AES67
- Relatively flexible:
 - ▶ 48kHz and 96kHz sampling
 - ▶ 16 and 24-bit depth
 - ▶ Variable packet timing - 125us to 1ms
 - ▶ Channel-count based on packet timing
 - 8 channels @ 1ms up to 64 channels @ 125us (conformance levels A / B / C)
- Low-bandwidth consumption, i.e.
 - ▶ 8 channels x 24 bits x 48,000 samples = 9.9Mbits/sec (incl. packet overhead)

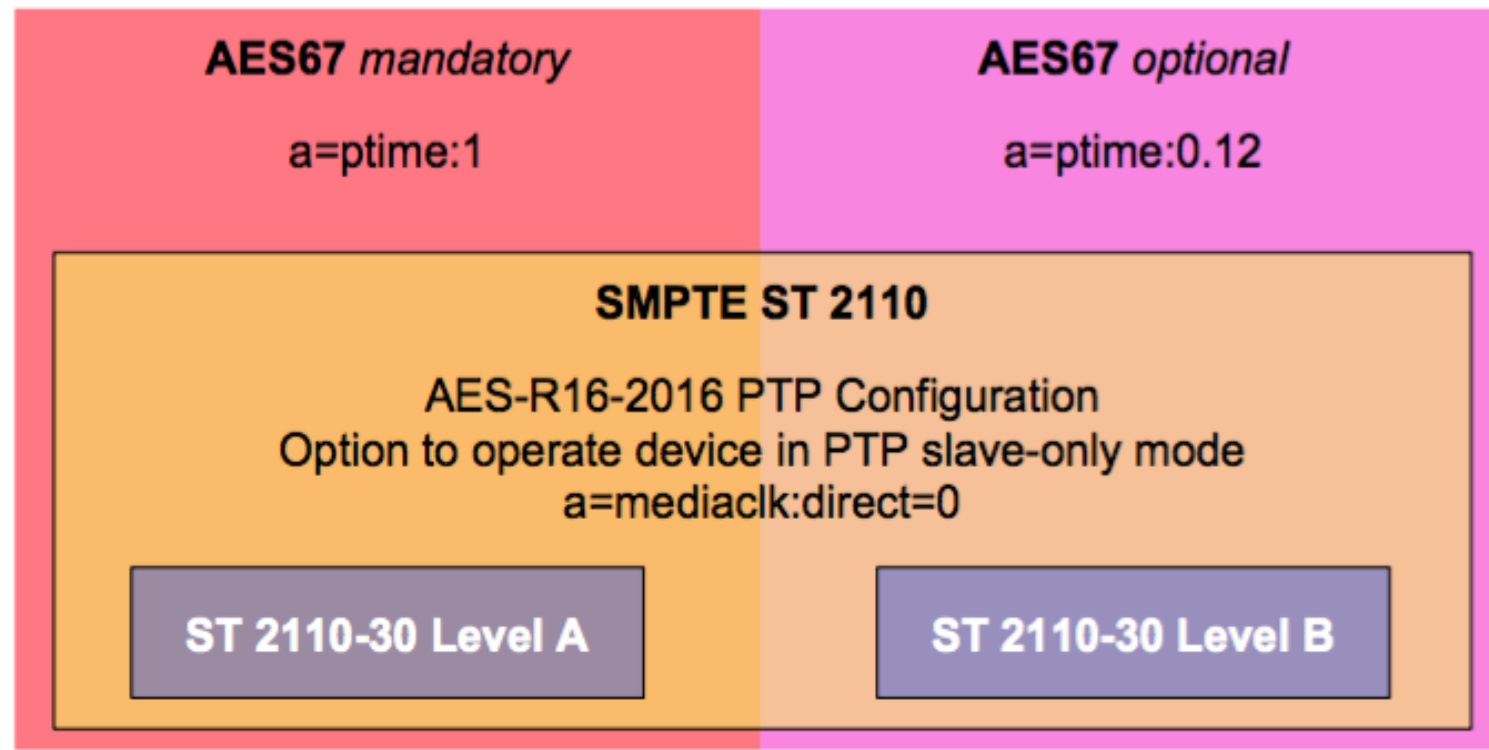


AES67



SMPTE ST 2110-30 and AES67 Compatibility

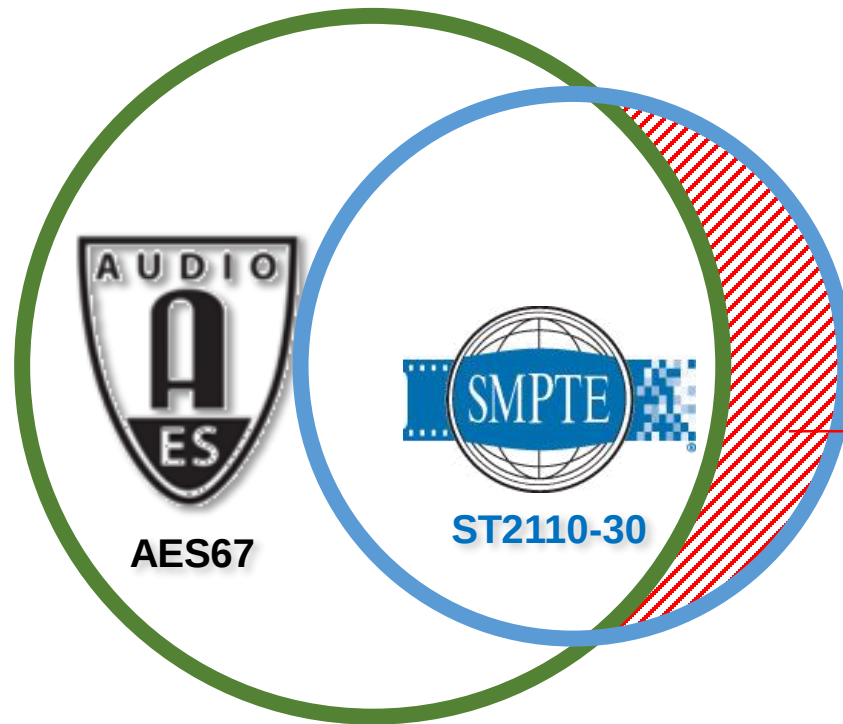
SMPTE ST 2110-30 is a subset of AES67,
adding constraints to clocking and streaming



AES67



SMPTE ST 2110-30 and AES67 Compatibility



AES67

Constraints!

- AES-R16-2016 PTP configuration
- option to operate device in PTP slave-only mode
- a=mediack:direct=0

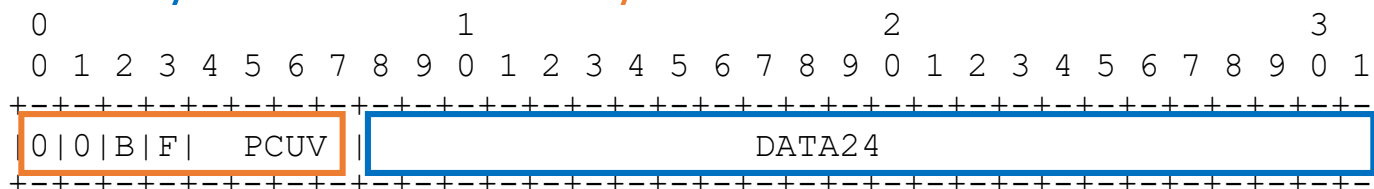


SMPTE ST 2110-31 AES3 Audio Data



Specifies the payload format for transparent transport of AES3 audio data

- Can transport any format which can be encapsulated in AES3:
 - ▶ L24 PCM w/ AES3 subframe meta data (PCUV bits)
 - ▶ non-PCM audio and data formats as defined by SMPTE ST 337 / 338 (i.e. Dolby®E etc.)
- Builds on RAVENNA's AM824 (IEC 61883-6) payload definition:
 - ▶ retains AES67 definitions for synchronization and RTP usage
 - ▶ uses 3 bytes for PCM24 + 1 byte for AES3 meta data



- ▶ RTP payload format signaled in SDP:

a=rtpmap:<pt> **AM824**/48000/<nchan>

- ▶ retains all other SDP parms

Andreas Hildebrand, AIMS / AES AVoIP Theatre @ AES 147th, Oct. 2019



SMPTE ST 2110-31 and AES67 Compatibility





The SMPTE ST 2110 Suite of Standards



Document structure (in development):

- 2110-22: Constant Bit-rate Compressed Video
 - defines payload format for CBR compressed video and a SMPTE registry for various payload formats (codecs)
- 2110-23: Single Video Essence Transport over Multiple 2110-20 Streams
 - defines how to split high-bandwidth signals into several lower-bandwidth 2110-20 tributary streams (constraints, grouping, addressing, RTP timestamps, SDP ...)
- 2110-41: Extensible Fast Metadata Transport
 - defines how to transport extensible, dynamic meta data in ST2110 context (including synchronization)



Further Work in SMPTE DGs

ST 2110

- 1-year review of: -10 / -20 / -21 / -40
- New work: -24 (SDO Definitions)
- PICS (analog to AES67-2018)

ST 2059

- 1-year review of: -1 & -2
- ST 2059 Security
- PTP Monitoring

Related:

VSF

- ST 2110-over-WAN, ST 2110 format enumeration

IEEE1588-2020 (PTPv2.1)

- Improvements and extensions, fully backwards-compatible



Joint Task Force on Networked Media (JT-NM)

[Home](#) [JT-NM Tested](#) [Roadmap](#) [Reference Architecture](#) [Phases](#) [Articles](#) [Contact](#) [About](#)

The Joint Task Force on Networked Media is led by the following JT-NM Admin Group members:

JT-NM Coordination Group

Mission - "A clearinghouse that... partner organizations can use to coordinate themselves, in order to facilitate a harmonized transition from legacy to Open Interoperability."

Each organi

Technical G

- AES-67
- AES-X
- AMWA
- AMWA
- AMWA
- EBU/A
- EBU P
- NABA
- SMPTE TC-32NF

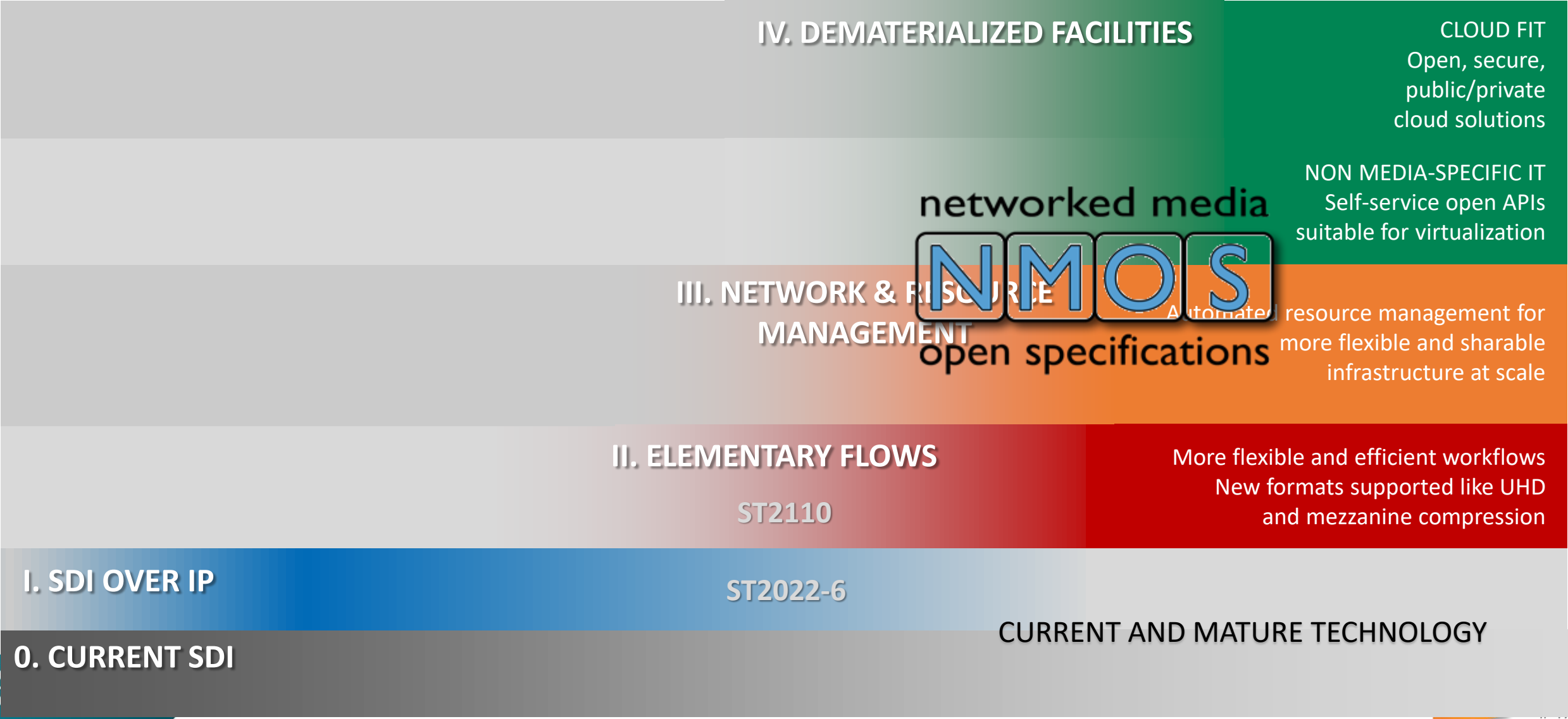


Each member is expert in their area. Members are working on different parts of IP transition. The group is self-coordinated through exchange of information.





JT-NM Roadmap





Overview on current SDO Activities



[HOME](#) [ABOUT](#) [SPECS](#) [MEMBERS](#) [JOIN](#) [CONTACT](#) ...

Defining the business need

Developing open specifications

Ensuring interoperability

Enabling networked media

The Advanced Media Workflow Association exists to help media businesses to improve efficiencies, increase agility and drive down costs. Our worldwide membership comprises electronic media companies, their suppliers plus individual technology specialists and developers.

NMOS

Networked Media Open Specifications

Networked Media Open Specifications result from the development of interoperable protocols for control and monitoring of media devices in an IP-based environment.

AGILE MEDIA

Business Agility in Media Workflows

A new research initiative to understand the evolving requirements of media companies

AAF

Advanced Authoring Format

A file interchange format designed for the video post-production and authoring.

MXF

Material Exchange Format

AMWA Application Specifications define a set of rules that constrain the MXF standard for a particular application, includes AS-11.

Media Companies:



Suppliers:





What are the Networked Media Open Specifications (NMOS)?

- NMOS is a growing family of specifications <...> to support the development of products and services which work within an open industry framework.
- The Specifications are being developed using Internet standards or Internet-friendly techniques.
- They are complementary to and co-exist with industry specifications; for example, SMPTE ST2110 and AES67.

Motivation for NMOS

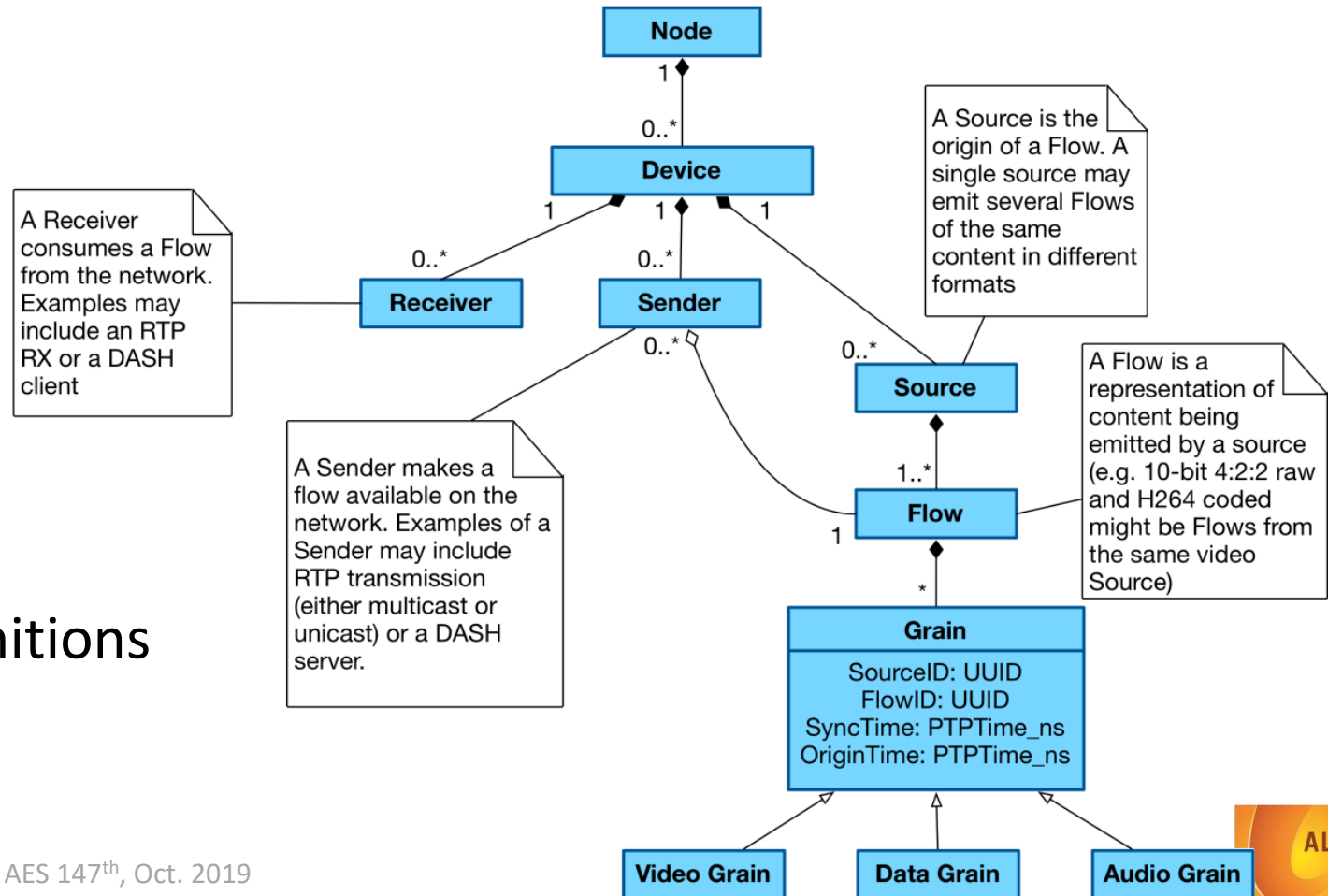
- Lack of interoperability in a growing and diversifying IP media landscape.

Goals

- To deliver interoperability among products across a wide range of suppliers.
- Open to all media companies and industry suppliers

Scope of NMOS work

- Follows the definitions of the JT-NM reference architecture (JT-NM RA-1.0)
 - Identity
 - Timing & Synchronization
 - Discovery & Registration
 - Connection Management
 - Routing & Grouping
 - Event Control
 - Authorization & Security
 - System & Parameter Definitions
 - ...





Overview on current SDO Activities

Id	Name	Status	Repository
IS-04	Discovery and Registration	AMWA Specification (Stable)	nmos-discovery-registration
IS-05	Device Connection Management	AMWA Specification (Stable)	nmos-device-connection-management
IS-06	Network Control	AMWA Specification	nmos-network-control
IS-07	Event & Tally	AMWA Specification	nmos-event-tally
IS-08	Audio Channel Mapping	AMWA Specification	nmos-audio-channel-mapping
IS-09	System	Work In Progress	nmos-system
IS-10	Authorization	Work In Progress	nmos-authorization
MS-04	ID & Timing Model	Work In Progress	nmos-id-timing-model
BCP-002-01	Natural Grouping	AMWA Specification	nmos-grouping
BCP-003-01	API Security: Communications	AMWA Specification	nmos-api-security
BCP-003-02	API Security: Authorization	Work In Progress	nmos-api-security
n/a	Parameter Registers	Continuing	nmos-parameter-registers





Minimum Stack for IP endpoints

necessary to build and manage a full scale facility

2110 is only the "tip of the pyramid"

Time and Sync

- PTPv2
- Both SMPTE and AES profiles
- BMCA for multi-interface redundancy

Configuration and Monitoring

- DHCP IP assignment
- Open configuration management (e.g., API, config file, SSH CLI, etc.)
- Open monitoring protocol (e.g., Agent-based, SNMPv3, etc.)

Media Transport

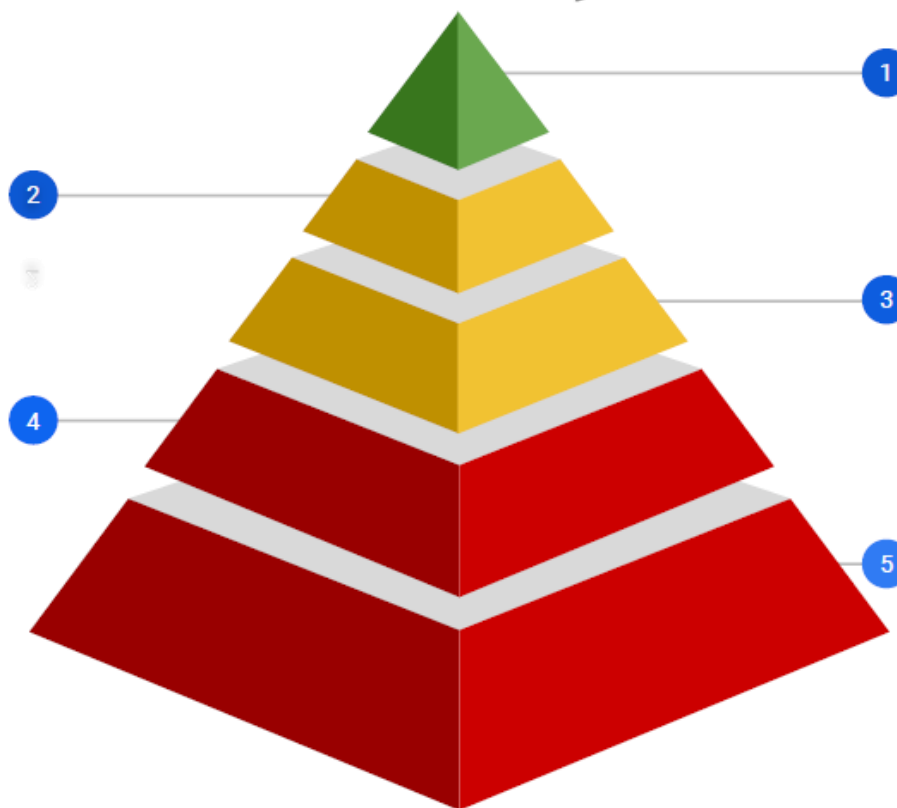
- Video SMPTE ST 2110-20/21 with Wide Rx
- Audio SMPTE ST 2110-30 Level C
- SMPTE ST 2022-7:2018 Protection
- UHD as a single flow (>25 GbE)

Discovery and Connection

- AMWA IS-04 Discovery and Registration
- AMWA IS-05 Connection Management
- LLDP Topology discovery

Security

- EBU R148 Tests
- HTTPS API calls
- AD, LDAP or Certificates - Authentication



Widely available

Partially available

Rarely available

EBU

JT-NM TR-1001-1:2018 v1.0

Andreas Hildebrand, AIMS / AES AVoIP Theatre @ AES 147th, Oct. 2019



Standards: AES/ IEEE / SMPTE

Standard	Description	Status
AES67-2018	High-performance streaming audio-over-IP interoperability	Approved
IEEE1588-2008	Precision Time Protocol	Approved
SMPTE ST 2022 - 6	High Bit-rate Media Transport (SDI over IP)	Approved
SMPTE ST 2022 - 7	Seamless Protection Switching (RTP streams)	Approved
SMPTE ST 2022 - 8	Timing of ST 2022-6 streams in ST 2110-10 systems	In Progress
SMPTE ST 2059 - 1	Generation of PTP Signals (including definition of Epoch)	Approved
SMPTE ST 2059 - 2	SMPTE Profile for IEEE1588 -2008 (operating parameters)	Approved



Standards: SMPTE ST 2110 Suite

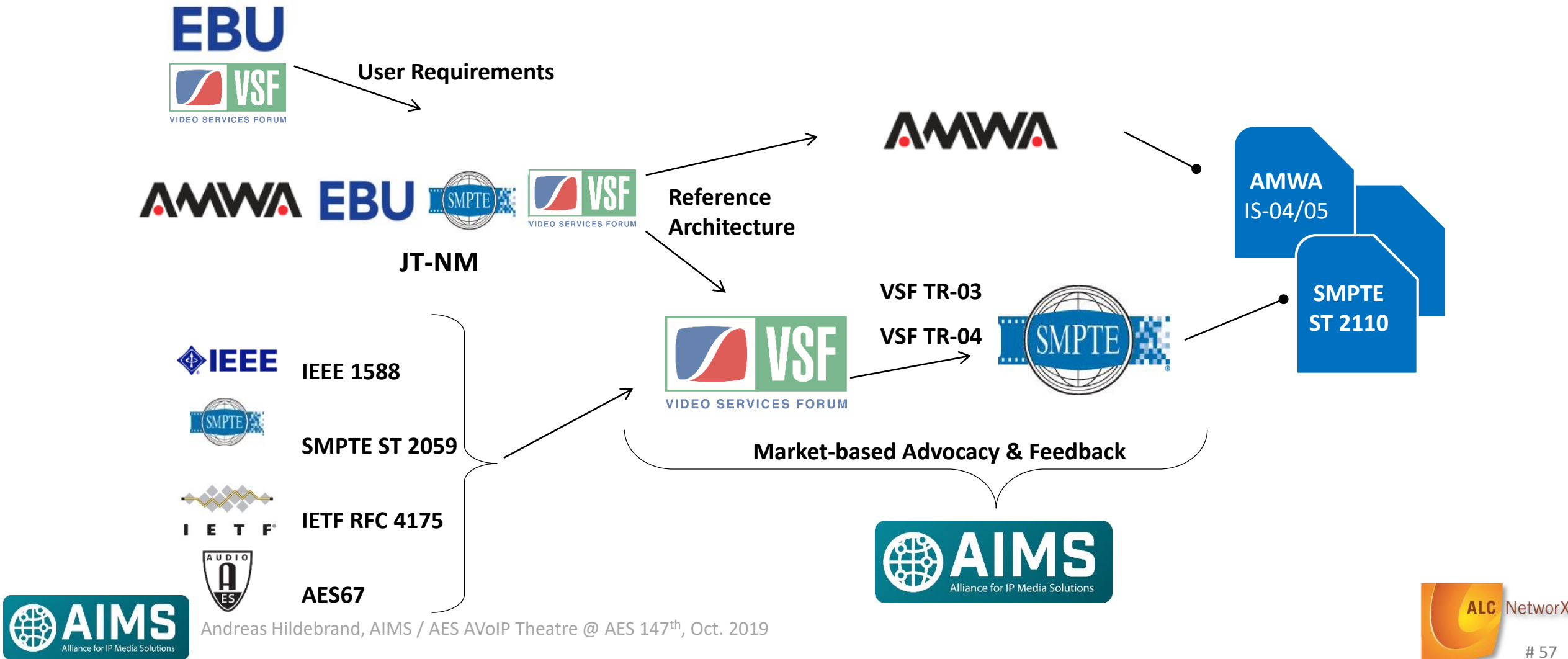
Standard	Description	Status
SMPTE ST 2110 - 10	System - PTP, RTP and SDP	Approved
SMPTE ST 2110 - 20	Video - Uncompressed	Approved
SMPTE ST 2110 - 21	Video - Traffic Shaping (packet pacing, bursts and gaps)	Approved
SMPTE ST 2110 - 22	Video - Compressed (CBR)	In Progress
SMPTE ST 2110 - 23	Video – Multistream (high-bw stream as separate low-bw streams)	In Progress
SMPTE ST 2110 - 30	Audio - Uncompressed (PCM)	Approved
SMPTE ST 2110 - 31	Audio - Compressed (AES3, non-PCM)	Approved
SMPTE ST 2110 - 40	Data - Ancillary (SDI)	Approved
SMPTE ST 2110 - 41	Data - Fast Meta Data	In Progress



Standards ? Technical Recommendations

Standard	Description
AMWA NMOS IS - 04	Device Discovery and Registration
AMWA NMOS IS - 05	Connection Management
AMWA NMOS IS - 06	Network Control
AMWA NMOS IS - 07	Event & Tally
AMWA NMOS IS - 08	Audio Channel Bundling
AMWA NMOS IS - xy	Flow Grouping, ID & Timing, Scalability, Security & more
SMPTE ST RDD 34	Sony LLVC compression
SMPTE ST RDD 35	IntoPIX TICO compression
JT-NM TR-1001-1	System Environment and Device Behavior

The Power of Collaboration





Thank you for your attention!

**RAVENNA booth @
AoIP Pavilion #963**

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