



AIMS Roadmap for Media Networking Interoperability

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Media-over-IP Technology Pavilion

Introduction

- AIMS has partnered with the AES to present this IP Networking Technology Pavilion here at the AES Convention
- Previous networking pavilions were focused primarily on audio networking
- This year we are expanding the scope to include a wide range of topics related to professional Media-over-IP networking
- Varied program of presentations from many of the industry's leading experts – free to attend for all visitors to either the AES or NAB shows



Who is AIMS?



Not for
profit
trade
alliance

Open to all

Funded by
members

*Common
Goal*

Who is AIMS?

AIMS Mission

*To foster the **adoption** of
one set of common, ubiquitous,
standards-based protocols
for **interoperability over IP**
in the media and entertainment industry,
and professional audio/video industries.*

Who is AIMS?

Background

- Media Networking Alliance (MNA) was formed in 2014
 - Mission to promote adoption of the newly ratified AES67 standard
- Alliance for IP Media Solutions (AIMS) was established at the end of 2015
 - Mandate to bring IP solutions to market that offer complete interoperability
 - Based on open standards
 - Integrate seamlessly into media workflow environments to foster industry innovation and efficiency
 - Initial focus on the Broadcast/Media and Entertainment industry

Who is AIMS?

MNA Merged into AIMS

- Following two years of close collaboration, MNA and AIMS joined forces through a merger at the end of 2017
- With many common objectives, the merger allowed the much larger and stronger AIMS to expand its focus beyond broadcast to also include the Pro Audio and Pro AV markets
- Following the merger, AIMS reached a peak of 100 members including many leading equipment manufacturers as well as major broadcast companies

AIMS Members



Background

- At the time AIMS was established, there was a lot of uncertainty in the industry
- Several different vendors had developed proprietary networking solutions for the broadcast industry
- This created an environment of risk which threatened to become a significant obstacle to adoption of IP media networking
 - Would a vendor or broadcaster choose the 'wrong' networking solution?
 - This could be a very expensive mistake to make



Background

- AIMS brought together a wide range of vendors and end-users with the goal of establishing one set of common, standards-based protocols for interoperability
- This initiative resulted in the publication of the AIMS Roadmap
 - AIMS role in this process has been to help identify requirements and foster adoption of the standards and specifications that appear in the AIMS Roadmap
 - AIMS itself is not a standards body but our members include many of the most active participants and even leaders of those efforts in organizations including AES, SMPTE, AMWA, VSF and others in the IT industry

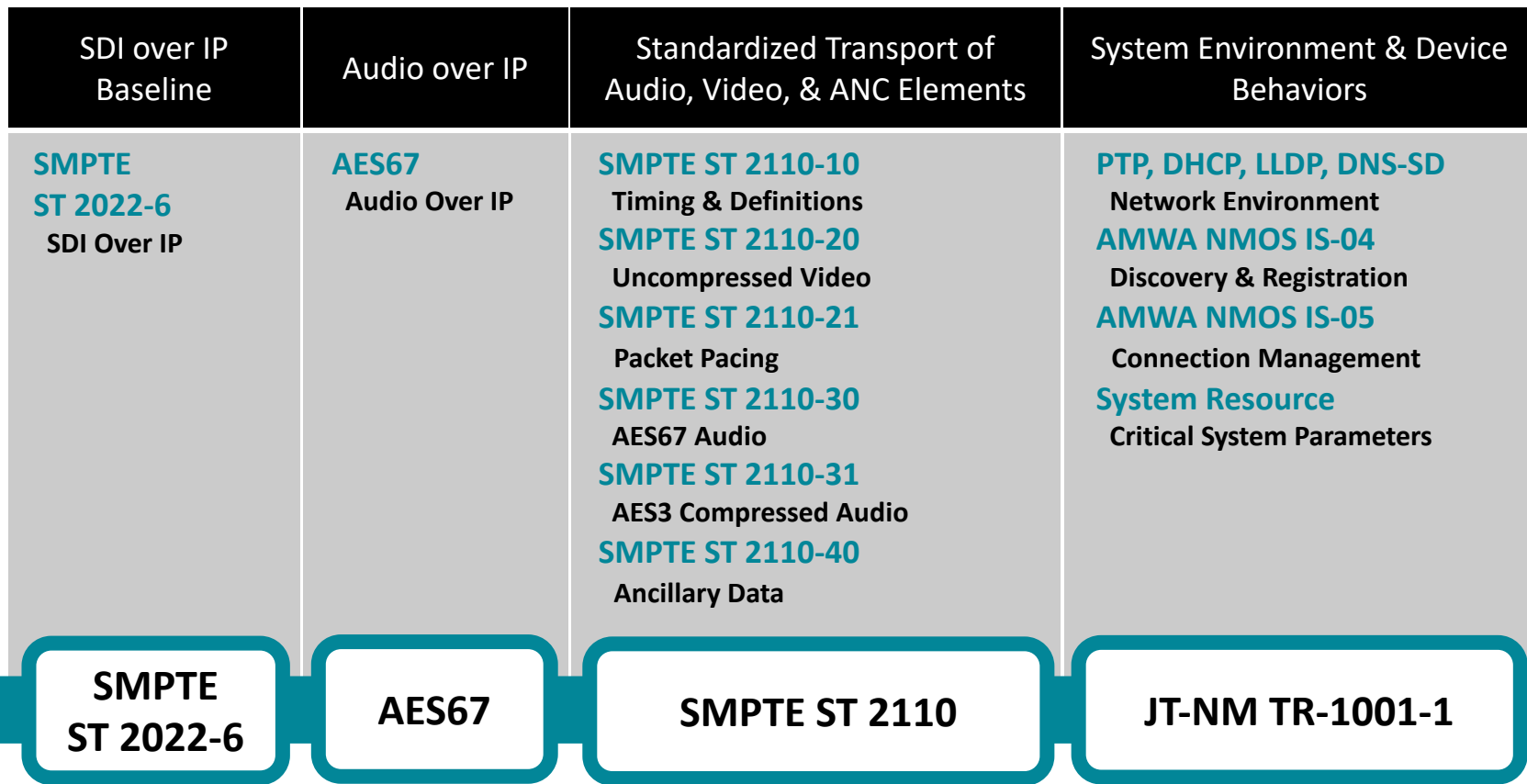


Open Standards

- This roadmap comprises a set of IP standards that has been developed using a collaborative, non-proprietary approach
- As a result, it has the support of more organizations than any other and is particularly well-suited to support the current and future needs of the industry



AIMS Roadmap



SDI over IP
Baseline

**SMPTE
ST 2022-6**
SDI Over IP

**SMPTE
ST 2022-6**

SMPTE ST 2022-6

- Transport of High Bit Rate Media Signals over IP Networks
- Published in 2012
- Defines a mechanism for encapsulating the data carried in SDI (component video, uncompressed audio, and ancillary information such as subtitles and timecode)
- Transports it reliably and with low latency over a local IP network

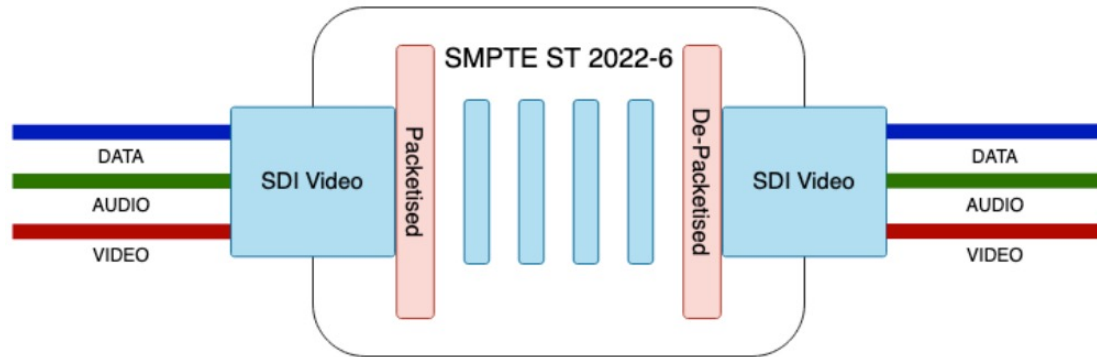
SDI over IP
Baseline

**SMPTE
ST 2022-6**

SDI Over IP

**SMPTE
ST 2022-6**

SMPTE ST 2022-6



- Allows the use of off-the-shelf IT networking hardware to deliver uncompressed video and audio over a network
 - Doesn't require specialized components or devices
- Easy to maintain audio/video synchronization
- Difficult to process just one part of a stream

AIMS Roadmap



AES67

- AES standard for audio applications of networks: High-performance streaming audio-over-IP interoperability
- First published in 2013
- Revisions published in 2015 and 2018

What was the original goal?

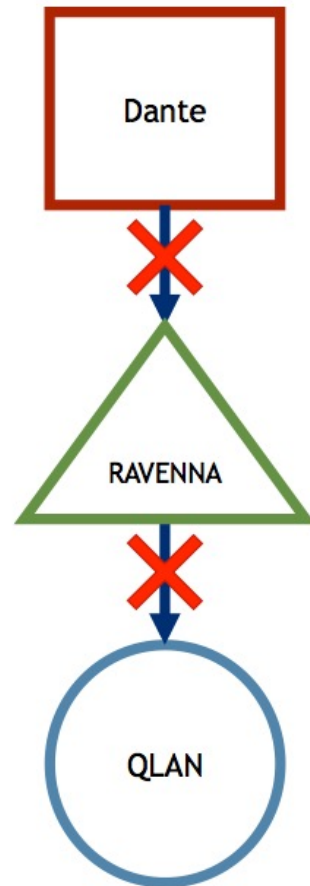
- “Provide a method to connect disparate Audio-over-IP systems to achieve workaround-free networked audio interoperability”

How is AES67 defined?

- Interoperability Standard for high performance Audio-over-IP networks
- Based on existing and trusted IT standards
 - This ensures compatibility with existing network infrastructure
 - Also allows coexistence with other IT data

Problem Statement

- Audio-over-IP (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



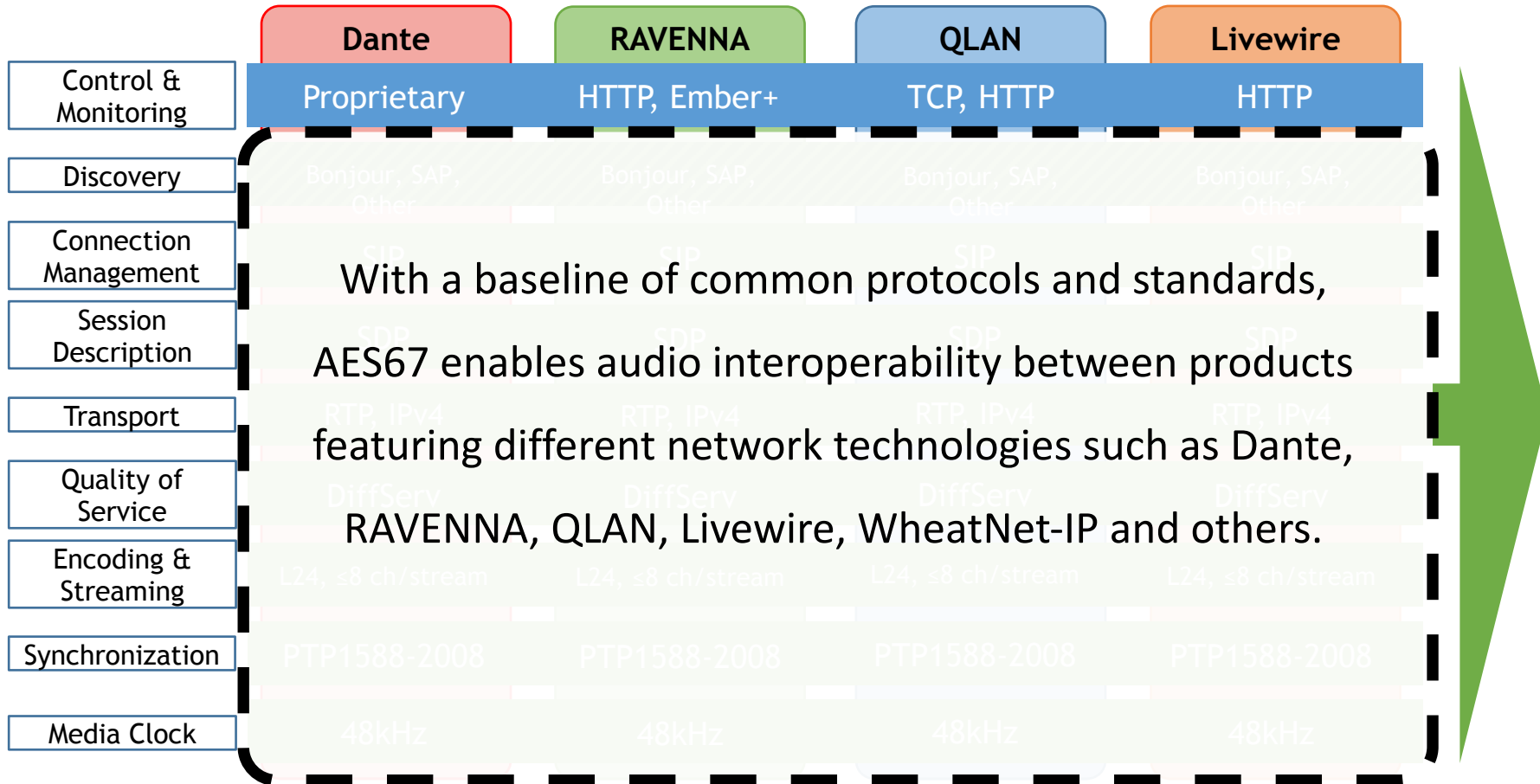
The Road to Incompatibility...

	Dante	RAVENNA	QLAN	Livewire
Control & Monitoring	Proprietary	HTTP, Ember+	TCP, HTTP	HTTP, Proprietary
Discovery	Proprietary	Bonjour	Proprietary	Proprietary
Connection Management	Proprietary	RTSP, SIP, IGMP	Proprietary	Proprietary, HTTP, IGMP
Session Description	Proprietary	SDP	Proprietary	Channel #
Transport	Proprietary, IPv4	RTP, IPv4	RTP, IPv4	RTP, IPv4
Quality of Service	DiffServ	DiffServ	DiffServ	DiffServ/802.1p
Encoding & Streaming	L16-32, ≤4 ch/flow	L16-32, ≤64 cha/str	32B-FP, ≤16 ch/str	L24, st, surr
Synchronization	PTP1588-2002	PTP1588-2008	PTP1588-2008	Proprietary
Media Clock	44.1kHz, 192kHz	44.1kHz - 384kHz	48kHz	48kHz

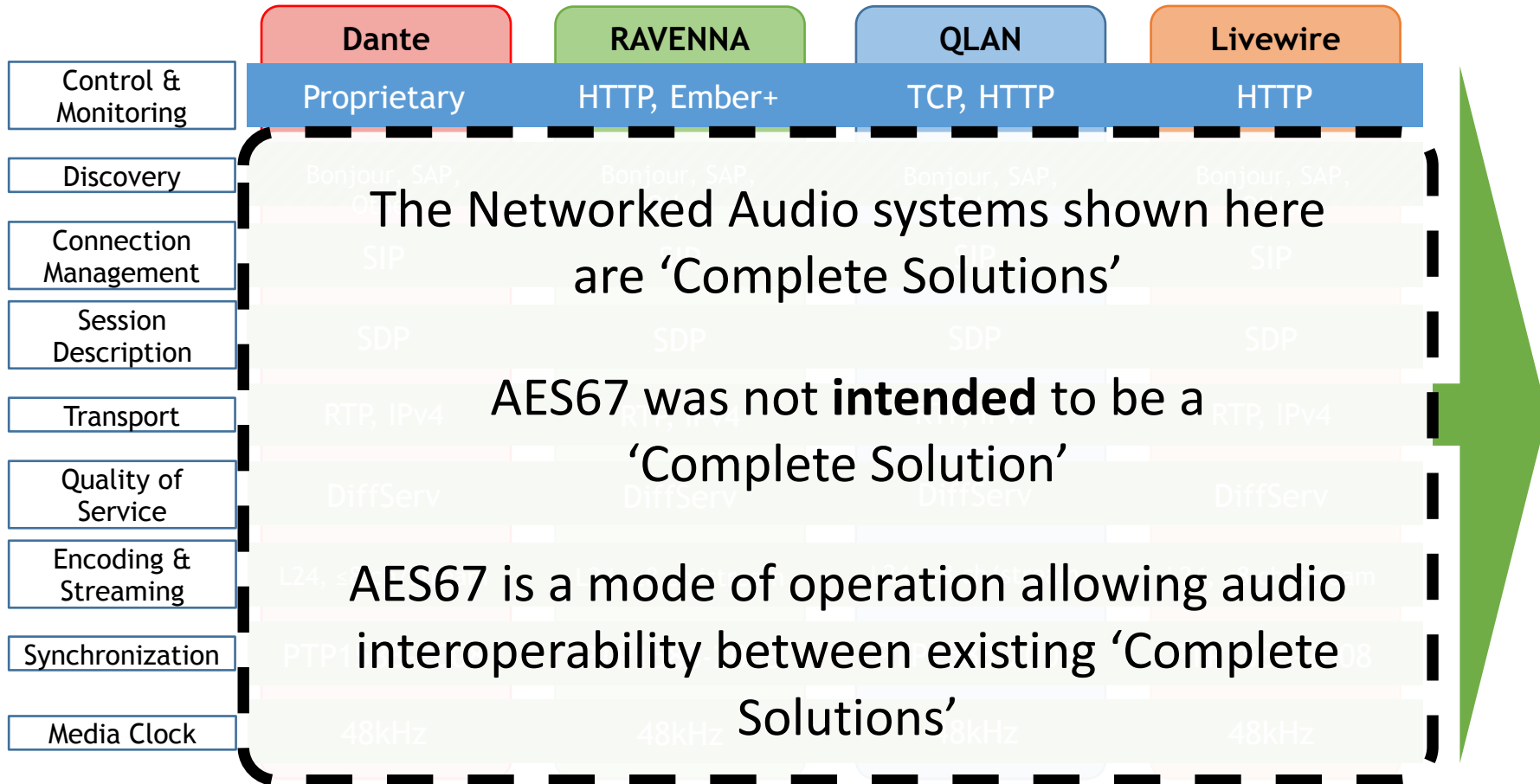
AES67 Compatibility Mode



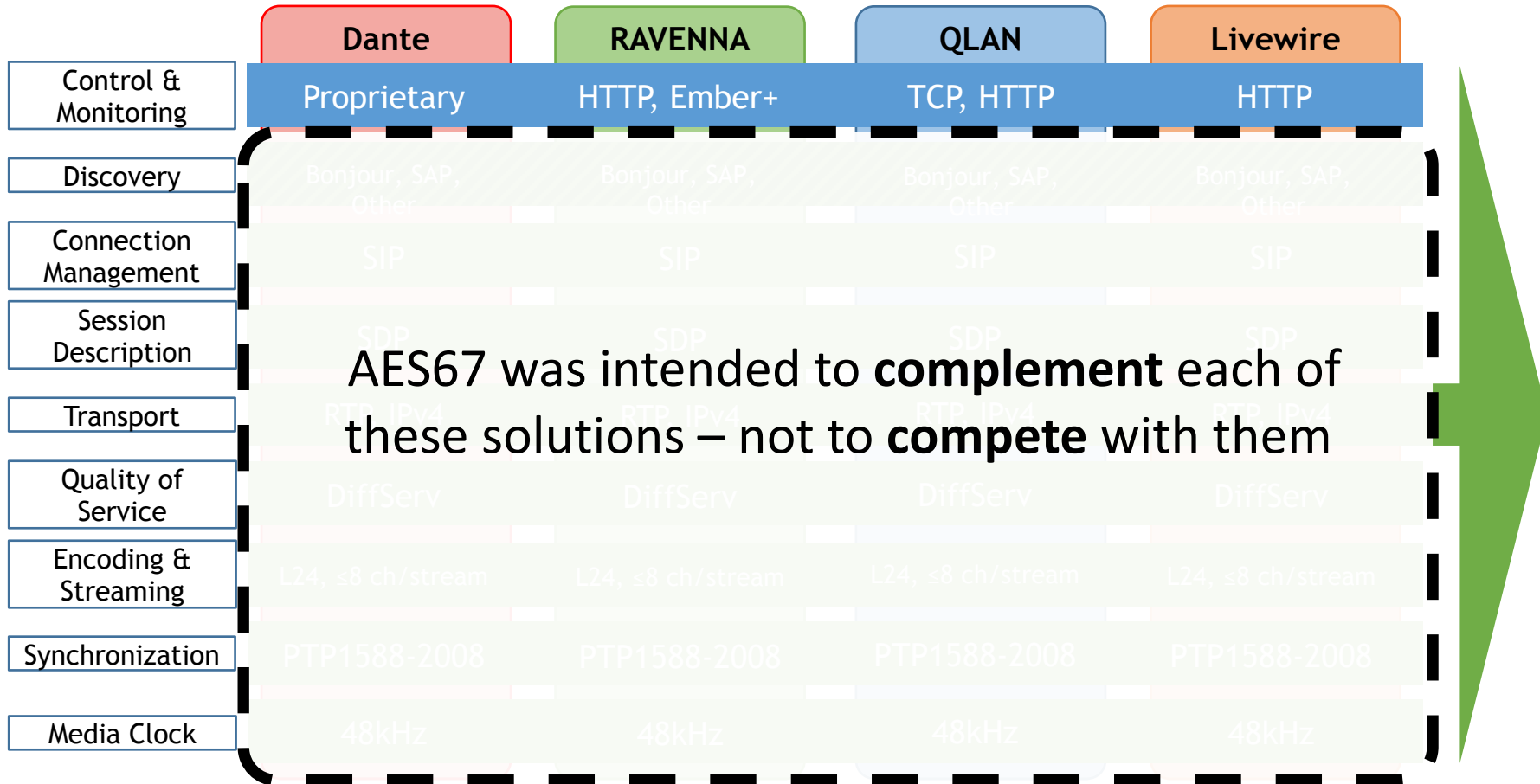
AES67 Compatibility Mode



AES67 Compatibility Mode



AES67 Compatibility Mode



AIMS Roadmap

SDI over IP Baseline	Audio over IP	Standardized Transport of Audio, Video, & ANC Elements
SMPTE ST 2022-6 SDI Over IP	AES67 Audio Over IP	SMPTE ST 2110-10 Timing & Definitions SMPTE ST 2110-20 Uncompressed Video SMPTE ST 2110-21 Packet Pacing SMPTE ST 2110-30 AES67 Audio SMPTE ST 2110-31 AES3 Compressed Audio SMPTE ST 2110-40 Ancillary Data
SMPTE ST 2022-6	AES67	SMPTE ST 2110

SMPTE ST 2110

- Professional Media over Managed IP Networks
- First parts published in late 2017

SMPTE ST 2110

- ST 2110 standards suite specifies the carriage, synchronization, and description of separate elementary essence streams over IP for real-time production, playout, and other professional media applications
- All elements can be routed separately and brought together again at the endpoint
- With ST 2110, each component flow (audio, video, metadata) is synchronized to each other while remaining independent streams
- Each media type is in a separate packet stream
- Easy to process individual components

Elements of SMPTE ST 2110 in the AIMS Roadmap

- ST 2110-10 System Timing and Definitions
- ST 2110-20 Uncompressed Video
- ST 2110-21 Traffic Shaping and Delivery Timing for Video
- ST 2110-30 Uncompressed PCM Audio (based on AES67)
- ST 2110-31 Transparent AES3 Audio Transport
- ST 2110-40 Ancillary Data

ST 2110-10 System Timing and Definitions

- ST 2110-10 defines:
 - Transport layer protocols
 - Datagram size limits
 - Requirements for Session Description Protocol (SDP)
 - Clocks and their timing relationships

ST 2110-10 System Timing and Definitions

- RTP: Real-time Transport Protocol
 - RFC 3550 from the IETF (Internet Engineering Task Force)
 - Provides end-to-end network transport functions suitable for applications transmitting real-time data, such as audio and video, over multicast or unicast network services
- SDP: Session Description Protocol
 - RFC 4566 from the IETF
 - SDP describes multimedia sessions for the purposes of session announcement, session invitation, and other forms of multimedia session initiation

ST 2110-10 System Timing and Definitions

- PTP: Precision Time Protocol
 - IEEE 1588-2008 (Institute of Electrical and Electronics Engineers)
 - Method for distributing precise, GPS-referenced time over an IP network
 - Proven technology used in multiple industries
 - Used for synchronization and alignment of media signals
 - AES67 and ST 2110 both use PTP

ST 2110-20 Uncompressed Video

- Specifies the requirements and the payload format for the transport of uncompressed active video
 - Uses an RTP format based on RFC 4175
- Uncompressed video images are transported (just like SDI), but only the data that make up the “active” portion of each video frame
 - Only the image samples (pixels) that comprise the pictures to be delivered to viewers are transported
 - This method significantly reduces the amount of data required to represent each frame of video by 20-30%

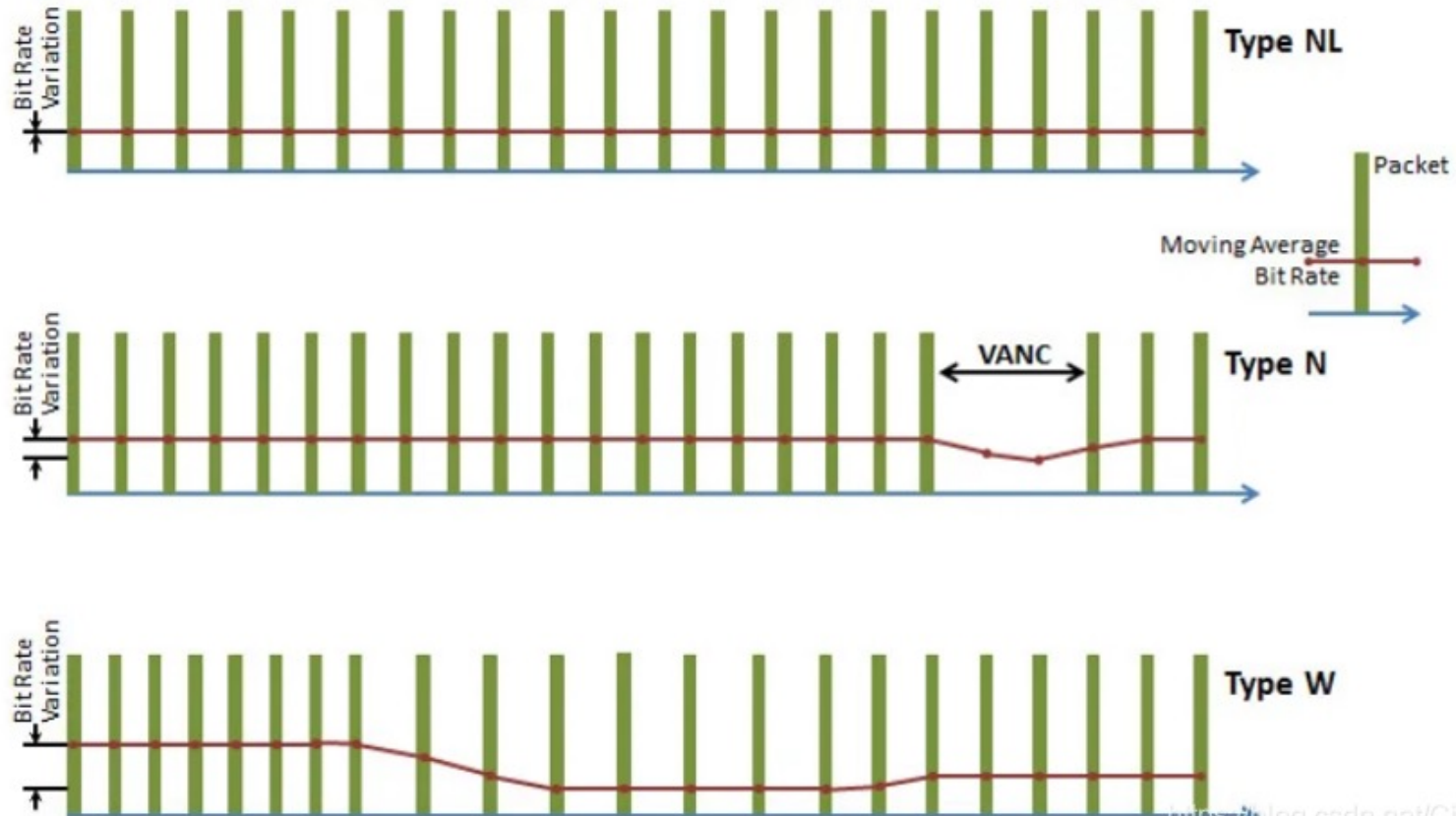
ST 2110-21 Traffic Shaping and Delivery Timing for Video

- Specifies the timing model for senders and receivers of video RTP streams
- Defines three classes of devices based on their transmission timing behavior
 - NL (Narrow Linear)
 - N (Narrow)
 - W (Wide)
- Impacts buffer requirements of network switches and receiver devices and sender / receiver compatibility

ST 2110-21 Traffic Shaping and Delivery Timing for Video

- NL (Narrow Linear) senders transmit data at a constant bit rate
- N (Narrow) senders may temporarily suspend transmission during the vertical blanking interval
- W (Wide) senders are intended to support software implementations of ST 2110 and adhere to less rigorous transmission timing requirements
 - Type W receivers should be able to receive from any type of sender, allowing for “burstiness”
 - Larger data buffers are required

ST 2110-21 Traffic Shaping and Delivery Timing for Video



ST 2110-30 Uncompressed PCM Audio

- Specifies the payload format for linear PCM audio only
- Based on AES67

SMPTE ST 2110-30

A CONSTRAINED SUBSET OF AES67



SMPTE ST 2110-30

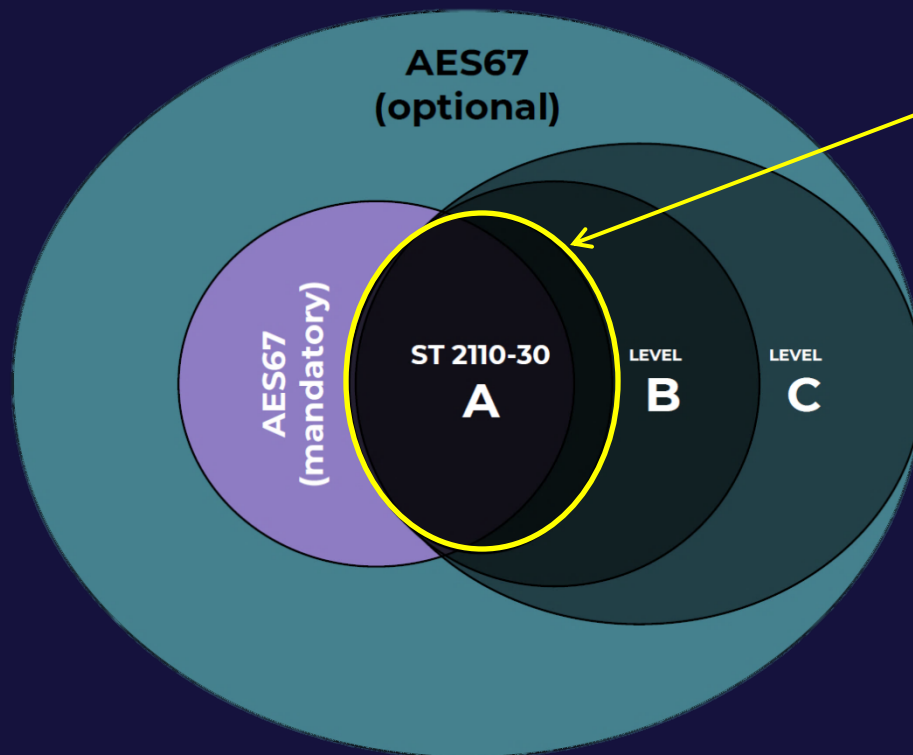
A CONSTRAINED SUBSET OF AES67



CONSTRAINTS = BETTER INTEROPERABILITY (via tighter operating point definition)

SMPTE ST 2110-30

A CONSTRAINED SUBSET OF AES67



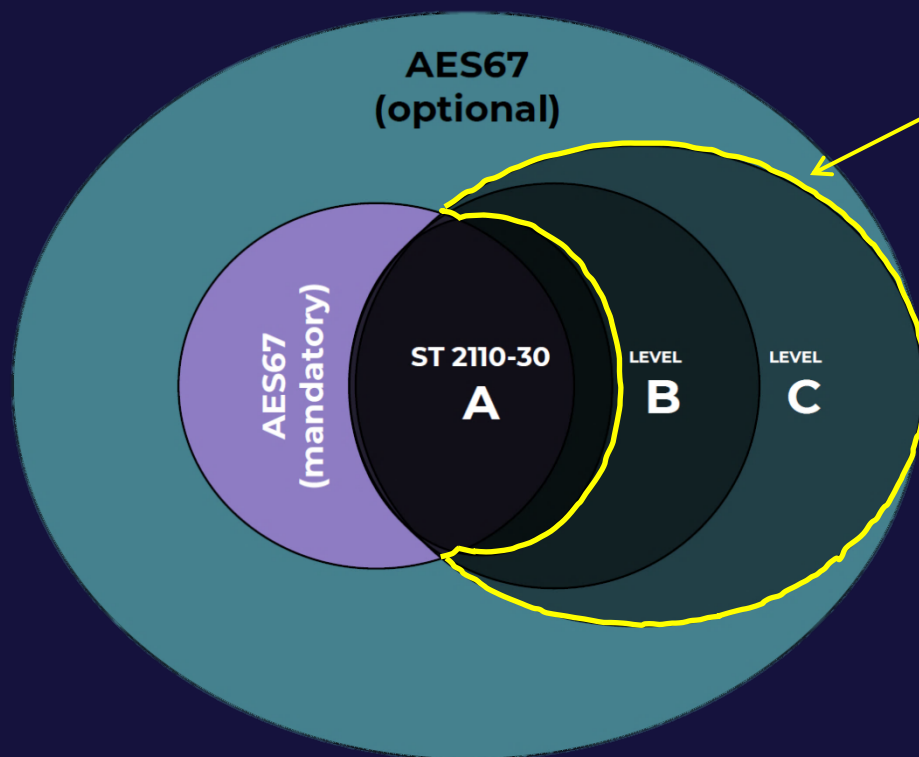
PRIMARY OPERATING POINT:

- **1 msec** packet times
- 2 & 8 channels per stream
- Common PTP operating point per AES-R16-2016
- RTP offset = 0 (unique to ST 2110-30)

CONSTRAINTS = BETTER INTEROPERABILITY (via tighter operating point definition)

SMPTE ST 2110-30

A CONSTRAINED SUBSET OF AES67



These two operating points (ST 2110-30 Level B & Level C) both support a shorter packet time of **125 μ s**, ideal for low-latency **LIVE PRODUCTION**

LEVEL B: up to 8 channels/stream

LEVEL C: up to 64 channels per stream

CONSTRAINTS = BETTER INTEROPERABILITY (via tighter operating point definition)

AES67 / SMPTE ST 2110 COMMONALITIES AND CONSTRAINTS

Explanation of the relationship between the SMPTE ST 2110 standard and the AES67 standard from the Audio Engineering Society

Updated – APRIL 2019

ST 2110-31 Transparent AES3 Audio Transport

- Published in 2018
- Specifies the real-time, RTP-based transport of AES3 audio signals over IP networks, referenced to a network clock
- Can transport any format which can be encapsulated in AES3:
 - L24 PCM with AES3 sub-frame meta data (channel status bits)
 - Non-PCM audio and data formats as defined by SMPTE ST 337/338 (e.g. Dolby E)

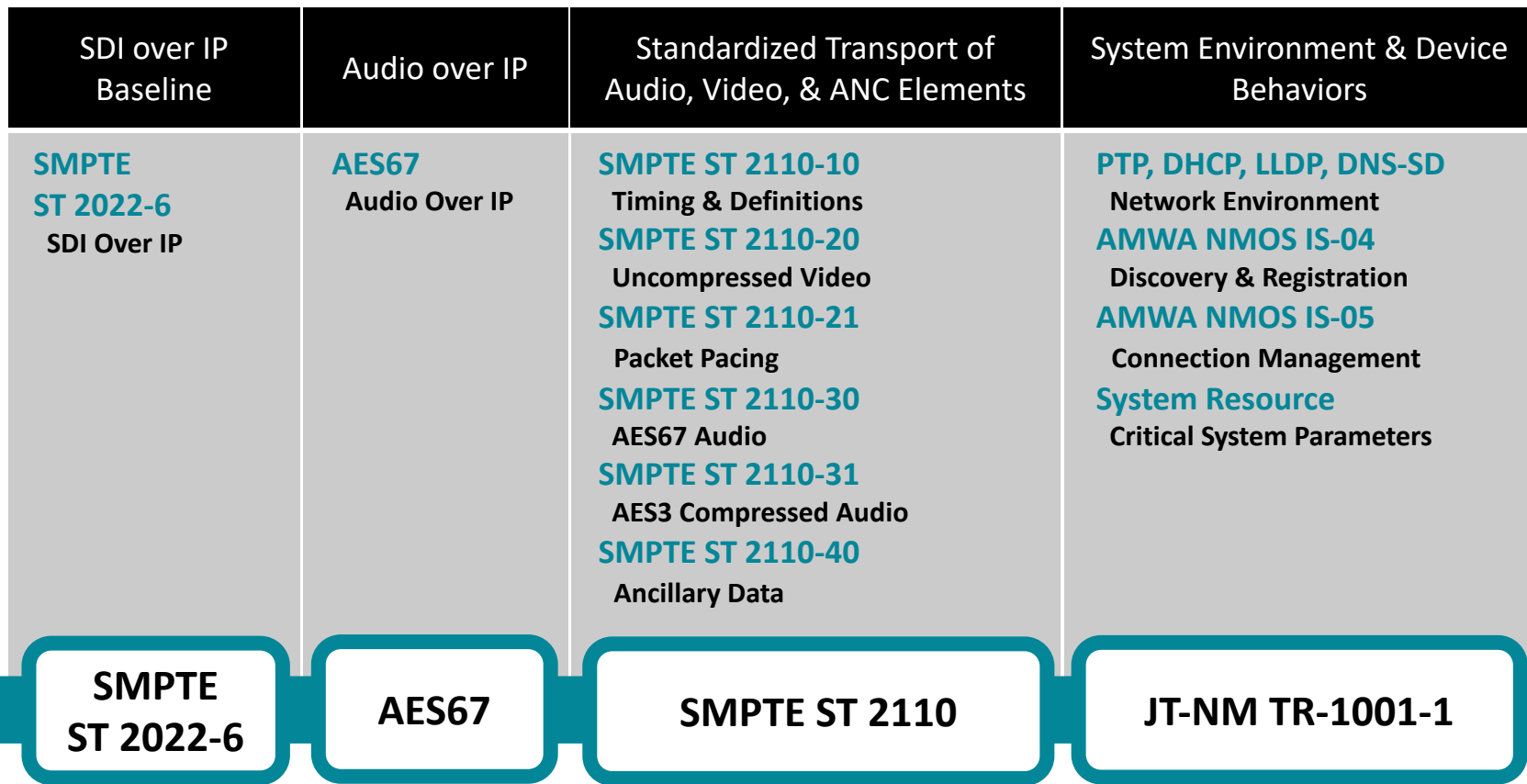
ST 2110-40 Ancillary Data

- Specifies the method of transporting (SDI) ancillary data via RTP
- Maps ancillary data packets (as defined in SMPTE ST 291-1) into RTP packets that are transported via UDP/IP
 - Timecode
 - Closed Captions
 - Subtitles
- Enables those packets to be moved synchronously with associated video and audio essence streams

Further ST 2110 Developments

- The suite of standards in ST 2110 continues to develop
- ST 2110-22: Constant bit-rate compressed video transport
 - Not yet included as part of the AIMS Roadmap
- Other parts are expected to be developed and published in the future
- AIMS continually assesses potential new additions to the Roadmap

AIMS Roadmap



JT-NM TR-1001-1

- **System Environment and Device Behaviors**

AIMS Roadmap

The Joint Task Force on Networked Media is a self-coordinating group of industry bodies led by the following members:



Our mission is to help drive development of a packet-based network infrastructure for the professional media industry by bringing together manufacturers, broadcasters and industry organizations to create, store, transfer and stream professional media.

JT-NM TR-1001-1

- **System Environment and Device Behaviors**
- Learning from the experiences of the first ST 2110 broadcast installations, the JT-NM developed a document aimed at addressing the challenges those early adopters encountered
- Goal of the document is to enable the creation of network environments where an end-user can:
 - Take delivery of new equipment
 - Connect it to their network
 - Configure it for use with a minimum amount of human interaction

JT-NM TR-1001-1

- Enables simplified network configuration, registration and connection management for SMPTE ST 2110 media nodes
- Includes previously published specifications from AMWA:
 - NMOS IS-04 defines how devices are discovered and registered
 - NMOS IS-05 specifies connection management
- TR-1001-1 goes beyond this and describes a range of other environment behaviors that addresses how devices work together within the context of a network system
- This utilizes a number of IT industry technologies when there is no reason to re-invent those elements for IP media networking

EBU Technology Pyramid

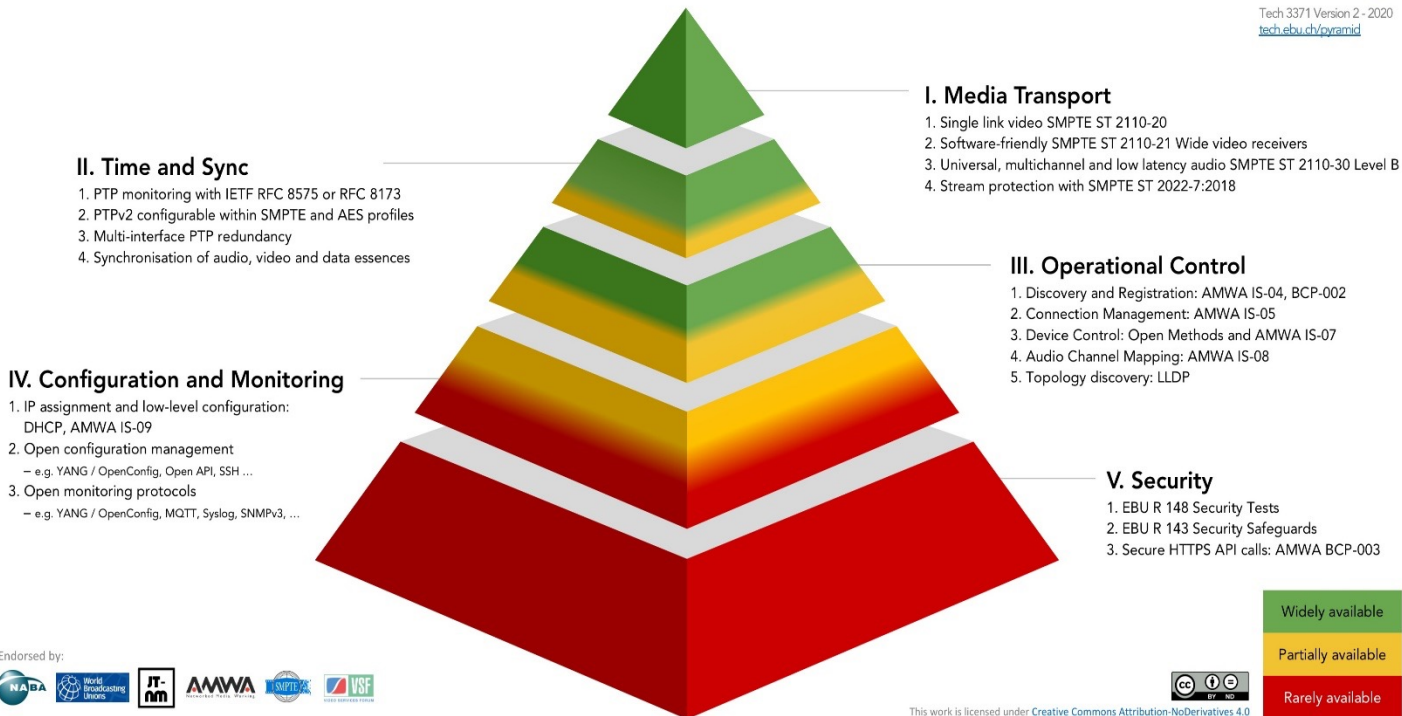
- Although much has been accomplished in the past several years, there is more work to be done
- The EBU Technology Pyramid project set out to identify gaps in the technologies and the availability of standards-based solutions
- The pyramid provides a visual representation of how the technology has developed and what areas still require further progress

THE TECHNOLOGY PYRAMID FOR MEDIA NODES

Minimum User Requirements to Build and Manage an IP-Based Media Facility using Open Standards & Specifications.



Tech 3371 Version 2 - 2020
tech.ebu.ch/pyramid



Endorsed by:



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JT-NM Tested Events

- Offers more documented insight into how vendor equipment aligns with the SMPTE ST 2110 standard
- Includes testing of JT-NM TR-1001-1 and AMWA NMOS specifications
- This program is not a certification program
 - It is a snapshot in time of how vendor equipment conforms to key parts of standards and specifications
- These testing events have been held for several years with the latest one being conducted in August 2022
 - A report from that latest event will be presented in this theater later today



AIMS Ongoing Activities

- Further additions to the Roadmap are under consideration
- IPMX: Internet Protocol Media Experience
 - Bringing open standards for media networking to the Pro AV industry
 - Based on ST 2110 and NMOS
 - Along with further elements required for the Pro AV industry
- Education Initiative
 - AIMS Education Library provides a resource for learning about IP technology for broadcast and Pro AV operations
 - Vast range of videos and presentations from AIMS members and partners
 - <https://aimsalliance.org/educational-library/>

