RAVENNA 2020 Webinar Series

RAVENNA
and its relationship to
AES67 & SMPTE ST 2110

Tue, Apr 14, 2020
15:00 h (CEST)

Presenter: Andreas Hildebrand, ALC NetworX

ALC NetworX

RAVENNA 2020 Webinar Series

Upcoming webinars:

- Tue, Apr 28, 2020 - 15:00 h (CEST):

  AES67 & SMPTE ST 2110 (Introduction / overview)

- Tue, May 12, 2020 - 15:00 h (CEST):

  AES67 & SMPTE ST 2110 (Deep dive)

More on a **bi-weekly** basis, to be announced on:
- **url** : ravenna-network.com/about-ravenna/trade-shows-events/
- 🐦 : @RAVENNA_Network
- **f** : facebook.com/RAVENNA.Network/
- **in** : linkedin.com/groups/7454171/

AES67 & SMPTE ST 2110

- The Vulcan Nerve Pinch to **RAVENNA** ?
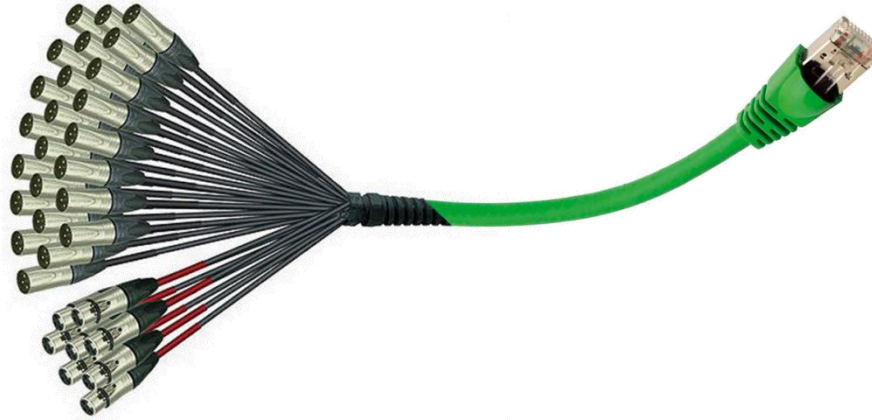
ALC NetworX

What is RAVENNA?

What is RAVENNA?

What is RAVENNA?

RAVENNA

The IP-based Real-Time Media Network

Real-time **A**udio & **V**ideo **E**nhanced
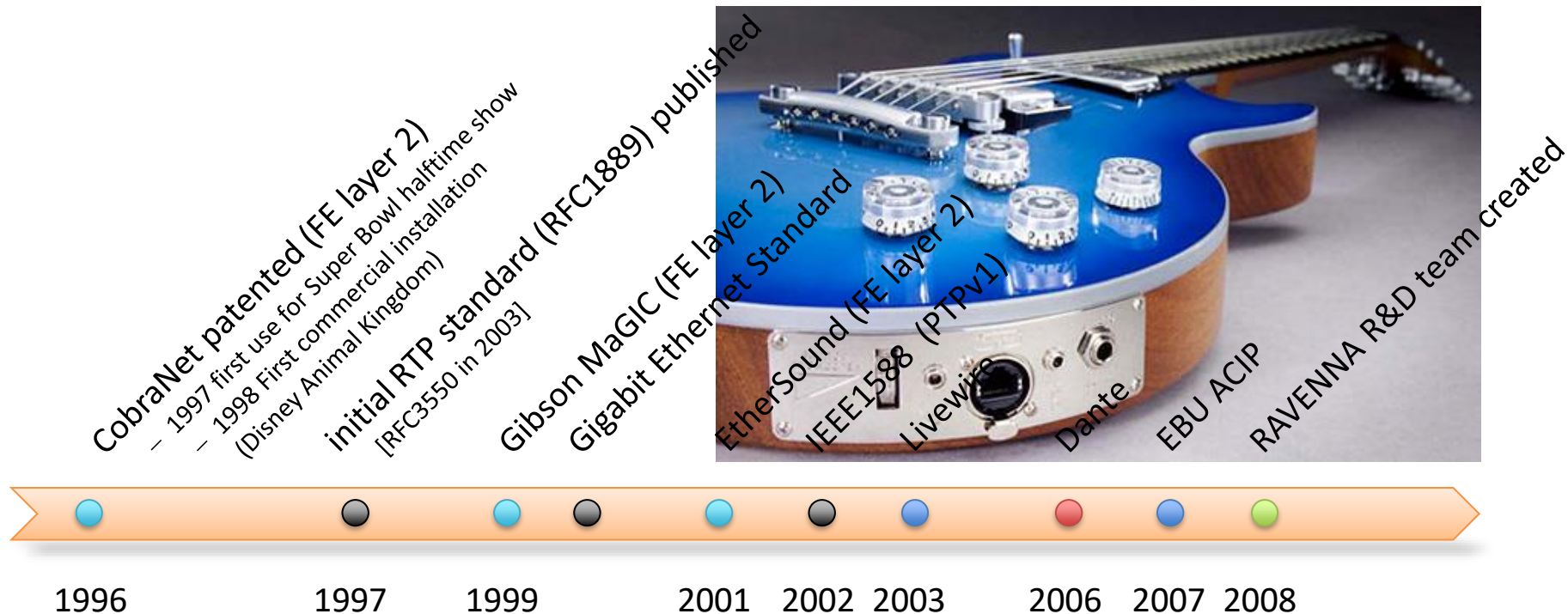
Next-Generation **N**etwork **A**rchitecture

Skip history

ALC NetworX

Why RAVENNA?

The IP-based Real-Time Media Network

Skip why

Networked audio timeline

CobraNet patented (FE layer 2)
– 1997 first use for Super Bowl halftime show
– 1998 First commercial installation
(Disney Animal Kingdom)

initial RTP standard (RFC1889) published
[RFC3550 in 2003]

Gibson MaGIC (FE layer 2)

Gigabit Ethernet Standard

EtherSound (FE layer 2)

IEEE1588 (PTPv1)

Livewire

Dante

EBU ACIP

RAVENNA R&D team created

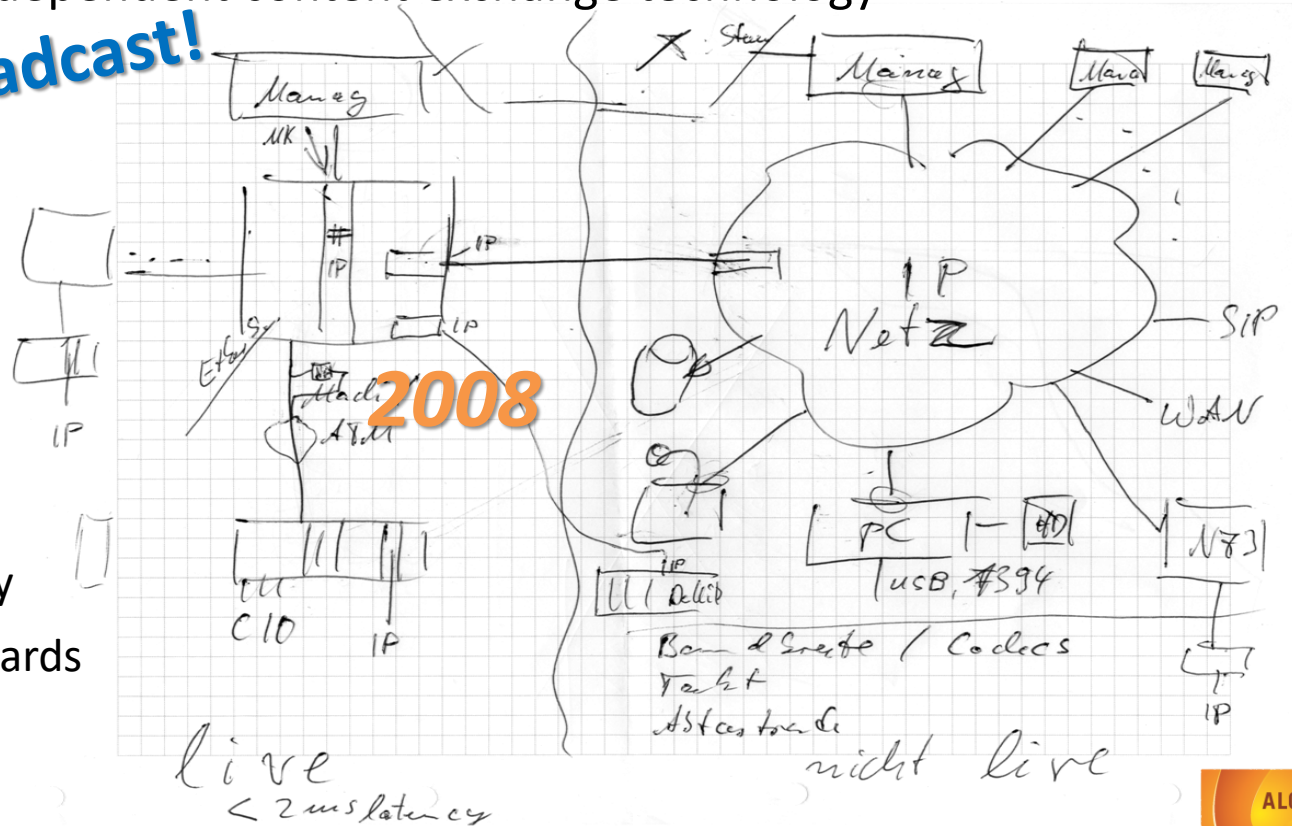| 1996 | 1997 | 1999 | 2001 | 2002 | 2003 | 2006 | 2007 | 2008 |

ALC NetworX

Vision: a platform-independent content exchange technology

Requirements:

Broadcast!

2008

- scalable
- fast
- shareable
- flexible
- reliable
- routable
- non-proprietary
- based on standards
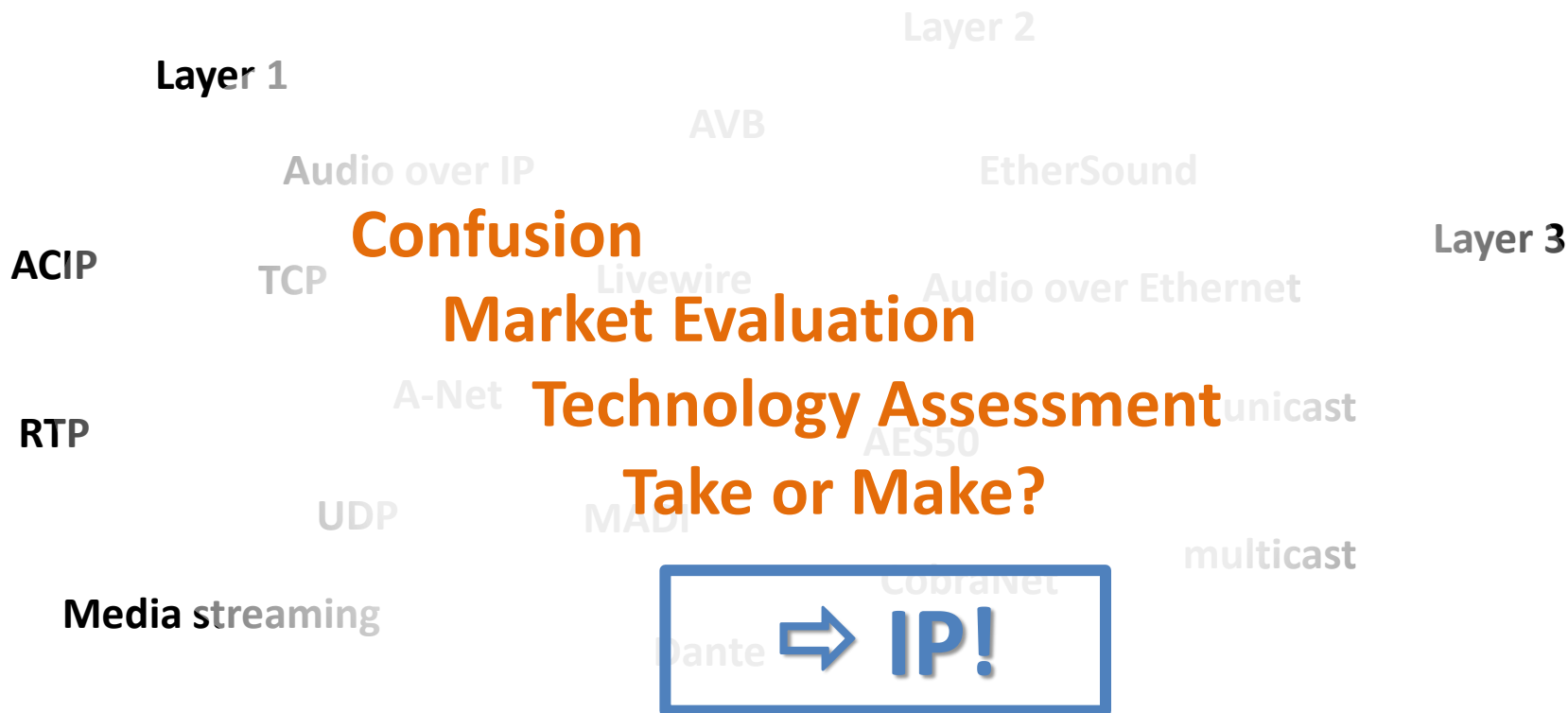
Why Networking?

- Availability – increase of network-based services (VoIP / NGN, IPTV, WAN distribution via "codecs" etc.) & performance of infrastructure (Ethernet / Gigabit, fiber, switches / routers etc.)

- Cost efficiency – equipment, cabling, planning, installation

- Flexibility – fast re-configuration / re-routing w/o change in cabling

- Scalability –performance scales w/ capabilities of network infrastructure

- Versatility – add'l services on same network (e.g. control signal, communication, "office" traffic etc.)

- Convergence – direct integration w/ PCs

- Resource efficiency – consolidation of maintenance efforts for engineering & service departments

ALC NetworX

Layer 2

Layer 1

AVB

Audio over IP

EtherSound

ACIP

Confusion

Layer 3

TCP

Livewire

Audio over Ethernet

Market Evaluation

A-Net

Technology Assessmentunicast

RTP

AES50

UDP

MADI

multicast

Media streaming

CobraNet

Dante ➡ **IP!**

Why IP-based Networking?

- General advantages of networking: Reliability, flexibility, versatility, accessibility, scalability, cost advantage, maintenance efficiency, …

- Availability: IP-capable network equipment and infrastructure readily available and widely deployed

- Based on standards: IP standard protocols (the "internet protocols") are widely supported (e.g. RTP/RTCP, RTSP, IGMP, SDP, DHCP, DNS etc.)

- Routing capability: content can be routed across campus networks and WAN connections without technology change

- Convergence: PCs can participate on the network without dedicated hardware

- Future-proof: IP-based services are growing into all areas of communication

Layer 2

Layer 1

AVB

Audio over IP

EtherSound

Layer 3

ACIP

TCP

Livewire

Audio over Ethernet

Confusion

Market Evaluation

A-Net

unicast

Technology Assessment

RTP

AES50

Take or Make?

UDP

MADI

multicast

CobraNet

Media streaming

Dante

➡ IP!

Existing Audio-over-IP solutions / technologies / initiatives:

Technology	Purveyor	Date introduced	Technical requirements matched?	Open technology?
Livewire	Telos/Axia	2003	😐	😐
Wheatnet-IP	Wheatstone	2005	☹️	☹️
Dante	Audinate	2006	🙂	☹️
N/ACIP	EBU	2007	☹️	🙂
AVB	IEEE, AVnu	2005	🙂😐☹️	🙂

Layer 2

Layer 1

AVB

Audio over IP

EtherSound

Confusion

Layer 3

ACIP

TCP

Livewire

Audio over Ethernet

Market Evaluation

MAKE!

RTP

A-Net

Technology Assessment unicast

AES50

UDP

Take or Make?

MADI

multicast

CobraNet

Media streaming

Dante

⇨ **IP!**

Networked audio timeline

RAVENNA R&D team created

RAVENNA development started

RAVENNA introduced to selected industry partners

RAVENNA published and introduced at IBC 2010

2008   2009   2010
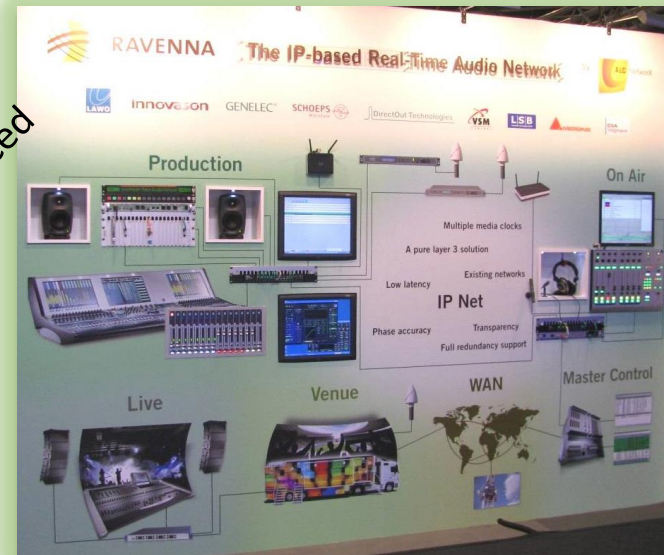
What is **RAVENNA** ?

An "Open Technology" platform:

- Based on **technology** publicly **available**
  - ⇨ *No proprietary "black box" design*
- Utilizes **standard protocols**
  - ⇨ *Proven technology, widely supported*
- Designed to work on **existing networks**
  - ⇨ *No new network equipment required*
- **No** proprietary **licensing** policy
  - ⇨ No cost per channel, suits all performance needs

- Draft on operating principles **published** since June 10th, 2011

ALC NetworX

25

What is *RAVENNA*?

RAVENNA Draft on
Operational Principles

Ingredients:

20 ml PTPv2

500 g RTP

1 pkt multicast

1 pinch of Bonjour

Cooking order:

1. Stew PTP to order
2. Add RTP
3. Mingle with multicast
4. Add Bonjour on top

Serve hot and Enjoy!

ravenna-network.com

An "Open Technology" platform:

- Based on **technology** publicly **available**

  ⇨ *No proprietary "black box" design*

- Utilizes **standard protocols**

  ⇨ *Proven technology, widely supported*

- Designed to work on **existing networks**

  ⇨ *No new network equipment required*

- **No** proprietary **licensing** policy

  ⇨ No cost per channel, suits all performance needs

- Draft on operating principles **published** since June 10th, 2011

  ⇨ *Anybody can implement / support RAVENNA technology*

- **Supported** by renowned companies from the ProAudio industry

  ⇨ *Broad market acceptance*

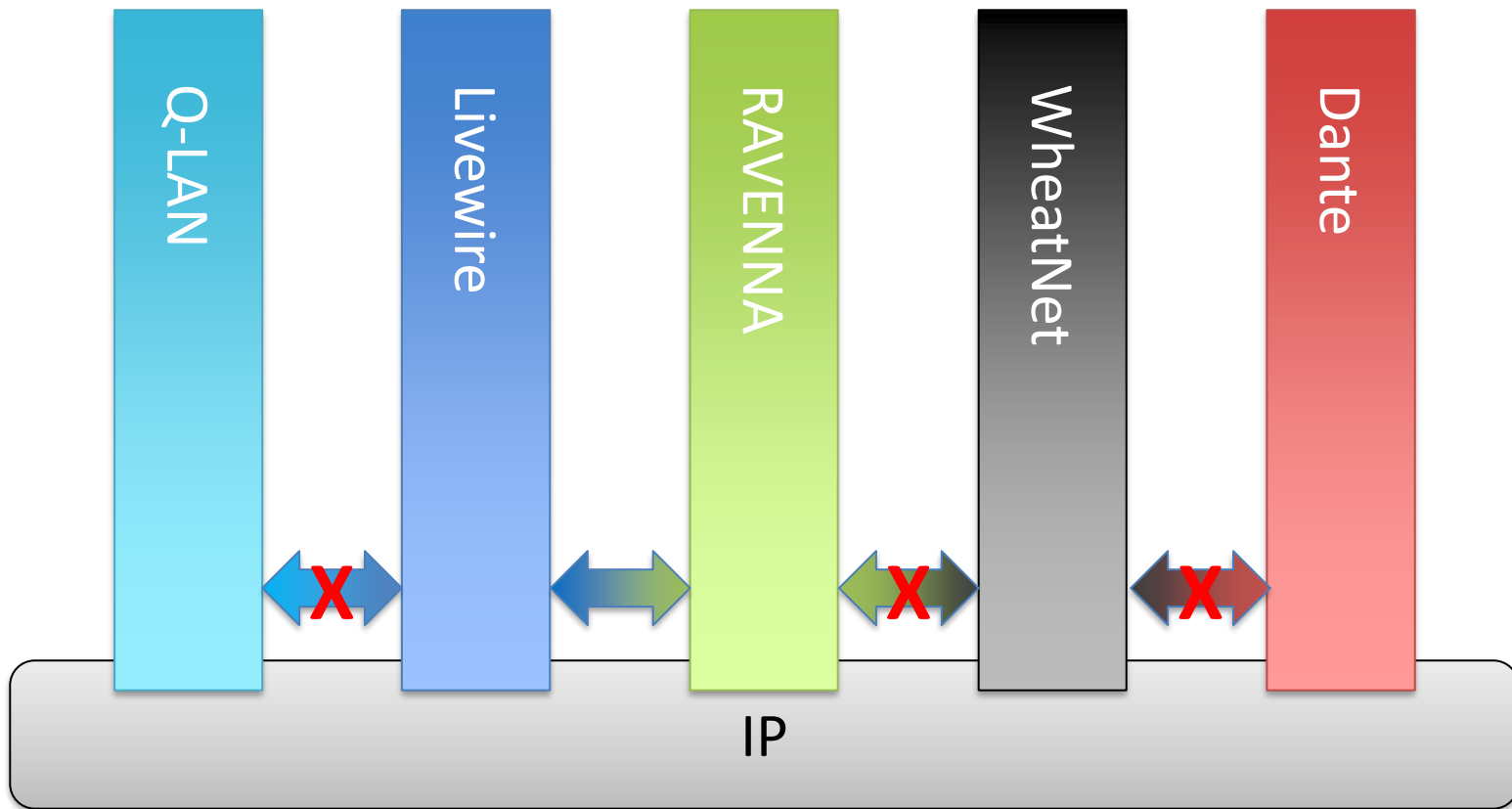*RAVENNA Partners (& AES67 Supporters):*

RAVENNA Key Features:

- A **layer 3** (IP) solution

- Can operate on most **existing network** infrastructures

- Allows p**hase-accurate** distribution of media clocks

- Full **bit-transparency** with all media formats

- Supports concurrent operation of **multiple media** clocks and **data formats**

- Allows **low latency** for real-time critical applications

- Capacity **scales** with underlying network infrastructure

- Supports distribution and synchronization **across network segments**

- Full network **redundancy** support (optional)

- Based on **standards**

- **Open technology**

Networked audio timeline
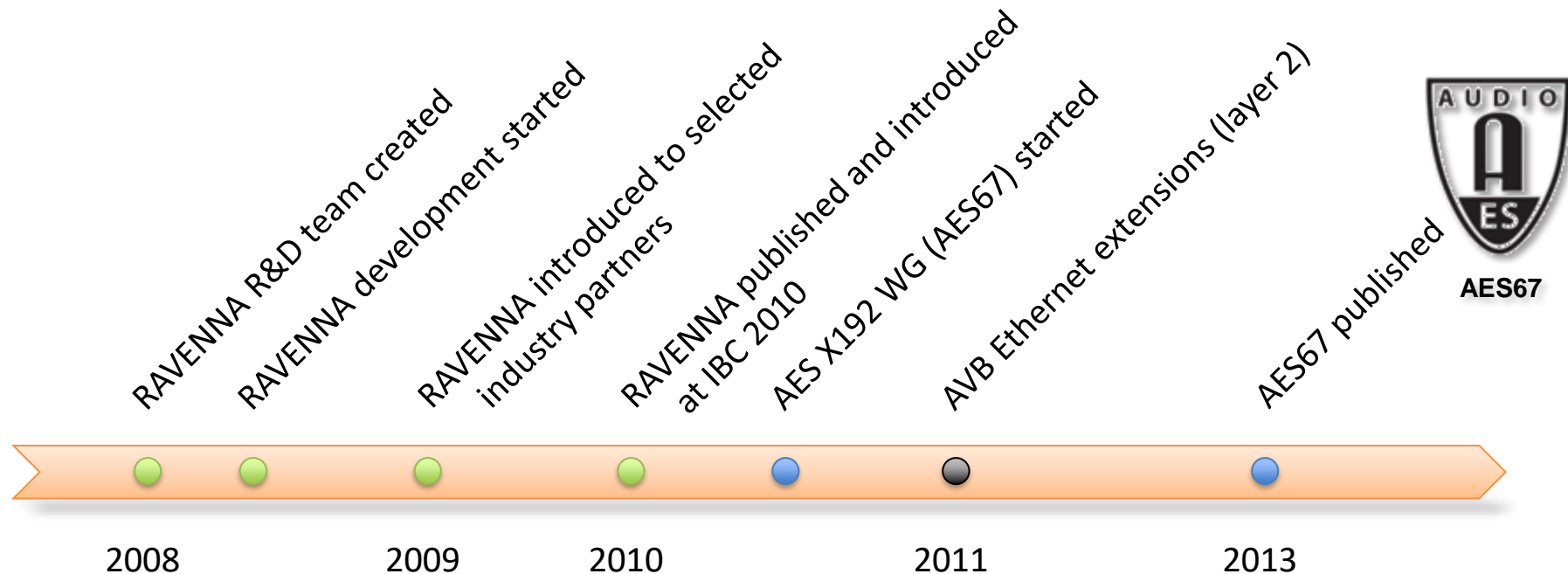
RAVENNA R&D team created

RAVENNA development started

RAVENNA introduced to selected industry partners

RAVENNA published and introduced at IBC 2010

AES X192 WG (AES67) started

AVB Ethernet extensions (layer 2)

AES67 published

AUDIO A ES

AES67

2008   2009   2010   2011   2013

ALC NetworX

AES standard for audio applications of networks -
High-performance streaming audio-over-IP interoperability

AES67

Q-LAN   Livewire   RAVENNA   WheatNet   Dante

AES67

IP

© ALC NetworX GmbH 2019

ALC NetworX

34

AES standard for audio applications of networks -
High-performance streaming audio-over-IP interoperability

AES67

Q-LAN
Livewire
RAVENNA
WheatNet
Dante

AES67

AES67

IP

© ALC NetworX GmbH 2019

ALC NetworX

35
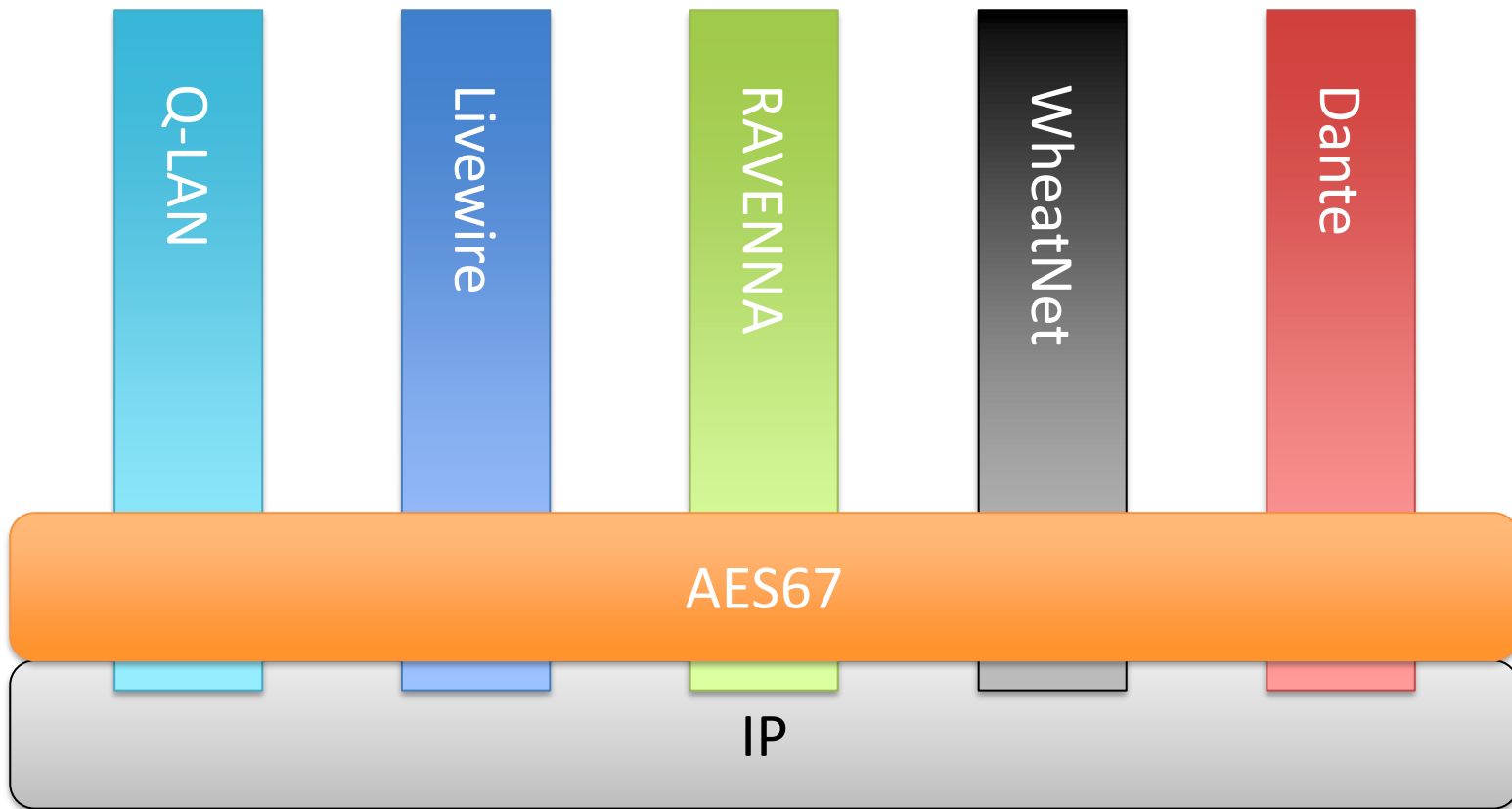
AES67 technology components

Discovery	Not specified
Connection Management	SIP (unicast), IGMP (multicast)
Session Description	SDP (RFC4566, RFC7273)
Encoding	L16/L24, 1..8 ch, 48 samples
QoS	Differentiated Services (DiffServ w/ 3 CoS)
Transport	RTP / UDP / IP, unicast & multicast
Media Clock	48 kHz
Synchronisation	IEEE 1588-2008 (PTPv2)

AUDIO A ES

AES67

ALC NetworX

AES67

AES67

?

RAVENNA

+ Discovery

+ Redundancy

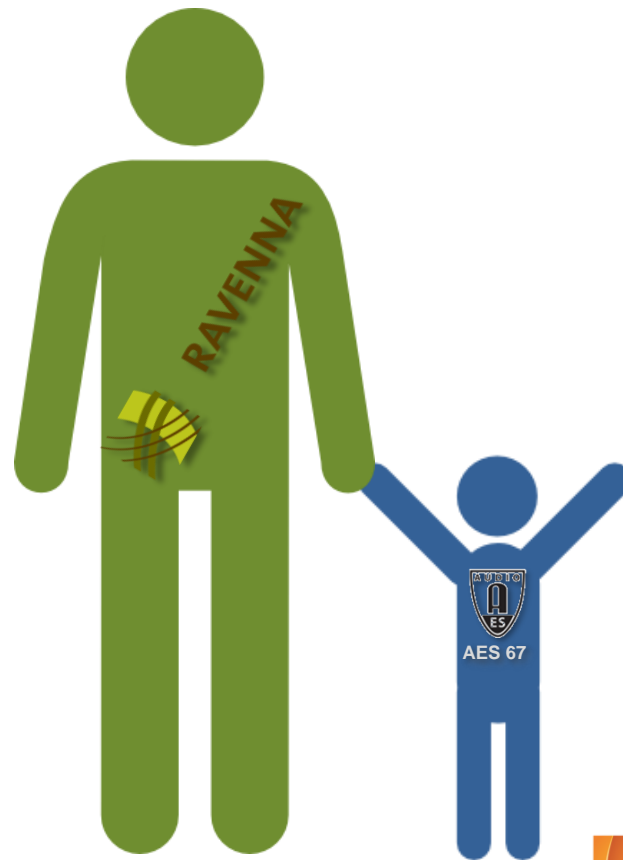| AES67	RAVENNA
QoS three classes	+ classes adjustable
Media Format L16/L24 PCM	+ AES/EBU, DSD/DXD, Video
48 Samples per packet	+ 1, 6, 12, 64…
1-8 Audio channels	+ 64, 128…
Encoding 48kHz	+ 44.1, 96, 192, 384kHz…

AES67

ALC NetworX

	RAVENNA AES67 built-in	+ Discovery	More Features
		+ Redundancy	
AUDIO AES67	QoS three classes	+ classes adjustable	More Options
	Media Format L16/L24 PCM	+ AES/EBU, DSD/DXD, Video	
	48 Samples per packet	+ 1, 6, 12, 64…	
	1-8 Audio channels	+ 64, 128…	
	Encoding 48kHz	+ 44.1, 96, 192, 384kHz…	

ALC NetworX

Networked audio timeline

AES67 published
– RAVENNA natively compatible

First RAVENNA OEM board (ALC NetworX)
– 2014 – low-channel count RAVENNA board (Archwave)

Telos announced AES67 support (Livewire+)

RAVENNA in all 12 Soccer World Cup stadiums
(commentary system)
– 2015 – RAVENNA used for ESC (6600 audio signals)

Revision of AES67

RAVENNA used for Rio Olympics
and European soccer championships

QSC announced AES67 compatibility

Audinate announced AES67 support

2013   2014   2015   2016   2017

Networked audio timeline

...ums

...tibility

AES67 support

RAVENNA AV award for "Elphi" Hamburg
(shared network for broadcast and live production,
including access rights management)

SMPTE ST 2110 published

2013   2014   2015   2016   2017

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.

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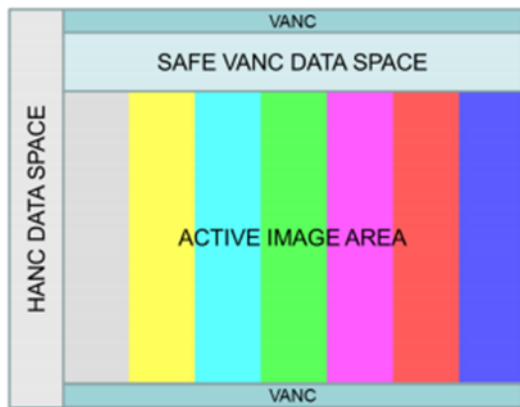
IP Packetization of SDI Raster
Method: **SMPTE ST 2022-6**

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

One Destination IP Address

A + V + meta
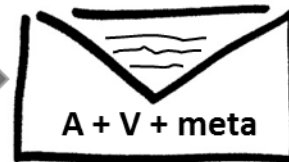
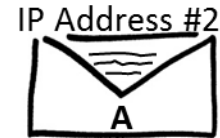Published beginning in 2012

The Essence-based Approach: SMPTE ST 2110

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

Active Video

IP Address #1
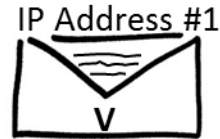
IP Packetization of Audio Channels
Method: **SMPTE ST 2110-30**

Audio

IP Address #2

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

Metadata

IP Address #3

Published beginning in 2017

Bundled vs. Essence-based Approach
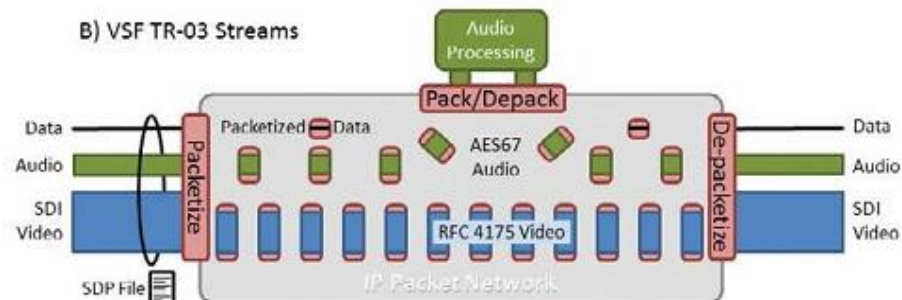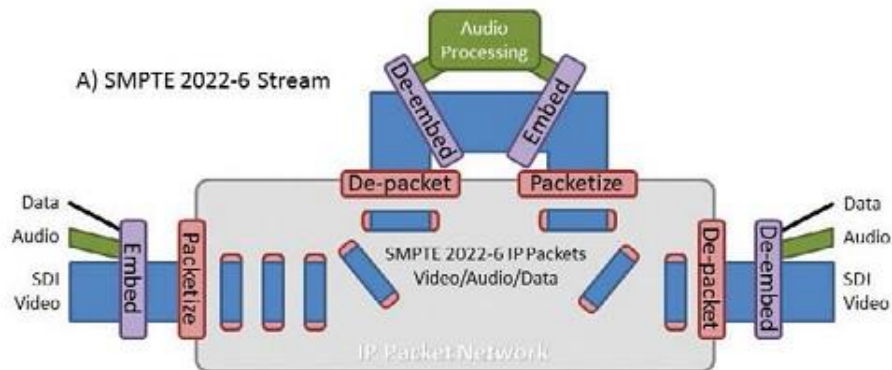
ST 2022-6

ST 2110

SMPTE 2110 - Professional Media over Managed IP Networks

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)

- 2110-22: Compressed Active Video
  - defines payload format for CBR-compressed video (no codec definition!)

SMPTE 2110 - Professional Media over Managed IP Networks

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 2110 - Professional Media over Managed IP Networks

Document structure (audio):

- 2110-**10**: System Timing & Definitions
  - defines transport layer and synchronization (SMPTE2059, clocks, RTP, SDP etc.)

- 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)

SMPTE 2110 - Professional Media over Managed IP Networks

Document structure (linear PCM audio):

- 2110-**10**: System Timing & Definitions
    - defines transport layer and synchronization (SMPTE2059, clocks, RTP, SDP etc.)

- 2110-**30**: PCM Digital Audio
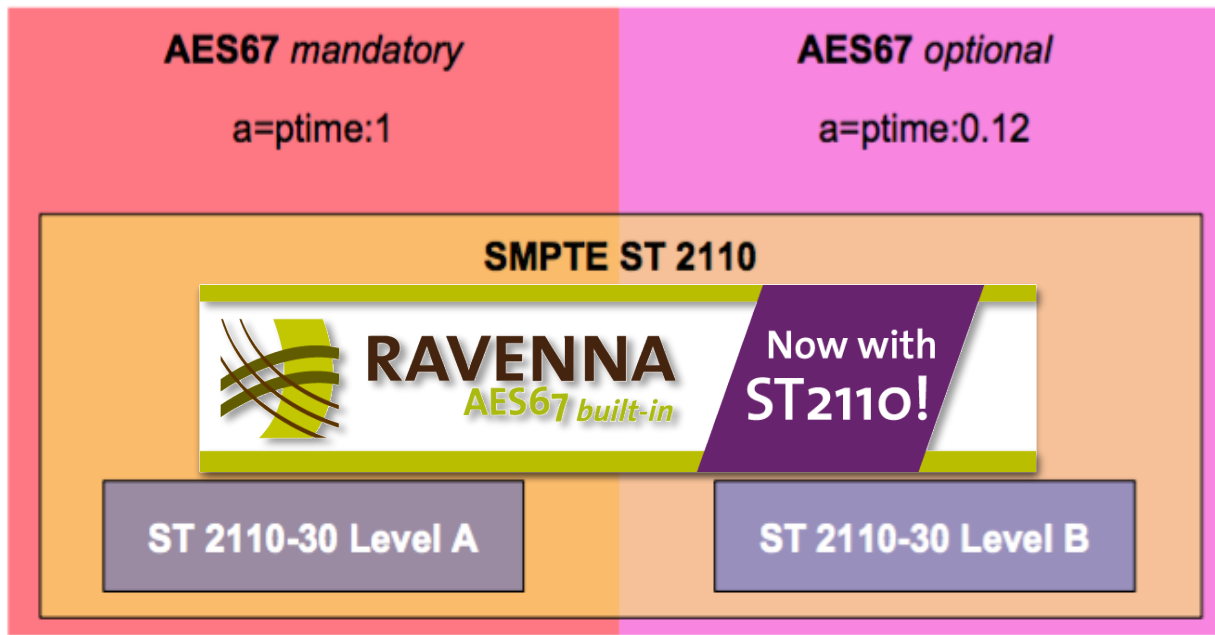   - defines payload format for linear audio (AES67, constraints)

AES67
Constraints!

⇨ AIMS WP on
AES67 / ST2110 Commonalities & Constraints
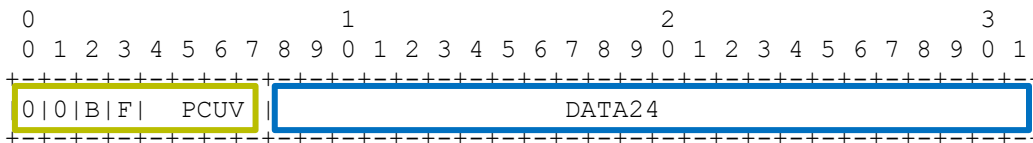
SMPTE ST 2110-30 and AES67 Compatibility

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

AES67 *mandatory*

a=ptime:1

AES67 *optional*

a=ptime:0.12

SMPTE ST 2110

RAVENNA
AES67 *built-in*

Now with
ST2110!

ST 2110-30 Level A

ST 2110-30 Level B

SMPTE 2110 - Professional Media over Managed IP Networks

2110-31 – 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

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0|B|F|  PCUV |                  DATA24                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

-
    - RTP payload format signaled in SDP:

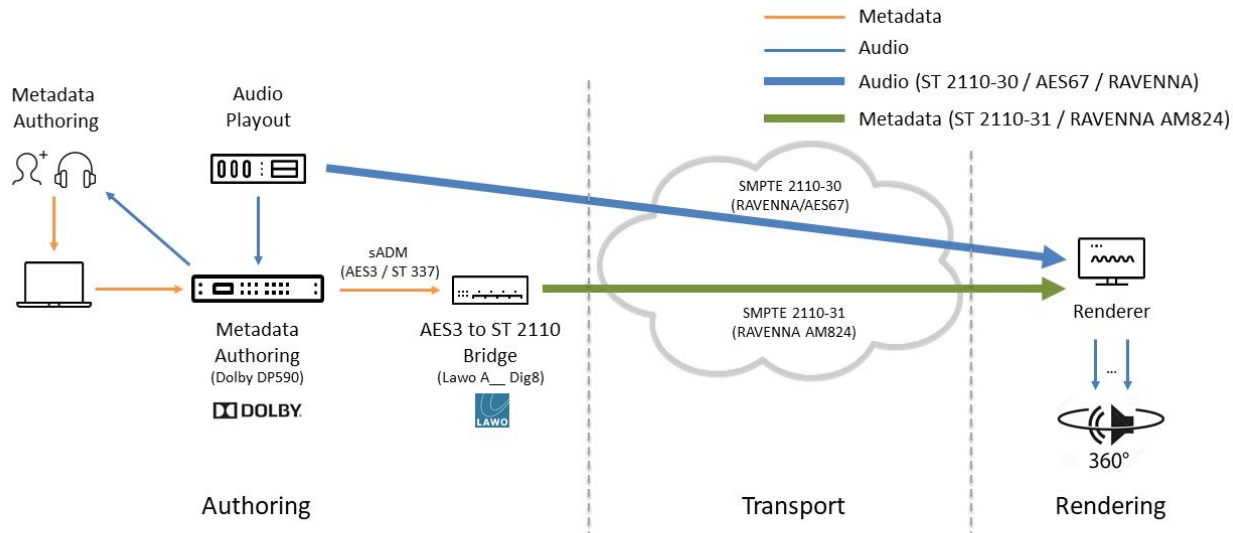   `a=rtpmap:<pt> AM824/48000/<nchan>` - with `<nchan>` always being an equal number (stereo channels)
    - retains all other SDP parms

ALC NetworX

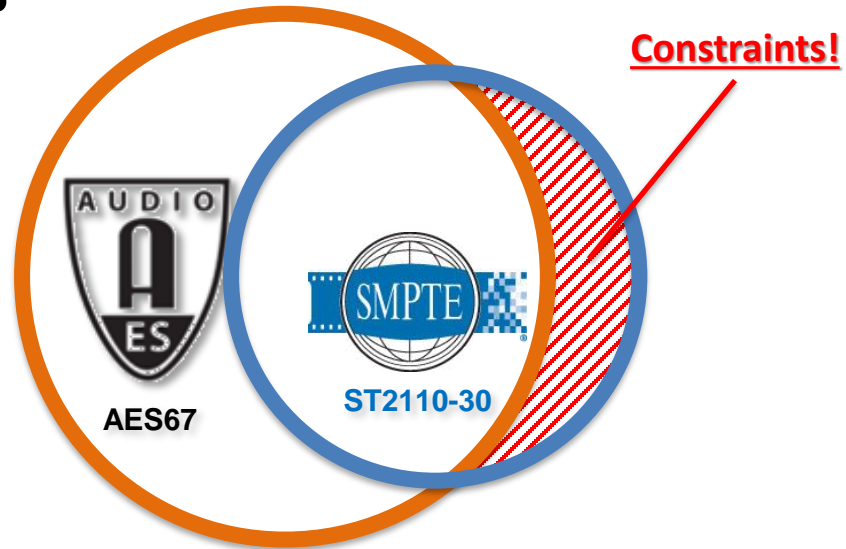Audio Metadata over SMPTE ST 2110-31 (RAVENNA AM824)

SMPTE 2110 - Professional Media over Managed IP Networks

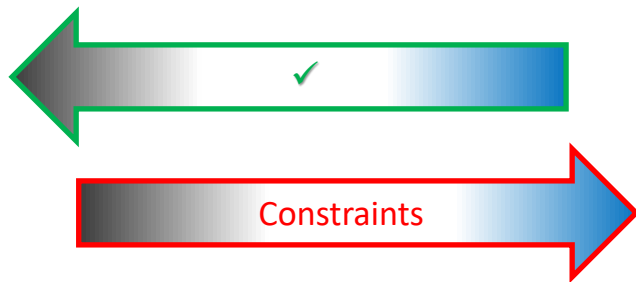**AES67 / ST2110 audio compatibility?**

24-bit PCM audio

Constraints!

AES67

ST2110-30

SMPTE 2110 - Professional Media over Managed IP Networks

AES67 / ST2110-30 stream compatibility?

AES67

✓

Constraints
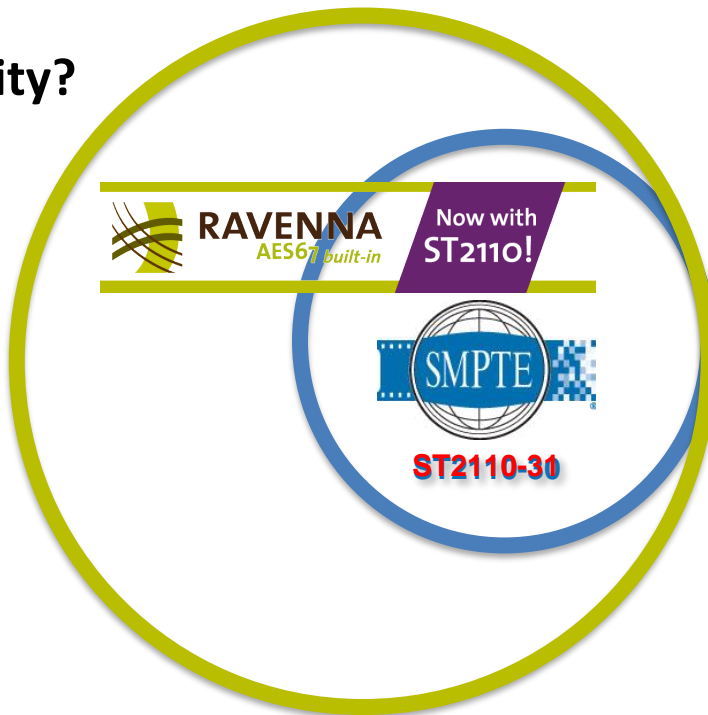
ST2110-30
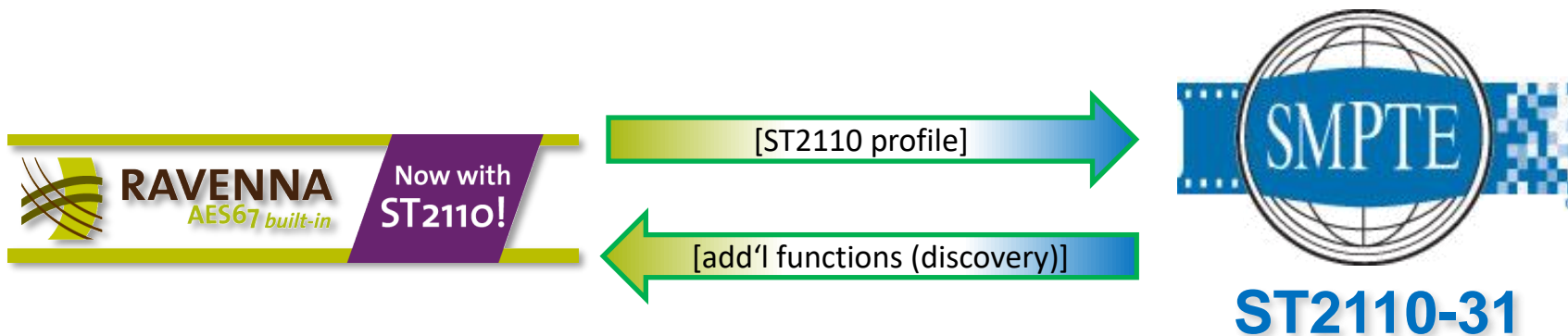
SMPTE 2110 - Professional Media over Managed IP Networks

AES67 / ST2110 audio compatibility?

AES3 audio

SMPTE 2110 - Professional Media over Managed IP Networks

AES67 / ST2110-31 stream compatibility?

Summary (why RAVENNA?):

- Flexibility
  - Wide range of formats, sampling rates and packet times
  - Accommodates any channel bundles

- Performance
  - Full bit-transparency
  - Capacity scales w/ network speed
  - Ultra-low latency possible ("MADI-over-IP")

- Open technology (can be enhanced / expanded)
  - No licensing, multiple adoptions & OEM provider
  - Based on existing standards
    - Operates on standard / managed IT networks (including routing)
  - Adaptable to emerging standards / technologies through layered approach
    - Fully compatible with AES67 / ST2110
    - SAP / SIP / ST 2059 / ST 2022-7 / NMOS

- Most prevalent technology in broadcast applications

ALC NetworX

AES67 & SMPTE ST 2110

- The Vulcan Nerve Pinch to **RAVENNA** ?

Not at all!

Thank you for your attention!

Contact information:

Andreas Hildebrand
Technology Evangelist

ravenna@alcnetworx.de

ALC NetworX GmbH
Am Loferfeld 58
81249 Munich
Germany

CELEBRATING **10 YEARS**
RAVENNA
AES67 & **ST 2110** *built-in*

www.ravenna-network.com