

Designing with

 **Dante**[®]

AES67

 **ST 2110**



 **audinate**[®]

Patrick Killianey
Technical Training Manager
Patrick.Killianey@audinate.com



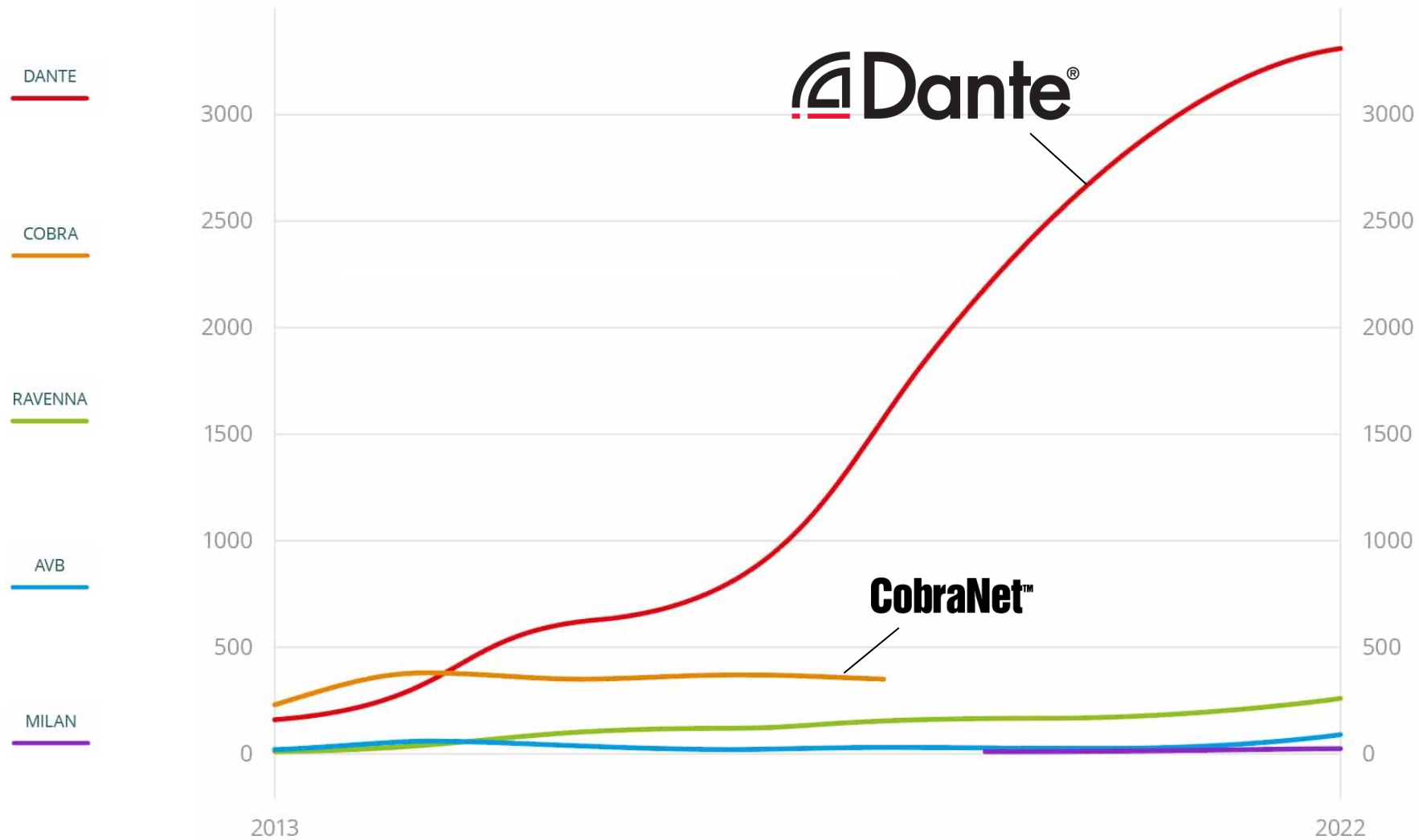
Audinate's Position in the Market

Consistent Behavior Across a Large Footprint

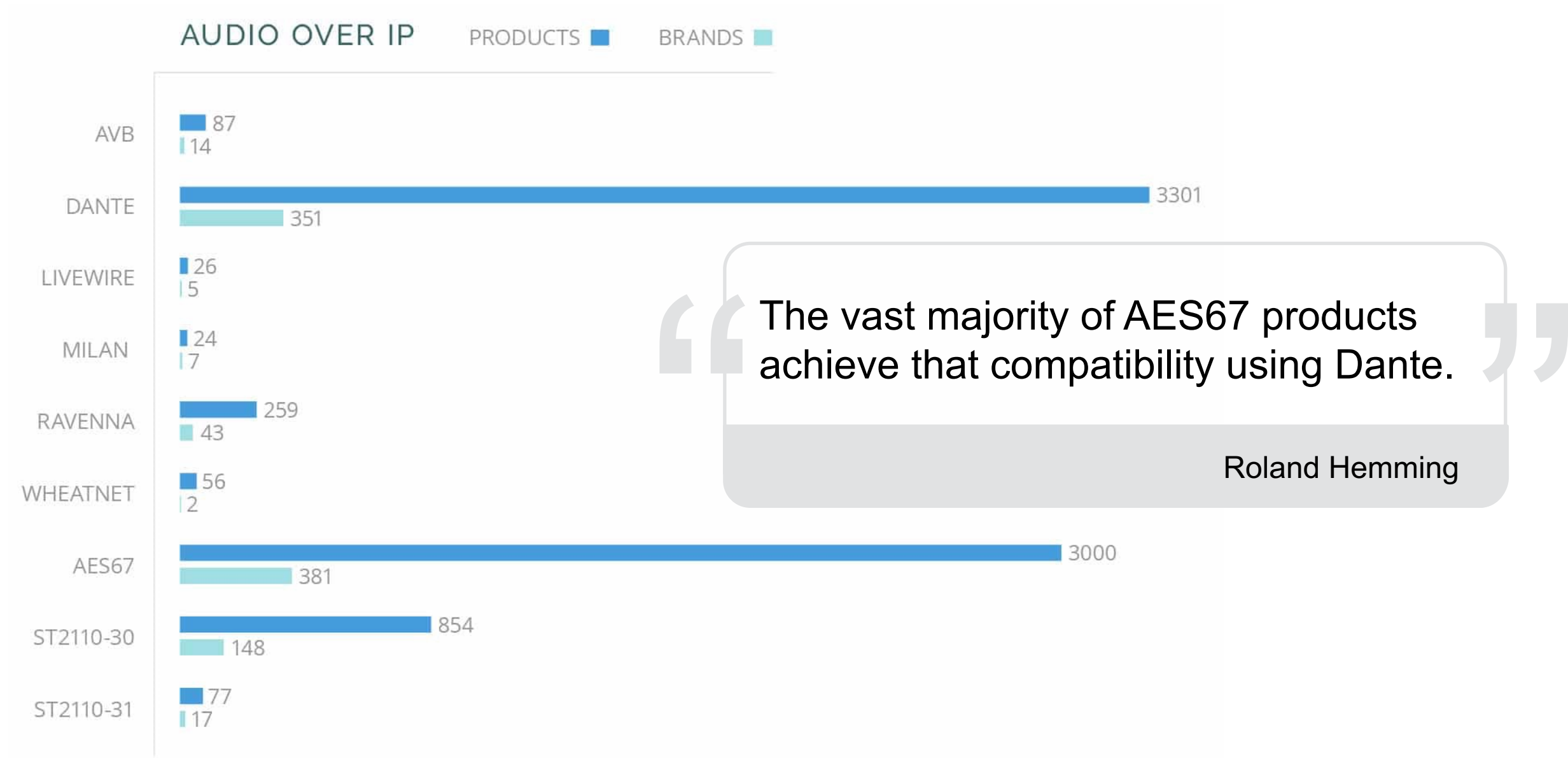


Dante Presence in the Market

Total Products Per Protocol



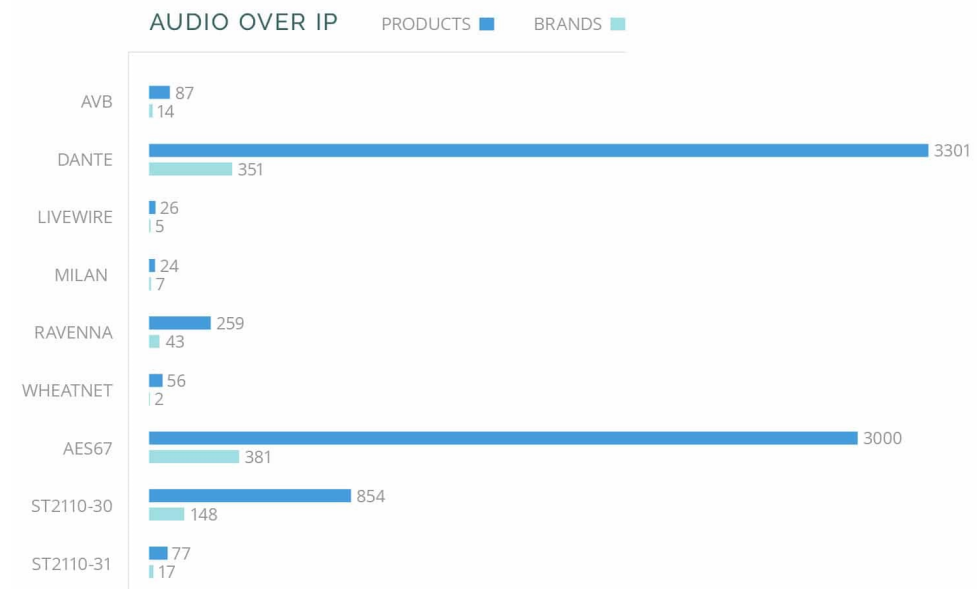
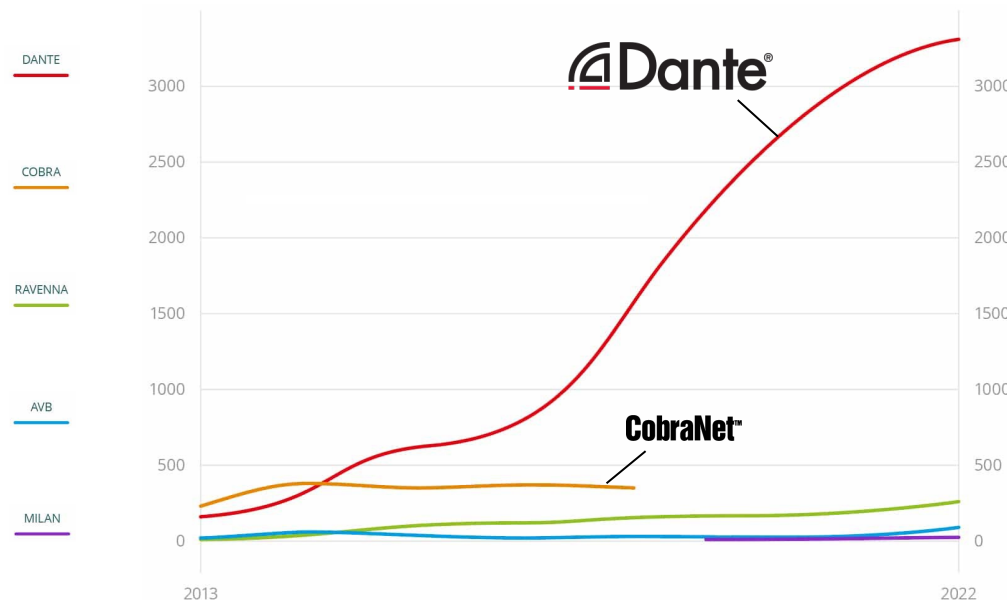
Dante Presence in the Market



Dante Presence in the Market

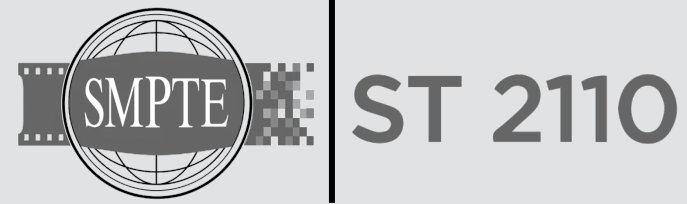
AES67 / SMPTE 2110 behaviors are consistent across the Dante platform:

- 2110-10 Defines the timing relationships between all components in the system
- 2110-30 RTP Audio transport, similar to AES67
- 2059-2 PTP Media Profile (IEEE 1588-2008)
- 2022-7 Redundancy



Audinate's Vision and Support for

AES67



The Goal of AES67 / ST 2110 in Audio



When all you have is a hammer,
everything looks like a nail.

- Abraham Maslow



If you avail yourself to a toolbox,
you'll use the right tool for the job.

- Montgomery Scott



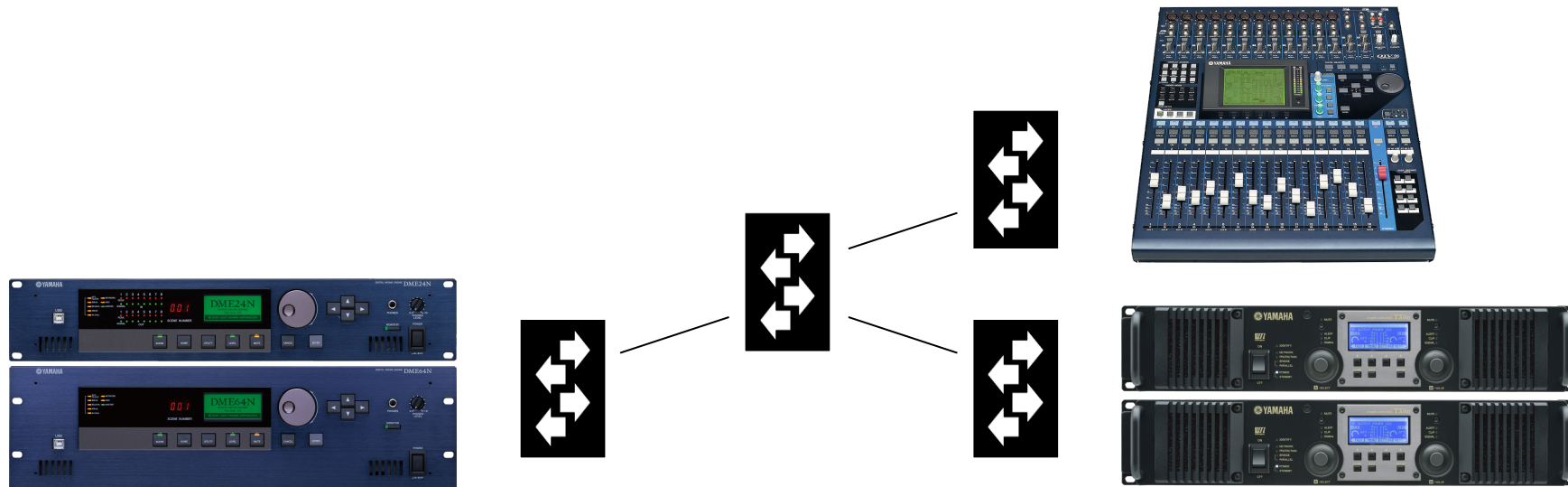
A Bit of History

CobraNet™

vs

Ether
ES
Sound

CobraNet had a flexible network topology but suffered from higher latency per link (5 1/3 msec)



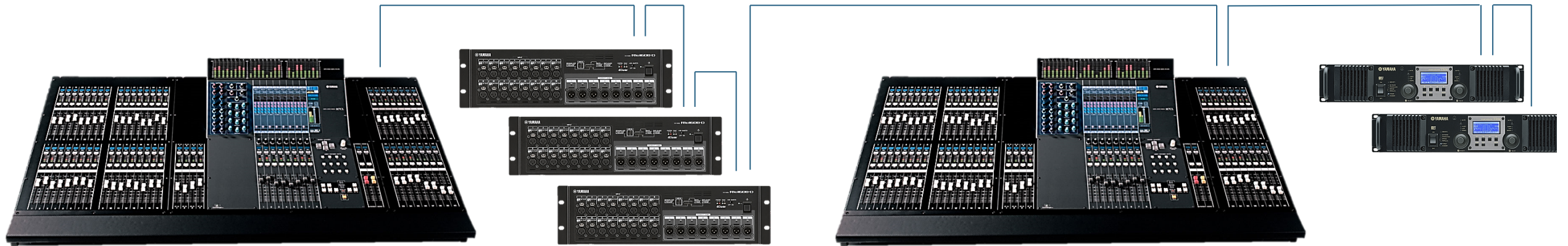
A Bit of History

CobraNet™

vs

Ether
ES
Sound

EtherSound had a lower latency but required a daisy chain topology.



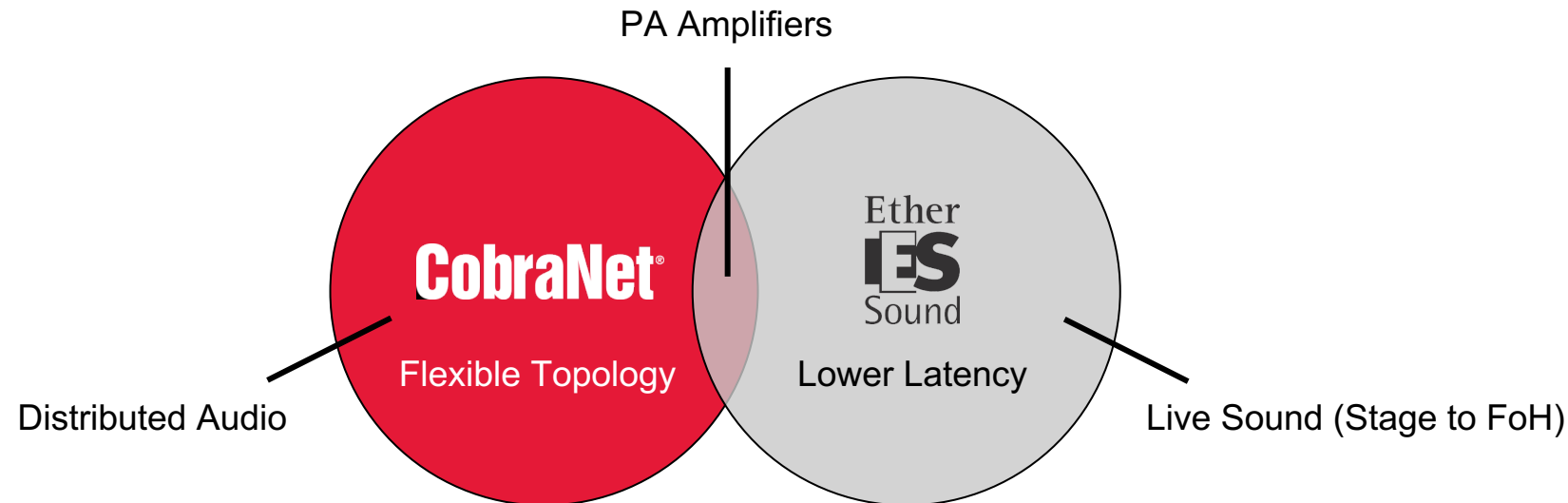
A Bit of History: Celebrating Strengths

CobraNet™

pluss

Ether
ES
Sound

Each network brought a different capability set. You knew which would be spec'd if you knew the application. Tours often used both together – EtherSound managed stage to FoH, CobraNet managed PA connections. In the same way, **Dante and ST 2110 should be used together, celebrating their respective strengths.**



The Goal of AES67 / ST 2110 in Audio



Best Practices for Audio Networks

AES AESTD1003V1, Published June 6, 2009

<http://www.aes.org/technical/documents/AESTD1003V1.pdf>



Livewire



CobraNet



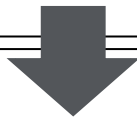
OPTOCORE

Commonality:

“Audio networking systems are characterized by the transport of uncompressed audio in PCM format, which in principle could be reformatted as requested.”

Differences:

“In practice, there are several issues for compatibility between formats that should be addressed and solved with specific implementations.”



AES67

Ratified 2013, Updated 2014, 2015, 2018



The Goal of AES67 / ST 2110 in Audio



Media Networking Alliance

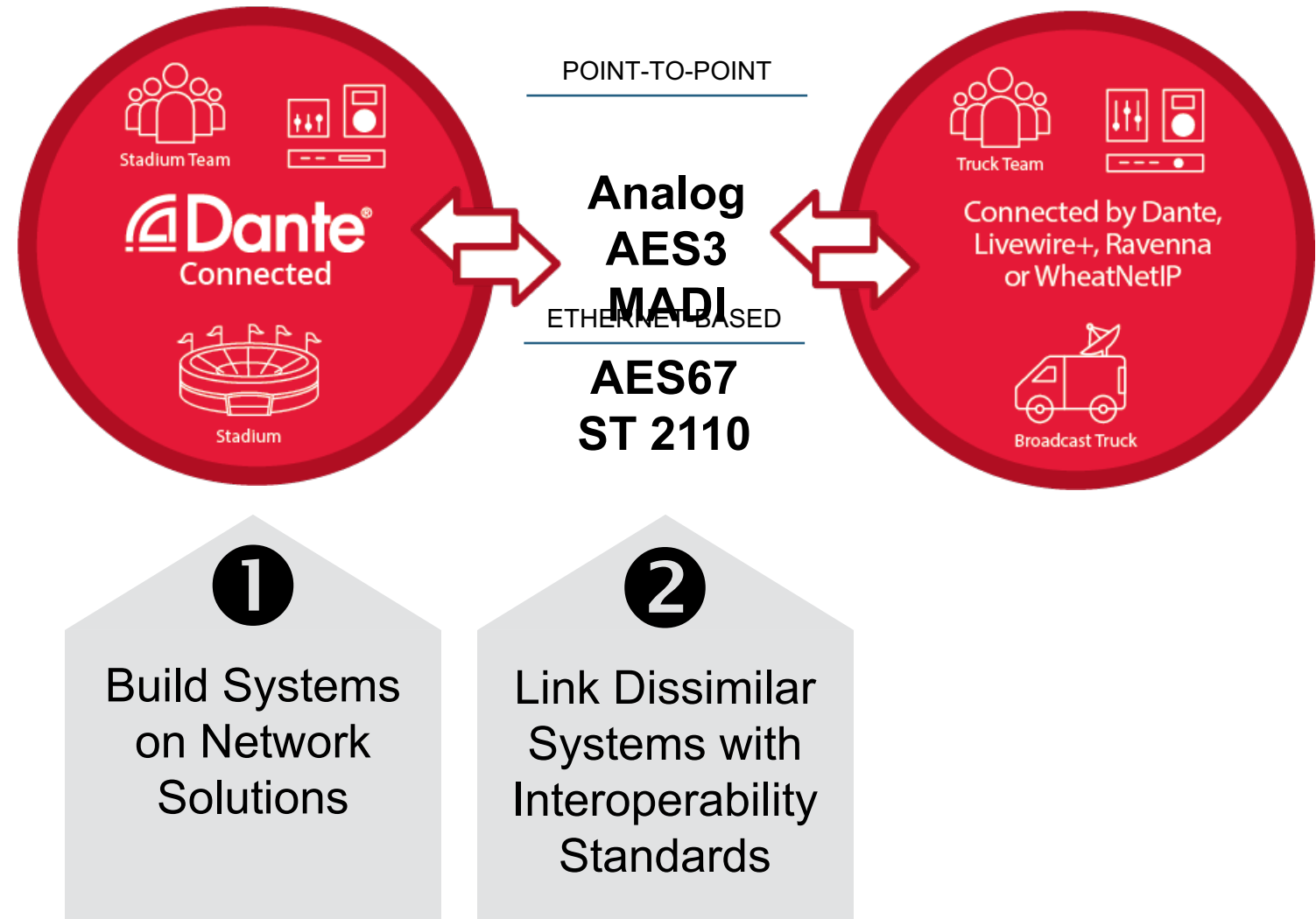
Promoting the Adoption of AES67

FAQ: What is AES67?

<https://medianetworkingalliance.com/faq/>

AES67 enables interoperability between audio networking [solutions] currently available, such as Dante, Livewire+, Q-LAN, Ravenna [and WheatNet IP].

[AES67] is not a new technology, but a bridging compliance mode.



The Goal of AES67 / ST 2110 in Audio

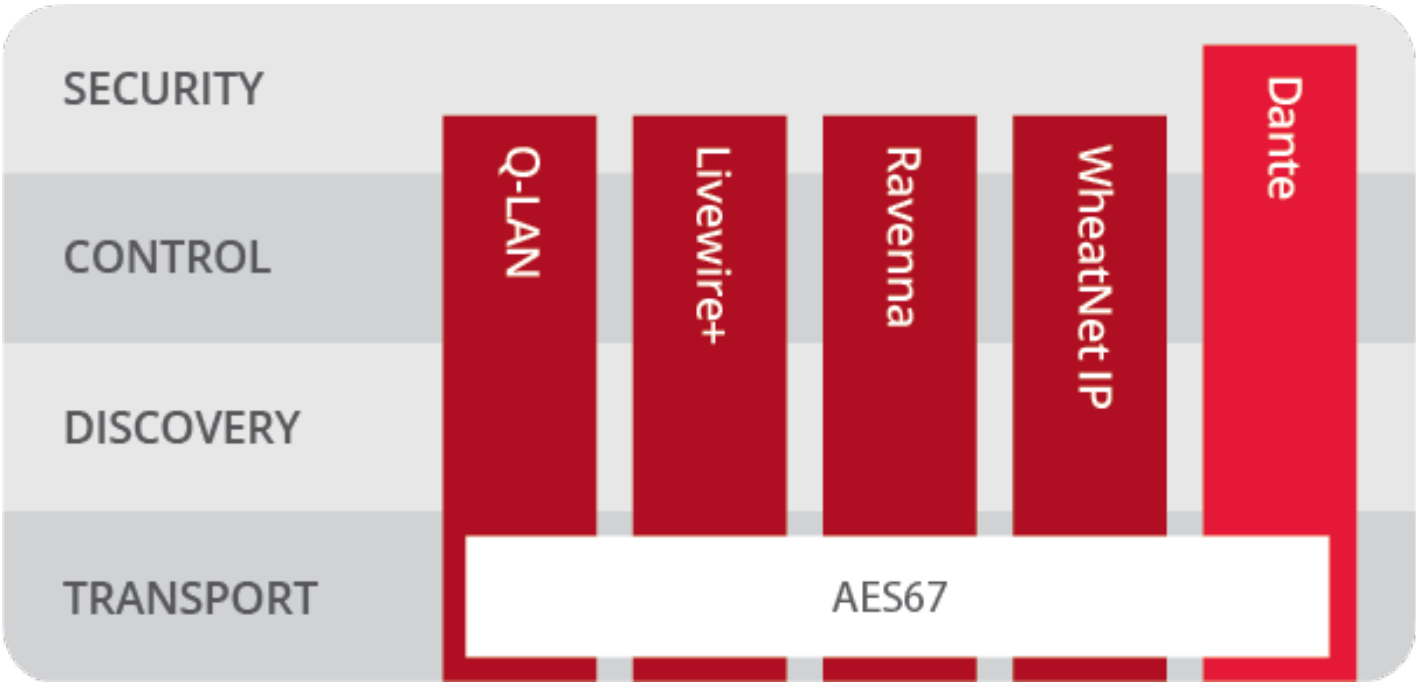


FAQ: What is AES67?

<https://medianetworkingalliance.com/faq/>

AES67 enables interoperability between audio networking [solutions] currently available, such as Dante, Livewire+, Q-LAN, Ravenna [and WheatNet IP].

[AES67] is not a new technology, but a bridging compliance mode.



SSL: IP Technology for Broadcast Audio Routing Systems
<https://s3.us-west-2.amazonaws.com/sslweb.solidstatelogic.com/content/system-t/SSL%20AoIP%20Information.pdf>

Network Solution: Dante, Livewire+, Ravenna, Q-LAN, WheatNet IP

Interoperability Standard: AES67, SMPTE 2110



The Goal of AES67 / ST 2110 in Audio

A Word Processing Analogy:



Microsoft®
Word



Corel®
WordPerfect®



Google
Documents

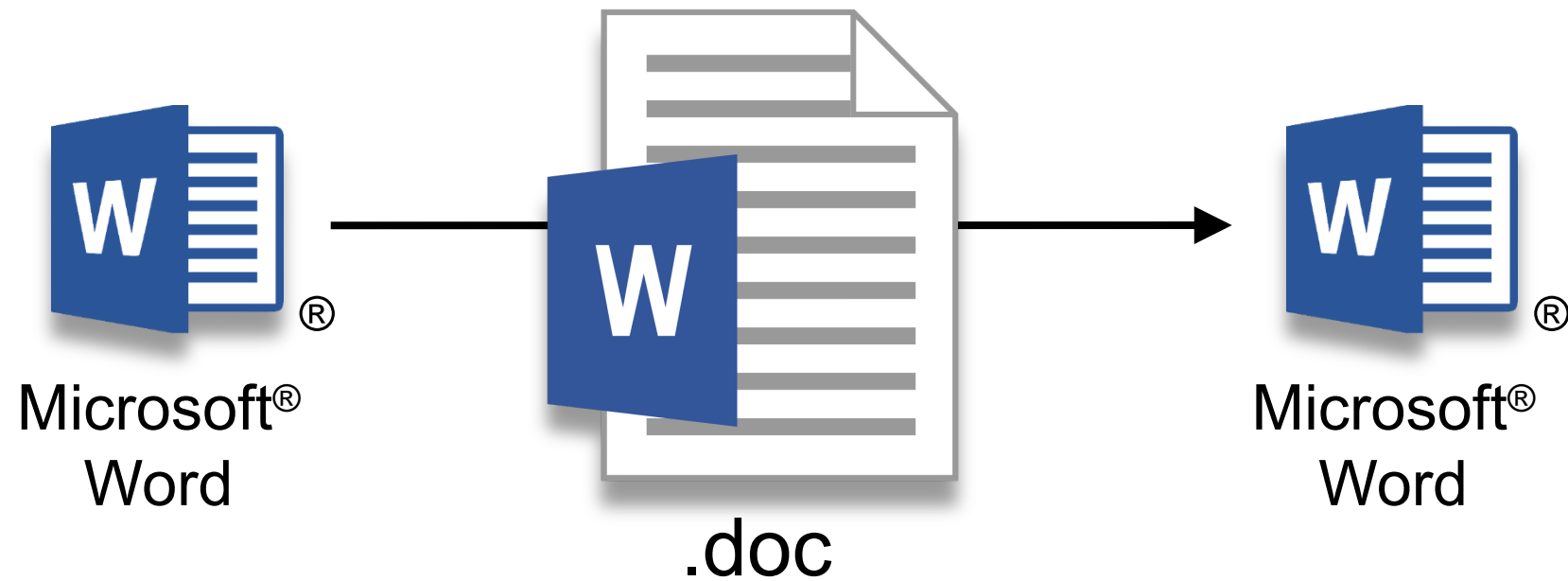


Apache
OpenOffice™



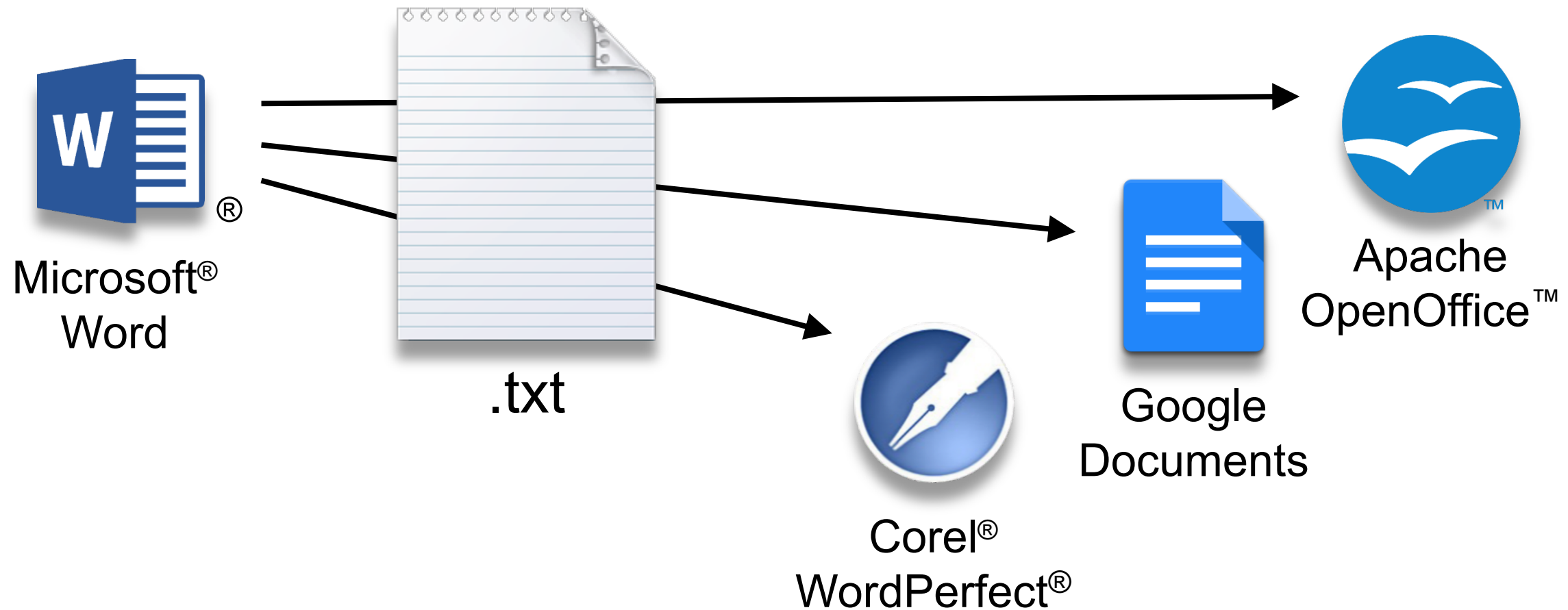
The Goal of AES67 / ST 2110 in Audio

A Word Processing Analogy:



The Goal of AES67 / ST 2110 in Audio

A Word Processing Analogy:



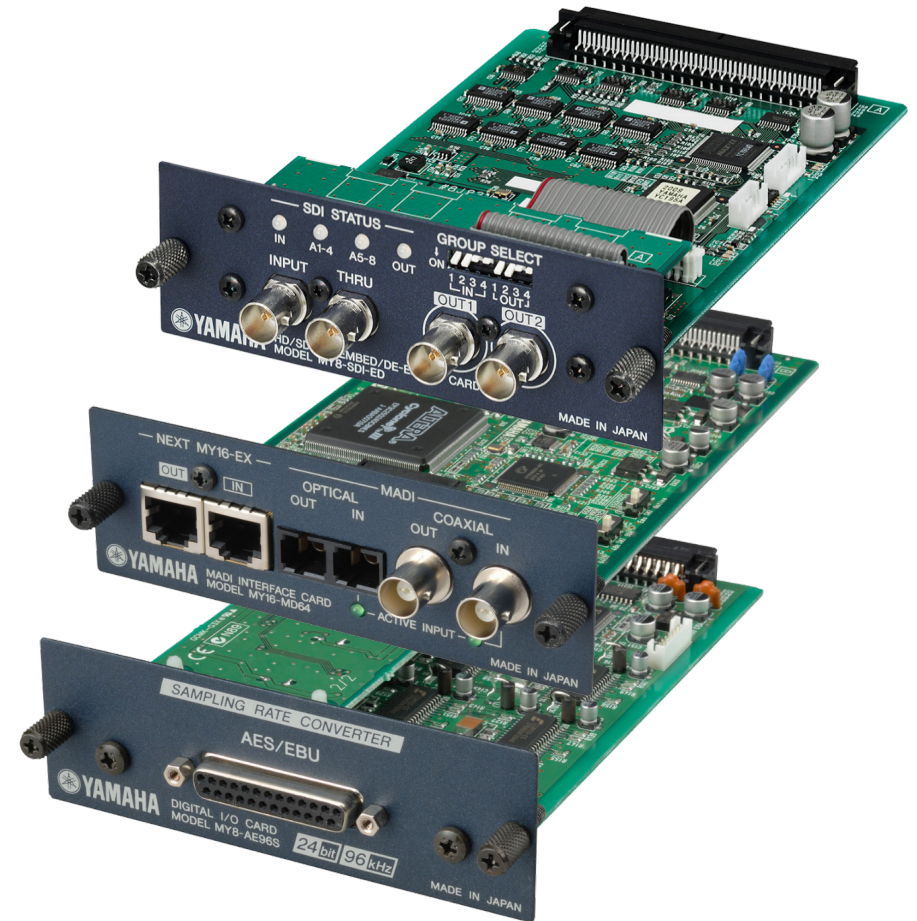
The Goal of AES67 / ST 2110 in Audio

Yamaha has long been known for ‘format neutrality’ – a reputation borne from our MY cards.

Maintaining this selection of option cards was neither a pleasure nor a profit center; it was simply a necessity to support our core business of producing quality professional audio tools.

Today, we are excited that our customers can enjoy the sophistication of Dante in their system designs and the convenience of compatibility with other facility systems all wrapped into our native Dante solution.

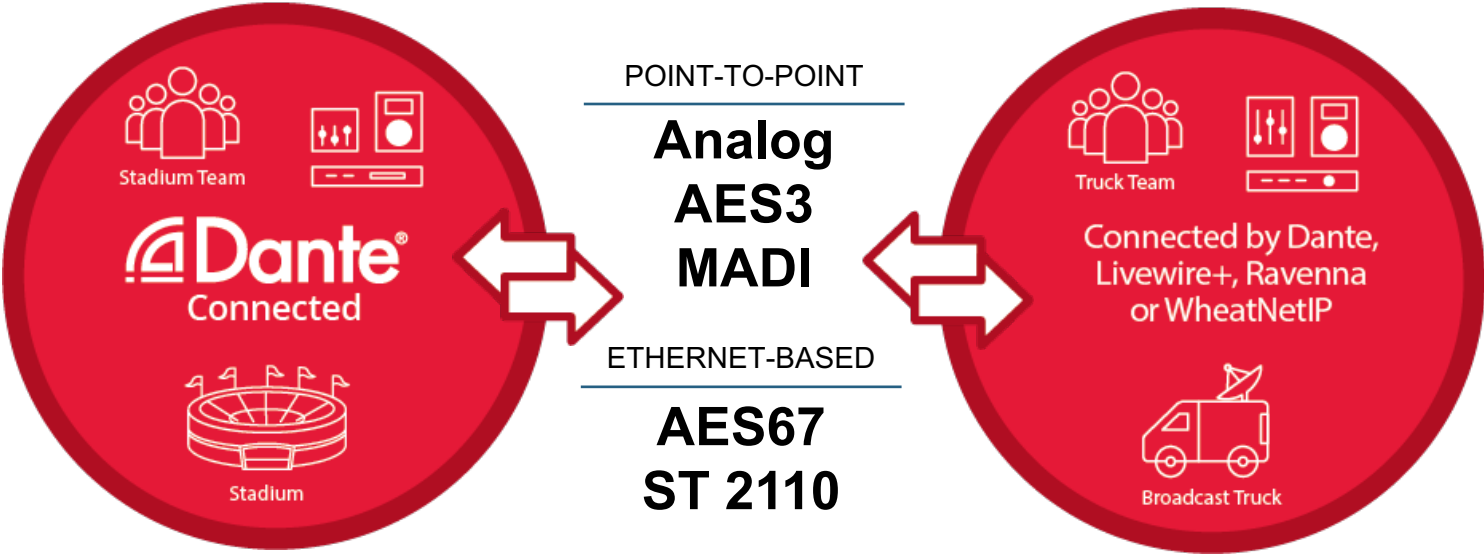
Taku Nishikori  **YAMAHA**



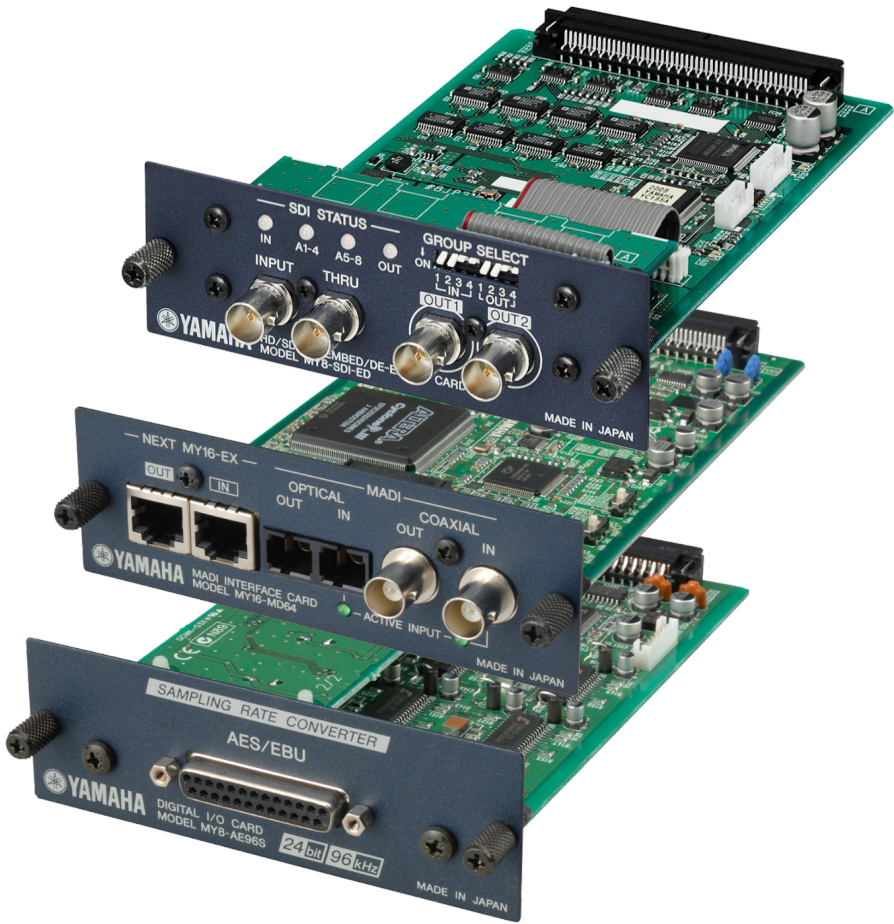
Yamaha SDI, MADI and AES3 “MY” Interface Cards



The Goal of AES67 / ST 2110 in Audio



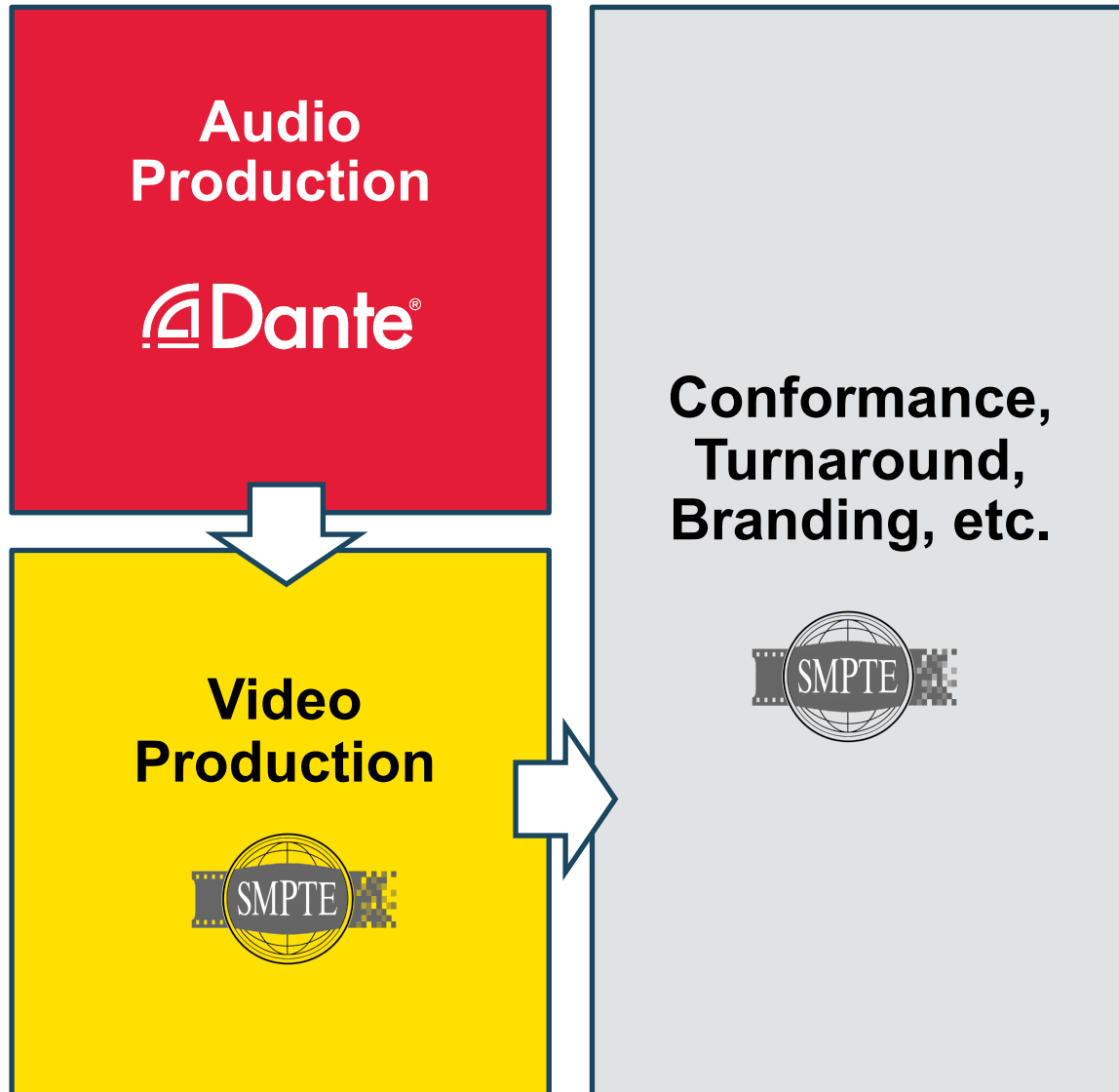
In the audio space,
AES67 and ST 2110 replace:
Video: SDI Embed/De-Embed
Audio: MADI, AES3 and Analog



Yamaha SDI, MADI and AES3 “MY” Interface Cards



The Goal of AES67 / ST 2110 in Audio



If you avail yourself to a toolbox,
you'll use the right tool for the job.

- Montgomery Scott



Basic Design Decisions

AES67 vs ST 2110 Modes
Managed vs Unmanaged Dante



Why does Audinate have “Modes” for Open Standards

 **Dante**[®]
with **AES67**



Audinate Public Support since 2015
“Simple” system configuration.

Hardcoded to PTPv2 Domain 0 (for simplicity)
Requires SAP Discovery Announcements or DDM

Updated parameters in 2019 to align with ST 2110
Manual Multicast Stream Address Option
PTPv2 profile aligned with ST 2059-2.



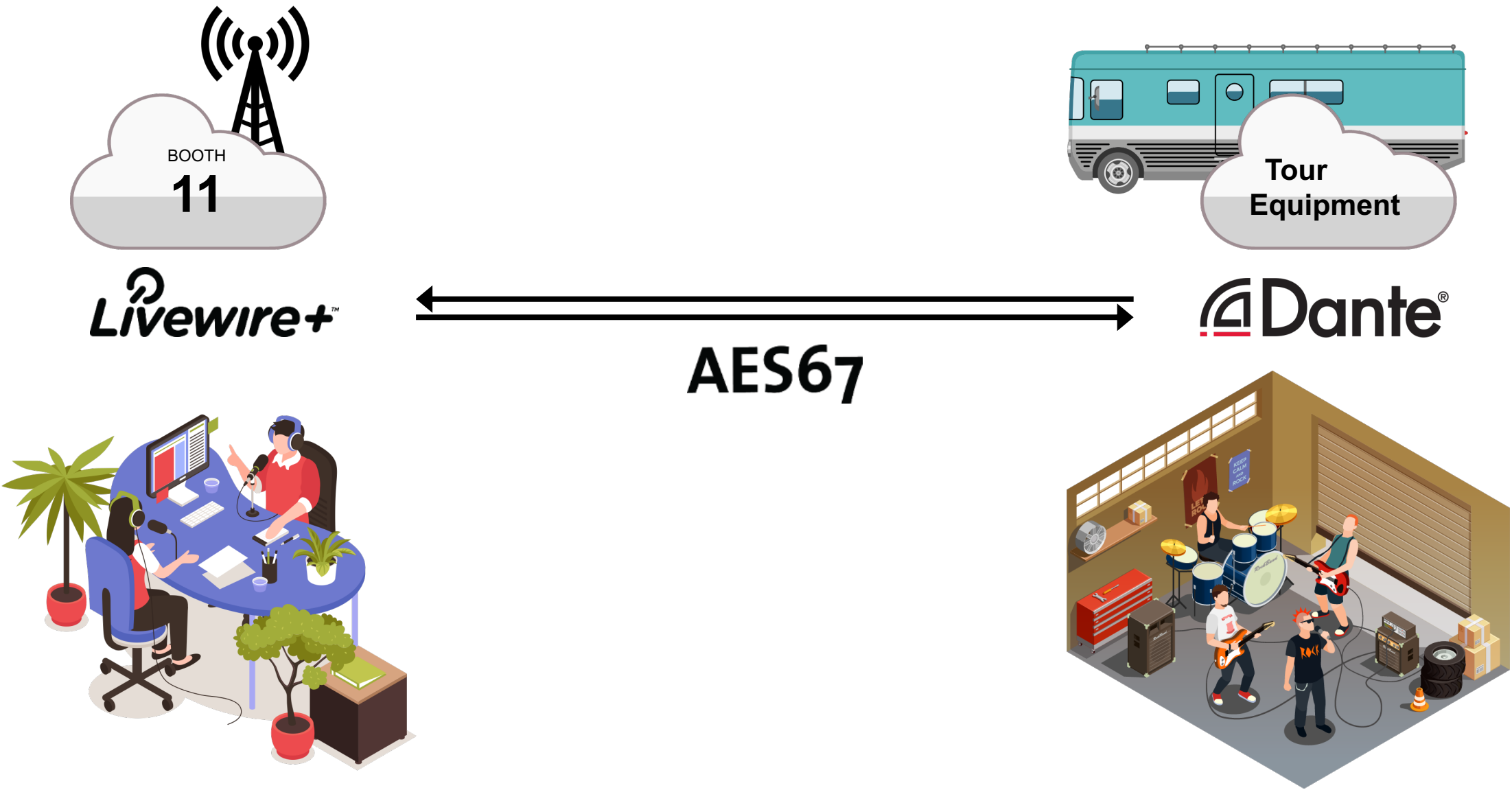
 **Dante**[®]
with  **ST 2110**

Audinate Public Support since 2019
(Including JT-NM Tested Devices)

Requires DDM which Centrally Adds:
Consolidated Control for Whole Deployment
Layer 3 Network Spanning, Access Control
Device Monitoring and Logging



The Idea Behind AES67 (2015)



The Idea Behind AES67 (2015)

Dante Controller - Network View

File Device View Help

Routing

Device Info

Clock Status

Network Status

Events

Dante

Filter Transmitters

Filter Receivers

Dante Transmitters

Dante Receivers

Rack-Monitor

01

02

03

04

05

06

07

08

09

10

11

12

13

14

15

16

17

18

19

Laptop-PK

Rack-Bridge

Rack-Mic-Line-IO

Rack-Monitor

Rack-Recorder

Y001-Mixer-Broadcast

AJA KonaIP 2110

01

02

03

04

05

06

07

08

Create Multicast Flow

Dante-Demonstration-Device supports up to 64 channels per flow.

RTP flows for AES67 have a maximum of 8 channels per flow.

Select one or more transmit channels to be placed in multicast flows.

Flow Config (Optional)

Dante

AES67

Destination Address:

Auto

Manual

IP Address:

239

69

21

101

Port:

5004

Channel Name	☐ Add to New Flow
Left	☒
Right	☒
Digital L	☐
Digital R	☐
05	☐
06	☐
07	☐
08	☐

Create

Cancel

©2021 Audinate, Inc.

The Idea Behind AES67 (2015)



AES, New York
2015



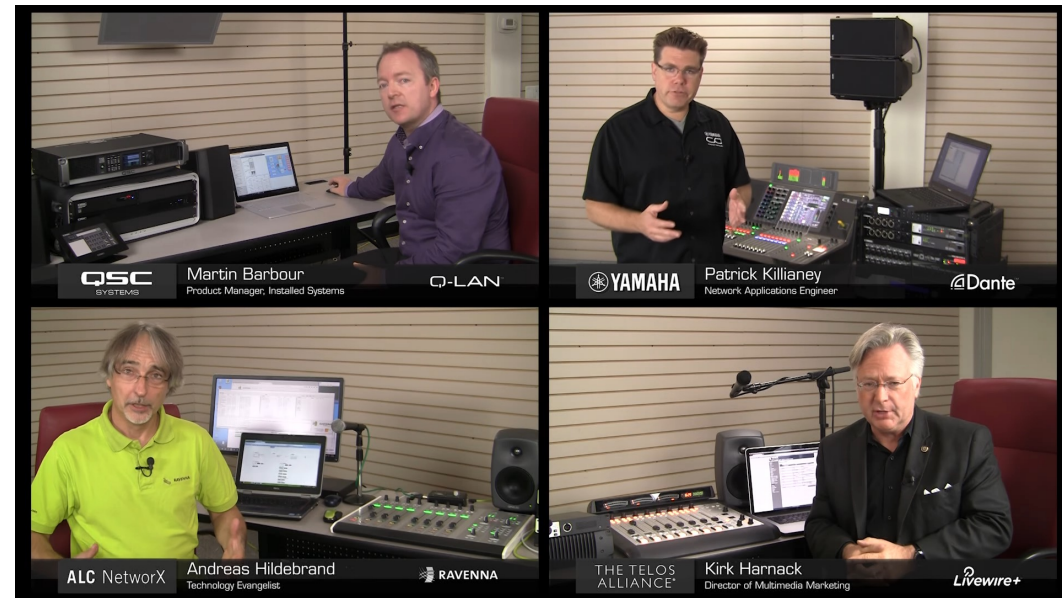
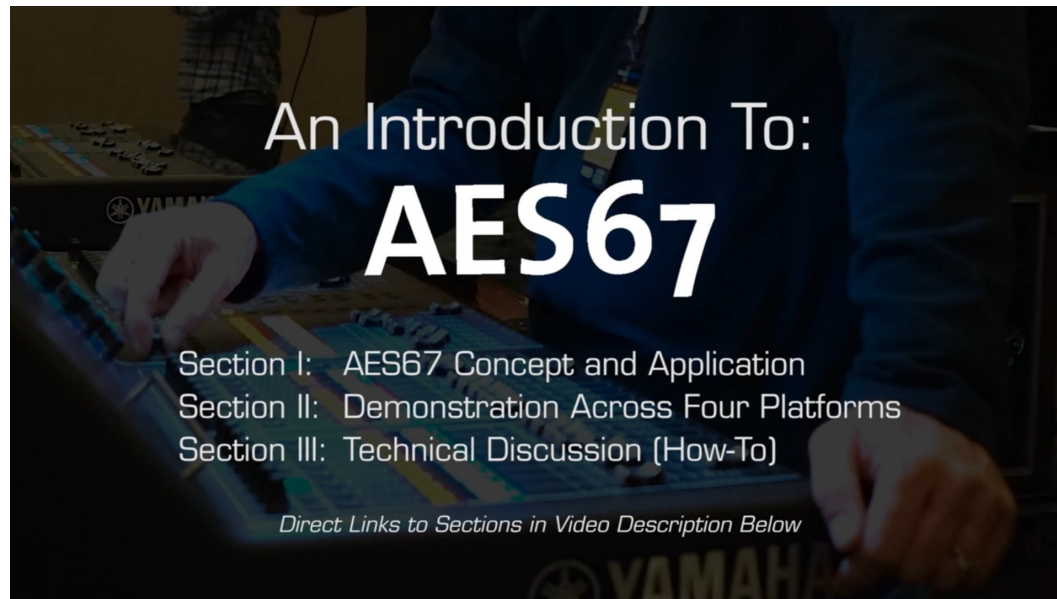
The Idea Behind AES67 (2015)

Introduction to AES67

ALC NetworX, QSC, The Telos Alliance, Yamaha. October 2016.

https://youtu.be/AmdFXxQp_lc?t=405 (This link jumps directly to the demonstration.)

- Explanations of AES67 Functionality
- Demonstration of Sending/Receiving AES67 and Platform-Native Traffic
- Demonstration of SAP Announcements using RAV2 SAP



Why does Audinate have “Modes” for Open Standards


with **AES67**




with  **ST 2110**

Audinate Public Support since 2015
“Simple” system configuration.

Hardcoded to PTPv2 Domain 0 (for simplicity)
Requires SAP Discovery Announcements or DDM

Updated parameters in 2019 to align with ST 2110
Manual Multicast Stream Address Option
PTPv2 profile aligned with ST 2059-2.

Audinate Public Support since 2019
(Including JT-NM Tested Devices)

Requires DDM which Centrally Adds:
Consolidated Control for Whole Deployment
Layer 3 Network Spanning, Access Control
Device Monitoring and Logging



The Idea Behind ST 2110 (2019)



The Idea Behind ST 2110 (2019)



The Idea Behind ST 2110 (2019)



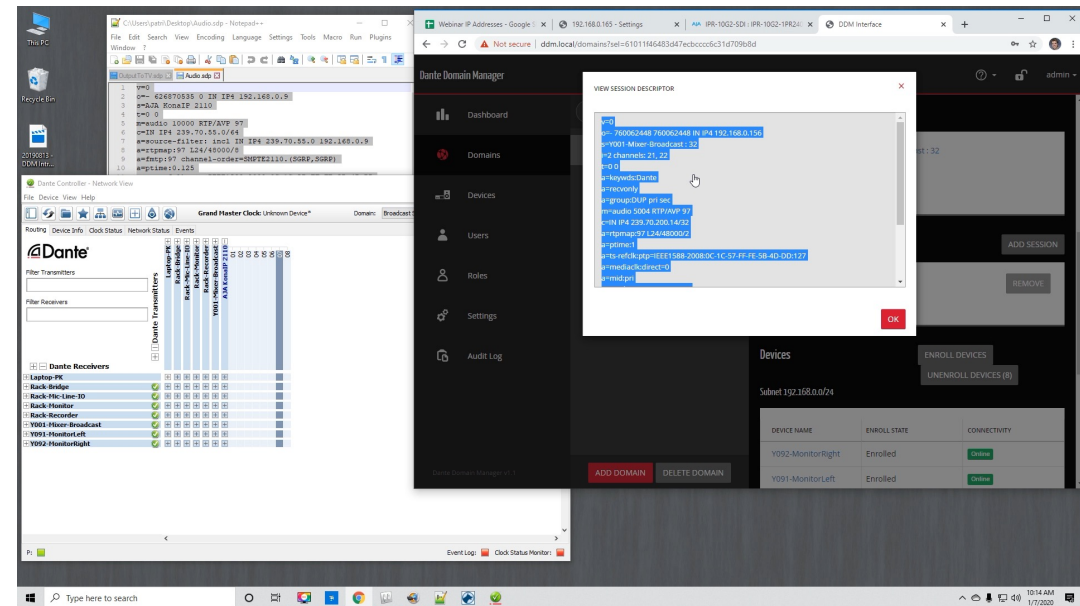
The Idea Behind ST 2110 (2019)

Understanding the Roles of Dante, AES67 and ST 2110

TV Technology, January 14, 2020

<https://event.on24.com/eventRegistration/EventLobbyServlet?target=reg20.jsp&referrer=&eventid=2155542&sessionid=1&key=A862BABDF4FF02F22A54D2A549A24393®Tag=&sourcepage=register>
<https://vimeo.com/684439955#t=1574> (This link jumps directly to the demonstration.)

- Demonstration of PTPv1 and PTPv2 compatibility
- Demonstration of Sending/Receiving ST 2110 Streams from Dante devices



Videos that explain the two modes:



with **AES67**



Introduction to AES67

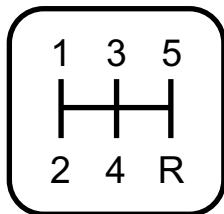
ALC NetworX, QSC, The Telos Alliance, Yamaha. October 2016.

https://youtu.be/AmdFXxQp_lc?t=405 (This link jumps directly to the demonstration.)

- Explanations of AES67 Functionality
- Demonstration of Sending/Receiving AES67 and Platform-Native Traffic
- Demonstration of SAP Announcements using RAV2 SAP



with  **ST 2110**



Understanding the Roles of Dante, AES67 and ST 2110

TV Technology, January 14, 2020

<https://event.on24.com/eventRegistration/EventLobbyServlet?target=req20.jsp&referrer=&eventid=2155542&sessionid=1&key=A862BABDF4FF02F22A54D2A549A24393&reqTag=&sourcepage=register>
<https://vimeo.com/684439955#t=1574> (This link jumps directly to the demonstration.)

- Demonstration of PTPv1 and PTPv2 compatibility
- Demonstration of Sending/Receiving ST 2110 Streams from Dante devices

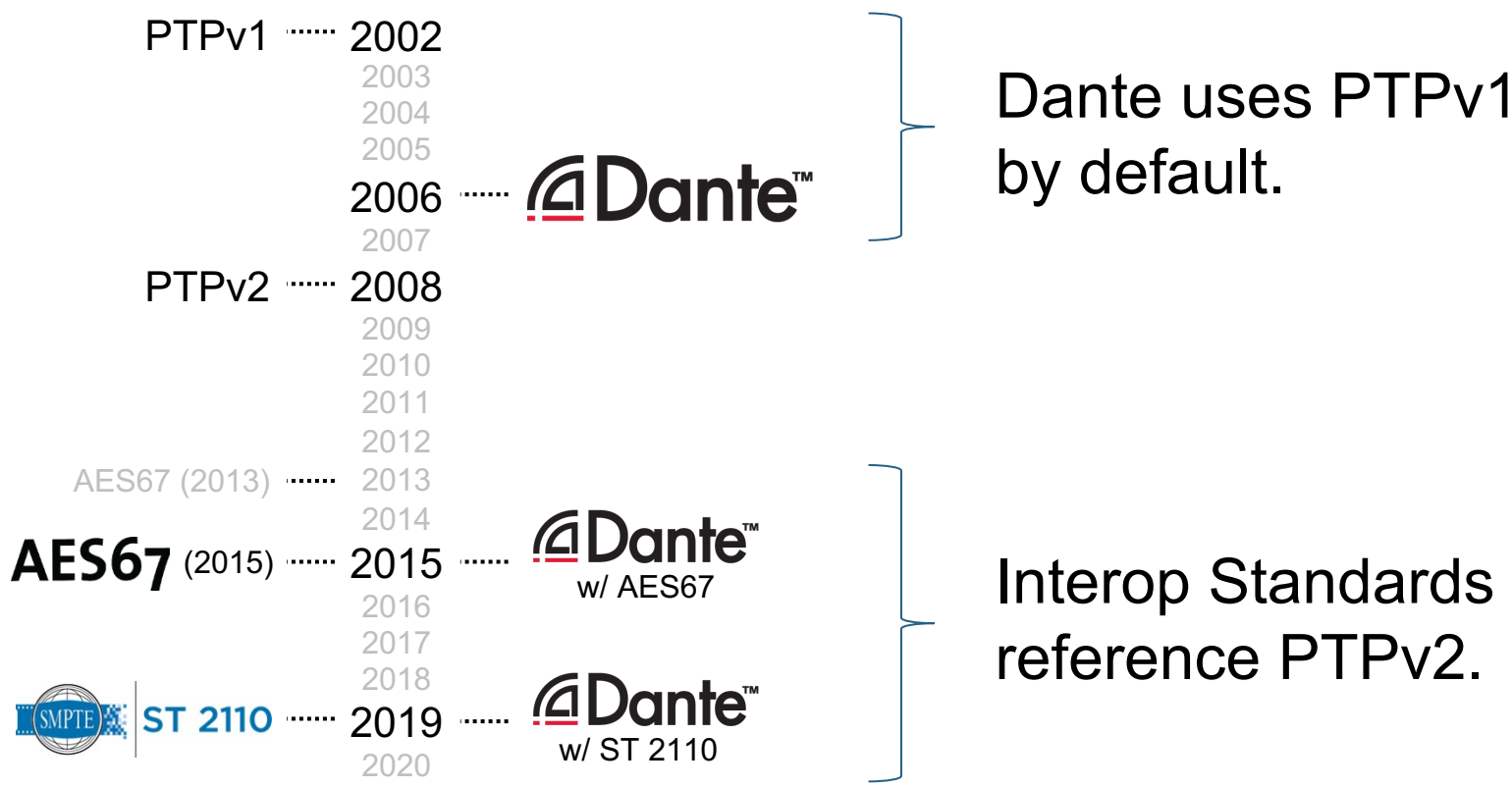


Addressing Misconceptions

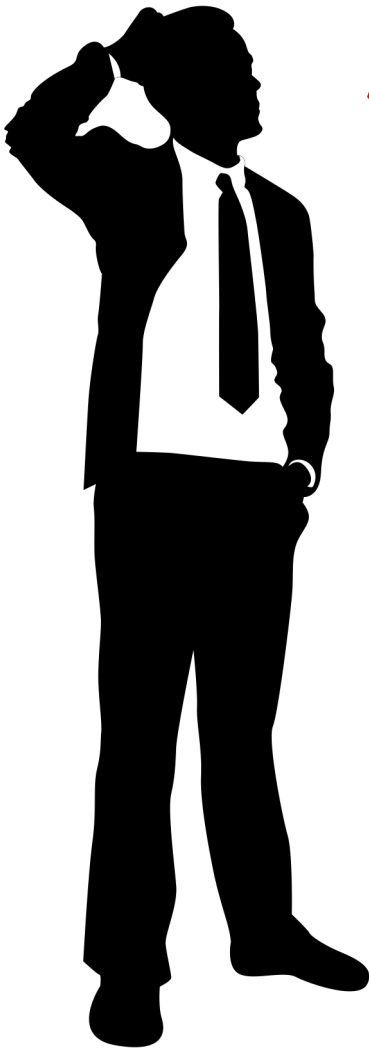
PTPv1 and PTPv2
QoS DSCP Markings



Precision Time Protocol (PTP): v1 and v2



Precision Time Protocol (PTP): v1 and v2



So, can Dante
sync with PTPv2?

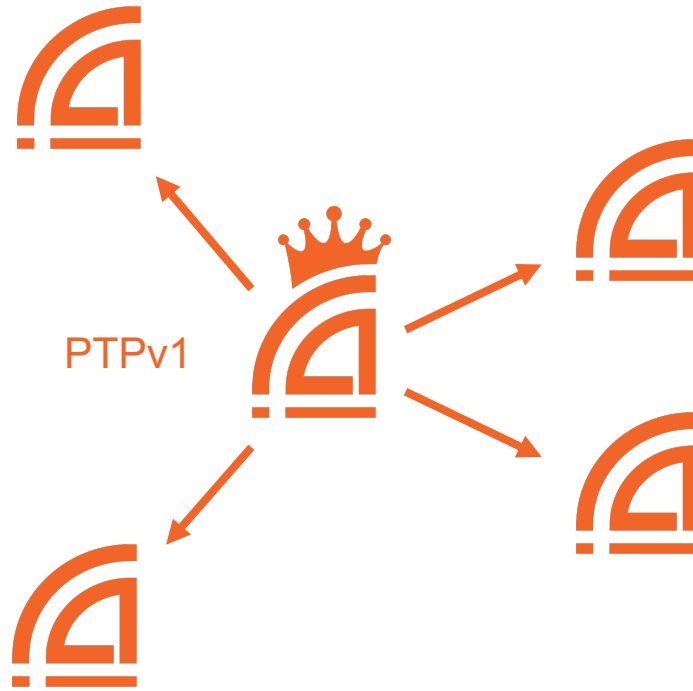
Dante uses PTPv1
by default.

Yes – Dante can
use v1 and v2
at the same time!

Interop Standards
reference PTPv2.



Precision Time Protocol (PTP): v1 and v2



Precision Time Protocol (PTP): v1 and v2

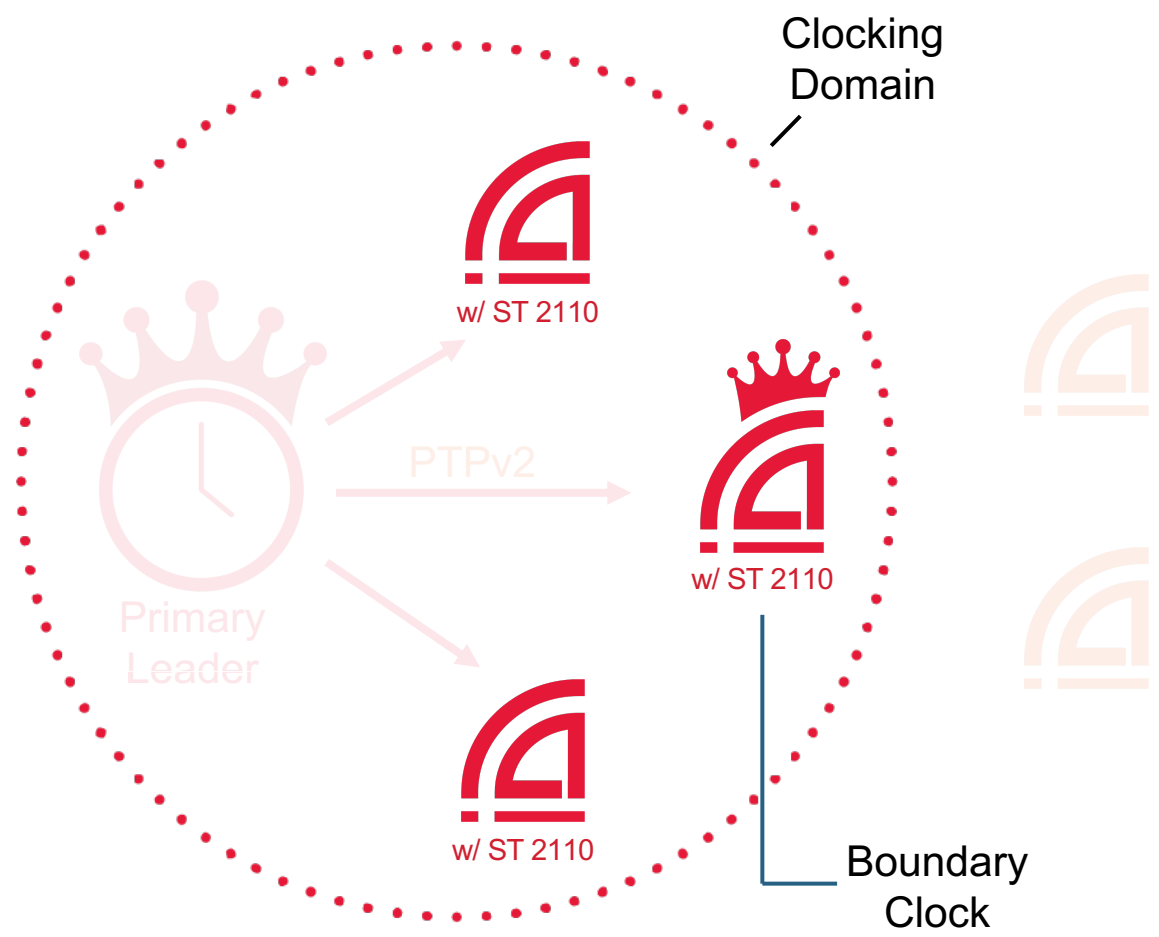
Dante devices with
AES67 or ST 2110
engaged can chase
PTPv2 master clocks.

Options:

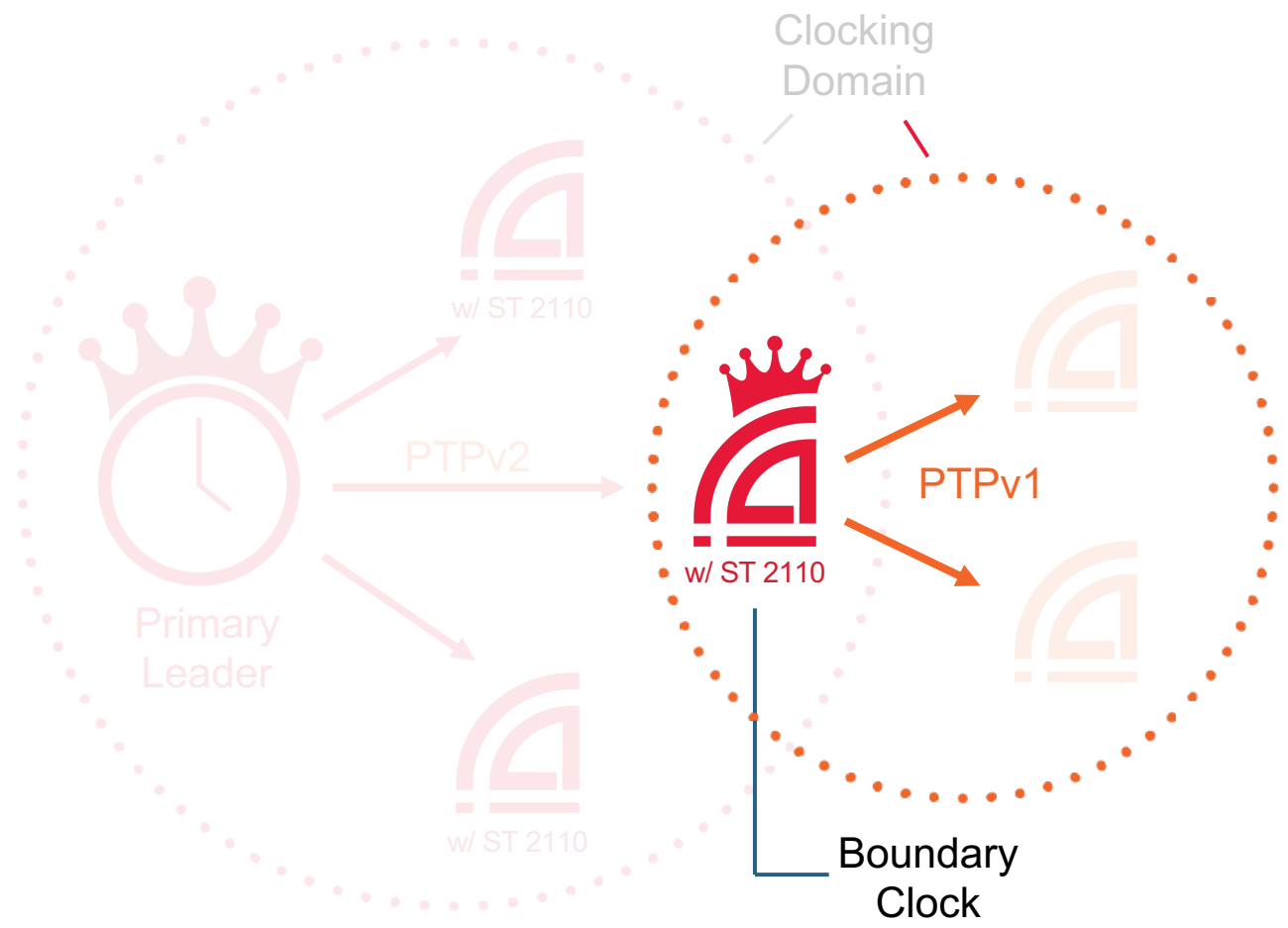
- 1) Prefer PTPv2 (BMCA)
- 2) PTPv2 Follower Only
(*ST 2110 Compliant*)



Precision Time Protocol (PTP): v1 and v2



Precision Time Protocol (PTP): v1 and v2



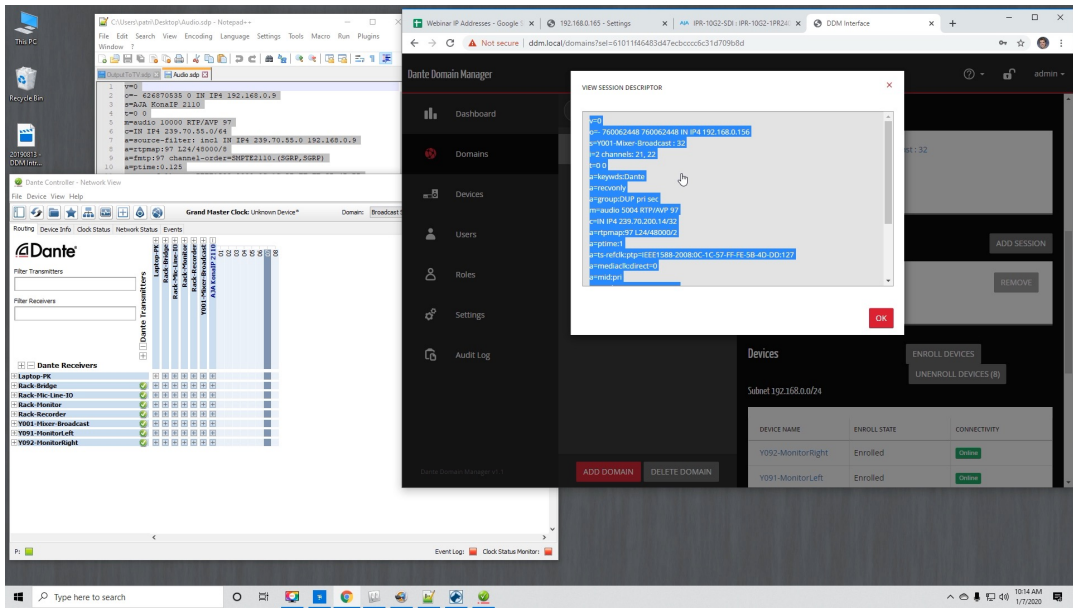
Precision Time Protocol (PTP): v1 and v2

Understanding the Roles of Dante, AES67 and ST 2110

TV Technology, January 14, 2020

<https://event.on24.com/eventRegistration/EventLobbyServlet?target=reg20.jsp&referrer=&eventid=2155542&sessionid=1&key=A862BABDF4FF02F22A54D2A549A24393®Tag=&sourcepage=register>
<https://vimeo.com/684439955#t=1574> (This link jumps directly to the demonstration.)

- Demonstration of PTPv1 and PTPv2 compatibility
- Demonstration of Sending/Receiving ST 2110 Streams from Dante devices



QoS DSCP Queues



QoS DSCP Queues

Other	Control 8 (CS1)	Audio/Video 46 (EF)	Clocking 56 (CS7)
			
Priority “Best Effort”	Priority Low	Priority Medium	Priority High

┌────────── Dante Uses 3 Priority Queues ─────────┐





AES67 & ST 2110

QoS Priority	Data Type	Recommended DSCP Values
High	PTPv2	46 (EF)
Medium	RTP Media	34 (AF41)

Audinate implements AES67-recommended DSCP values
for AES67 and ST 2110 clocking packets and media streams as of v4.2 in 2019.



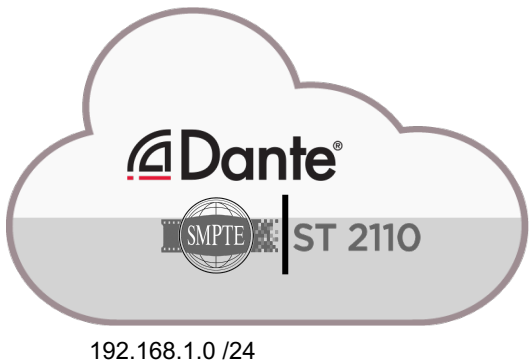
Design Topology

Concepts & Suggestions

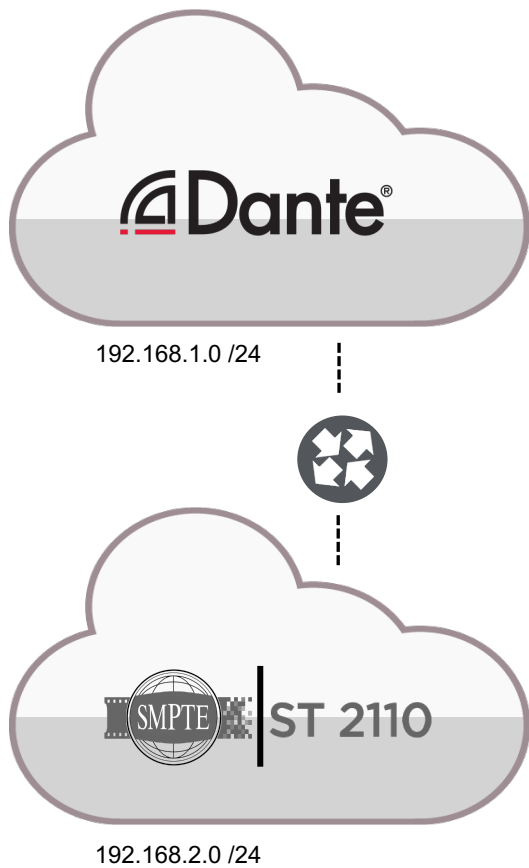


Topology Options

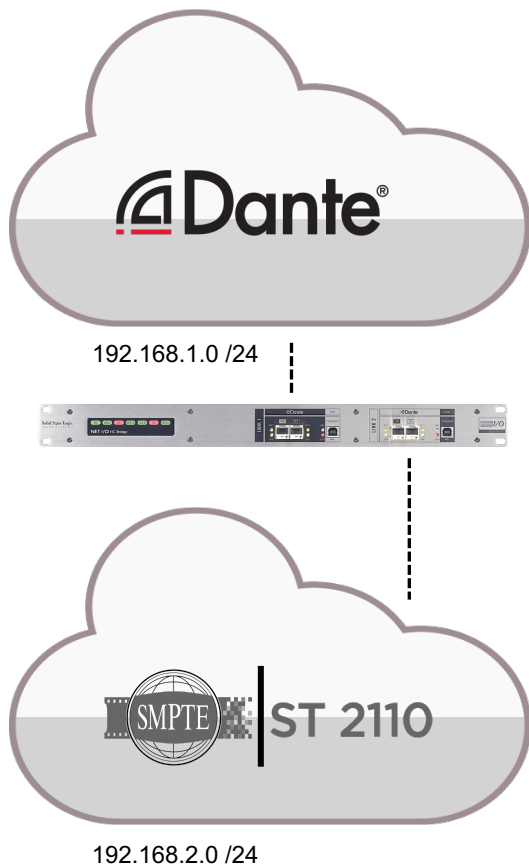
Option 1:
Complete Coexistence



Option 2:
Routed VLANs

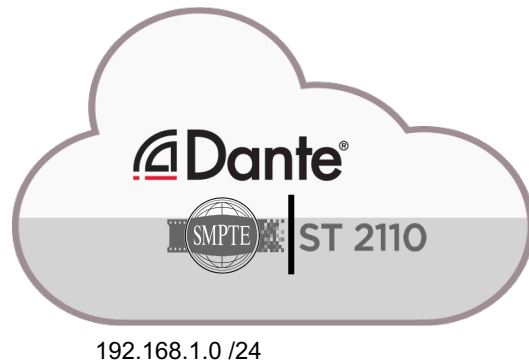


Option 3:
Bridged Networks



Topology Options

Option 1: Complete Coexistence

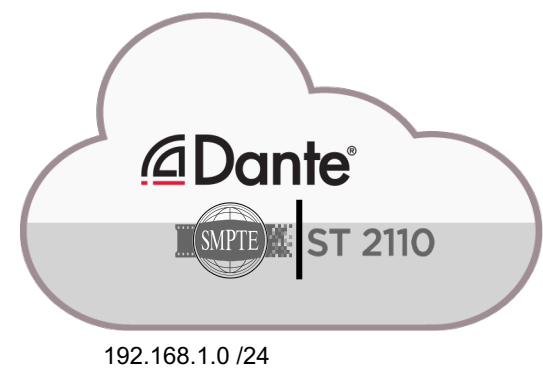


- Basic Principles:
 - Dante devices will be managed by **Dante Domain Manager™**
- Special Notes:
 - If QoS is engaged, QoS DSCP 56 (CS7) elevated for PTPv1.
 - If you want to disable PTPv1, that is the first option in the list.
(Requires all Dante devices to support ST 2110 directly.)



Topology Options

Option 1: Complete Coexistence



Dante Domain Manager™

Webinar IP Addresses - Google S x | 192.168.0.165 - Settings x | IPR-10G2-SDI : IPR-10G2-1PR240 x | DDM Interface x +

Not secure | ddm.local/domains/advanced?sel=61011f46483d47ecbcccc6c31d709b8d

Dante Domain Manager

Dashboard Domains Devices Users Roles Settings Audit Log

Broadcast Studio

Advanced settings can be used to configure interoperability, site-based clocking partitioning and unicast clocking device selection.

Warning! Changing settings may interrupt audio.

Audio/Clocking Parameters

MODE	SMPTE
PTP V1 MULTICAST	☐
PTP V2 DOMAIN	127
NUMBER	
PTP V2 PRIORITY 1	128
PTP V2 PRIORITY 2	128
PTP V2 SYNC	-3
INTERVAL	
PTP V2 ANNOUNCE	-2
INTERVAL	
PTP V2 MULTICAST	16
TTL	

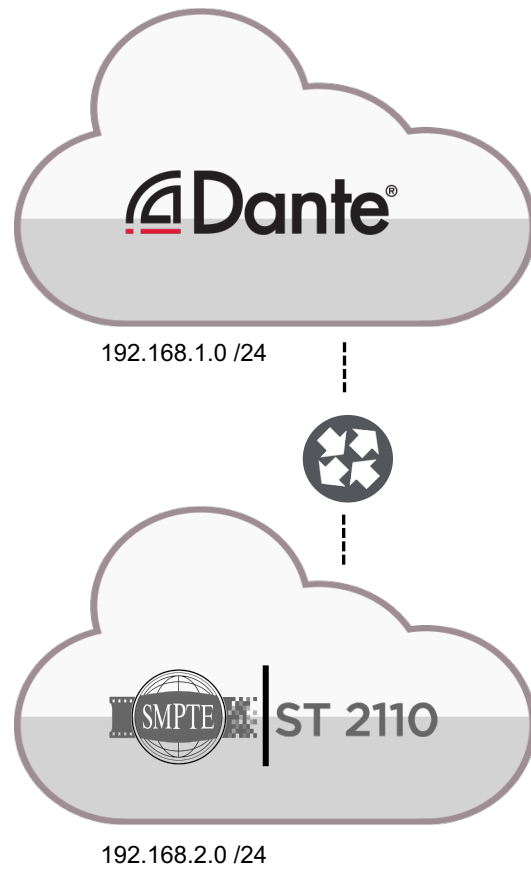
Dante Domain Manager v1.1

ADD DOMAIN DELETE DOMAIN



Topology Options

Option 2: Routed VLANs

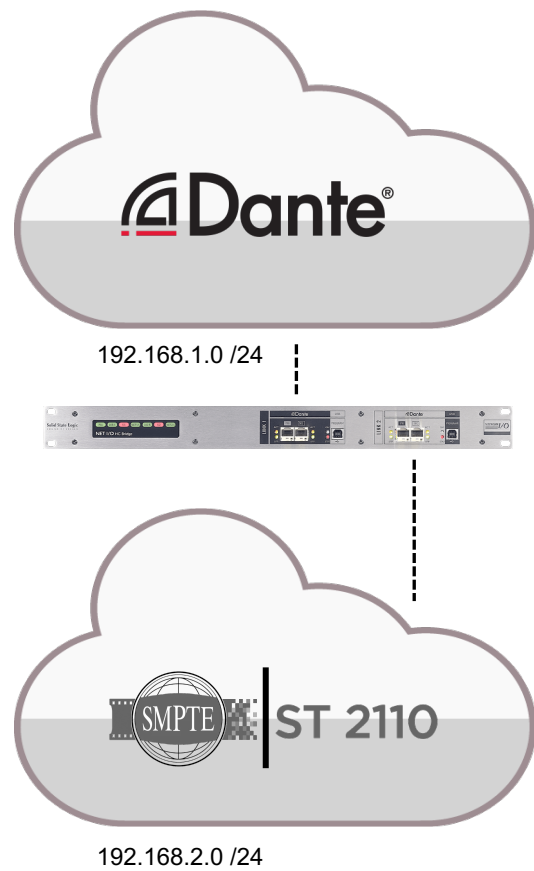


- Basic Principles:
 - Dante devices will be managed by **Dante Domain Manager™**
 - Separate VLAN simplifies separate Dante traffic optimization.
- Special Notes:
 - If QoS is engaged, QoS DSCP 56 (CS7) elevated for PTPv1
- Easy for wider range of Dante devices without ST 2110 support
(*Dante Virtual Soundcard is a leading example.*)



Topology Options

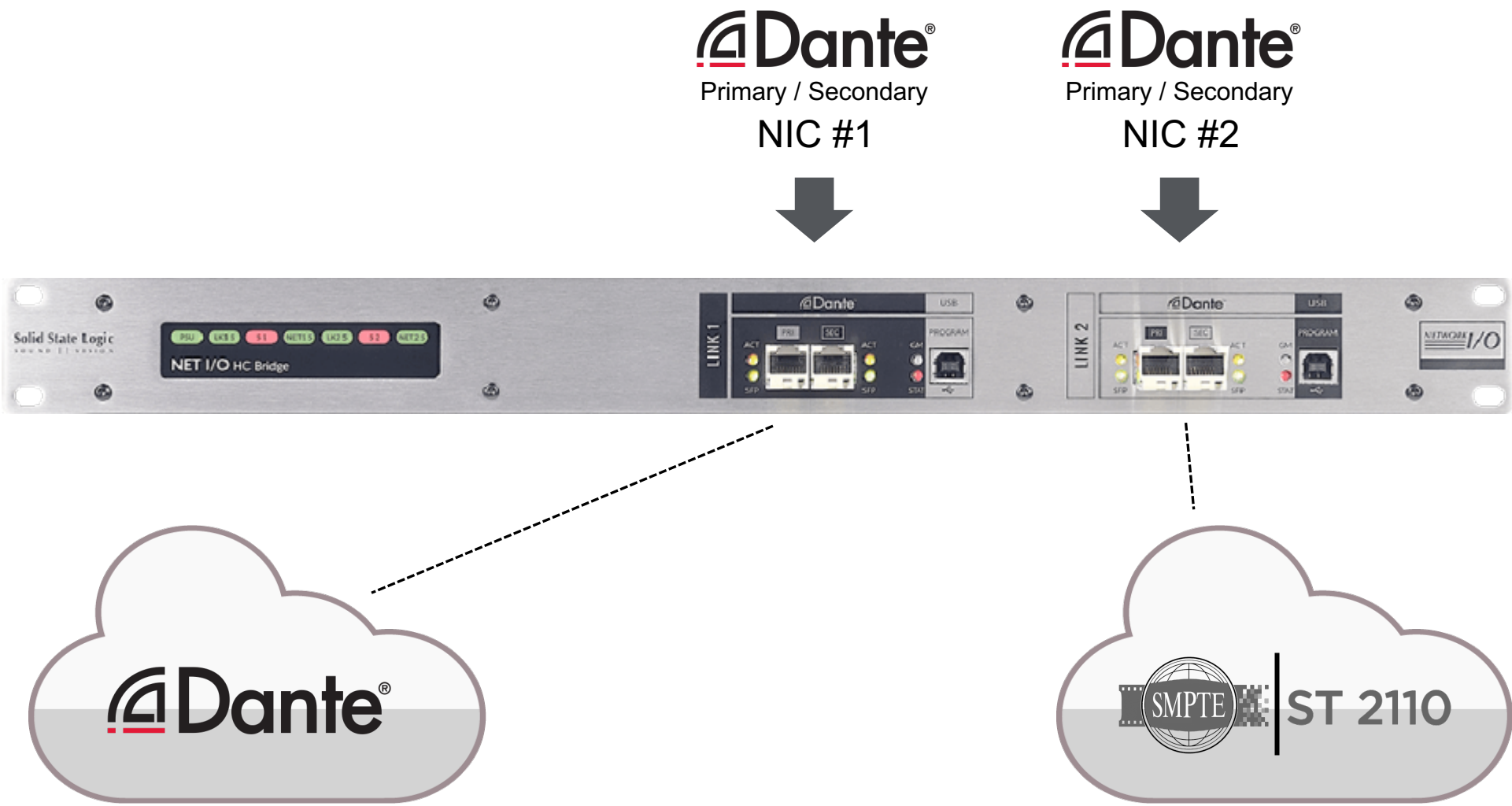
Option 3: Bridged Networks



- Basic Principles:
 - **Dante Domain Manager™** only required for the ST 2110 bridge
 - Separate VLAN simplifies separate Dante traffic optimization.
- Easy to isolate PTPv1 for devices that don't support ST 2110
(Most common would be Dante Virtual Soundcard.)
- On networks that are constantly changing, this can isolate any network concerns to the local soundstage.
- Bridge device can manage sample rate conversion if production and network sample rates are different.



Topology Options



Topology Options

You don't necessarily need to have a dedicated bridge device on the network – you can also do it with a single device (like an mixer).



Linked Resources

The World's Stage

Designing and Managing the World's Largest Single-Room Speaker System at the Royal Albert Hall

April 17, 2020

<https://go.audinate.com/resources/assets/rah-webinar-2020-f>

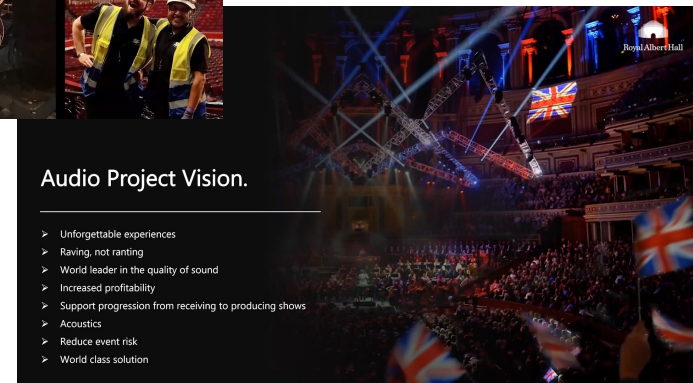
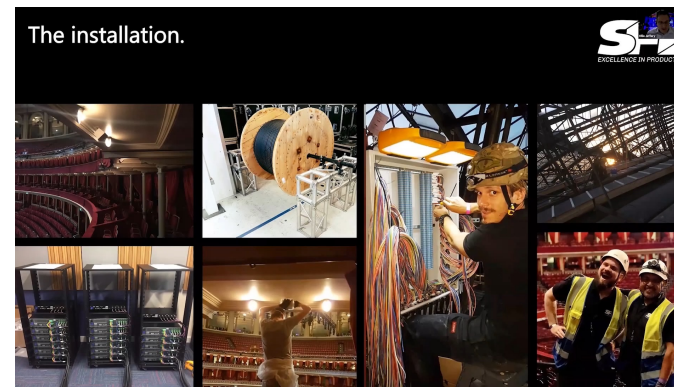
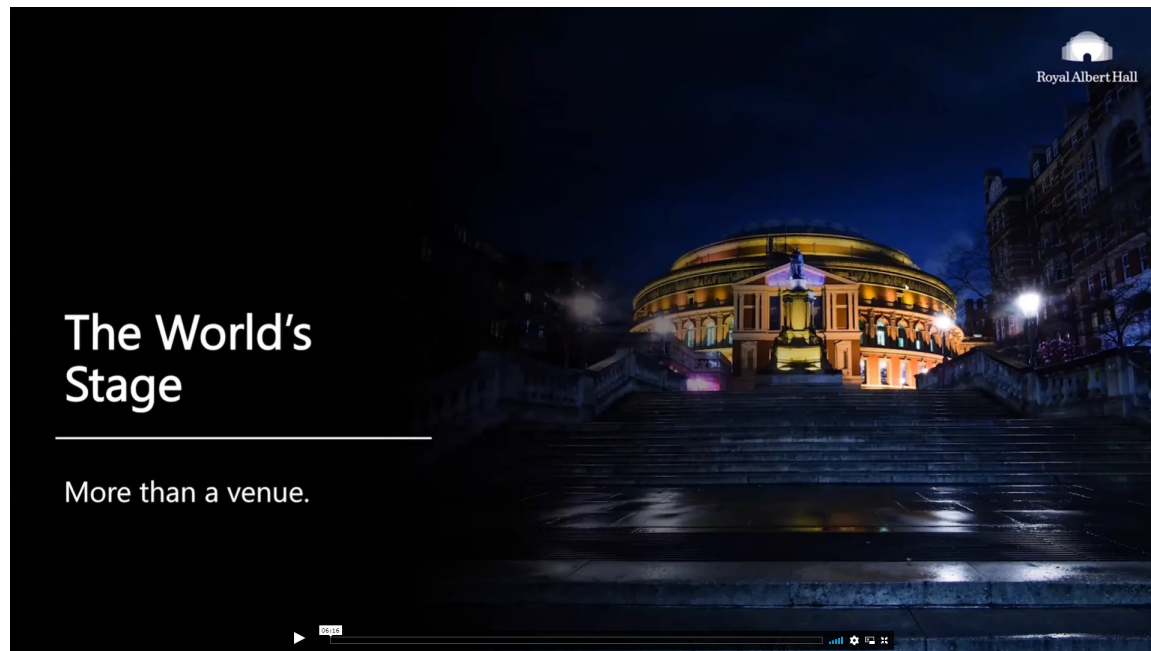
Olliver Jeffrey, Head of Production and Technical, Royal Albert Hall

Steven Jones, Applications Support & Education Team Leader, d&b AudioTechnik

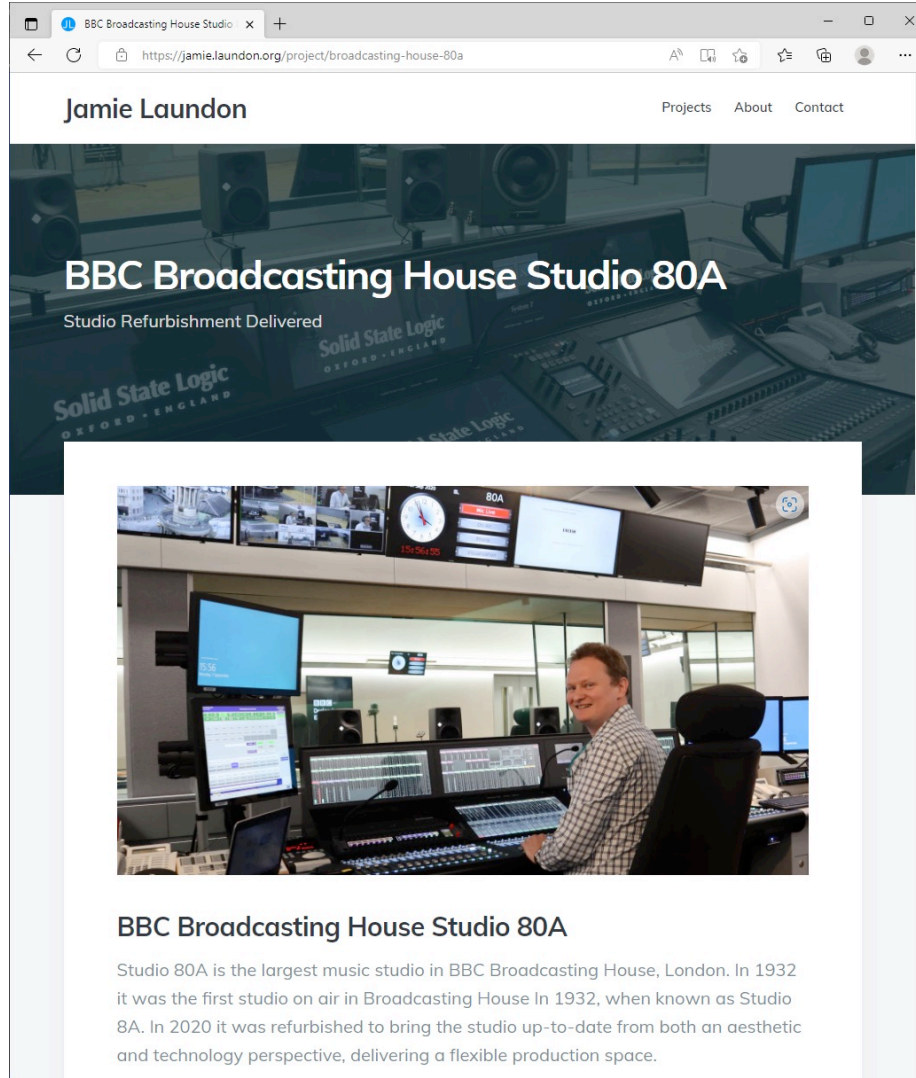
George Veys, Project Manager and Solution Architect, SFL Group

Kieran Walsh, Director of Applications Engineering, Audinate

Julian Carro, Account Director, Audinate



Linked Resources



BBC Broadcasting House Studio 80A Studio Refurbishment Delivered

Jamie Laundon, September 21, 2021

<https://jamie.laundon.org/project/broadcasting-house-80a>

It is the first time AES67 interoperability between Dante and Ravenna was implemented in BBC Broadcasting House.

The use of networked audio became invaluable during COVID working practices, including rapid reconfiguration to allow remote production techniques.

Jamie Laundon, Solution Lead, BBC Technology Group



NFL Los Angeles Spotlight (Part 2)

SVG NEWS

SPORTS VIDEO GROUP

Search Site

GO

LOG IN

NFL Los Angeles Spotlight (Part 2): Inside NFL Media's New Facility and the Cutting-Edge Technology Behind It

IP-based, 4K- and HDR-capable facility sets a new technical watermark for industry

By Jason Dachman, Chief Editor
Tuesday, September 21, 2021 - 2:35 pm
[Print This Story](#) | [Subscribe](#)

The day before the 2021 NFL season kicked off, the league officially opened NFL Los Angeles. The 450,000-sq.-ft. Class A building at Hollywood Park adjacent to SoFi Stadium features 214,063 sq. ft. of office space and 74,922 sq. ft. of studio and studio-support space. As the new home for NFL Network, NFL.com, NFL RedZone, the NFL app, and other media and business operations, the new facility is among the most technologically advanced in the industry.



NFL Staff arrived on Tuesday, Aug. 31 in Inglewood, CA. (Photo: Dan Steinberg/AP Images for NFL)

"When we do tours with people now, we actually look at each other and go, 'Wow! I can't believe we did this.' It's really quite remarkable," says **Bruce Goldfeder, VP, Engineering, NFL Media**. "I think the team that we put together here is the best team in the country in terms of dealing with this [next-generation] technology, and that shows in the final product."

Latest Headlines

YES Network Yankees Producer Troy Benjamin Reflects on Memorable 2022 Season, Aaron Judge Home Run Chase

More Than a Game: Whisper To Showcase Social Impact of Rugby League World Cup as Part of Host Broadcast Coverage

VAR Kick Off in Scottish Premiership Paves Way for Expanded QTV Remote Production Facility

NESN To Live-Stream All Bruins Home Games in 4K HDR on NESN 360 App

Drone, Pit PTZ Cameras Enhance NHRA Coverage as Season Sprints Toward Finals

Ratings Roundup: Giants-Packers is NFL Network's Most-Watched International Series Game on Record, College Football Posts New Highs on FOX & FS1

Behind the Mic: Announcer Teams Set for ALDS Telecasts in Spanish on MLB Network, *NBA Countdown* Team Returns on ESPN and ABC

SVG On Demand: LTN's Colin Moran on the Growth of Remote Production Workflows

The SVG Podcast: Previewing the 2022 FIFA World Cup with Telemundo Deportes

NHL Puck Drop 2022: *NHL on TNT* Returns as Warner Bros. Discovery Sports Gears Up for Stanley Cup Season

[Read more](#)

Latest News

[Production](#)

[Technology](#)

[Business](#)

[College](#)

NFL Los Angeles Spotlight (Part 2) Inside NFL Media's New Facility and the Cutting-Edge Technology Behind it.

SVG News, September 21, 2021

<https://www.sportsvideo.org/2021/09/21/nfl-los-angeles-spotlight-part-2-inside-nfl-medias-new-facility-and-the-cutting-edge-technology-behind-it/>

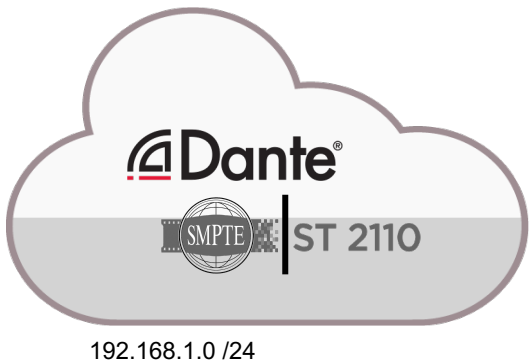
“We actually have two different types of PTP — one running the Dante network, the other one running our ST 2110 network — and they live on the same switch. And they have worked very well together.”

Bruce Goldfeder, VP Engineer, NFL Media

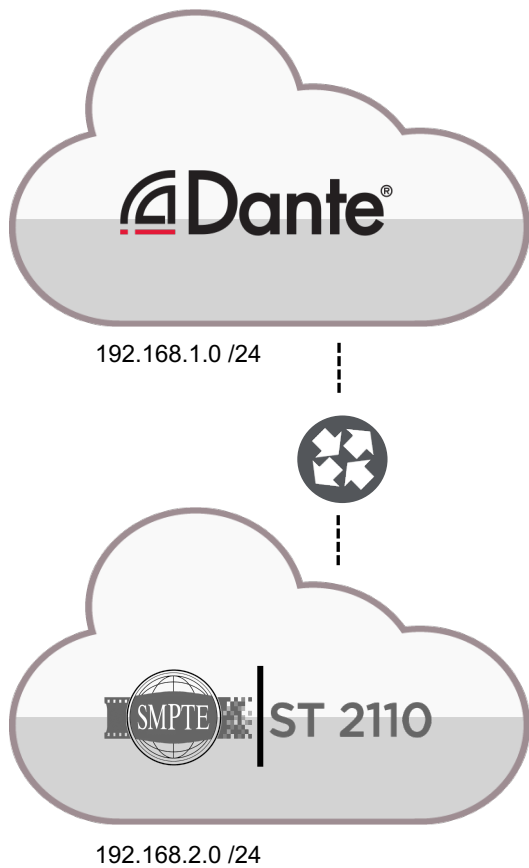


Topology Options

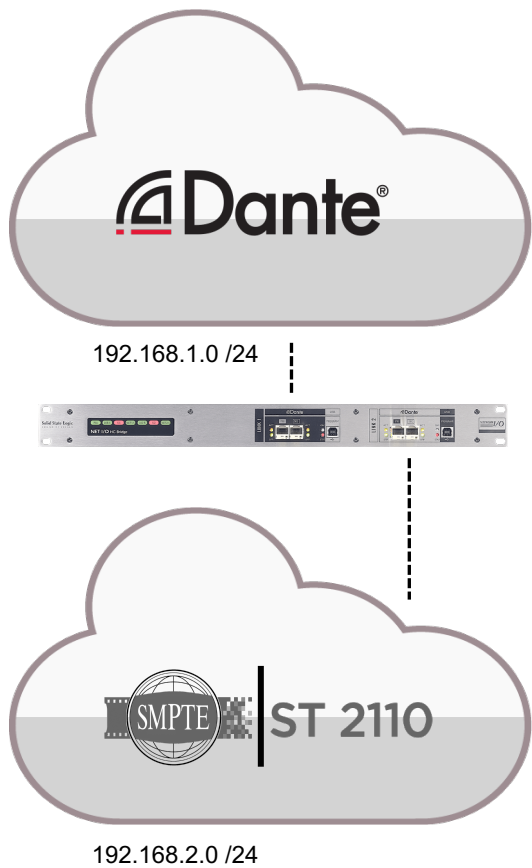
Option 1:
Complete Coexistence



Option 2:
Routed VLANs



Option 3:
Bridged Networks



Summary

Dante products are ubiquitous and implement AES67 and ST 2110 in a very consistent way.

AES67 and ST 2110 are replacements for Analog, AES3, MADI and SDI.

Don't view every design as a nail because you're holding a hammer – use the right tool for the job.

Dante's AES67 and ST 2110 “modes” represent the era they were released in.

AES67 is more ad-hoc, ST 2110 is a managed solution for larger tasks.

Dante supports PTPv1 and PTPv2 – you can use both simultaneously.

If desired, in ST 2110 mode, you can turn off PTPv1

Dante respects AES67-suggested QoS DSCP Markings for PTPv2 and RTP packets (2019).

When designing systems, consider the best topology for your scenario.



Summary of Linked Pages and Resources

Number of Devices by Protocol – RH Consulting (2022)

<https://rhconsulting.uk/blog/networked-audio-products-2022/>

Best Practices for Audio Networks, AES AESTD1003V1, June 6, 2009.

<http://www.aes.org/technical/documents/AESTD1003V1.pdf>

Media Networking Alliance FAQ: What is AES67?

<https://medianetworkingalliance.com/faq/>

SSL: IP Technology for Broadcast Audio Routing Systems

<https://s3.us-west-2.amazonaws.com/sslweb.solidstatellogic.com/content/system-t/SSL%20AoIP%20Information.pdf>

Introduction to AES67, YouTube, October 2016

https://youtu.be/AmdFXxQp_Ic?t=405 (This link jumps directly to the demonstration.)

https://youtu.be/AmdFXxQp_Ic

Whitepaper: The Relationship Between Dante, AES67 and SMPTE ST 2110, Audinate, 2019.

<https://go.audinate.com/resources/assets/broadcast-ddm-wp-f>

Understanding the Roles of Dante, AES67 and ST 2110 - TV Technology, January 14, 2020

<https://vimeo.com/684439955#t=1574> (This link jumps directly to the demonstration.)

<https://event.on24.com/eventRegistration/EventLobbyServlet?target=req20.jsp&referrer=&eventid=2155542&sessionid=1&key=A862BABDF4FF02F22A54D2A549A24393®Tag=&sourcepage=register>

Whitepaper: The Relationship Between Dante, AES67 and SMPTE ST 2110, Audinate, 2019.

<https://go.audinate.com/resources/assets/broadcast-ddm-wp-f>



Summary of Linked Pages and Resources

Webinar: Peltrix, Audinate and Blue Note Group take Dante over Distance

<https://www.audinate.com/webinar-peltrix-takes-dante-over-distance-with-blue-note-entertainment-group>

Webinar: Dante on the World Stage – A profile of the Royal Albert Hall

<https://go.audinate.com/resources/assets/rah-webinar-2020-f>

Article: Jamie Laundon, BBC Broadcasting House 80 Refurbishment

<https://jamie.laundon.org/project/broadcasting-house-80a>

Article: NFL Spotlight (Part 2): Inside NFL Media's New Facility and the Cutting Edge Technology Behind It

<https://www.sportsvideo.org/2021/09/21/nfl-los-angeles-spotlight-part-2-inside-nfl-medias-new-facility-and-the-cutting-edge-technology-behind-it/>

Announcement of Audinate Releasing AES67 Firmware (2015)

<https://audioxpress.com/news/Audinate-Announces-Firmware-Update-to-Support-AES67#:~:text=Audinate%20Announces%20Firmware%20Update%20to%20Support%20AES67%20April,standard%20through%20a%20firmware%20update%20to%20existing%20solutions.>

Announcement of Audinate Releasing ST 2110 Firmware (2019)

<https://www.audinate.com/news/press-releases/audinate-releases-major-update-to-dante-domain-manager>

Photo of Will Hoult and Kevin Gross at AES67 Public Demo (2015)

<https://www.svgeurope.org/blog/headlines/live-from-aes-2015-historic-public-demo-for-aqip-interoperability-standard/>

IEEE. (2008 07 24). 1588-2008 - IEEE Standard for a Precision Clock Synchronization Protocol for Network Measurement and Control Systems.

<https://ieeexplore.ieee.org/document/4579760>

Audinate – So You're Adding Dante to Your Network

<https://assets.audinate.com/wp-content/uploads/2022/03/dante-information-for-network-admins.pdf?>

Dante Certification Program, Second Edition

<https://audinate.com/certify>



Designing with

 **Dante**[®]

AES67

 **ST 2110**



 **audinate**[®]

Patrick Killianey
Technical Training Manager
Patrick.Killianey@audinate.com

