SMPTE ST 2110-30

SMPTE ST 2110-30

en Application Note

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1 Safety

1.1 Copyright and Disclaimer

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1.2 Notices

		
The lightning flash and arrowhead within the triangle is a warning sign alerting you of dangerous voltage inside the product.	Caution: To reduce the risk of electric shock, do not remove cover. No user-serviceable parts inside. Refer servicing to qualified service personnel	The exclamation point within the triangle is a warning sign alerting you of important instructions accompanying the product.
See marking on bottom/back of product.		

Warning!
Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, such as vases, shall be placed on the apparatus.

Warning!
The main power plug must remain readily operable.

Caution!
To reduce the risk of electric shock, grounding of the center pin of this plug must be maintained.

Warning!
To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.

∿	This product is AC only.

CE	CE Compliant and UL Certified
UL	

Warning!
This is a CLASS A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

1.3 Important safety instructions

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with a dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
13. Unplug the apparatus during lightning storms or when unused for long periods of time.
14. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

2 RTS Intercoms SMPTE ST 2110-30

Manufacturer test in the Netherlands

Participants:

- Paul de Bresser, product manager at Grass Valley
- John Hommel, head of engineering at Grass Valley
- Martin Veenstra, BT-CO/ETP1
- Sven Bindels, BT-CO/MKA3

Manufacturer test in China

Participants: Jee Zhou, BT/SAS-CN

Date of the test: 19 November 2019

Date of writing: 11 December 2019

Author: Sven Bindels, BT-CO/MKA3

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- Martin Veenstra, BT-CO/ETP1
- Marc Smaak, BT-CO/ETP1
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- Shawn Anderson, BT-CO/MKA3
- Jee Zhou, BT/SAS-CN
- Paul de Bresser

3 SMPTE ST 2110 definitions

SMPTE ST 2110 is a standard suite that specifies the transport, synchronization and description of elementary essence streams such as video, audio and data over managed IP-networks at any speed beyond 1GbE for real-time production, playout and other professional media applications.

In this standard, the IP-network transport is based on two fundamentals:

1. Bundled
2. Essence-based

Bundled video, audio and data to travel coherently requires extra work to unpack separate essences. Ideally, bundled transport and essence-based extraction for production workflows would keep individual PTP-sync untouched.

The structure of SMPTE ST 2110 is based on several sub instances:

- ST 2110-10
- ST 2110-20
- ST 2110-21
- ST 2110-22
- ST 2110-23
- ST 2110-30
- ST 2110-31
- ST 2110-40
- ST 2110-41

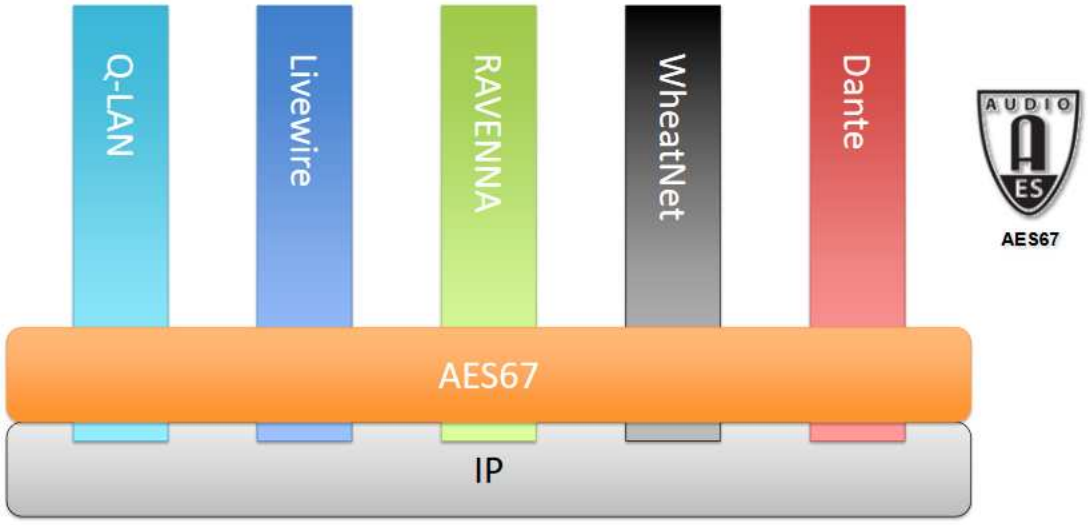
In this document, we dive into testing results of SMPTE ST 2110-30.

4 SMPTE ST 2110 precision time protocol

Precision Time Protocol (PTP), specified in IEEE 1588, is a packet-based technology used to synchronize the media clocks of all end-nodes. In order to achieve the time synchronization, packets are transmitted and received between a master clock and a slave clock. The master clock is selected automatically or provided by a specific device. All other devices operate in slave mode and synchronize to the master clock. The network latency between the master and the slaves is measured and compensated so all devices run synchronously.

5 SMPTE ST 2110-30 definition

SMPTE ST 2110-30 specifies the payload format for PCM digital audio streams as uncompressed linear PCM audio only. This standard is based on existing protocols and trusted IT standards, to allow coexistence with current IT data and existing network infrastructure. One of those standards is AES67, which is relatively flexible in operation. It provides 48 kHz and 96 kHz sampling in 16- and 24-bit depth with variable packet timing of 125 µs (microseconds) to 1 ms (milliseconds), where channel-count is based on packet timing in different conformance levels and low bandwidth consumption.



There are six conformance levels; A, B, C, AX, BX and CX.

- Conformance level **A** allows operation with reception of 48 kHz streams up to 8 channels with a packet time of 1 ms (milliseconds).
- Conformance level **B** allows operation with reception of 48 kHz streams up to 8 channels with a packet time of 125 µs (microseconds).
- Conformance level **C** allows operation with reception of 48 kHz streams up to 64 channels with a packet time of 125 µs (microseconds).
- Conformance level **AX** allows operation with reception of 96 kHz streams up to 4 channels with a packet time of 1 ms (milliseconds).
- Conformance level **BX** allows operation with reception of 96 kHz streams up to 8 channels with a packet time of 125 µs (microseconds).
- Conformance level **CX** allows operation with reception of 96 kHz streams up to 32 channels with a packet time of 125 µs (microseconds).

6 Setup and configuration with Grass Valley

At 19th of November we, RTS Intercoms as manufacturer, had an appointment with Grass Valley in Breda, the Netherlands. This appointment has been setup to confirm SMPTE ST 2110-30 audio streams between devices of each brand on conformance level A with an external PTP-master.

All RTS Intercoms products were preconfigured and tested in Breda on October 29, 2019. The ODIN had connected on channel 1, 2 and 3 the KP-series with channel 4 till 16 available for DANTE channel purposes. During these preparations we created a domain in the DANTE Domain Manager, running at one of our laptops, and enrolled all devices by automatic discovery into a single domain as shown in image 5.1.2 and 5.1.3.

During this test we have used the following equipment:

- ODIN, firmware version 1.1.1 and FPGA version 6.60.6693
- DKP-4016, firmware version 2.3.0 and FPGA version 6.60.6693
- KP-4016, firmware version 2.3.0 and FPGA version 6.60.6693
- KP-5032, firmware version 2.3.0 and FPGA version 6.60.6693
- Cisco SG-500X 24 ports
- Grass Valley LDX86N
- Grass Valley XCU UXF
- Workstation with RAV2SAP software
- Beyer DT109 headset (dynamic)
- Panasonic AJ-MC700-P

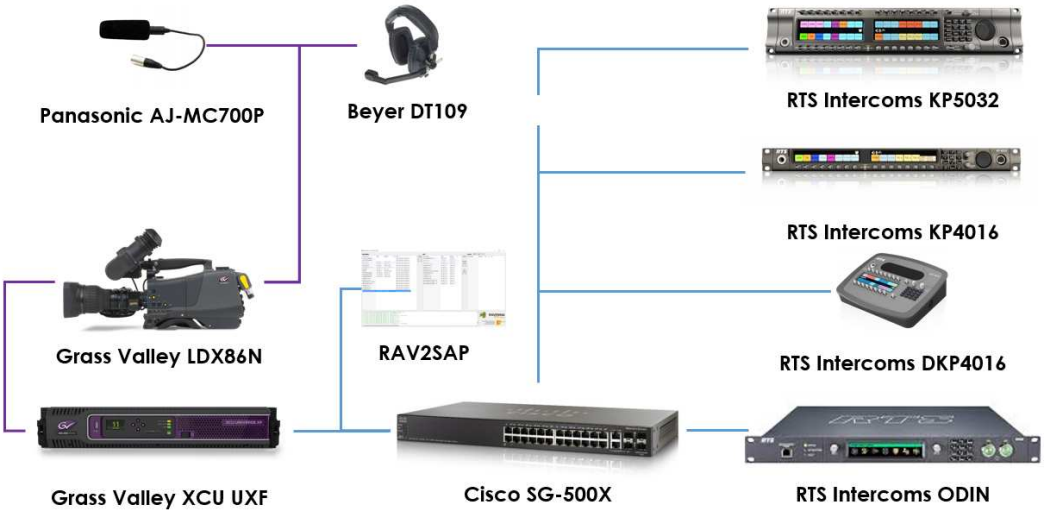


Figure 6.1: Network schematic

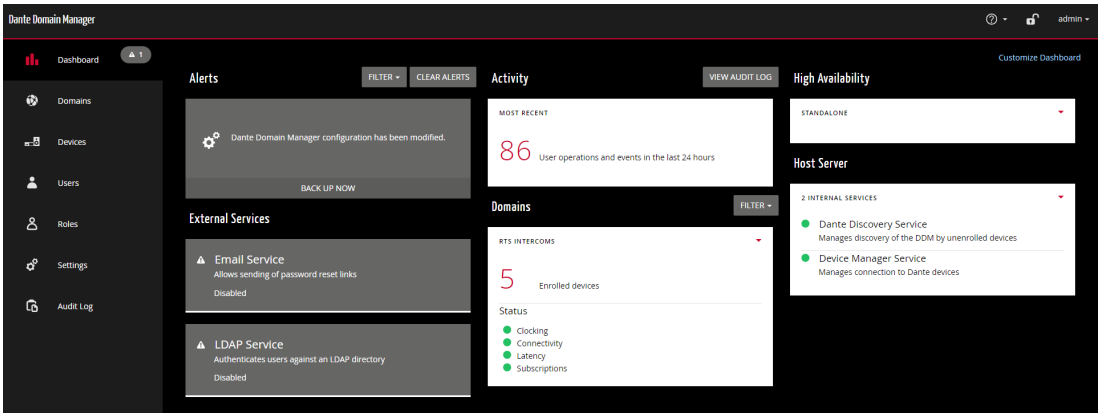


Figure 6.2: DANTE Domain Manager dashboard

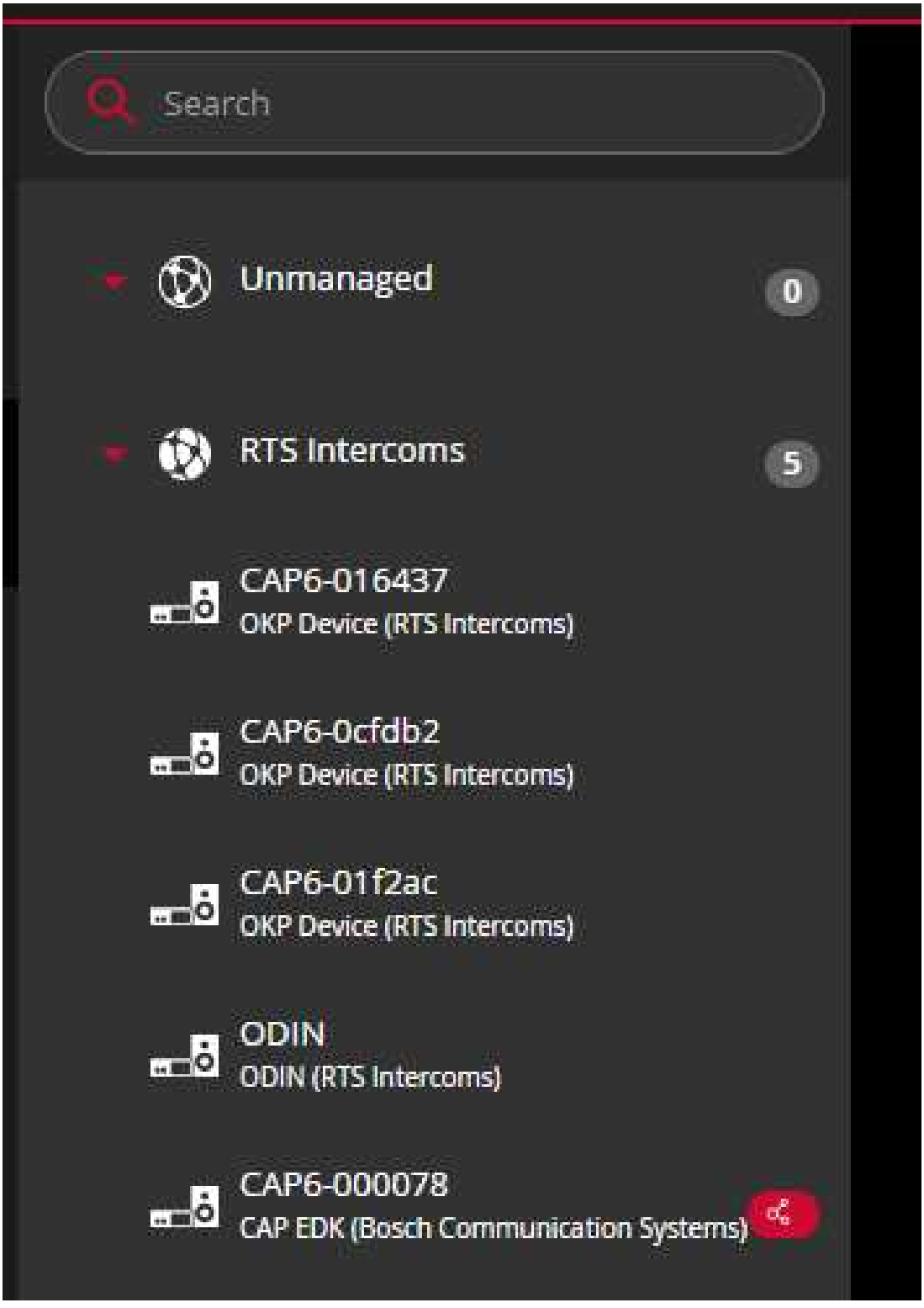


Figure 6.3: Devices enrolled into a single domain

All equipment, as well the RTS Intercoms as Grass Valley equipment, were connected to the Cisco network switch. From there we confirmed the network switch and edge ports were configured according our OMNEO Requirements and Considerations document.

We selected the domain and entered Advanced Settings, to confirm the mode the DANTE Domain Manager is running and PTP-clock settings. This is shown in image 5.1.4, 5.1.5. and 5.1.6.

DANTE domain manager advanced settings

Mode	SMPTE
PTP v1 multicast	Yes
PTP v2 domain number	127
PTP v2 priority 1	128
PTP v2 priority 2	128
PTP v2 sync interval	-3
PTP v2 announce	-2
PTP v2 multicast TTL	16
PTP slave only	Yes[1]
RTP transmit port	5004
System packet time	1 ms
RX latency	2 ms
RTP prefix v4	69
Unicast clocking	No

This setting is not shown at all images.

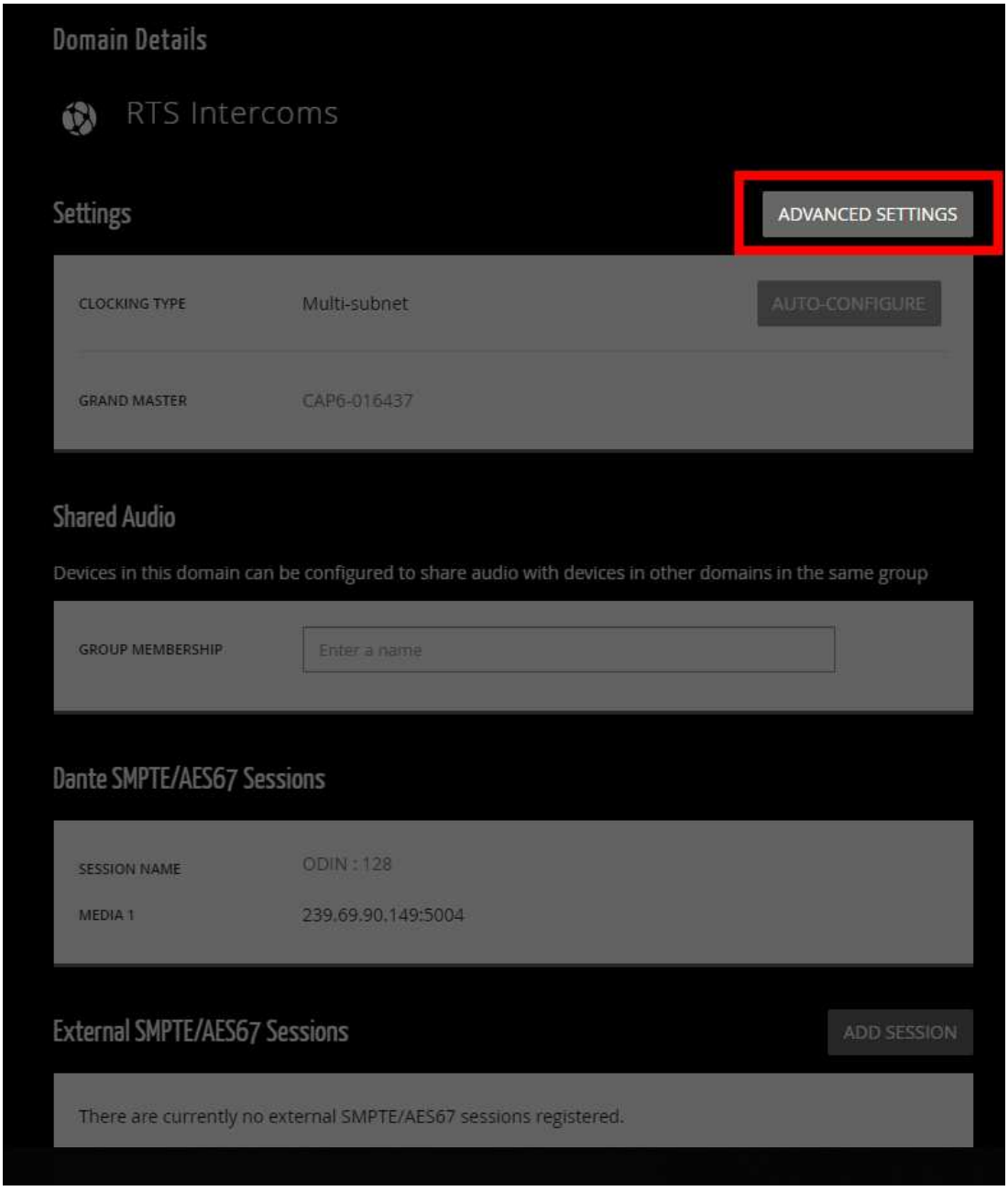


Figure 6.4: Domain selection with Advanced Settings option

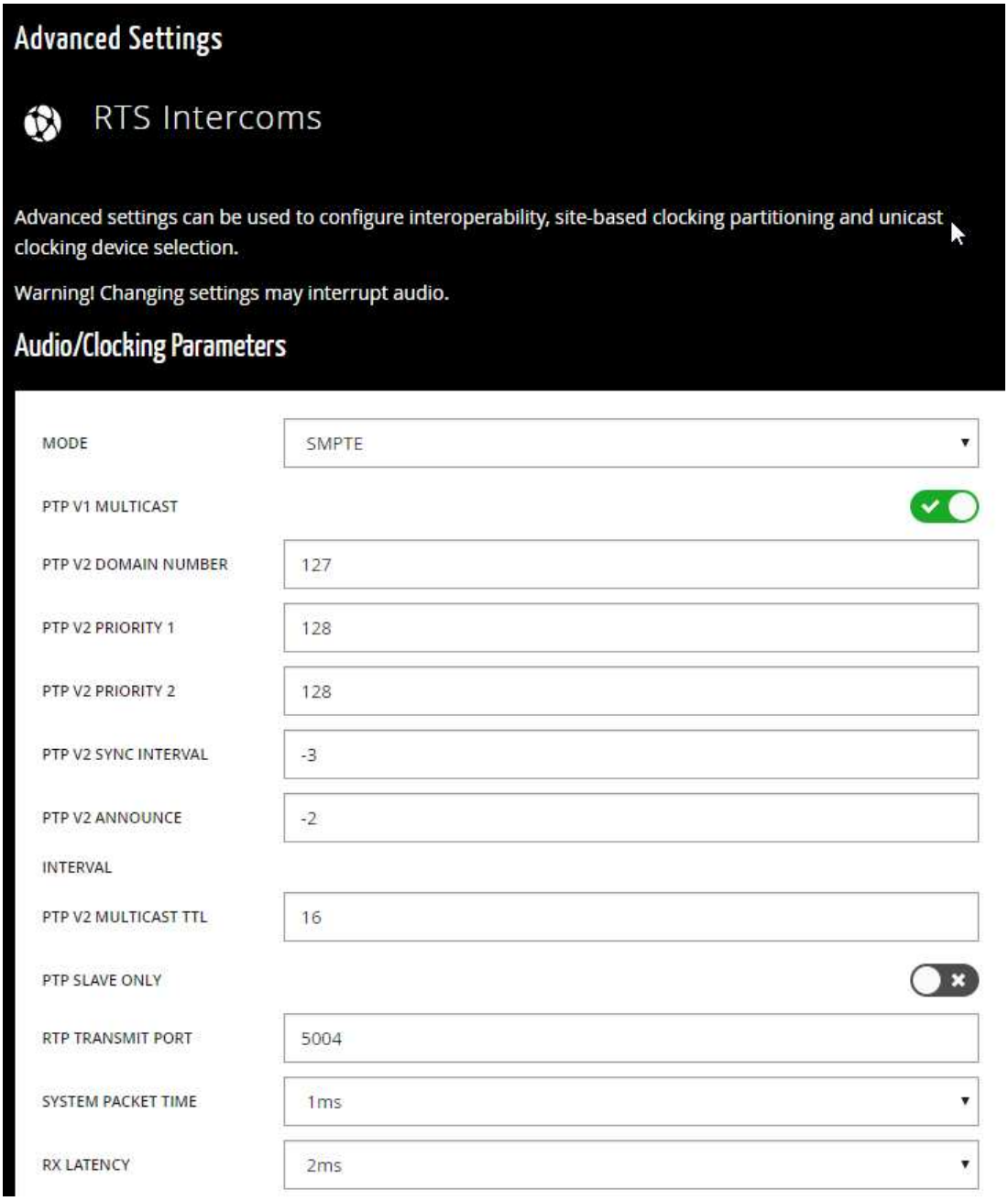


Figure 6.5: Advanced settings audio/clocking parameters

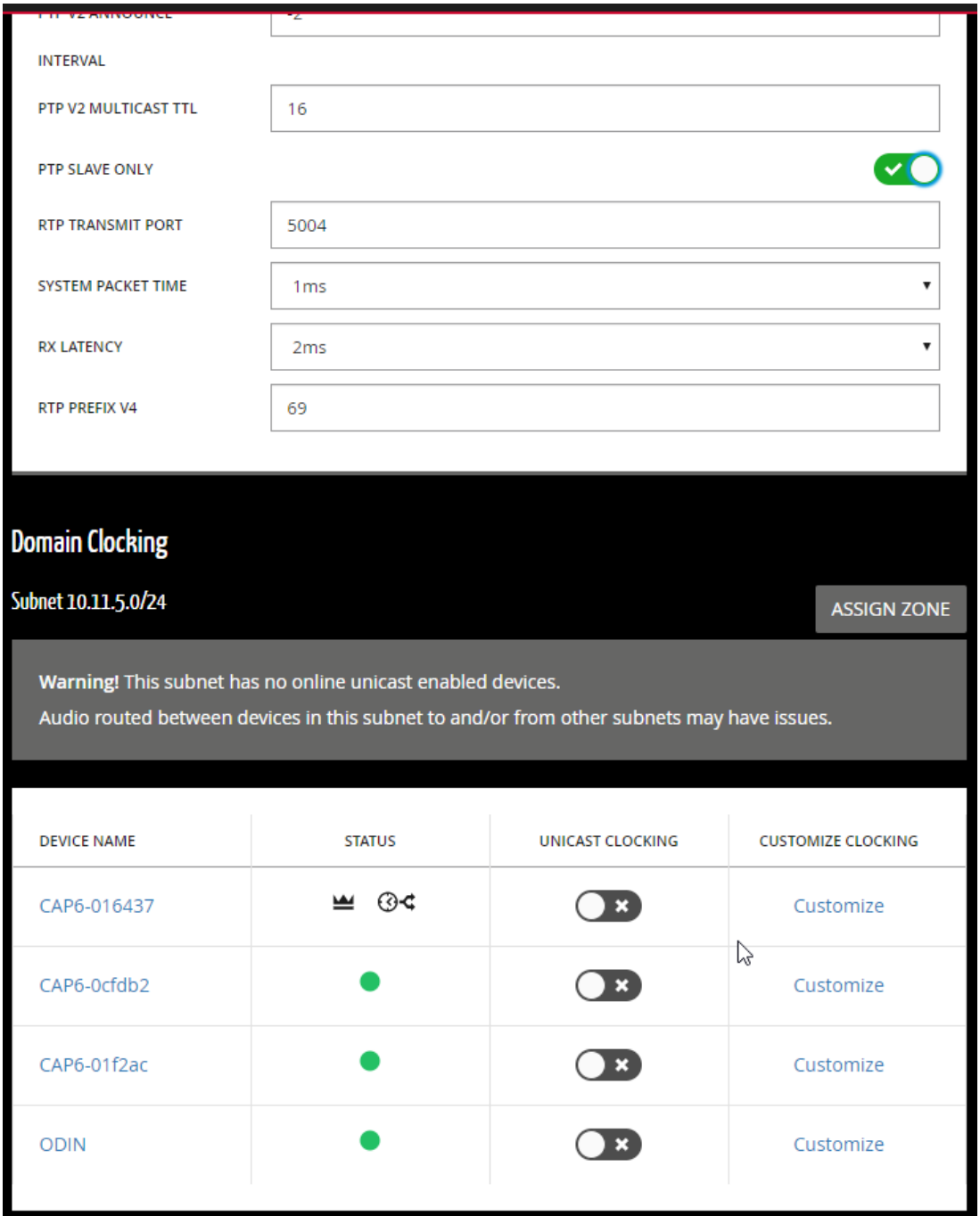


Figure 6.6: PTP Slave only mode enabled and domain clocking information

As result, after configuration and testing audio, we can confirm by DANTE Controller in Interop Status tab that ODIN is in SMTPE mode with as destination multicast address 239.69.xxx.xx. Shown at image 5.1.7.

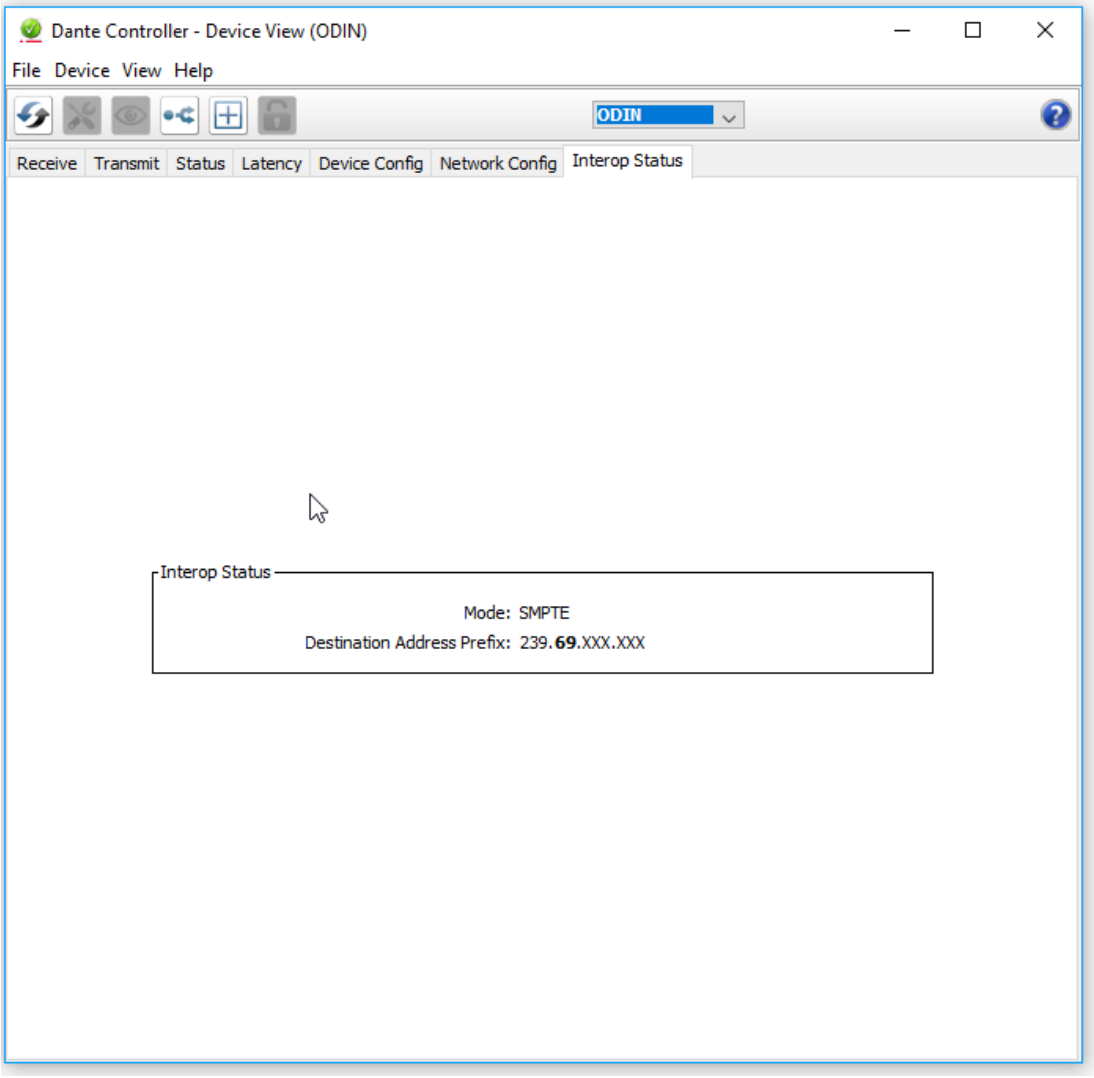


Figure 6.7: Interop status from CANTE Controller of an ODIN

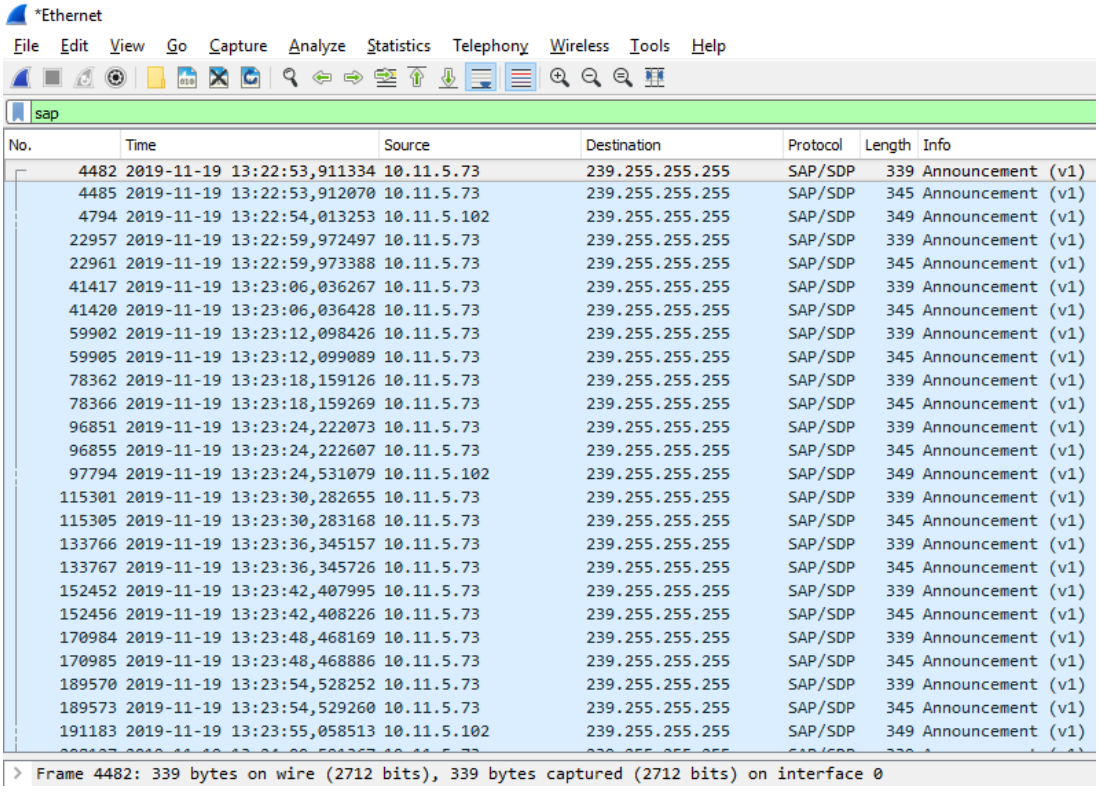


Figure 6.8: SAP announcements captured by Wireshark

To get an interconnection between our devices, running SMPTE 2110, we require to interconnect devices by DANTE Controller. Once the device has been detected, as shown in image 5.1.9, then audio routing can be done. In this test we required two channels to be setup between the frame and camera.

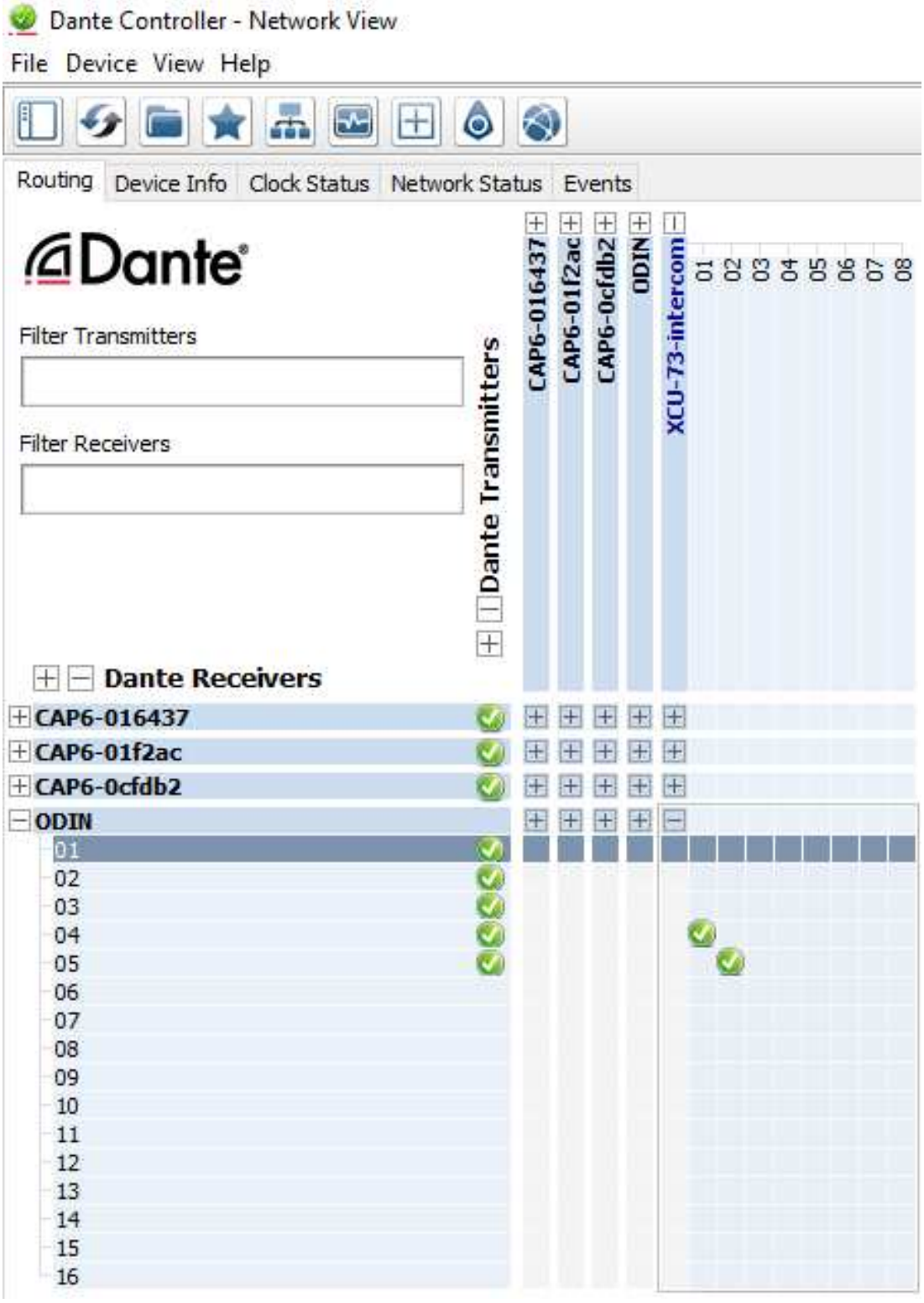


Figure 6.9: Audio routing by DANTE Controller

7 SMPTE ST 2110-30 conformance level A result

The audio test has been confirmed as operational with high quality from any individual keypanel towards the Grass Valley LDX86N based on a SMPTE stream.
The audio test has been confirmed as operational with high quality from the Grass Valley LDX86N towards any individual keypanel who enabled listening or was part of a partyline based on a SMPTE stream.

8 SMPTE ST 2110-30 conformance level B result

Based on the results of conformance level A, all system packet timers were set to 125 µs to confirm whether or not conformance level B would work out.
At the RTS Intercoms / DANTE Domain Manager side we have modified the System packet time to125 µs. Grass Valley changed to the same value on their equipment or management software. With this, our test of conformance level B succeeded with both direction audio without loss of quality or else compared to the first test.

9 Standard AES67 result

In addition, while all equipment was at one location, the standard AES67 has been tested. Between SMPTE ST 2110-30 and standard AES67 there was no difference in operations, other than different standard applied in DANTE Controller where SMPTE ST 2110 streams has been disabled in DANTE Domain Manager. Also this succeeded without loss of quality or else.

10 SMPTE ST 2110-30 test summary in China

On date Jee Zhou (BT/SAS-CN) has tested SMPTE ST 2110-30. Equipment used during this test:

- ODIN, firmware version 1.1.1 and FPGA version 7.00.8888
- KP-3016, AIO mode
- Huawei CE 8850
- Huawei S5720S
- Cisco N92160
- Grass Valley XCU XF IP
- Grass Valley IPG 3901
- Sony HDCU 4300
- Sony NXLK IP50
- Workstation with RAV2SAP software

During this test the PTP time sync has been tested on 125µs (microsecond) and 1ms (millisecond). Also ODIN has been tested in glitch-free mode, to send flows on both networks. It was confirmed during this test that ODIN FPGA version 6.60 had time synchronization issues and was there for updated to version 7.00.

Tests one has been executed with Sony equipment in combination with Huawei network equipment. As the Sony cameras could only receive AVP 97, it was mandatory to setup two channels. One channel was meant for AVP 97 and one channel was meant for AVP96.

Test two has been executed with Grass Valley equipment in combination with Cisco network equipment.

Both tests has been successfully accomplished.

11 SMPTE ST 2110 sub instances and definitions

– ST 2110-10; System timing and definitions

Defines transport layer and clock synchronization in standards like SMPTE ST 2059, RTP, SDP and PTP.

– ST 2110-20; Uncompressed active video

Defines payload format of raw video.

– ST 2110-21; Traffic shaping and delivery timing for uncompressed video

Defines timing model for transmitters and receivers.

– ST 2110-22; Constant bit-rate with compressed video

Defines payload format for compressed video and SMPTE registration for various payload formats by codec.

– ST 2110-23; Single video essence transport over multiple streams (SMPTE ST 2110-20).

Defines how to split high-bandwidth signals into several lower-bandwidth tributary streams (SMPTE ST 2110-20).

– ST 2110-30; PCM digital audio

Defines payload format for linear audio such as AES67.

– ST 2110-31; AES3 transparent transport

Defines payload format for non-linear audio such as RAVENNA.

– ST 2110-40; Transport of SMPTE ancillary data

Defines Real-time Transport Protocol (RTP) payload format for SDI ancillary data.

– ST 2110-41; Extensible fast metadata transport

Defines how to transport extensible, dynamic metadata in context.

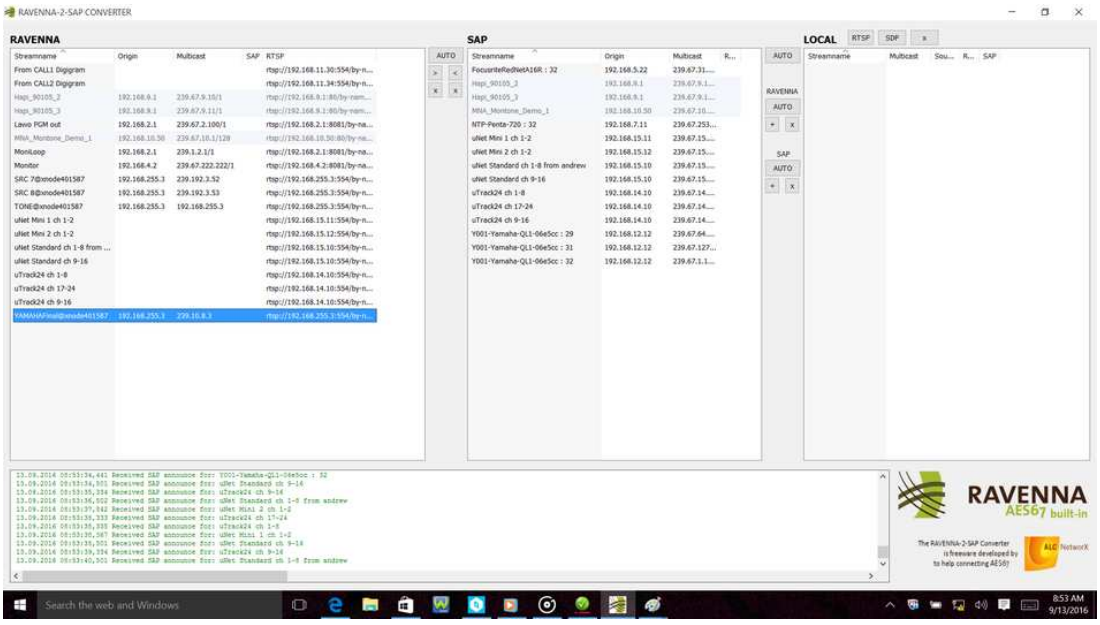
Andreas Hildebrand, member of AIMS Alliance and senior product manager at ALC NetworkX, presented SMPTE ST 2110 and all sub standards at ISE 2019, February, as written above.

12 RAVENNA to SAP

RAV2SAP is a free-of-charge tool that helps connecting Ravenna devices to other AES67-enabled devices (i.e. based on DANTE). It can be downloaded via the website of RAVENNA after registration. Please find the link below.
When the AES67 Standard for High-performance Audio-over-IP Interoperability was published in 2013, all ingredients required to establish audio content interchange between different audio network systems based on IP were defined to its necessary minimum. However, since the standard focusses on interoperability, some advanced functions typically offered by various audio network solutions such as advertisement & discovery and connection management information exchange are left open as different methods and protocols exists which suitability depends on specific use cases and application environment.
The RAVENNA-2-SAP Converter helps bridging this gap by providing session announcement translation between RAVENNA and SAP-based systems or devices, including SDP translation and forwarding to ease connection management.
Source: https://ravenna-network.com/aes67/rav2sap

12.1 Configuration of RAV2SAP tool

Thanks to ALC NetworkX developers, a tool to facilitate interoperability has been developed and released in the form of RAV2SAP.



In the left column you will find all RAVENNA sessions that are discovered on the network. It includes following information:

- Session name (bonjour announcement);
- IP-address of the source;
- Multicast address of the related stream;
- RTSP information;
- SAP column indicating the status of the translation:
  - Empty field indicates as not translated;
  - “W” indicates as system awaits expected SAP time-out period;
  - “A” indicates as session is translated into SAP.

In the second column you will find all SAP sessions that are discovered on the network. It includes following information:

- Session name;
- IP-address of the source;
- Multicast address of the related stream;
- RAV column indicating the status of the translation:
  - Empty field indicates as not translated;
  - “A” indicates as session is translated into RAVENNA.

In the third column you will find all local created sessions. It includes following information:

- Session name;
- Multicast address of the related stream;
- Source, indicating if the stream has been created by manual SDP data entry or RSTP uri;
- RAVP / SAP columns;
  - Empty field indicates as not translated;
  - “A” indicates as session is translated into RAVENNA or SAP.

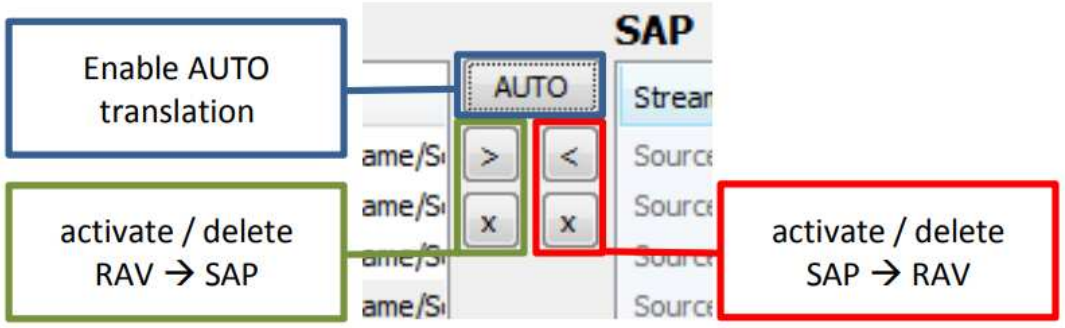
The buttons between the columns are meant to control the RAVENNA to SAP translation and vice versa. In order to translate an entry to the other side, the desired entry should be selected and hitting “>” or “<” sign.

- The “>” sign translate RAVENNA to SAP;
- The “<” sign translates SAP to RAVENNA.

When sessions are shown in grey text color, they cannot be translated due to:

- Detection of an already existing identical announcement;
- It had been generated from a local session announcement;
- SAP time-out waiting after initial announcement detection;
  - This is a temporarily condition.

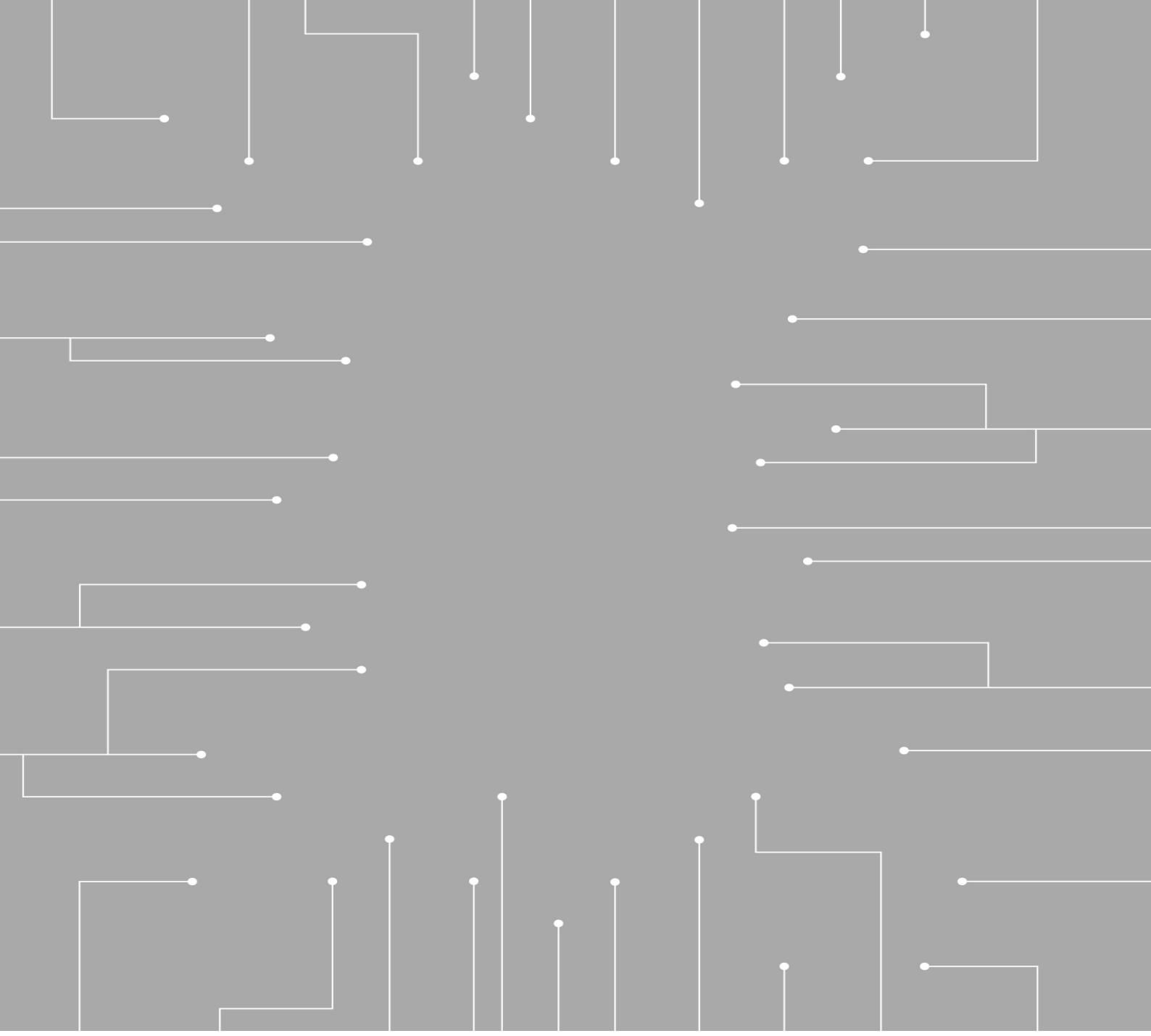
To remove active translates, select the desired entry and press “X” button. The left “X” will remove active RAVENNA to SAP entry and the right “X” will remove the SAP to RAVENNA entry. For the local announcements, these buttons work similar way. The “+” button can be used to add an announcement from RAVENNA to SAP or from SAP to RAVENNA, where the “X” button should be used to remove any local entry.



12.2 Download link of RAV2SAP tool

More information can be found in the RAV2SAP User Guide, which can be found at the website of RAVENNA.

The download link to RAV2SAP can be found here: https://www.ravenna-network.com/resources/.



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