APPLICATION NOTES

POWERSOFT AMPLIFIERS AND AoIP
(DANTE/AES67)

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INTRODUCTION

This document aims to provide general recommendations and configurations for network switches to be used with Powersoft amplifiers for Dante and AES67 connectivity, including practical examples.

For remote control and monitoring of amplifiers, any type of network switch running on at least 100 Mbps will be sufficient. However, for transport of Audio-over-IP like Dante or AES67, dedicated network switches and configurations may be necessary.
This is specially the case of large and heavily loaded, or mixed, networks (e.g. audio + video + other data types).

The following are general recommendations when working with networks, especially in the case of larger networks:

- **Topology** – Although "daisy chaining" may be suitable for connecting devices in a network, the failure of any device in the chain will break connections to devices further down in the "stream". In general, switched networks are best thought of when using a "star", or "hub and spoke" topology. In such a setup, all devices on a star are connected to a single switch and, if any device fails, the others continue to communicate. As the network gets larger, additional switches may be brought in to extend the network. The star topology can be easily extended in a multiple-star arrangement to suit larger systems (Figure 1).
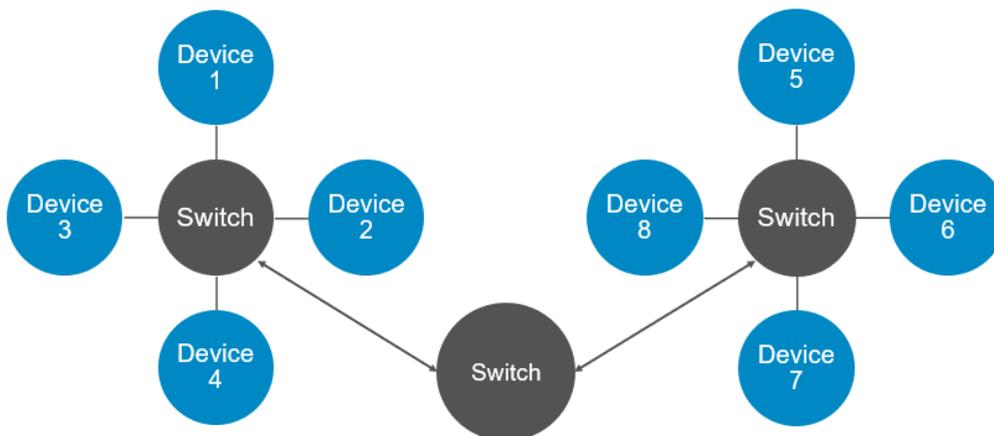
Figure 1 – Example of a multiple-star topology, where no device is more than 4 "hops" away from any other.

- **Cabling** – Any type of ethernet cable is suitable for a Dante or AES67 network, although, in gigabit speed network, CAT5e or CAT6 cables are recommended. CAT6 cables are rated for greater noise resistance in electrically noisy environments, however, CAT5e is enough for most applications. The maximum allowed length for a normal ethernet cable is approximately 100m. For longer distances, fibre optics will be necessary, as it can run for several kilometres when required. The drawback is that fibre connections will require network interfaces that can support it, such as Small Form-Factor Pluggable (SFP).

GENERAL RECOMMENDATIONS FOR DANTE & AES67

DANTE: What is it?

DANTE audio network is a network audio protocol by Audinate that transport uncompressed, multi-channel, low-latency digital audio over a standard ethernet network, using layer 3 internet protocol packets.

AES67: What is it?

AES67 is a standard (not a protocol) defined by the Audio Engineering Society for audio over IP interoperability. It ensures interoperability between previously competing networked audio protocol.
AES67 defines requirements for synchronizing clocks, setting QoS priorities for media traffic, and initiating media streams with standard protocols among all other networking specifications.

For maximum Dante and/or AES67 network reliability, it is recommended that switches be/have:

- **Rated for gigabit Ethernet** – although 100Mbps may be enough for a small and audio-dedicated network, larger and heavier installations may require a switch running on at least 1Gbps.

- **Non-blocking** – in this type of device (almost every switch nowadays), all ports can run at full speed without any loss of data packets. The switch can handle the total bandwidth on all ports, establishing routing to any free output port without interfering with other traffic.

- **EEE* (Energy Efficient Ethernet)** <u>DISABLED</u> – switches that do not have energy efficient or energy save mode do not require any additional configuration.
  However, this function needs to be disabled in switches that offer it, as it will impede proper operation of low-latency audio over IP.
  The energy-save function tends to delay packets sent over the network.

*EEE is also sometimes referred to as 'Green Ethernet' or 'IEEE 802'. Beware that some unmanaged switches have EEE enabled by default and will not allow the user to disable this function.

- **Managed** – differently from unmanaged switches (plug-and-play), managed switches offer a series of different options and adjustments, such as the ability to prioritise the transport of certain types of data over others, and creating Virtual Local Area Networks (VLANs), which are particularly important in mixed networks, where audio is combined with other types of data. For small and audio-dedicated networks, unmanaged switches may be sufficient for Dante and AES67 operations. However, in heavily loaded networks, or where audio streams share the network with other data (e.g. video, security, etc.), a managed switch will likely be necessary.

- **Quality of Service (QoS) management** – only available in managed switches. QoS network management allows the switch to prioritise certain types of data packets over others. Such packets get preferential treatment and are "moved to the front of the line" ahead of other traffic (Figure 2). In the case of audio streams, the priority must first be given to clocks for device and audio signal synchronization, followed by the audio packets themselves. This is to guarantee low-latency and high-quality audio streams across the network. Dante networks require at least four priority queues, whilst AES67 only requires three.

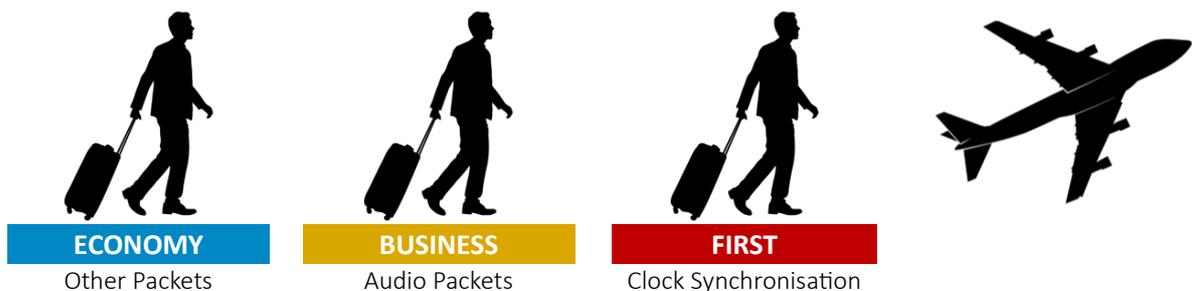| ECONOMY	BUSINESS	FIRST
Other Packets	Audio Packets	Clock Synchronisation

Figure 2 – Sketch of different priority queues for audio data management in an AES67 network.

- **Differentiated Services Code Points (DSCP) QoS** – DSCP is a type of QoS management. To prioritise the different packets of information, Dante/AES67 networks use DSCP labels and numbers to organise these packets in different priority queues. Such management is done by the switch and, therefore, where managed network switches are necessary, these must work with DSCP QoS.

  Many switches have Layer 2 "CoS QoS" management enabled by default, and this configuration needs to be changed to Layer 3 "DiffServ/DSCP QoS". Once enabled, check the priority assignments. The switch will require special configuration to recognise and prioritise the specific DSCP values used by Dante (Table 1) and by AES67 (Table 2). A configuration example is covered later in this document.

PRIORITY QUEUES	USAGE	DSCP LABEL	DSCP NUMBER
1. High	Clock synchronisation	CS7	56
2. Medium	Audio packets	EF	46
3. Low	Video packets/Reserved	CS1	8
4. None	Other packets	Best-Effort	0

Table 1 – DANTE's different priority queues and their respective DSCP values.

PRIORITY QUEUES	USAGE	DSCP LABEL	DSCP NUMBER
1. High	Clock synchronisation	EF	46
2. Medium	Audio packets	AF41	34
3. None	Other packets	Best-Effort	0

Table 2 – AES67's different priority queues and their respective DSCP values.

In mixed networks with Dante and AES67 streams generated from a Dante device, it is always recommended that the DSCP values from Table 1 are used, and that clock synch packets always receive the highest priority treatment.
Values in Table 2 should only be used in AES67 networks that do not contain Dante streams.

IMPORTANT NOTE:
In larger Wide Area Network (WAN) connections, such as those used in large corporate environments, DSCP tags may not be respected by edge routers.
Consult your network administrator to discuss options to bypass this constraint if it exists.

RECOMMENDATIONS FOR MULTICAST TRAFFIC

The following switch configurations apply to networks containing multicast data traffic. Dante devices may be configured to transmit either unicast or multicast audio streams, while AES67 only works with multicast transmission.

For Dante, unicast data traffic will require less switch and routing configurations, making it a simpler and faster solution for small and dedicated networks, under normal circumstances. However, in larger scenarios, and specially where multiple devices receive the same audio stream, the use of multicast over unicast for audio transmission may be beneficial. If correctly configured, multicast can be more efficient than unicast in terms of bandwidth consumption.

For maximum multicast efficiency and reliability, it is recommended that network switches have:

- **IGMP Snooping Activated** – When using multicast traffic, it is important to configure the network accordingly to increase efficiency and reduce bandwidth consumption. Without a proper configuration to manage this traffic, multicast packets will be broadcast to all receivers in the domain, including devices that have not requested those packets (Figure 3). This could be a problem to some amplifiers that may not be able to manage a high count of incoming data packets. To overcome this issue, **IGMP Snooping** must be activated in the network switch.

  Internet Group Management Protocol (IGMP) is a communication protocol used to establish multicast groups and manage memberships of receiving and transmitting devices. When a multicast transmission starts, a multicast group is created and an announcement is sent to all devices over the network, after which, devices wishing to receive the multicast packets, will send IGMP join messages, specifying the IP multicast group they want to join.

  IGMP Snooping is the process where the network switch examines the IGMP communications between devices to create a table with which multicast packets are needed and in which of its ports. In this process, the switch will only forward multicast data packets to the designated ports and receivers (Figure 3).
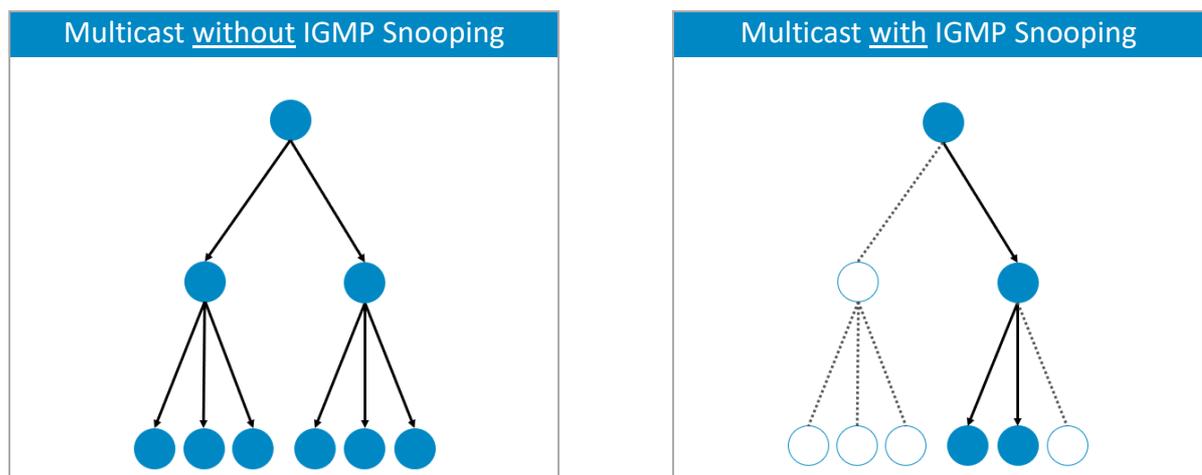

Figure 3 – Difference between multicast packet transmission with and without IGMP Snooping in operation.

For a stable IGMP Snooping operation, an **IGMP Snooping Querier** must also be enabled. The aim of a querier is to keep the table with all the multicast group memberships up to date. It sends out IGMP queries on a timed interval to all members belonging to the IP multicast group. All devices wishing to remain in the group must reply to the query with a confirmation. Those devices that do not respond within a defined amount of time will be removed from the group's table and will no longer be forwarded those multicast streams.

Although a network can accommodate multiple IGMP Snooping Queriers (and will automatically select one), it is safer to have only one IGMP querier enabled, preferably on a switch sitting close to the root of the network topology.

Some switches also allow the configuration of a 'Query Interval', which is related to the group membership timeout, and is the number of seconds that must pass before the switch determines that no more members of a multicast group exist on the network. When the 'Query Interval' is large, the time required for the multicast stream to start or stop working becomes longer and the user may experience than an amplifier will take longer to start playing audio.

An example of IGMP Snooping configuration for a Cisco switch is given later in this document.

Finally, IGMP has three different versions: v1, v2, and v3. However, IGMPv2 supports IGMPv1, and IGMPv3 supports IGMPv2. Although not all features of an earlier version of IGMP are supported, the features related to membership query and membership report messages are supported for all IGMP versions.
For Dante and AES67, IGMPv2 or IGMPv3 are recommended.

Powersoft Amplifiers AoIP table summary

		Dante Rx	AES67 Rx	Dante Tx	AES67 Tx
Unica	9K4	✓	✓	✓	✓
	12K4	✓	✓	✓	✓
	16K4	✓	✓	✓	✓
	2K8	✓	✓	✓	✓
	4K8	✓	✓	✓	✓
	8K8	✓	✓	✓	✓
Mezzo Series	602 AD	✓	✓	✓	✓
	324 AD	✓	✓	✓	✓
	322 AD	✓	✓	✓	✓
	322 AD	✓	✓	✓	✓
	604 A+		✓		✓
	602 A+		✓		✓
	324 A+		✓		✓
	322 A+		✓		✓
Quattrocanali Series	8804 DSP+D	✓	✓		
	4804 DSP+D	✓	✓		
	2404 DSP+D	✓	✓		
	1204 DSP+D	✓	✓		
	8804 DSP+		✓		
	4804 DSP+		✓		
	2404 DSP+		✓		
	1204 DSP+		✓		
Duecanali Series	6404 DSP+D	✓	✓		
	4804 DSP+D	✓	✓		
	1604 DSP+D	✓	✓		
	804 DSP+D	✓	✓		
	6404 DSP+		✓		
	4804 DSP+		✓		
	1604 DSP+		✓		
	804 DSP+		✓		

		Dante Rx	AES67 Rx	Dante Tx	AES67 Tx
Ottocanali Series	4K4 DSP+D	✓	✓	✓	✓
	8K4 DSP+D	✓	✓	✓	✓
	12K4 DSP+D	✓	✓	✓	✓
X Series	X8 D	✓	✓	✓	✓
	X4L D	✓	✓	✓	✓
	X4 D	✓	✓	✓	✓
T Series	604	✓	✓	✓	✓
	602	✓	✓	✓	✓
	304	✓	✓	✓	✓
	302	✓	✓	✓	✓

Table 3 – List of AoIP protocols and compatibility with Dynamic Music Distribution.

DANTE SETUP AND OPERATIONS

Connecting Powersoft Amplifiers to a Dante Network

Physical connection to a Dante network is done via regular CAT5e (or higher) wiring. If a switch is used, special attention should be given to its capabilities, as certain products are not compatible with Dante Networks.

For more information on switch requirements for Dante compatibility, and on how to create and manage Dante networks, please refer to Audinate's website.

When opening the 'Dante Controller', all devices connected to the Dante network will be displayed in the list of transmitters and receivers (Figure 4).
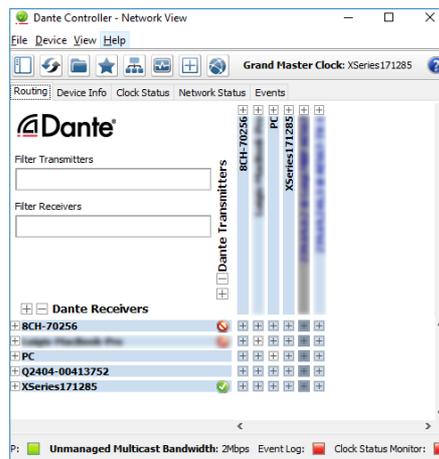
Figure 4 − Dante Controller Network View window.

If the computer in use features multiple network ports, in some instances, 'Dante Controller' may connect to the wrong one. To overcome this issue, click on the square next to 'P:' at the bottom left corner of the 'Network View' window. This will open the Dante interface configuration window (Figure 5), from where the correct port can be selected.
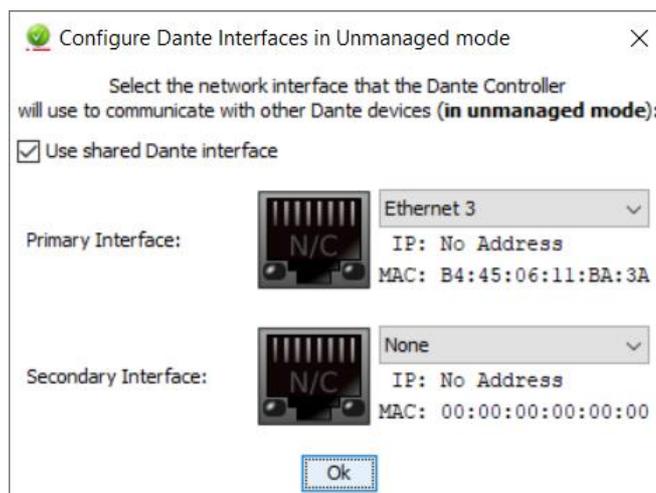

Figure 5 − Configuration of Dante network interfaces.

Powersoft amplifiers connected to the Dante network will automatically obtain IP addresses by default, and in most circumstances, there is no need to change the address settings. However, static IP addresses can be assigned if necessary.

To assign a static IP address:

1. Open the 'Device View' window by double-clicking on the device to be configured.
2. Click on the 'Network Config' tab (Figure 6).
3. Under 'Addresses' switch to the option 'Manually configure an IP Address'
4. Enter the IP Address and Netmask.
5. Click 'Apply'.

The DNS Server and Gateway settings are optional - the device will use network defaults if they are not specified. To revert to the previous settings, click 'Revert'.

It is important to note that this operation requires a device reboot. This can be done by simply clicking 'Reboot' under 'Reset Device'. However, in some instances, it has been verified that a manual reboot of the amplifier is necessary for modifications to take effect and is therefore recommended as best practice.
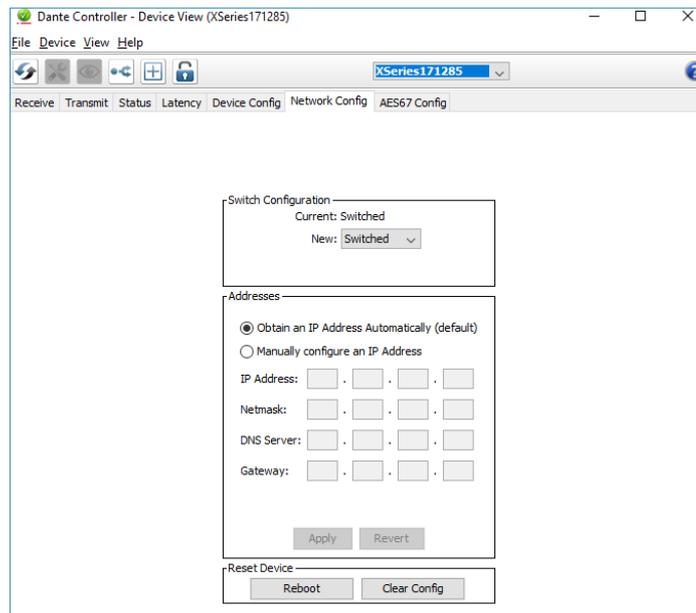

Figure 6 – Dante Controller 'Network Config' tab in the 'Device View' window.

Please note that when Powersoft amplifiers are set to automatically obtain IP addresses, Dante Controller must be running on a host computer also configured to obtain IP addresses automatically. Likewise, for static IP address configurations, fixed IP addresses must be assigned to both host computer and amplifier, with both devices operating within the same subnet.

The assignment of fixed IP to a Powersoft amplifier can also be done via ArmoniaPlus. Figure 7 is showing the IP assignment page of the amplifier's Dante setting in ArmoniaPlus.
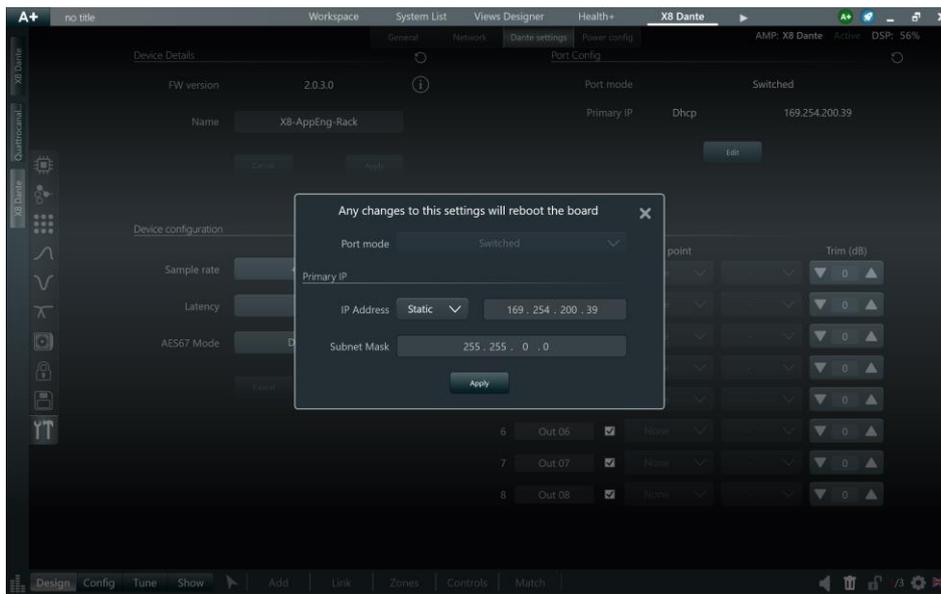

Figure 7 – ArmoniaPlus 'Network Config' window in the 'Dante Settings' tab.

Other Dante settings, as Dante device name, Dante latency, sample rate and AES67 mode, can be edited via ArmonìaPlus, in the same Dante settings page as shown in Figure 7.
For advanced Dante settings Audinate Dante Controller software must be used.

Network interface configuration: Switched, Split, Redundant

Powersoft amplifiers may feature one or two Dante ethernet ports. Amplifiers with a single Dante port also feature an additional standard Ethernet port, with each port operating independently from one another. In amplifiers where two Dante ports are available (labelled primary and secondary), it is possible to switch between different operation modes:

- Switched Mode- The secondary Dante port behaves as a standard switch port, allowing daisy-chaining through the amplifier (Figure 8). This is the default configuration for Powersoft amplifiers with two Dante ports.
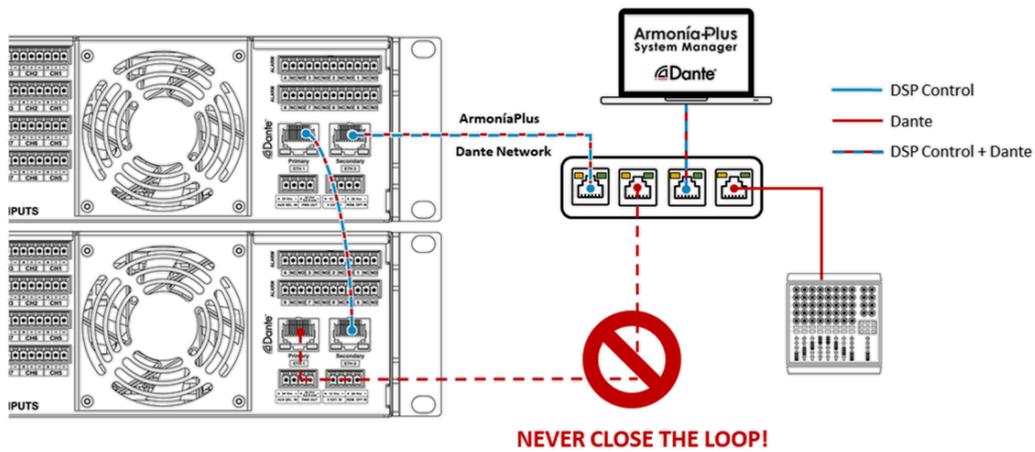
NEVER CLOSE THE LOOP!

Figure 8 – Example of Dante Switched Mode configuration with Powersoft amplifiers.

- Split Mode- For amplifiers with a single Dante port and one Ethernet port, this is the default and only operation mode available. In amplifiers with two Dante ports, 'Split Mode' can be selected, allowing the primary port to behave as a regular Ethernet port operating independently from the Dante network (Figure 9).
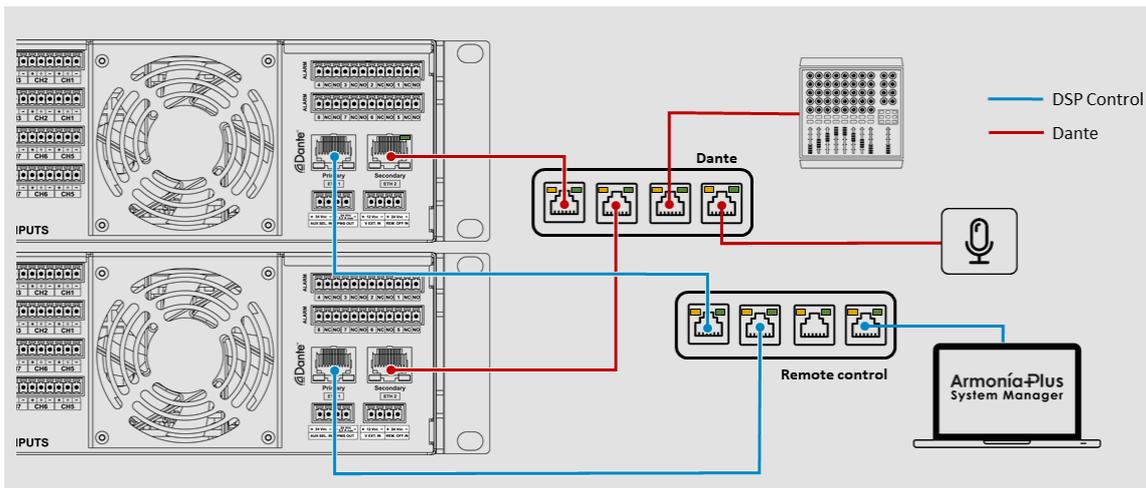

Figure 9 – Example of Dante Split Mode configuration with Powersoft amplifiers.

- Redundant Mode –When an amplifier is set to 'Redundant', it will duplicate the Dante audio traffic to both Dante ports, allowing the implementation of a redundant network via the secondary port (Figure 10).
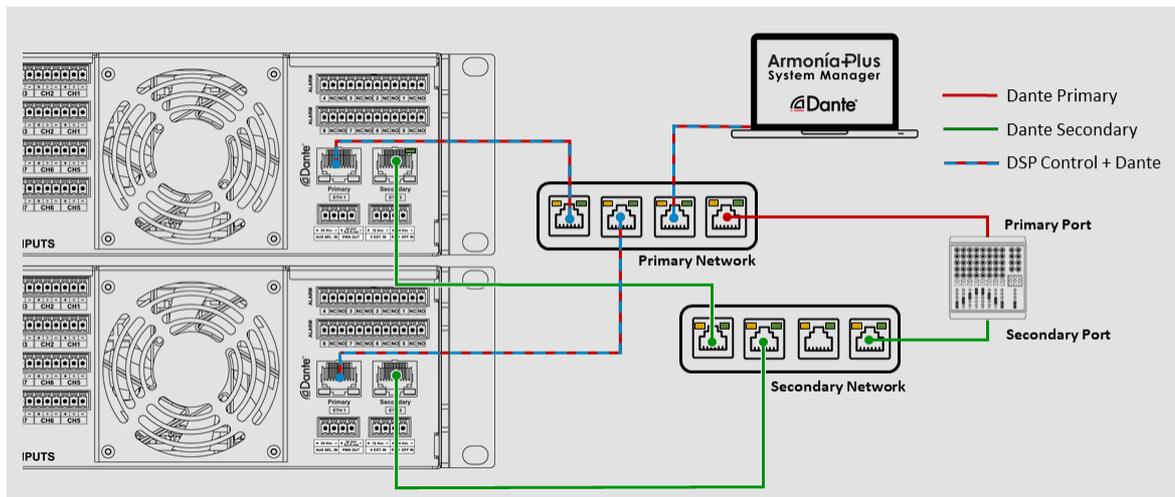
Figure 10 − Example of Dante Redundancy Mode configuration with Powersoft amplifiers.

AES67 CONFIGURATION ON DANTE DEVICES

Powersoft amplifiers support a limited number of audio streams, also known as 'flows' − the actual number varies by device according to the Dante card it utilizes. In general, 'Dante Ultimo' cards allow for a maximum of 2 transmit flows and 2 receive flows to be created, while amplifiers with 'Dante Brooklyn II' cards can simultaneously stream 32 x 32 flows.

Table 4 below presents a summary of all Dante enabled Powersoft amplifiers and their flow streaming capabilities.

	Ultimo UXT (2 x 2 flows)	Ultimo UXT (2 x 0 flows)	Ultimo ULT (2 x 0 flows)	Brooklyn II (32 x 32 flows)	Dante Embedded Platform
Unica 4L					✓ (4 x 4 flows)
Unica 8M					✓ (8 x 8 flows)
Mezzo AD	✓				
Quattrocanali DSP+D [1]		✓	✓		
Duecanali DSP+D[1]		✓	✓		
Ottocanali DSP+D				✓	
X Series				✓	
T Series[2]	✓				

Table 4 − List of Dante-enabled Powersoft amplifiers' number of Rx and Tx flows.

NOTE 1: Quattrocanali DSP+D and Duecanali DSP+D amplifiers cannot transmit Dante flows.

NOTE 2: Four-channel versions of T Series amplifiers can be configured to have channels as either 4-IN/4-OUT at 48 kHz or 4-IN/0-OUT at 96kHz. Selection can be done in ArmoníaPlus, in the amplifier's internal configurations, under Options > Dante Settings > Device Configuration.

The Dante modules in Powersoft amplifiers operate with their own dedicated firmware. To ensure a correct configuration of AES67, it is recommended that all modules are running the latest Dante firmware.

The following firmware versions are recommended for Dante cards in Powersoft amplifiers:
- Brooklyn II – version 2.0.1.0 or above.
- Ultimo UXT (T Series) – version 2.1.3.0 or above.
- Ultimo UXT (Quattrocanali and Duecanali Series) – version 4.1.1.4 or above.
- Ultimo ULT– version 3.10.4.1 or above.

More information on how to update the Dante firmware in Powersoft amplifiers can be found on Powersoft's website.

Enabling AES67 and Receiving Flows

Before setting up an AES67 connection between an amplifier and a third-party device, it is necessary to enable AES67 streaming on the amplifier. This is done via the software application 'Dante Controller' provided by Audinate. Free download versions of the software are available for 'Windows' and 'Mac OS X' directly on Audinate's website.

When opening 'Dante Controller', all devices connected to the Dante network will be displayed in the list of transmitters and receivers.

To enable AES67 streaming:

1. Open the **Device View** window by double-clicking on the device to be configured.
2. Select the **AES67 Config** tab[1] (Figure 11).
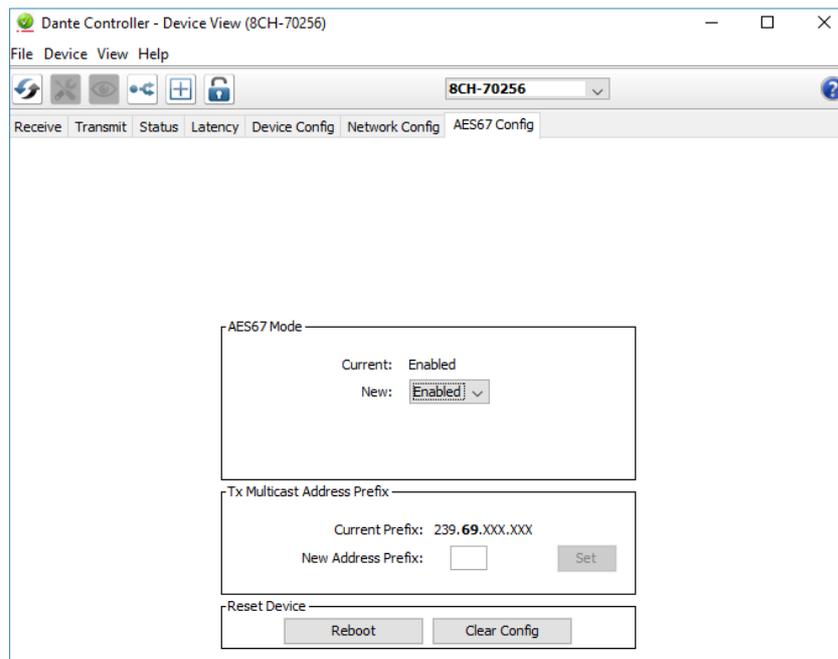3. Under 'AES67 Mode' select 'Enabled' from the drop-down list.

Figure 11 − Dante Controller AES67 Config tab in the Device View window.

NOTE 1: If the AES67 Config tab is not showing in the amplifier's device view, the most likely solution for this issue is to update the firmware of the Dante card. More information can be found on Powersoft's website.

It is important to note that this operation requires a device reboot. This can be done by simply clicking 'Reboot' under 'Reset Device'. However, in some instances, it has been verified that a manual reboot of the amplifier is necessary for modifications to take effect and is, therefore, recommended as best practice.

The above operation will automatically enable the amplifier to receive AES67 streams, and in most circumstances, this is the only necessary configuration. However, some amplifiers can also be set to transmit AES67 audio streams over the Dante network.

Transmitting AES67 Flows

Although enabling AES67 in the 'Dante Controller' automatically configures the amplifier to receive AES67 streams, an additional step is necessary if transmitting audio streams is desired.

In Dante, there are two types of audio streams, or 'flows': Unicast and Multicast. Unicast flows are one-to-one routes that deliver audio to and from specific devices, and support 4 channels of audio simultaneously. A multicast flow "broadcasts" the audio so that multiple receivers can subscribe to it, but the transmitting device is only using one of its available flows. It allows up to 8 audio channels to be streamed in one flow.

When connecting two devices in Dante Controller, a unicast transmit flow is automatically created by default from the transmitter to the receiver. However, AES67 connections only utilise multicast flows, as this is a universal communication method used by most network systems. Therefore, it is necessary to create a multicast flow for the channels of the AES67 transmitting device.

To create a multicast Dante flow and enable AES67 streaming from a transmitting device:

1. Open the **Device View** window by double-clicking on the transmitting device to be configured.
2. Click on the 'Create a new multicast' button at the top bar.

3. In the 'Create Multicast Flow' window, tick the box next to 'AES67 Flow' (Figure 12).
4. Select the channels to be included in the multicast flow.
5. Click 'Create'

Figure 12 – Dante Controller 'AES67 Config' tab in the 'Device View' window.

A list of all the transmit flows created for the device, including multicast AES67 flows, can be found in the **Device View** window, under the **Transmit** tab.

Important note: Dante Controller gives the user the option to save all the routing information as a preset by clicking on the "Save preset" button . It is however strongly advised that the preset feature is not used, as loading saved presets in Dante Controller will erase all patching previously made with AES67 devices.

AES67 CONFIGURATION ON AES67 ONLY AMPLIFIERS

Powersoft DSP+ and Mezzo A+ models can be set up to receive audio over IP streams compliant to AES67 interoperability standard.

This section describes how to properly configure the amplifier and patch it to a compatible AES67 stream using the software ArmoniaPlus.

AES67 specifications

AES67 is a technical standard for audio applications of networks that allows high-performance streaming Audio-over-IP interoperability between different networking systems. All Powersoft amplifiers featuring a Dante card can be configured to work with AES67 audio streams according to Audinate's compatibility specification by enabling the *"AES67 mode"* via ArmoníaPlus or Dante controller.

Powersoft DSP+ and Mezzo A+ models can receive AES67 streams natively when connecting the dedicated network port labelled "AoIP" to your AES67 network.

Network port configuration for DSP+ models is S*plit Mode* and cannot be changed: the two ports have their own IP Address that can be configured in DHCP mode (default configuration) or in Static mode. The first port *"Ethernet"* is used for remote control via ArmoníaPlus or third-party clients while the second port *"AoIP"* is for receiving AES67 compatible streams.

Network ports for Mezzo A+ models can be configured to S*plit Mode* or *Switched Mode*. In *Split Mode*, the two ports have their own IP Address that can be configured in DHCP mode (default configuration) or in Static mode. While on *Switched Mode*, both ports have a single IP Address and would act as an internal switch for the amplifier containing both control and AES67 streams.

Table 5 describes the specification of AES67 streams supported by DSP+ models:

AES67	
Discovery	SAP/SDP
Network	Multicast
Packet Time	1 ms
Sample Rate	48 kHz
Encoding	L24
Channels	Up to 8 per stream

Table 5 – DSP+ and Mezzo A+ AES67 specifications.

AES67 settings

 The AES67 chipset in DSP+ and Mezzo A+ amplifiers can be configured accessing the "AES67 settings" tab available in the option of the amplifier (Figure 13).

 Parameters available are:

- Device Name
- IP address (DHCP or Static)
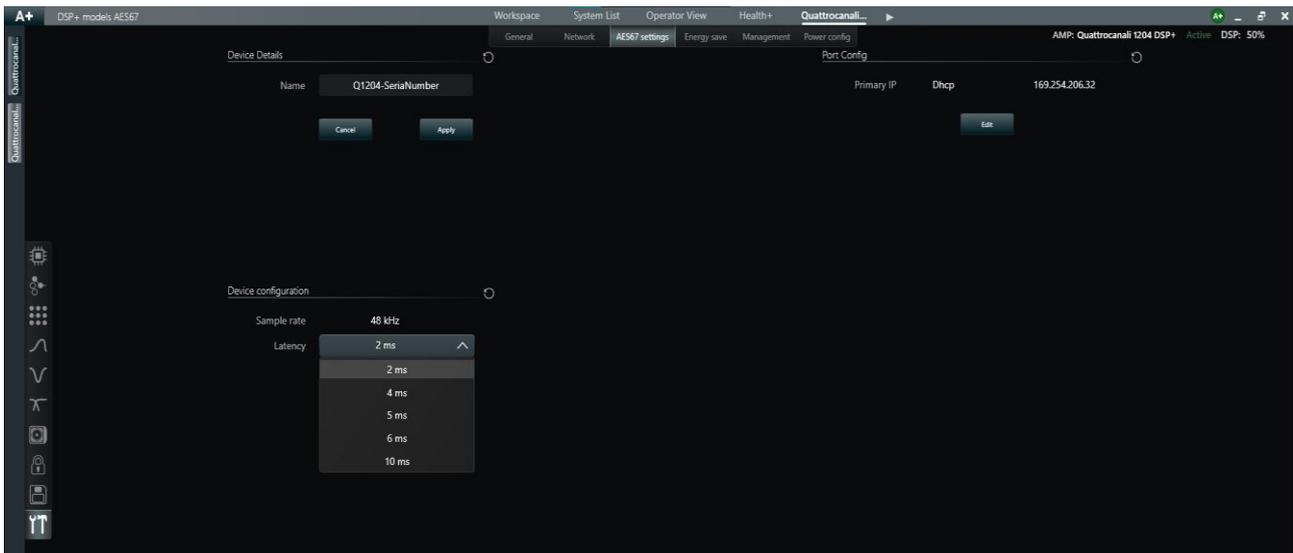- Sample rate (fixed at 48kHz)
- Latency

Figure 13 – AES67 settings window in ArmoniaPlus.

The latency parameter can be set according to the network bandwidth available and the desired performances.
A higher latency value is suggested to have more stability and avoid audio dropouts or clock issues.

AES67 patching

Patching a DSP+ or Mezzo A+ amplifier to receive an AES67 stream is a very easy operation through ArmoníaPlus:

1. Connect your PC with ArmoníaPlus to both remote control and AES67 network.
2. Open the 'Communication Manager' and enable the Dante/AES67 button to allow ArmoníaPlus to scan for AES67 streams (Figure 14).
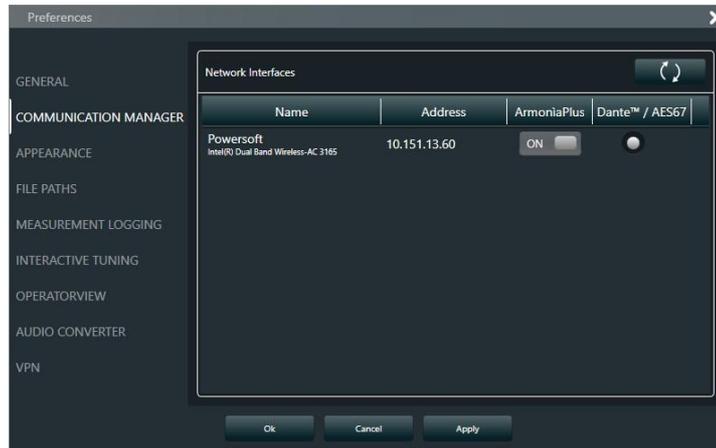

Figure 14 – ArmoníaPlus Communication Manager.

3. Click "Ok" to confirm and close the window.
4. Go to the tab "Config" and select the "Input" function.
5. Select the input of the amplifier that you want to patch. (Multiple input selection is available when using same amplifier series).
6. Click on the desired priority box and select "AES67" on the amplifier input column.
7. Choose the AES67 Rx channel of the amplifier that you want to be patched.
8. Select the Tx stream in the "Network devices" column and the source channel (Figure 15).

Figure 15 – AES67 input patching window.

Patching a DSP+ or Mezzo A+ amplifier can also be done through the amplfiers designated Web Interface.

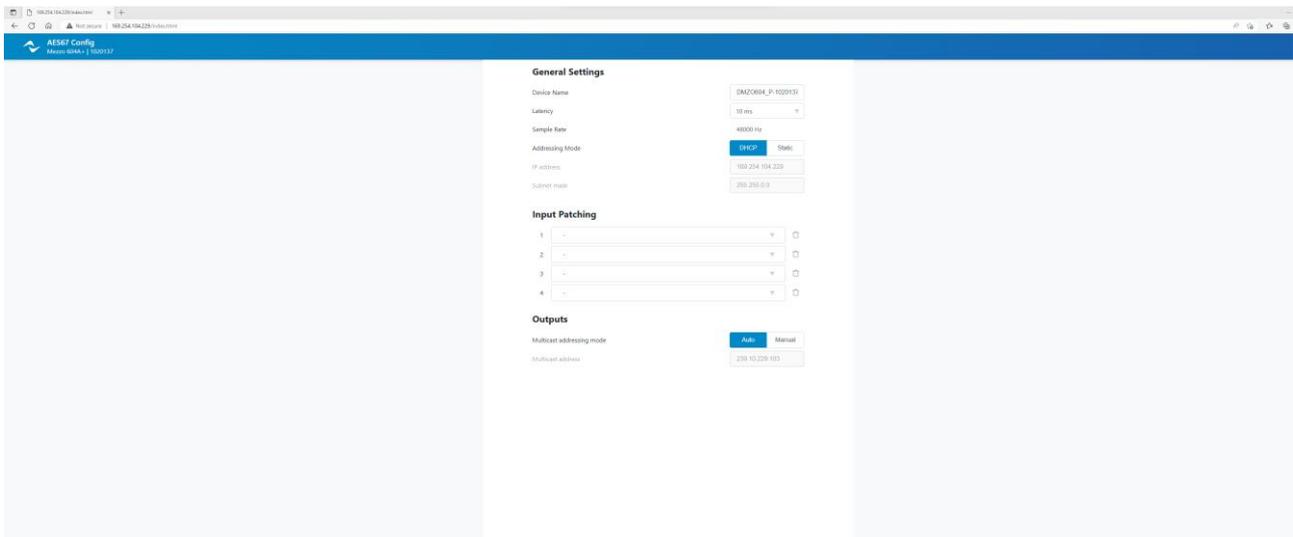To access the amplifers Web Interface enter the AoIP port unique IP address into your web browser (Figure 16).

Figure 16 – DSP+ and Mezzo A+ Web Interface.

Patching Rx flows can be completed within the "Input Patching" section of the Web Interface.

Transmitting AES67 Flows with Mezzo A+

The AES67 Chipset for Mezzo A+ models allow users to convert any analog stream to AES67 or to re-transmit on the network any other AES67 input.
To convert an analog stream to AES67 (or to transmit a digital input on the output channels of the AES67 chipset) select the "AES67 settings" tab available within the option tab of the amplifier. The user can leave the transmitter channel selection to "Auto" mode***** or choose the desired "Pick Point" (Figure 17).

- Physical IN
- Source Selection
- Matrix
- Out
- Out Current – Used for third-party output current readings
- Out Voltage – Used for third-party output voltage readings

* NOTE: when creating a DMD System the transmission of AES67 streams is done automatically and "Auto" checkbox must be flagged. If the user is not creating a DMD System "Disabled" label will be showed instead of "Auto" and, if flagged, the Tx channels of AES67 chipset will be disabled.
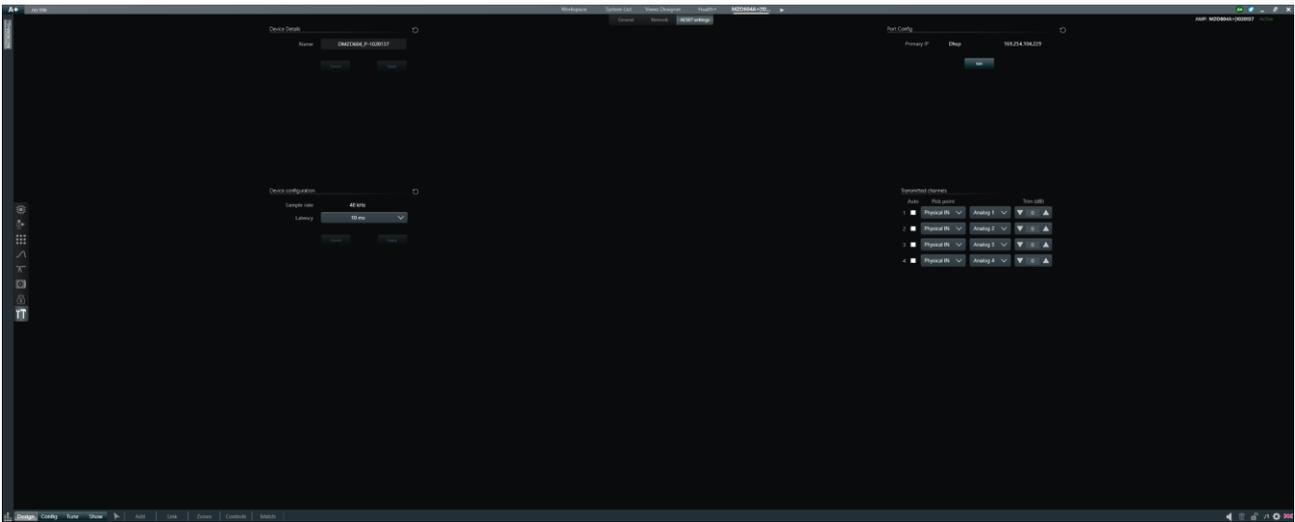
Figure 17 – Mezzo A+ AES67 Settings Tab.

Completing the patch is made within ArmoníaPlus (Figure 18).

Figure 18 – Patching a Mezzo A+ AES67 Tx to DSP+ Rx.

Thanks to this Mezzo's capability it is possible to have available over the AES67 network an analog source physically connected to the amplifier.

With DMD Systems this allows to share to all the Zones of the project an Analog source that is not physically connected to the same amplifier of the Zone-related speakers (this sharing is done automatically by the system).

With non-DMD systems this feature allows the users to have available an analog source as AES67 input over the network, to be used, for example, as a new input for Canali DSP+ Series amplifiers.

POWERSOFT AMPLIFIERS AND Q-SYS NETWORKING VIA AES67

The following notes are applicable to Q-SYS and Powersoft amplifiers connections via an AES67 network. Powersoft has also made a series of free plug-ins and communication protocols available for the control of amplifiers directly from the Q-SYS Designer platform.

The integration of Powersoft amplifiers and a Q-SYS AES67 network is done via Dante Controller and the additional software application 'Q-SYS Designer', which can be downloaded directly from QSC's website.

Before creating any AES67 connections with Q-SYS, verify that the properties of Q-SYS Designer match those of Dante 'Quality of Service' (QoS) management. This is specially the case for networks running both AES67 and Dante streams.

In Q-SYS Designer go to **File > Design Properties** (Figure 19). Under 'QoS Preset' select 'Audinate' from the drop-down menu.
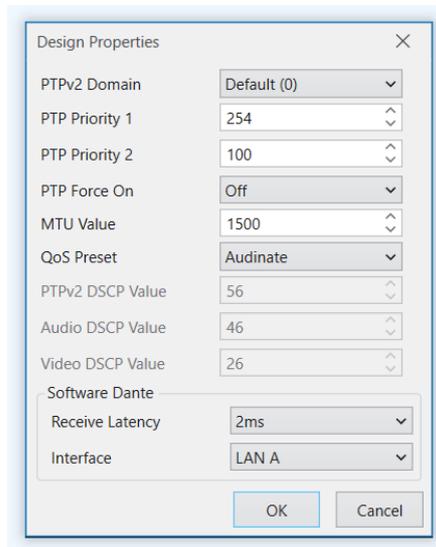

Figure 19 –Matching Q-SYS Designer properties with Dante QoS management properties.

The operation above assumes that Dante streams are present in the network, therefore, any network switch in place must be configured to work with a Dante network, i.e., with the DSCP parameters shown in 'Figure 19'.

If no Dante streams are present and only AES67 streams are used in the network, the switch may be configured following DSCP parameters suggested by QSC, and in such case, 'QLAN' should be the QoS preset selected.

If no Dante streams are present and only AES67 streams are used in the network, the switch may be configured following DSCP parameters suggested by QSC, and in such case, 'QLAN' should be the QoS preset selected.
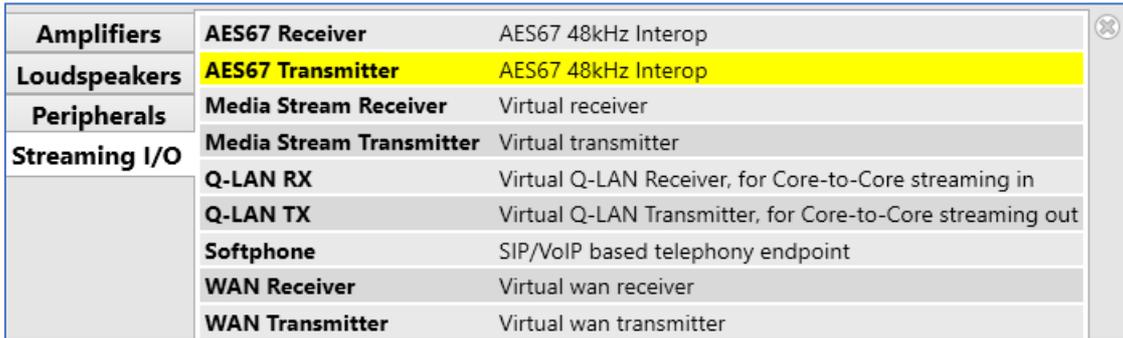
AES67 from Q-SYS to Powersoft Amplifiers

For this operation, the amplifier must first be configured in Dante Controller so that AES67 streaming is enabled. This is done by following the steps described in the section 'Enabling AES67 and Receiving Flows' of this document.

To set up a Q-SYS AES67 transmitter:

1. Open Q-SYS Designer.
2. In the **Inventory** pane, click the '**+**' symbol to add a device.
3. Select the option **Streaming I/O** and then **AES67 Transmitter** (Figure 20).

Figure 20 – List of streaming devices available in Q-SYS Designer.

4. An AES67 Transmitter device will be added to the Inventory list. Click, drag, and drop this device as a component onto the design schematic window (Figure 21).
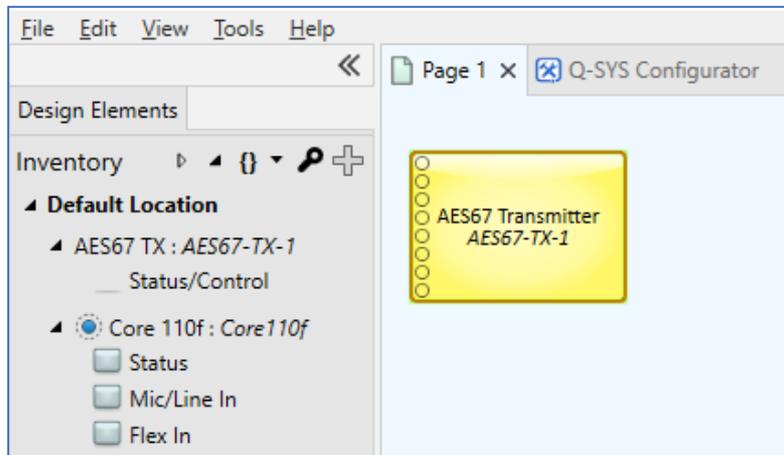

Figure 21 – AES67 Transmitter device in Q-SYS Designer.

5. Click on the AES67 Transmitter component to view its properties under the **Properties Pane**. Set 'Connection Mode' to 'Auto' and edit the 'Channel Count' to the number of channels to be transmitted from Q-SYS to the amplifier in the AES67 flow (Figure 22). It is **important** to note that it has been verified that changing the 'Channel Count', without deleting/redoing the patching in Dante Controller, creates audible HF distortion in the audio signal.
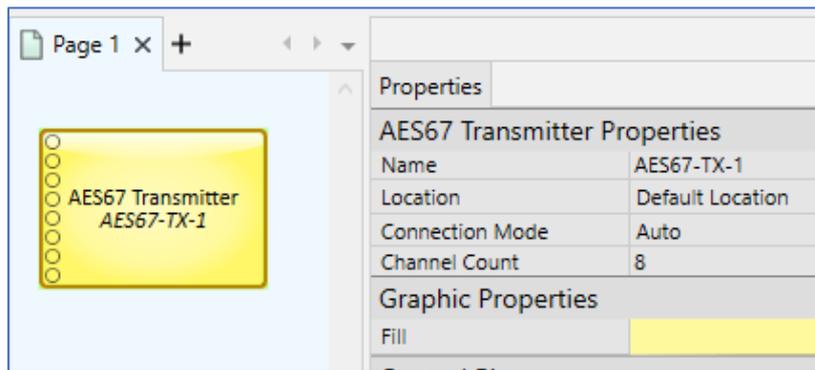
Figure 22 – AES67 Transmitter properties in Q-SYS Designer.

6. Save the design to the Q-SYS Core by pressing **F5** or selecting **File > Save to Core & Run**.
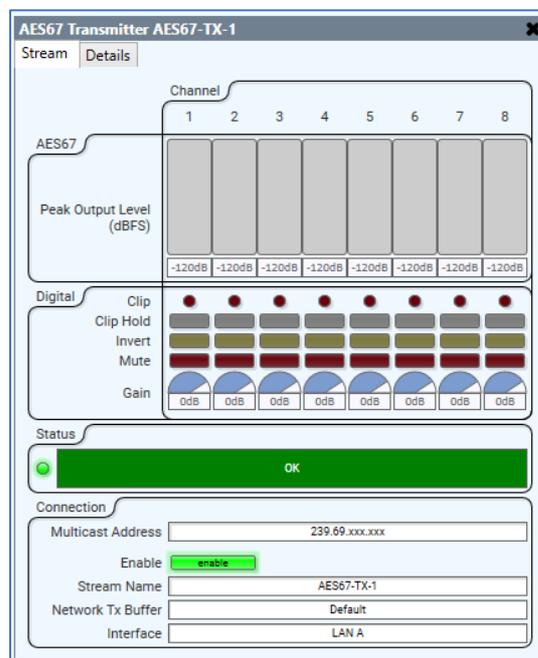7. Double-click the AES67 Transmitter component to open the **Connection** pane (Figure 23).

Figure 23 – AES67 Transmitter Connection pane.

8. Note that the AES67 Transmitter automatically assigns a name to the 'Stream Name'. The AES Transmitter device is now available for connection with other AES67 devices and can be seen in the list of Dante Transmitters in Dante Controller (Figure 24).
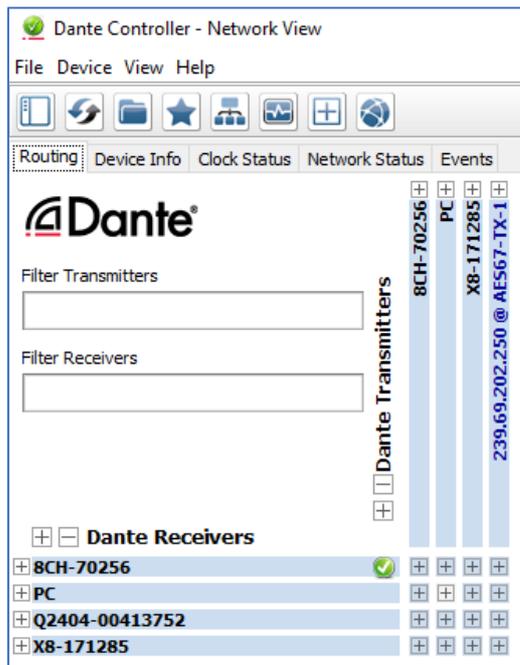
Figure 24 – The AES67 Transmitter in Dante Controller.

9. Note from 'Figure 21' that Q-SYS has automatically assigned an IP address to the AES67 Transmitter flow (239.69.xxx.xxx). This default configuration is appropriate when only one AES67 Transmitter component is used in the Q-SYS design schematic. However, when several transmitter components are added to the design, Q-SYS will incorrectly assign the same IP address to all AES67 flows. In such instance, it is recommended to manually configure the IP of the 'Multicast Address' in each transmitter component independently (Figure 25).
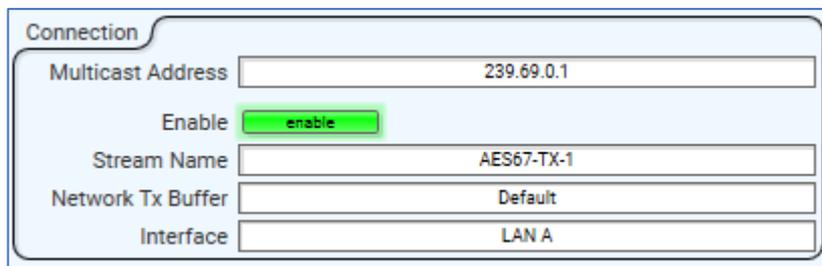

Figure 25 – Manual configuration of the 'Multicast Address' for an AES67 Transmitter.

For best practice, it is recommended that static multicast IP addresses are always used for Q-SYS AES67 Transmitter flows, as it will make the network routing more reliable. This is specially the case when devices are restarted and/or put in a different network, causing the IP addresses to change and the routing to be lost.

Patching of AES67 streams to a Powersoft amplifier can be done either from Dante Controller (for a Dante based amplifier on AES67 mode) or ArmoníaPlus or via a dedicated webpage on the amplifier (for AES67 only amplifier).

NETWORK SWITCH CONFIGURATION EXAMPLE: CISCO SG350

The following is an example of how to configure a Cisco switch with some of the key parameters for a correct Dante/AES67 operation.

The configurations page for most switches can be accessed by typing its IP address in any web browser address bar. For this to work correctly, the computer must be in the same IP range/subnet of the switch it is connected to. By default, Cisco switches are in the IP range 192.168.1.X and the configuration web page can be accessed by typing "192.168.1.254" in the URL bar.

To change the computer's IP address and subnet mask, in WINDOWS:

1. Connect the computer to any of the switch ethernet ports.

2. On a Windows PC, access the **Ethernet Status** window (Figure 26). Usually this is done from the 'Network and Sharing Centre', by clicking on 'Ethernet' from the active networks.

3. In the Ethernet Status window, click on 'Properties' to open the **Ethernet Properties** window, select 'Internet Protocol Version 4 (TCP/IPv4)', and click 'Properties' (Figure 27).

4. In the **TCP/IPv4 Properties** window, select 'Use the following IP address' to configure a static IP address for the PC (Figure 28).

5. Type in an IP address following 192.168.1.X; where X can be any number from 1 to 253, assuming there are no other devices in the same subnet connected to the switch for which one of those numbers has already been allocated.

6. Under Subnet Mask, type in 255.255.255.0, and click 'OK'.
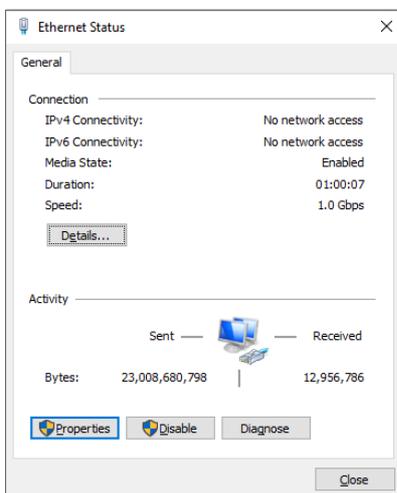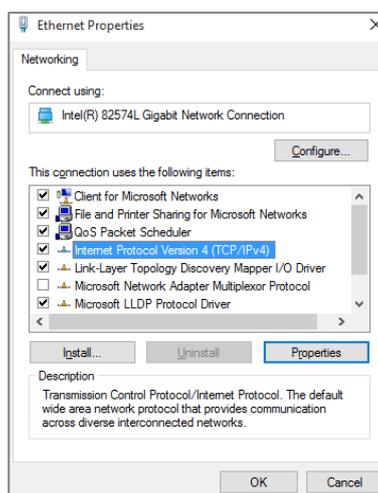

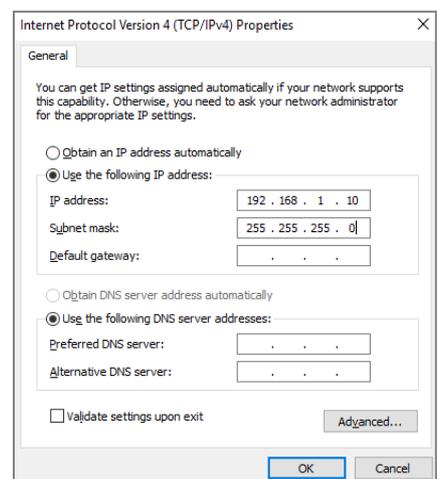Figure 26 – Ethernet Status window.   Figure 27 – Ethernet Properties.   Figure 28 – TCP/IPv4 Properties.

After the configuration of the switch is done, remember to revert the operation by selecting 'Obtain an IP address automatically' from the **TCP/IPv4 Properties** window and clicking OK.

Once both the computer and the network switch are on the same subnet IP range:

1. Open any web browser on the computer and type the IP address of the switch in the address bar. By default, Cisco switches use the IP address 192.168.1.254.

2. This should open the switch configurations page (Figure 29). Type in the request username and password. The default for the SG350-10 is "cisco" for both fields.
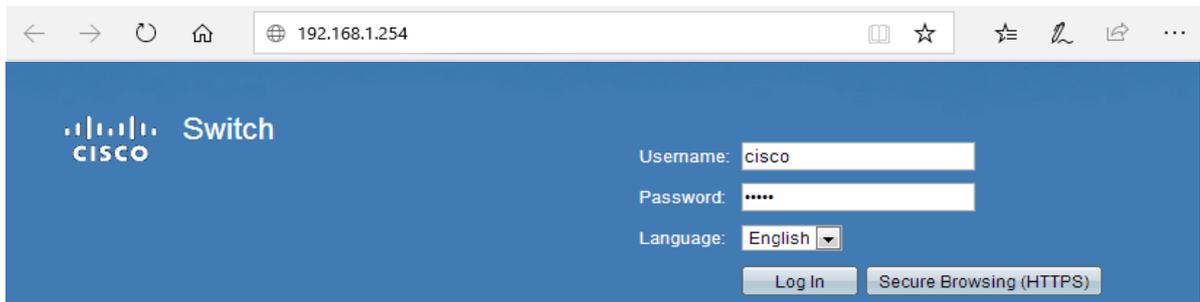
Figure 29 – Ethernet Status window.

Once connected to the switch and logged into the configurations page, it will be possible to access and adjust each one of the configuration parameters.

DSCP Configuration for QoS Management

To configure DSCP parameters:

1. From the main switch configurations page, using the left-hand side menu, follow the path 'Quality of Service > General > QoS Properties' and enable **QoS Advanced Mode** (Figure 30).

Figure 30 – Enabling QoS Advanced Mode.

2. It is then necessary to change the settings from Layer 2 CoS management to Layer 3 DSCP. Under 'Quality of Service > QoS Advanc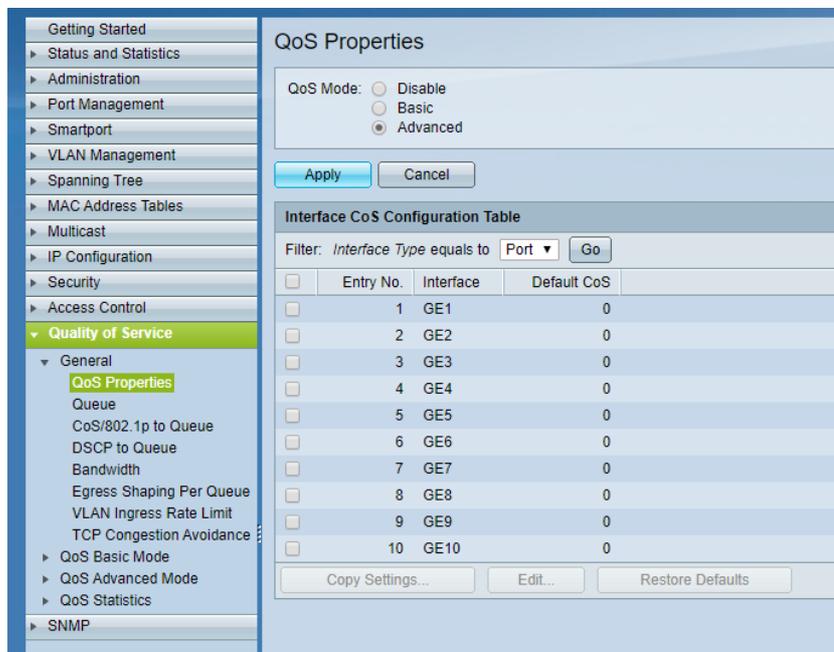ed Mode > Global Settings', select **DSCP** as the 'Trust Mode', **Trusted** as the 'Default Mode Status', and click 'Apply' (Figure 31).

Figure 31 – Global settings configuration.

3. Next, go to 'Quality of Service > General > DSCP to Queue', specify the priority output queue of each DSCP label, and click 'Apply' (Figure 32). In Cisco switches, queue number 1 has the lowest priority, while queue 4 has the highest.

The labels to which a priority must be given depending on the type of audio network in use.

For Dante		AES67 (non-Audinate)	
56 (CS7)	4	46 (EF)	4
46 (EF)	3	34 (AF41)	3
8 (CS1)	2	-	2
Everything else	1	Everything else	1

IMPORTANT NOTE:
Consult your network administrator in case the network presents other pre-existing systems, such as a LAN VoIP, as the settings above may need to be reviewed.

Figure 32 – Configuration of DSCP queues.

Disabling Energy Efficient Ethernet (EEE)

To disable EEE in the Cisco switch:

1. From the main switch configurations page, using the left-hand side menu, follow the path 'Port Management > Green Ethernet > Properties' (Figure 33).

2. Untick the '802.3 Energy Efficient Ethernet (EEE)' enable box and click 'Apply'.

Figure 33 – Disabling EEE.

Enabling and Configuring IGMP Snooping

To enable IGMP Snooping in the Cisco switch, for when multicast traffic is necessary:

1. From the main switch configurations page, using the left-hand side menu, follow the path 'Multicast > Properties' (Figure 34).

2. Tick the enable check box for 'Bridge Multicast Filtering Status'.

3. Under 'VLAN ID', select the VLAN for which multicast traffic will be used. If no VLANs have been configured, select 1.

4. Select **IP Group Address** for both 'Forwarding Method IPv6' and 'Forwarding Method IPv4'.
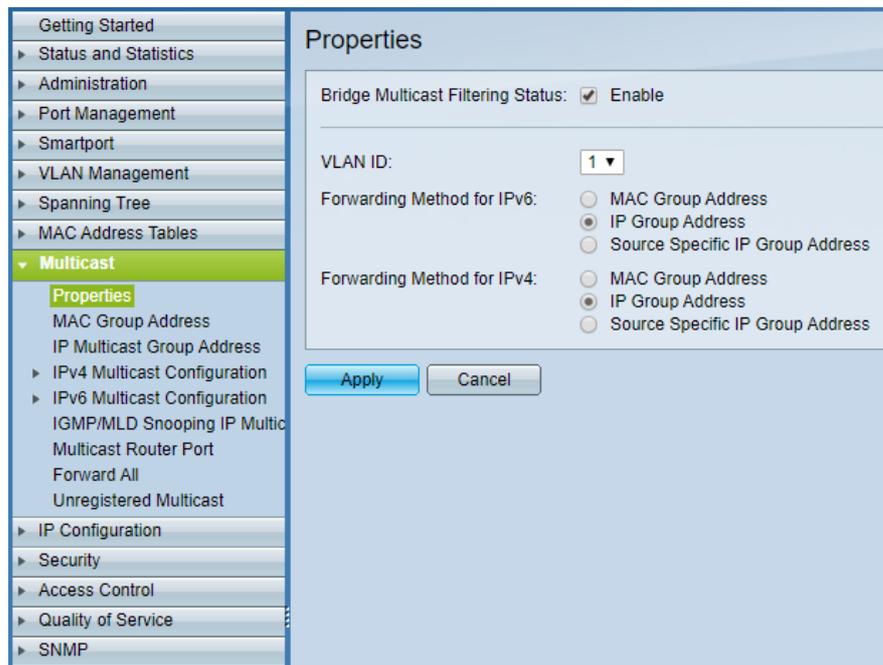

Figure 34 – Setting up multicast properties.

5. Next, go to 'Multicast > IPv4 Multicast Configuration > IGMP Snooping' (Figure 35).

6. Select the enable check box for both 'IGMP Snooping Status' and 'IGMP Querier Status' and click 'Apply'.
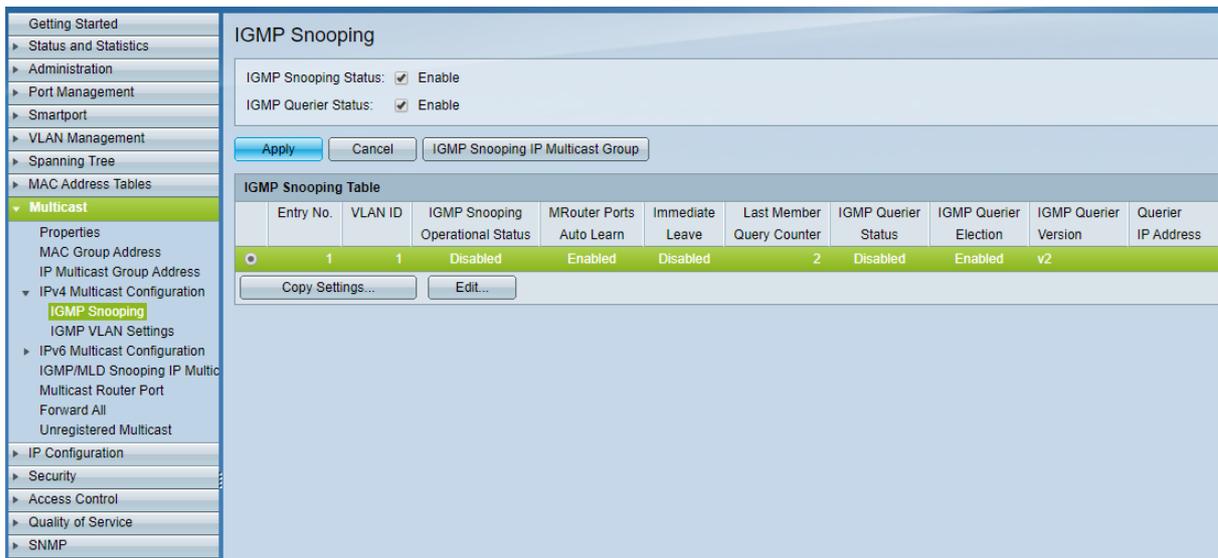
Figure 35 – Enabling IGMP Snooping.

7. To edit the IGMP Snooping settings, still on the same page, under 'IGMP Snooping Table', select the multicast VLAN ID and click 'Edit'. This will open the 'Edit IGMP Snooping' window (Figure 36).

8. Make sure the 'IGMP Snooping Status' is enabled, as well as 'MRouter Ports Auto Learn'.

9. Next, enable the 'IGMP Querier Status', 'IGMP Querier Election', and set the 'IGMP Querier Version' to **IGMPv3** and click 'Apply'. This is a recommended setting. As mentioned previously, Dante and AES67 both support IGMPv2 and IGMPv3. The important thing is that all switches in the network are configured to run on the same version.
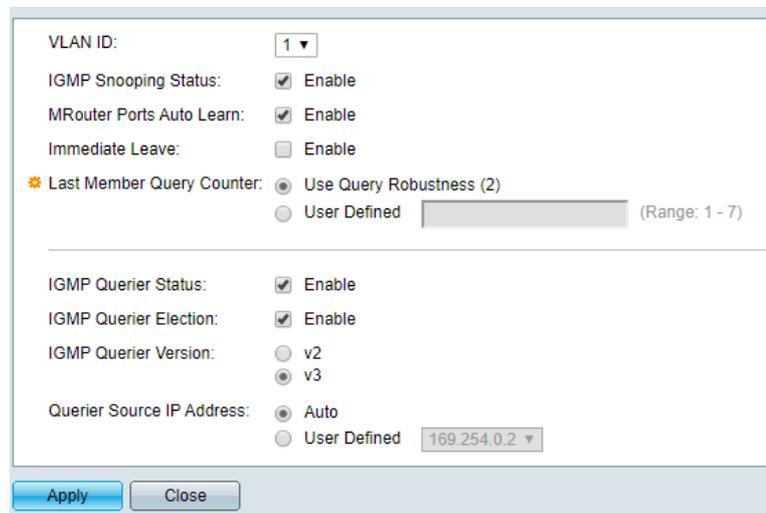

Figure 36 – IGMP Snooping Settings.

IMPORTANT NOTE:
Remember from the previous sections of this document that in networks using multiple switches, it is safer to have only one IGMP Querier enabled, preferably on a switch sitting close to the root of the network topology.

In this case, the functions in step 9 above should be disabled for all switches down in the connection chain and that will not operate as IGMP Queriers.

Appendix

The following summary shows the relevant information to consider based on the AoIP sources used in a network that has been discussed at length above.

Dante Sources

Priority Que	Usage	Dante	
		DSCP Label	DSCP Number
High	Clock Sync	CS7	56
Medium	Audio Packets	EF	46
Low	Reserved	CS1	8
None	Others	Best-Effort	0
Energy Efficient Ethernet		Disable	
Audio Stream		Unicast/Multicast	
IGMP Snooping Activated		Yes	
IGMP Version		v2/v3	
Patching Supported		Dante Controller/A+/3rd Party	
Amplifiers Supported (non-DMD) *		Mezzo AD, Duecanali DSP+D, Quattrocanali DSP+D, Ottocanali DSP+D, T Series (non A), X Series	
Amplifiers Supported (DMD) **		Mezzo AD, Duecanali DSP+D, Quattrocanali DSP+D, Ottocanali DSP+D, T Series (non-A), X Series	

* AES67 mode needs to be enabled for Dante sources if want to patch to AES67 amplifier. Multicast AES67 streams needs to be created.

** On DMD, separate sources must be created for AES67 and Dante including a single Dante source with AES67 mode enabled. Multicast AES67 streams need to be created for a Dante source with AES67 mode enabled. AES67 sources, either Dante based, or non-Dante based, can only be patched to AES67 based amplifier.

AES67 Sources (Dante Based)

Priority Que	Usage	AES67 (Dante Based)	
		DSCP Label	DSCP Number
High	Clock Sync	EF	46
Medium	Audio Packets	AF41	34
Low	Reserved	-	
None	Others	Best-Effort	0
Energy Efficient Ethernet		Disable	
Audio Stream		Multicast	
IGMP Snooping Activated		Yes	
IGMP Version		v2/v3	
Patching Supported		Web Browser/A+/3rd Party (coming soon)	
Amplifiers Supported (non-DMD) *		Mezzo A+, Duecanali DSP+, Quattrocanali DSP+	
Amplifiers Supported (DMD) **		Mezzo A+, Duecanali DSP+, Quattrocanali DSP+,	

* Patching a Dante amplifier with AES67 mode enabled with an AES67 enabled Dante source will only patch in Dante mode, not AES67.

** On DMD, multicast AES67 stream needs to be created for Dante source with AES67 mode enabled. Patching a Dante amplifier with AES67 mode enabled with an AES67 enabled Dante source will not work.

AES67 Sources

Priority Que	Usage	AES67	
		DSCP Label	DSCP Number
High	Clock Sync	EF	46
Medium	Audio Packets	AF41	34
Low	Reserved	-	
None	Others	Best-Effort	0
Energy Efficient Ethernet		Disable	
Audio Stream		Multicast	
IGMP Snooping Activated		Yes	
IGMP Version		v2/v3	
Patching Supported		Web Browser/A+/3rd Party (coming soon)	
Amplifiers Supported (non-DMD) *		Mezzo AD & A+, Duecanali DSP+D & DSP+, Quattrocanali DSP+D & DSP+, Ottocanali DSP+D, T Series (non A), X Series	
Amplifiers Supported (DMD)		Mezzo A+, Duecanali DSP+, Quattrocanali DSP+	

* AES67 mode needs to be enabled for Dante amplifier.

Dante, AES67 (Dante based) and AES67 Mixed Sources

Priority Que	Usage	AES67	
		DSCP Label	DSCP Number
High	Clock Sync	CS7	56
Medium	Audio Packets	EF	46
Low	Reserved	CS1	8
None	Others	Best-Effort	0
Energy Efficient Ethernet		Disable	
Audio Stream		Multicast	
IGMP Snooping Activated		Yes	
IGMP Version		v2/v3	
Patching Supported		Dante Controller/A+/3rd Party	
Amplifiers Supported (non-DMD) *		Mezzo AD & A+, Duecanali DSP+D & DSP+, Quattrocanali DSP+ Ottocanali DSP+D, T Series (non A), X Series	
Amplifiers Supported (DMD) **		Mezzo AD & A+, Duecanali DSP+D & DSP+, Quattrocanali DSP+ Ottocanali DSP+D, T Series (non A), X Series	

* Patching Dante amplifiers with AES67 mode enabled with an AES67 enabled Dante source will only patch in Dante mode, not AES67.

** On DMD, separate sources must be created for AES67 and Dante, even with a single Dante source with AES67 mode enabled. AES67 sources, either Dante based, or non-Dante based, can only be patched to AES67 based amplifier.

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