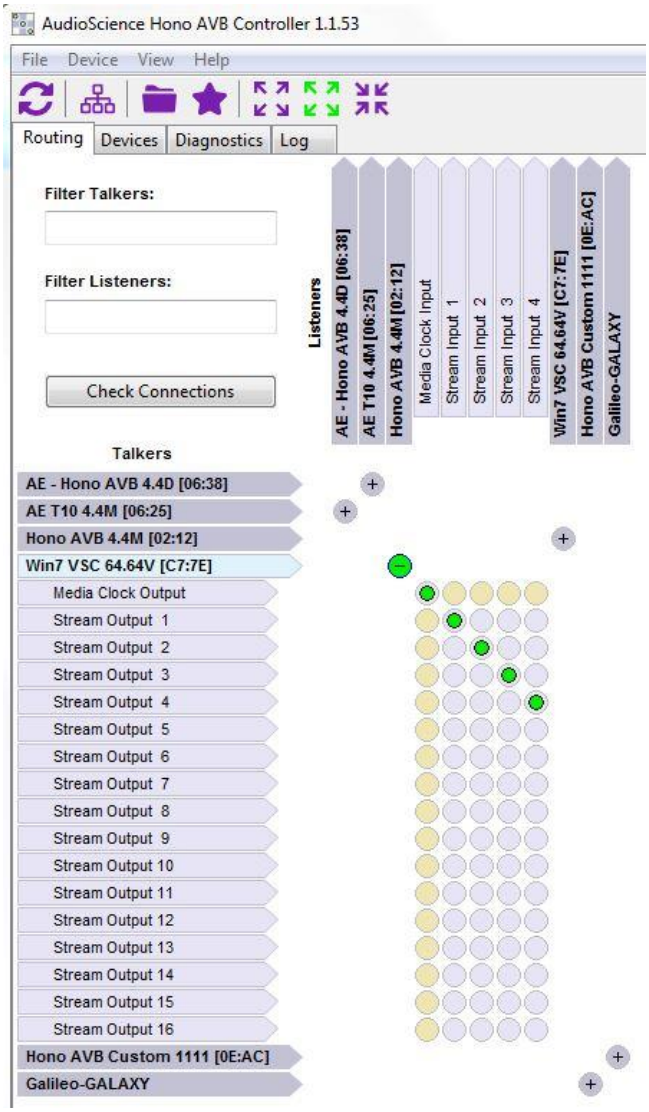
Hono AVB Controller

IEEE1722.1 Configuration Software

1 INTRODUCTION

The Hono AVB Controller is a Graphical User Interface (GUI) application intended for use with AudioScience products combined with other 3rd party AVB devices. The controller provides configuration and routing of IEEE 1722 audio stream formats using the IEEE 1722.1 AVDECC protocol. It supports AudioScience AVB devices with IEEE 1722.1 dynamic stream mappings, allowing individual channels to be selected from incoming streams and routed to outgoing streams.

Hono AVB Controller is built upon the foundation of avdecc-lib, an open source AVB controller library. Avdecc-lib is part of the AVnu OpenAVB effort, an open source project for AVnu software, drivers and building blocks.



2 FEATURES

- View all IEEE 1722.1 enabled AVB devices and their streams.
- Route streams on AVB devices and examine existing stream routes.
- Presets
    - Save audio routing and device configuration presets
    - Apply previously saved presets
    - Edit presets offline and use for new device configurations
- View and adjust per-device settings, if implemented, including:
    - Lock/unlock devices
    - Device name
    - Device Sample rate
    - Media clock source
    - Network information
- View and adjust per stream settings including
    - Stream name
    - Media format
    - Audio channel mappings
    - IEEE 1722 Presentation time/stream latency
- View network status information, including:
    - IEEE 802.1AS clock synchronisation grandmaster
- View device error and notification logs
- Runs on Windows 7 and 10, 32 and 64bit platforms and Apple macOS Sierra and High Sierra

3 REVISIONS

Date	Description
August 1, 2016	First Release, 1.0.24
August 17, 2016	Adding Presets, name tweaks to configuration dialog, 1.0.28
August 26, 2016	Device Configuration documentation, Update Menu bar, specify preset auto assignment rules, add appendix with 1722.1 commands
August 30, 2016	Activation Dialog, Mappings documentation
March 27, 2017	Latency and Connection Failed documentation. Update Figures.
May 8, 2018	Updated for software changes and added macOS support

4 CONTENTS

5 SYSTEM REQUIREMENTS

5.1 Windows

- Network switch with AVnu certified AVB support. Compatible switches include:
  - Extreme X430, X440, X460 with AVB license installed, v15.5.3.4 or later
- Computer with Ethernet NIC connected to an AVB network
- Windows 7 or 10

6 DEVICE REQUIREMENTS

- AudioScience Hono AVB device or other IEEE1722.1 compliant AVB device(s)
- See Appendix for the full list of the IEEE1722.1 device commands utilized by Hono AVB Controller.

7 INSTALLING OR REMOVING HONO AVB CONTROLLER

7.1 Windows

7.1.1 Install

1. Ensure you are logged on to your PC as an administrator
2. Download the Hono AVB Controller software from AudioScience's website: http://www.audioscience.com/internet/products/avb/hono_avb_controller.htm
3. Run the installer, and follow the instructions provided
4. WinPcap software (https://www.winpcap.org) is required and included within this installer. If your computer already has WinPcap software installed, click **Cancel** when prompted.

   Hono AVB Controller will then be installed. The application is added to the start menu under AudioScience. A desktop shortcut is also provided.

If network interface is through a USB to Ethernet dongle, additional steps may be required to make the interface visible to the Hono AVB Controller. Specifically:

1. Open a command prompt in administrator mode and issue commands
2. "net stop npf"
3. "net start mpf"

7.1.2 Uninstall

You should not need to uninstall Hono AVB Controller when upgrading to a new version. However, if you still wish to uninstall, the application can be uninstalled in several ways:

1. Using the Start menu shortcut: Start > Programs > AudioScience > Hono AVB Controller > Uninstall
2. Using the operating system's built in uninstall process in Windows Control Panel (exact instructions vary depending on your version of Windows)
3. Going to Start > Run and entering C:\Program Files (x86)\AudioScience\Hono AVB Controller\Uninstall.exe

8 RUNNING HONO AVB CONTROLLER

8.1 Where to find the Hono AVB Controller application

8.1.1 Windows

- By default Hono AVB Controller will be installed in Program Files (x86)
- It can be started in several ways:

1. Double-clicking on the desktop shortcut: 

2. Using the Start menu shortcut: Start > Programs > AudioScience > Hono AVB Controller > Hono AVB Controller

3. Run by going to Start > Run and entering:

C:\Program Files (x86)\AudioScience\Hono AVB Controller\bin\hono_avb_controller.exe

8.2 Configuring Hono AVB Controller

8.2.1 Network Interface Selection

- The first time Hono AVB Controller is run, a dialog box will appear, providing a list of network interfaces from which to select. Once an interface is selected, it is remembered for future use, and this dialog box will not be shown when Hono AVB Controller is run subsequently.

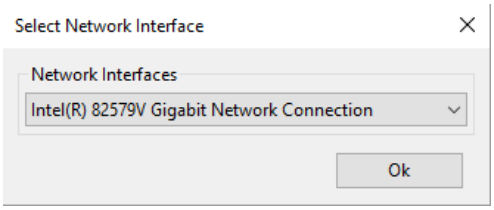
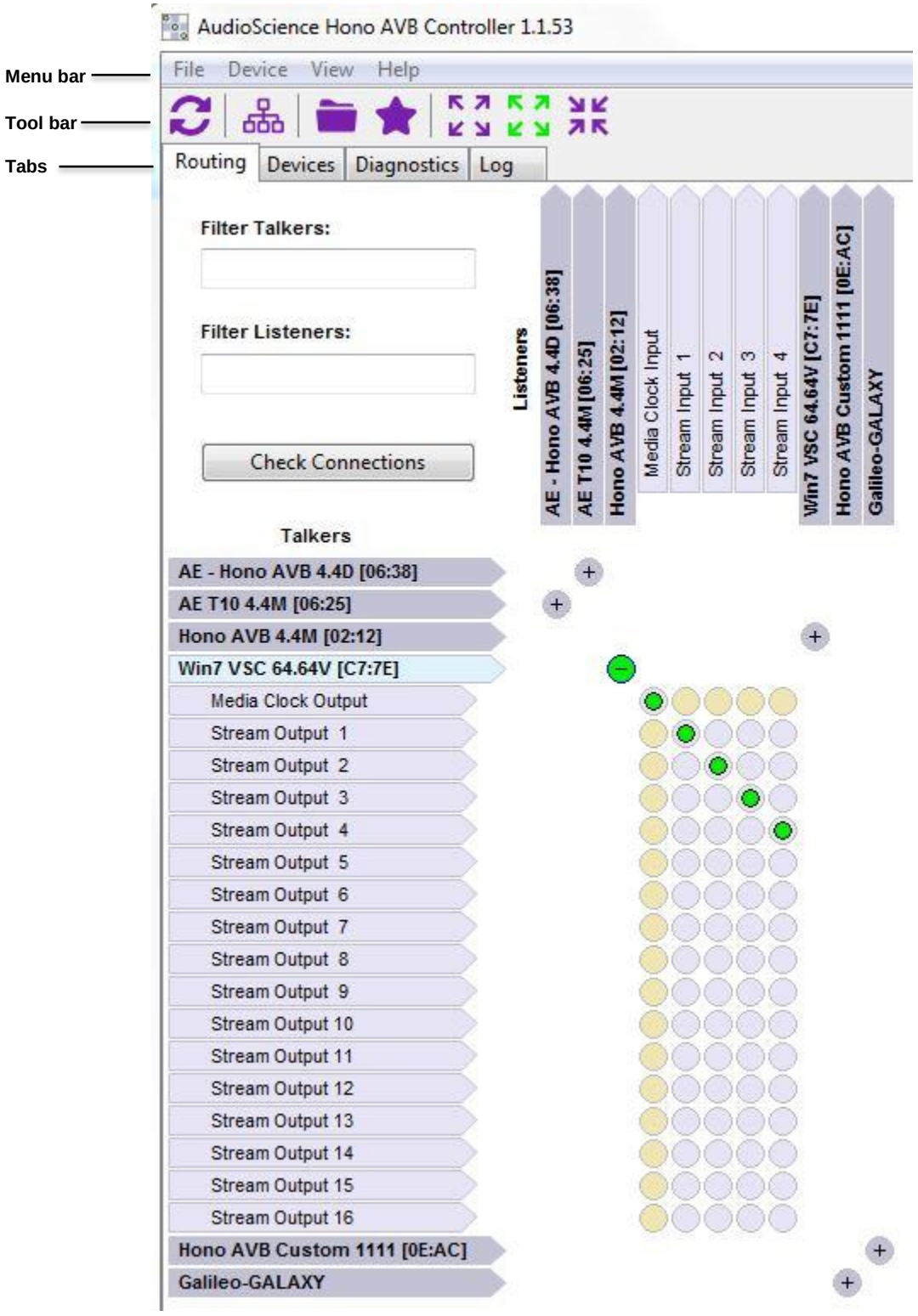


Figure 1: Select Network Interface Dialog

- To display this dialog at any other time, click the  icon in the main toolbar

9 USING HONO AVB CONTROLLER



9.1 Menu bar

The menu bar includes four menus: **File**, **Device**, **View**, **Help**.

9.1.1 File

- Load Preset: apply a saved preset
- Save Preset: save a preset
- Network Interface: open the select network interface dialog
- Exit: Quit Hono AVB Controller

9.1.2 Device

- Device View Ctrl-D: Opens the Device View Tab, similar to double clicking a device in either the "Talkers" column or the "Listeners" row.

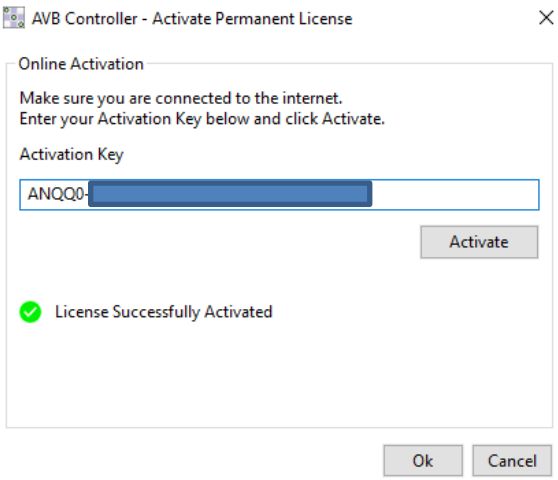
9.1.3 View

Note: These menu options apply only to the Routing tab

- Expand All: expand all devices and streams (same as)
- Expand Active: expand only the devices that currently have a connection (same as)
- Contract All: show only device names (Hide Stream Names) (same as

9.1.4 Help

- About: opens a window with information about Hono AVB Controller
- Activate License: opens a window for activating your permanent Hono AVB Controller license key



9.2 Tool bar

Network Refresh	Clear all information and rediscover devices on the network.
Select Network Interface	Open the select interface dialog.
Load Preset	Load a preset. See Applying a Preset.
Save Preset	Save a preset. See Saving a Preset.
Expand All Connections	Expand all devices and streams.

	**Expand Active Connections**	Expand only the devices that currently have a connection.
	**Contract All Connections**	Show only device names.

9.3 Tabs

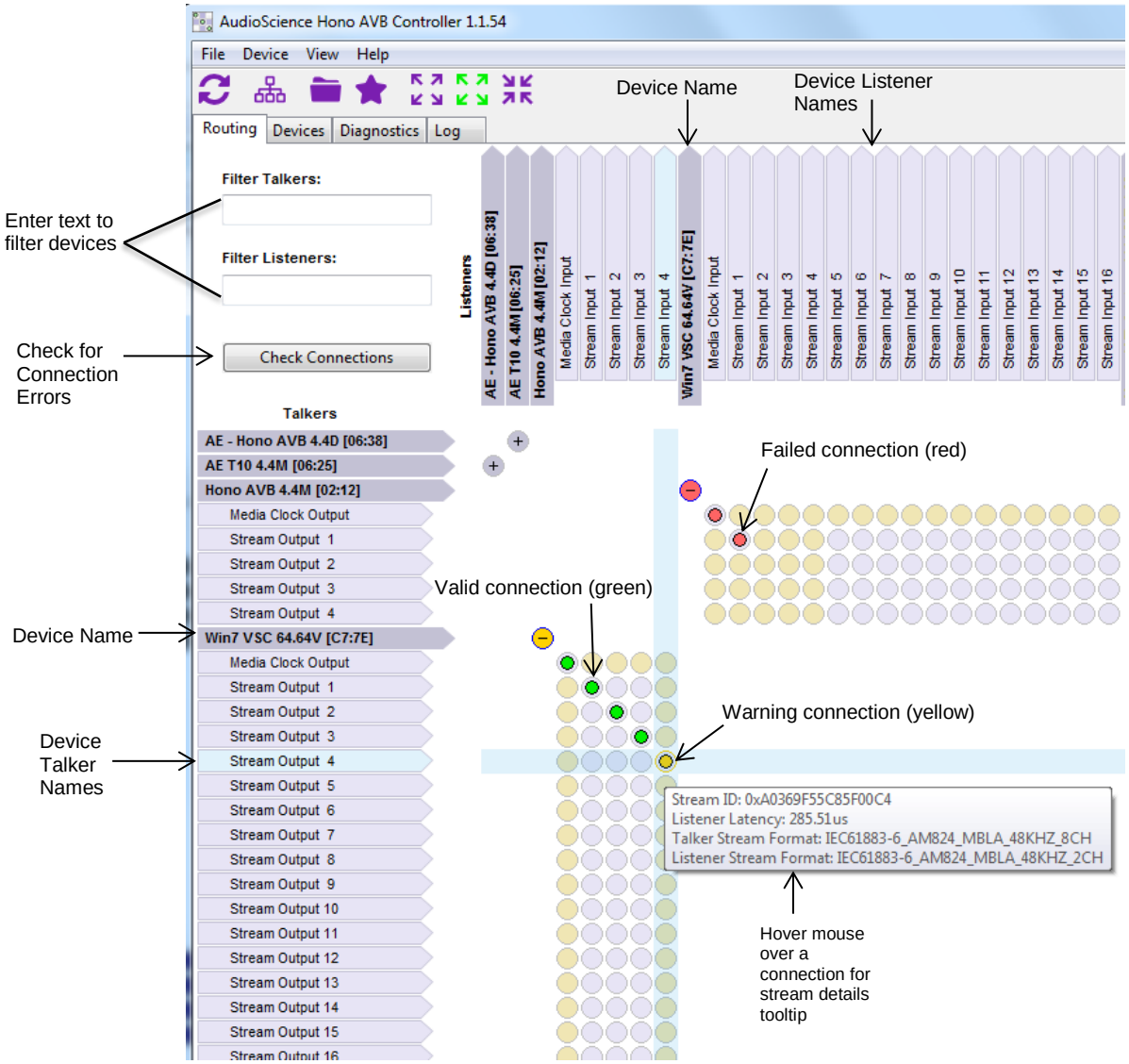
Hono AVB Controller consists of four tabbed views. The use of each of these tabs is described in the next section

- Routing
- Devices
- Diagnostics
- Log

9.3.1 Routing Tab

Hono AVB Controller opens with the routing tab selected. This view provides a matrix for controlling and monitoring streams.

Double-clicking on a device name opens the Device Configuration window.



9.3.1.1 Expanding a Device Intersection

In the Routing View, a plus/minus toggle button at the intersection of a Listener and a Talker indicates that stream connections between those two devices are possible. If a button is not present at a device intersection, the two devices do not share the same IEEE 802.1AS Grandmaster ID and therefore cannot be connected.

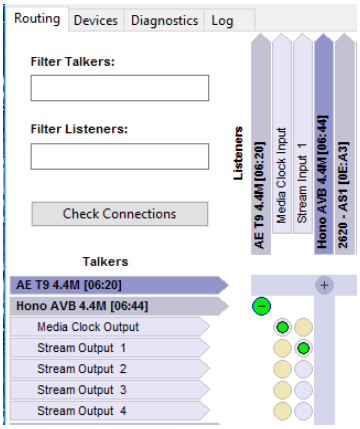


Figure 2: Device Intersection

Clicking on the toggle button at a device intersection will expand the matrix to reveal the Talker and Listener streams and the connection crosspoints for the device pair.

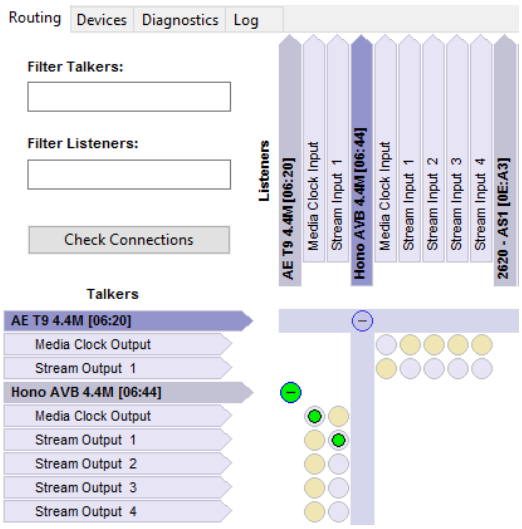


Figure 3: Device Intersection Expanded

Matrix crosspoints that can be connected will appear as purple circles

Matrix crosspoints with different stream formats will be indicated by amber circles

A disconnected device will be disabled in the Routing View. Matrix crosspoints for that device will also be disabled – indicated by a grey circle

Connections that were active before the disconnection are indicated by a black dot

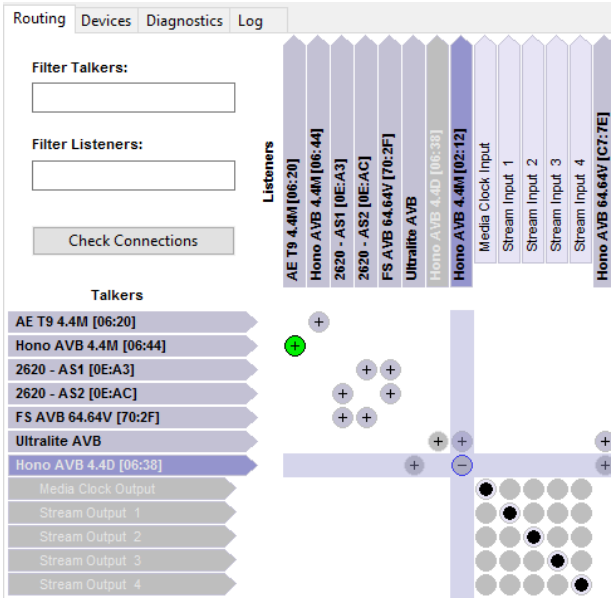


Figure 4: Disconnected Device Intersection Expanded

9.3.1.2 Connecting a Stream

Hono AVB Controller will attempt to connect the device streams when you click on an applicable crosspoint.

9.3.1.2.1 Connection Success

A green circle ● will appear in the matrix crosspoint if the connection is successful.

9.3.1.2.2 Connection Warning

Though not recommended, Hono AVB Controller allows streams of different formats to be connected.

An yellow circle ● will appear if the connection has a format mismatch. A popup will accompany a connection warning, describing the different formats:

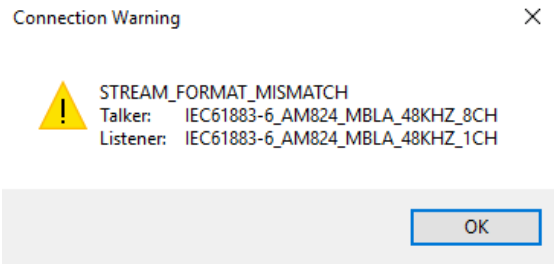


Figure 5: Connection Warning Example Popup

9.3.1.2.3 Connection Failure

If a connection cannot be established, a popup will appear, indicating why the connection failed:

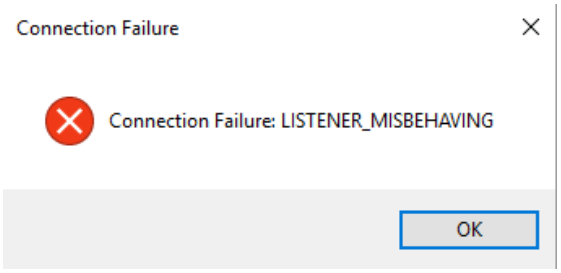


Figure 6: Connection Failure Example Popup

9.3.1.2.4 Connection Failed

Hono AVB Controller detects stream MSRP errors and invalid packet counts if a device implements the required 1722.1 commands (see Appendix).

A connection dot will turn red ● if a connected stream reports an MSRP error or a connected Listener reports a zero packet count.

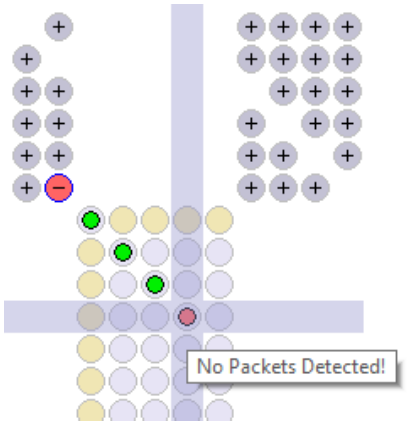


Figure 7: Connection Failed Packet Error

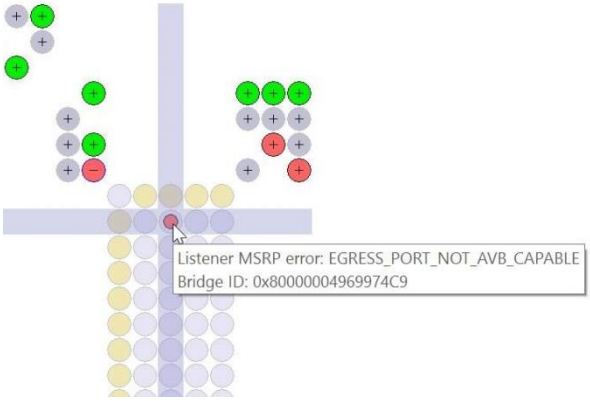


Figure 8: Connection Failed MSRP Error

9.3.1.3 Device Intersection Connection Status

Device intersection toggle buttons indicate the connection status of the device pair. A toggle button will be green when only valid connections exist, yellow if a warning connection exists, and red if a failed connection exists between the two devices.

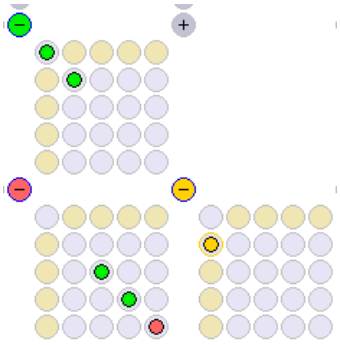


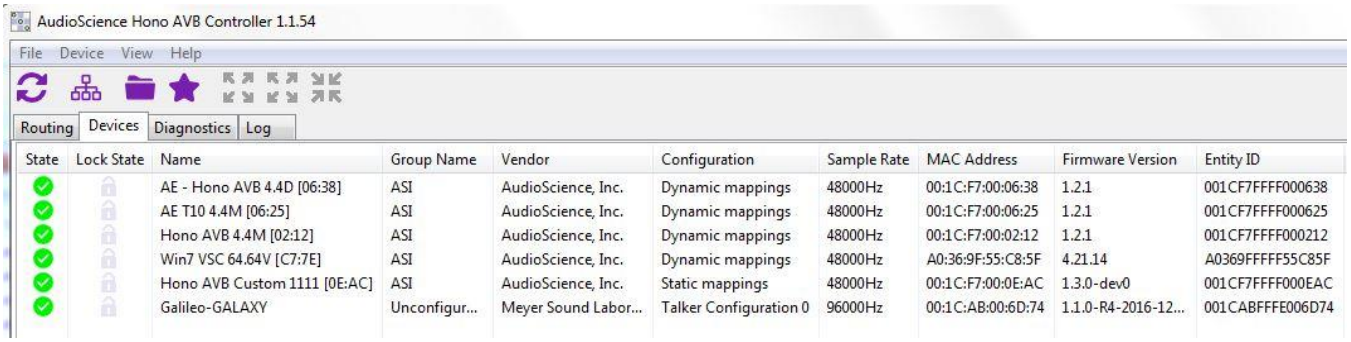
Figure 9: Device Intersection Button Colors

9.3.2 Devices Tab

The devices tab provides a network-wide overview of device configuration and operating information. This tabular view presents the following informing, in columns from the left:

- **State** : The status of the device. Connected or Disconnected
- **Lock State** : The permission status of the device. See Lock Status
- **Name** : The Entity Name of the device
- **Group Name** : The Group Name of the device
- **Vendor**: The Vendor Name of the device
- **Configuration**: Mapping type device is set to
- **Sample Rate**: Current sample rate of device
- **MAC** : The MAC address of the device
- **Firmware Version**: The current firmware version of the device
- **Entity ID**: The Entity ID of the device

Double-clicking on a device opens the individual Device View window.

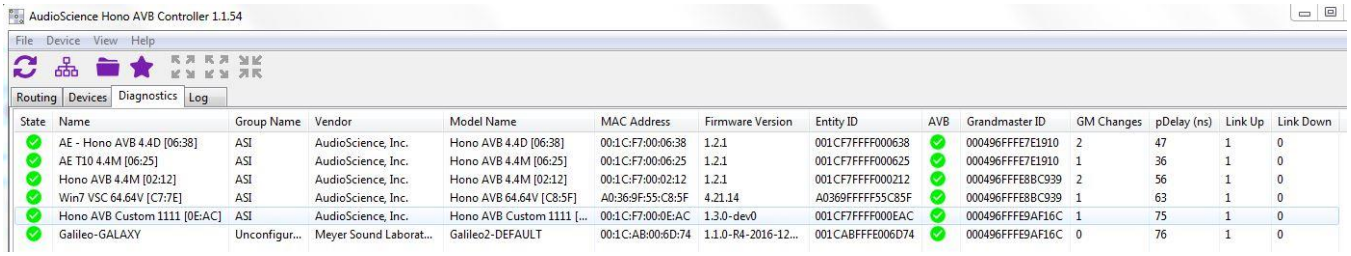


9.3.3 Diagnostics Tab

The Diagnostics tab includes information pertaining to a device's AVB status.
This tabular view presents the following informing, in columns from the left:

- **State**: The connection status of the device. Connected or Disconnected
- **Name**: The Entity Name of the device
- **Group Name**: The Group Name of the device
- **Vendor**: The Vendor Name of the device
- **Model Name**: The Model Name of the device
- **MAC**: The MAC address of the device
- **Firmware Version**: The current firmware version of the device
- **Entity ID**: The Entity ID of the device
- **AVB**: IEE802.1AS capable or not asCapable
- **Grandmaster ID**: The gPTP Grandmaster ID of the device
- **GM Changes**: The number of gPTP Grandmaster changes
- **pDelay**: The propagation delay of device (ns)
- **Link up**: The number of the link ups
- **Link down**: The number of link downs

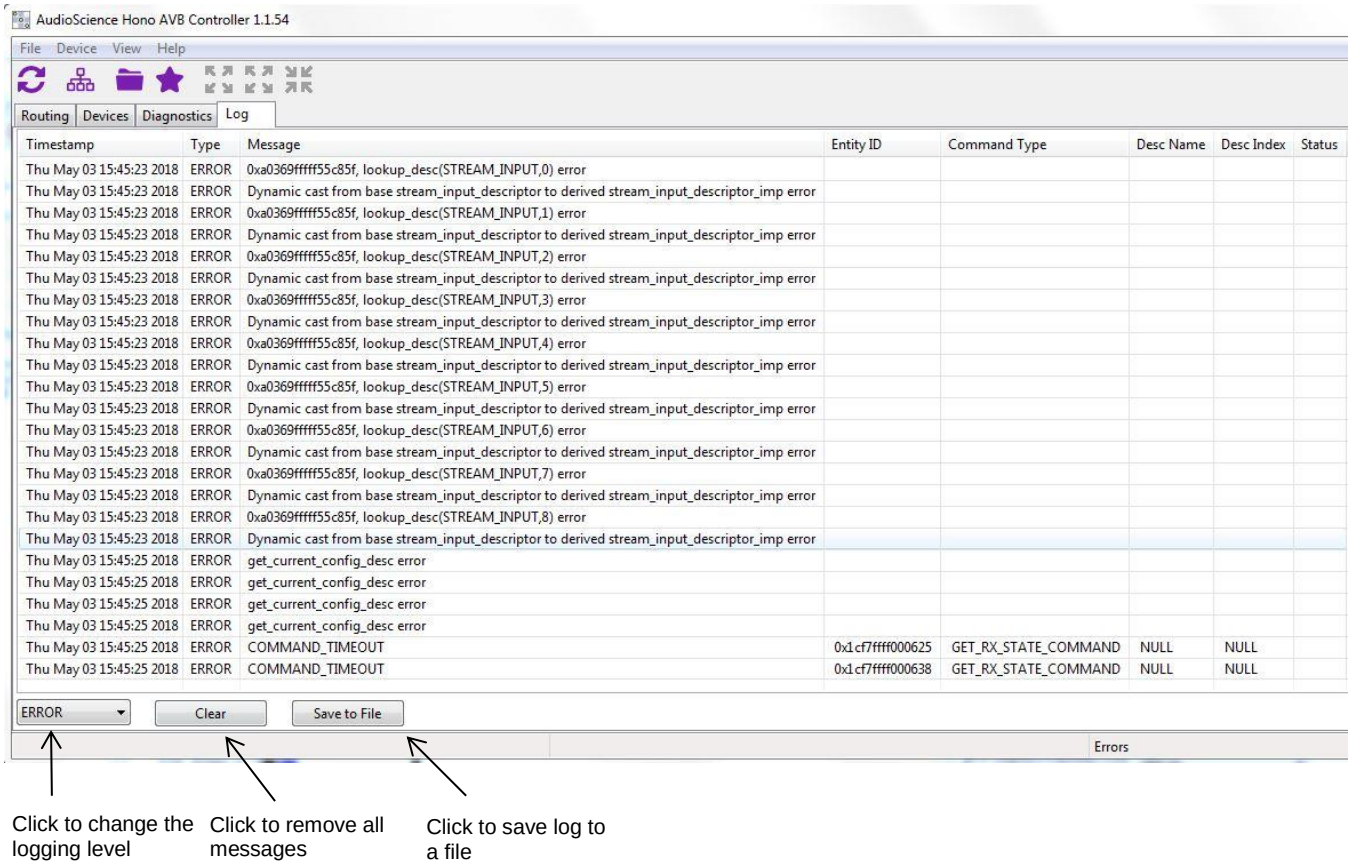
Double-clicking on a device opens the individual Device View window.



9.3.4 Log Tab

The Log tab stores error and notification messages.
This tabular view presents the following informing, in columns from the left:

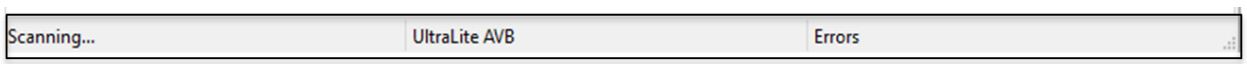
- **Timestamp** : The time and date of the event
- **Type** : The type of event - ERROR or NOTIFICATION
- **Message** : The message received
- **Entity ID**: The Entity ID of the device sending the message, if applicable
- **Command Type**: The command type that triggered the message, if applicable
- **Desc Name**: The descriptor name of the message, if applicable
- **Desc Index**: The descriptor index of the message, if applicable
- **Status**: The status of the message, if applicable



9.4 Status Bar

The Status Bar displays the following information at the bottom of the app:

- The current device being enumerated (e.g. Scanning… UltraLite AVB)
- Error Status

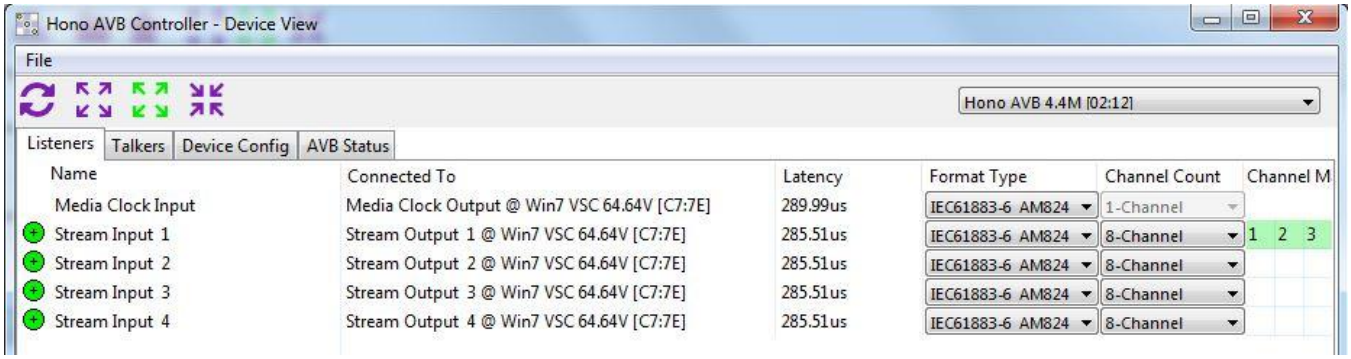


9.5 Device View Window

The Device View window is used to view and modify settings for a specific device. Double clicking a device name in the Routing tab or on a device in the Devices tab or Diagnostic tab opens up the Device View window. The Device View window consists of several tabs.

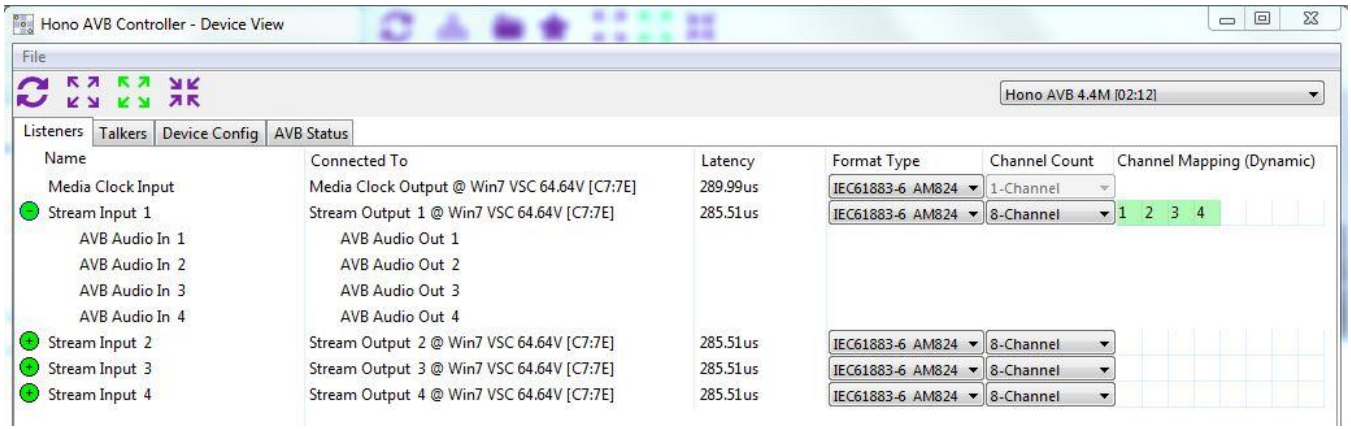
- Listeners: Shows configuration and status for all Listeners on device
- Talkers: Shows configuration and status for all Talkers on device
- Device Config: Configuration options that apply to the entire device

- AVB Status: Informational page showing current AVB status and statistics



In the upper right hand corner there is a drop down box that allows you to easily switch to a different device without having to close the Device View window. This is present on all tabs.

9.5.1 Device View – Listeners Tab



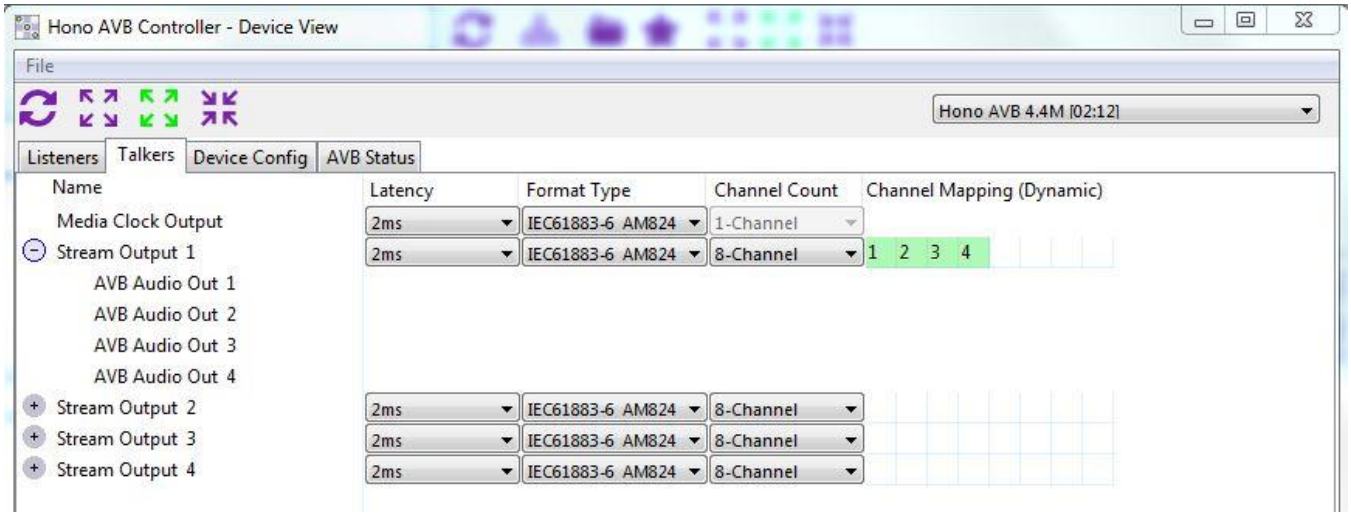
The Device View Listeners tab shows you all information relevant to the listener side of you AVB device. The following fields are included:

- Plus/minus expand/contract button: Toggles view of each individual listener
- Name: Identifying name for listeners and individual streams
- Connected to: Shows info on what it's connected to If currently connected
- Latency: Actual measured latency between the ingress and egress points of connection
- Format Type: Stream format as defined by the IEEE 1722.1 standard
- Channel Count: Number of channels stream is set to receive
- Channel Mapping: Channel assignments within the stream (see AVB Audio Routing section for more information)

9.5.2 Device View – Talkers Tab

The Device View Talkers tab is similar to the Listeners tab but deals with the units outgoing traffic. The following fields are included:

- Plus/minus expand/contract button: Toggles view of each individual talker
- Name: Identifying name for talkers and individual streams (can be customized)
- Latency: Indicates the stream's MSRP accumulated latency
- Format Type: Stream format as defined by the IEEE 1722.1 standard
- Channel Count: Number of channels stream is set to send
- Channel Mapping: Channel assignments within the stream (see AVB Audio Routing and Channel mapping sections for more information)



9.5.3 Device View – Device Config Tab

The Device Config tab allows you to view and set global parameters that will apply to the unit as a whole, these include:

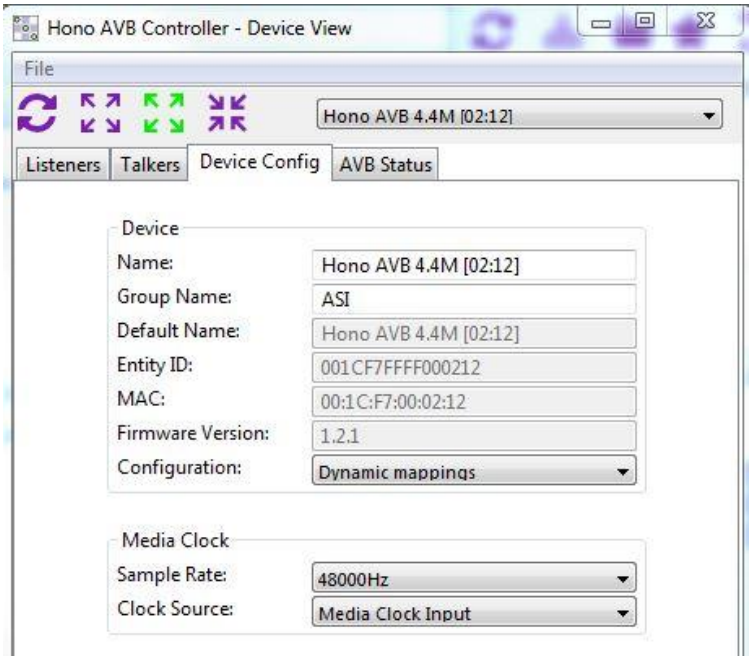
Device

- Name: Customizable name displayed in other tabs
- Group Name: Add a group name to help identify multiple units
- Default Name*: The hardware's default or hardwired name
- Entity ID*: Unique global ID assigned to AVB hardware to identify it on a network
- MAC*: MAC address of the unit
- Firmware version**: The firmware revision currently installed on the hardware
- Configuration: Drop down for to choose channel mapping configurations supported by unit.

  * Read only – for informational purposes, cannot be changed
  ** Read only – cannot be changed in AVB Controller but may be updatable on hardware

Media Clock

- Sample Rate: The sample rate the unit is set to
- Clock Source: The clock source the unit will use for syncing purposes



9.5.3.1 Setting Name options

In the “Device” grouping, you have the option to set a device’s name and group name to make it easier to identify each unit. Enter the name you wish to set and click “Apply” at the bottom of the window or continue on to make other changes as needed.

Figure 10: Device and Group Names

9.5.4 Setting Configuration options

In the “Device” grouping, you have the option to change a device’s configuration setting. Select the configuration you wish to apply from the dropdown. Available options will vary depending on your AVB devices manufacturer. See your devices user’s manual for specifics relevant to your exact unit.

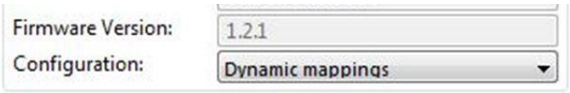


Figure 11: Configuration

Hono AVB Controller will prompt the user if actions must be taken before the configuration can be changed.

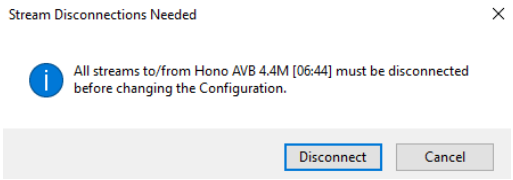


Figure 12: Configuration Action Needed Example

9.5.5 Setting Sample Rate options

In the “Media Clock” grouping, you will see a drop down box with different options for setting the sampling rate. Select the sampling rate that you wish to set and click “Apply” at the bottom of the window to make the change or continue on to make other changes as needed.

Note that the sampling rate cannot be changed if there is an active connection involving the device. If the drop down box is greyed out, you must disconnect the connections to that device before you can continue.

Figure 13: Sample Rate dropdown

9.5.6 Setting Clock Source options

In the “Media Clock” grouping, you will see a drop down box with different options for setting the Clock Source. The list of options is read from the AVB device. Both names and options may vary between manufacturers. Choose the option that matches your setup and click it to set. Then click “Apply” at the bottom of the window to make the change or continue on to make other changes as needed.

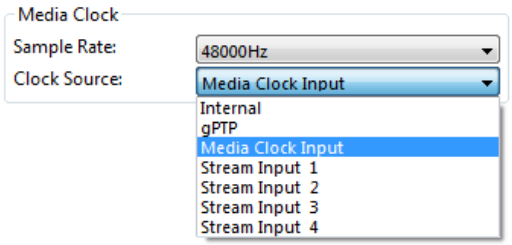
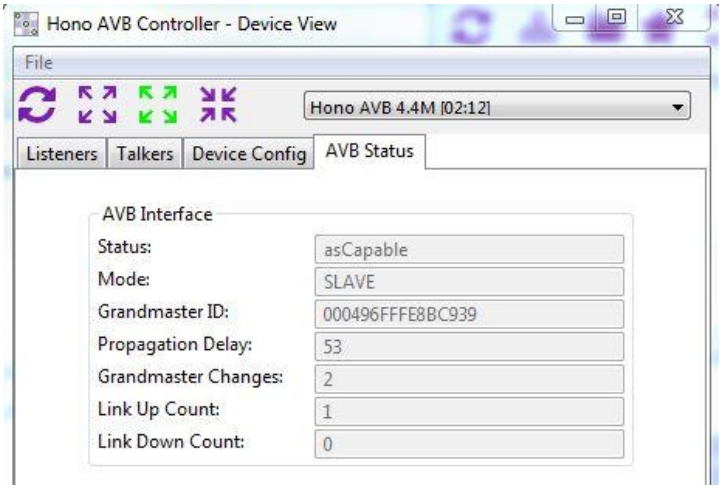


Figure 14: Clock Source dropdown

9.5.7 AVB Status Tab

Shows the current status of the unit’s global AVB parameters

- Status: asCapable if device is able to send/receive AVB traffic
- Mode: Master or Slave depending on device’s timing hierarchy as determined by AVB network
- Grandmaster ID: The gPTP Grandmaster ID of the device
- Propagation Delay: The propagation delay of device (ns)
- Grandmaster Changes: The number of gPTP Grandmaster changes
- Link Up Count: The number of the link ups
- Link Down Count: The number of the link downs



9.6 AVB Audio Routing in Hono AVB Controller

The following section describes how to configure AVB routing and channel mappings using the Listeners and Talkers tabs in Device View as well as a brief introduction to AVB routing concepts and terminology.

9.6.1 AVB Routing concepts and terminology

IEEE 1722.1 mappings are used to define the routing between audio clusters and the Listener or Talker streams.

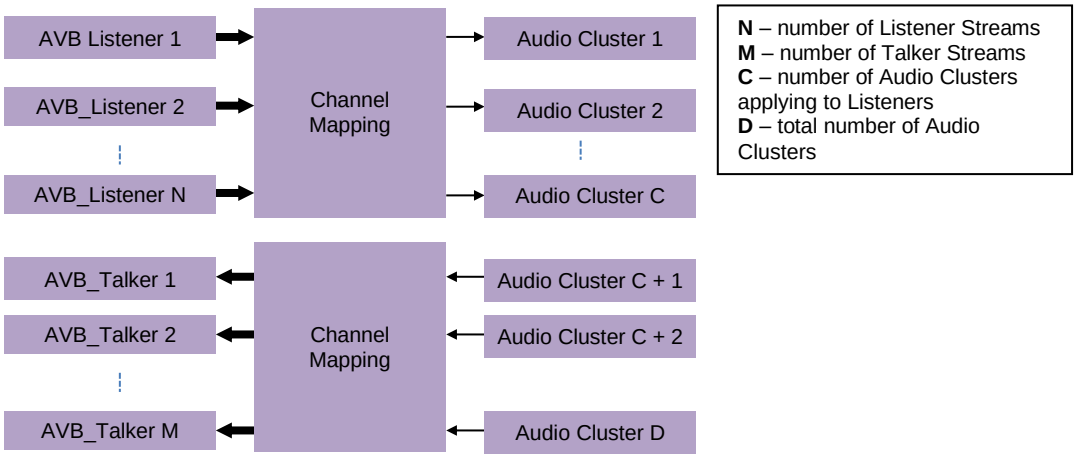


Figure 15: AVB Mappings

IEEE1722.1 Mappings are implemented dynamically or statically. Dynamic mappings can be changed at runtime by Hono AVB Controller via the Channel Mappings grid. If a device implements static mappings, this portion of the Device Configuration window will be disabled.

The following sections describe how to configure AVB routing and channel mappings for an AudioScience Hono AVB device. The concepts are the same for all AVB devices but the terminology and naming of some features may vary by manufacturer.

AudioScience mappings route to the embedded mixer in the Hono AVB device. AVB_Audio_In nodes, which are all mono, are used as the mixer audio input nodes for Listeners streams. AVB_Audio_Out nodes, which are all mono, are used as the mixer audio output nodes for Talker streams.

9.6.1.1 Talker Configuration

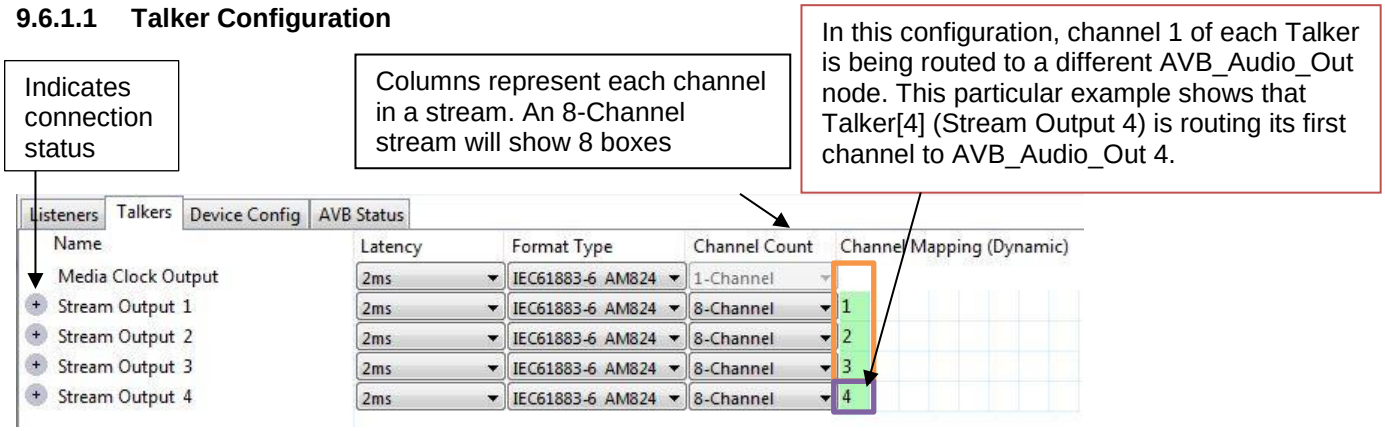


Figure 16: Talker Configuration

9.6.1.2 Listener Configuration

Terminology is similar on the Listener side. Here, the first channel of Listeners 1 – 4 are routed to mixer nodes AVB_Audio_In 1 – 4, respectively.

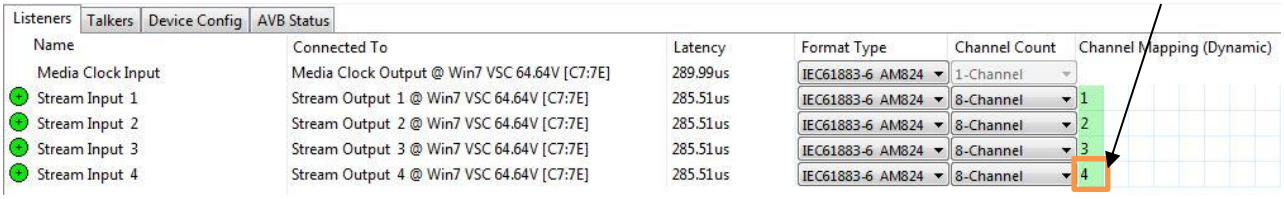


Figure 17: Listener Configuration

9.6.1.3 Stream Latency

9.6.1.3.1 Talkers

In the Talkers section, the Latency column indicates the stream's MSRP accumulated latency. To adjust the Talker stream latency, select an option from the dropdown. Then, click "Apply" at the bottom of the window to make the change or continue on to make other changes as needed.

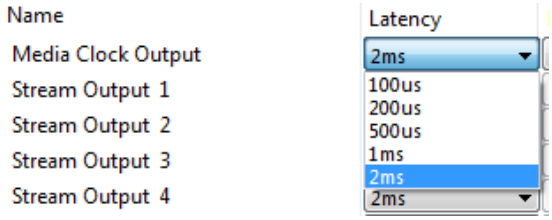


Figure 18: Talker Stream MSRP Latency

9.6.1.3.2 Listeners

In the Listeners section, the Latency column indicates the stream's MSRP Talker Advertise if the stream is connected and reporting a valid MSRP accumulated latency.

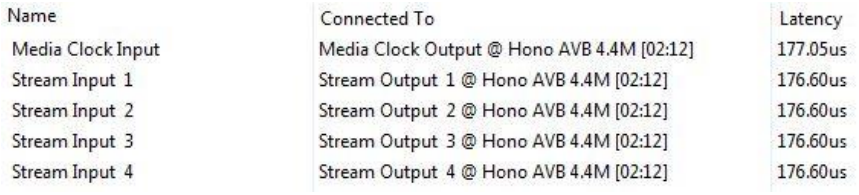


Figure 19: Listener Stream MSRP Talker Advertise

9.6.1.4 Setting Stream Format

In the section for either the Talkers or the Listeners (depending on your routing scheme), select the drop down box next to the stream name you are setting the channels for as shown below. You will see options for the channel counts supported. Choose the number that matches the number of channels you will set on the other end of the link.

Note that changes cannot be made if there is an active connection involving the stream. If the drop down box is greyed out, you must disconnect the connection(s) involving that stream before you can continue.

Once you have selected the correct channel count option, you are ready to map the channels in the stream. See Channel Mapping section.

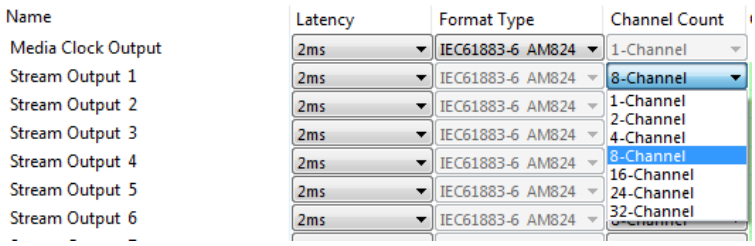


Figure 20: Stream Format dropdown

Please note that not all AVB units are capable of using all channels. For example, the AudioScience Hono AVB 4.4M is able to send and receive 8 channel streams, but since it only has 4 physical ins and outs, it can only use a subset of the 8 channels at one time. Allowing the ability to set the stream channel count to 1,2,4, 8 or more channels gives the flexibility to connect to a broad range of other AVB equipment. It's important to be aware that selecting 8 channel streams does not expand the unit's native capabilities; setting a Hono AVB 4.4M stream to 8-Channel mode does not allow it use more than its 4 physical channels, it just allows you to connect to another AVB device that only supports 8-Channel streams.

9.6.1.5 Channel Mapping

Once you've selected the format you wish to use, the mapping section will change to reflect your usable channels. In the example below, Stream Input 1 on a Hono AVB 4.4M has been set to 8-Channel mode to match the incoming Talker stream from the "Win7 VSC 64.64V" and that channels 1-4 have been assigned in order to Stream Input 1. This means that all 4 of the unit's available Listener channels will be received on a single stream from the Talker. Note how the channels show 1,2,3,4 for Stream Input 1 and are blank for all other Stream Inputs.

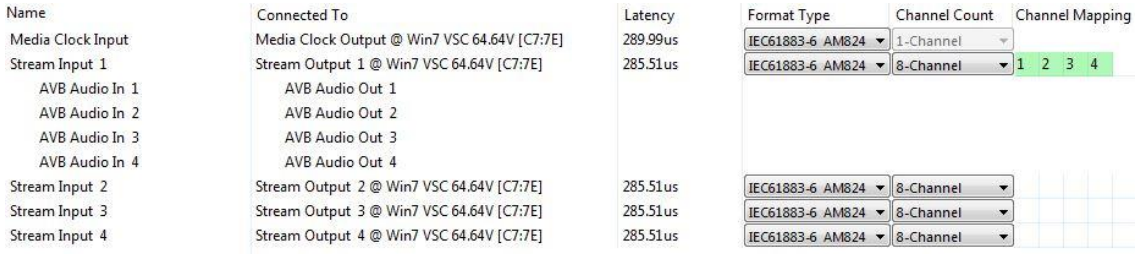


Figure 21: Active channel mapping example

Note that the box has been colored green to indicate this is a valid number to use for this type of AVB unit. If you tried to enter an invalid number (in this case 9 or anything higher, because this is a 8 channel AVB unit) then the box would turn red as in the example below.

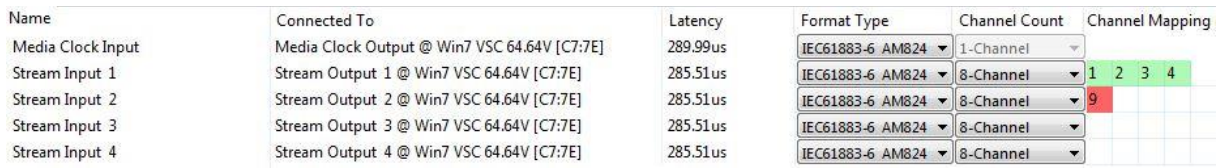


Figure 22: Channel mapping error example

Also note that the boxes will auto-fill when you press enter after typing a number, making setup a little easier. Type “1” in the first box and press enter and it will automatically fill in the remaining available channels in order (2,3,4,5,6,7,8 in this case).

One final note about number entry on the input side: if you subsequently enter the same number in another box, it will remove it from the first entry and replace that one with a blank because you cannot have the same number in more than one box. This is not the case on the outputs. This follows logically because there is no reason to receive 2 different signals on the same input but there could be situations where you want to transmit the same signal out to 2 different devices.

9.7 Presets

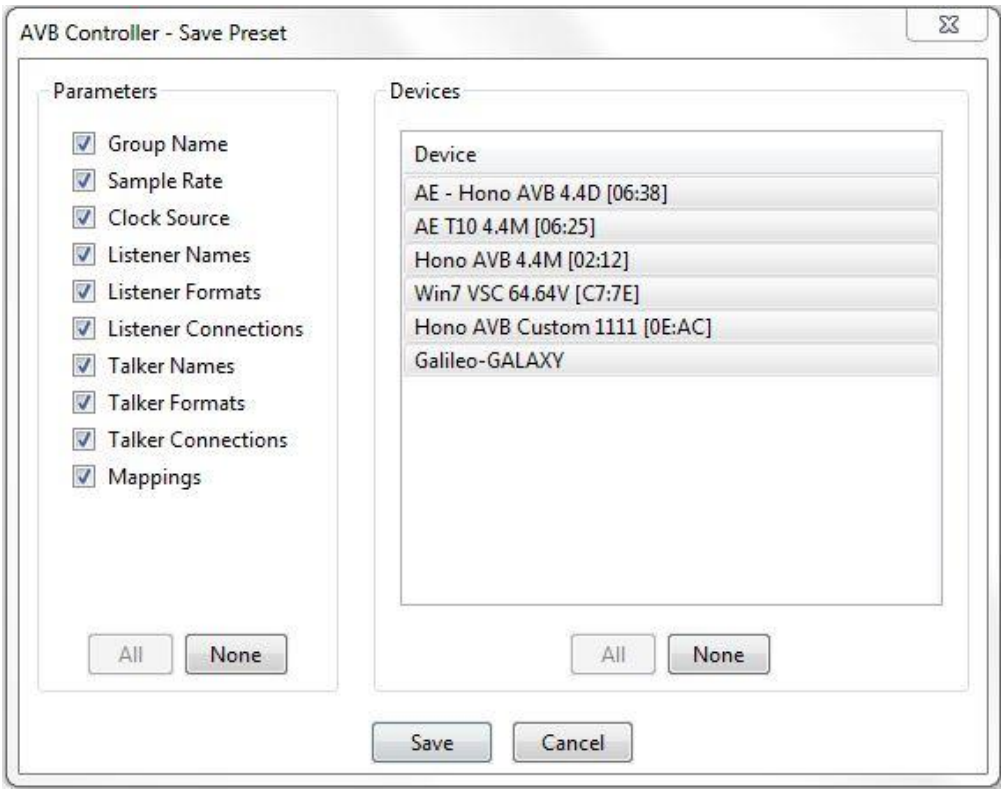
Presets save device configuration and routing settings as device roles – transferable sets of parameters.

9.7.1 Saving Presets

To save a preset:

1. Click the Save Preset icon from the main toolbar or select **File** > **Save Preset** from the main menu.
2. Select the devices that you wish to include in the preset. Click **All** to select all devices, or **None** to clear all selections. By default, all devices are selected.
3. Select the parameters that you wish to save for the selected devices.
4. Click **Save**.

   Note: The Device Name will always be saved.



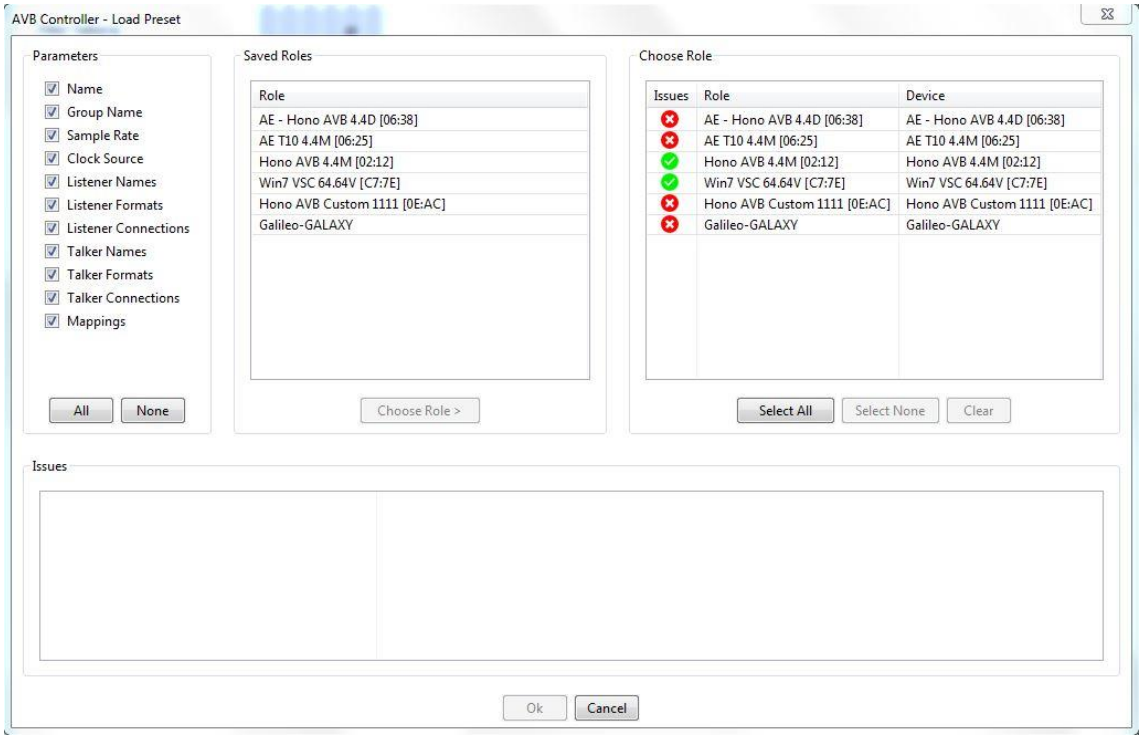
Presets are saved as an xml file, which can be manually edited if required, using a text editor.

The following device parameters can be saved:

- Group Name
- Sampe Rate
- Clock Source
- Listeners Configuration
  - Name
  - Format
  - Connected Talker
- Talkers Configuration
  - Name
  - Format
  - Connected Listeners
- Mappings

9.7.2 Applying Presets

To load a preset, click the Load Preset icon from the main toolbar or select **File** > **Load Preset** from the main menu.



9.7.2.1 Preset Parameters

The Parameters column lists the fields read from the selected xml file. Parameters not saved will appear as disabled. Select the parameters you wish to apply from the preset to the target device(s).

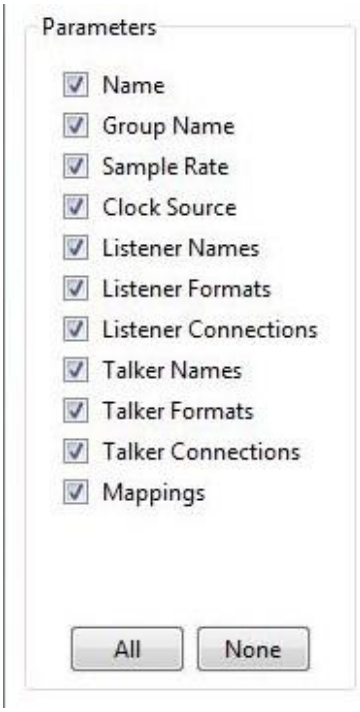


Figure 23. Load Preset Parameters

9.7.2.2 Saved Roles

The Saved Roles column lists the roles that were saved in the preset.

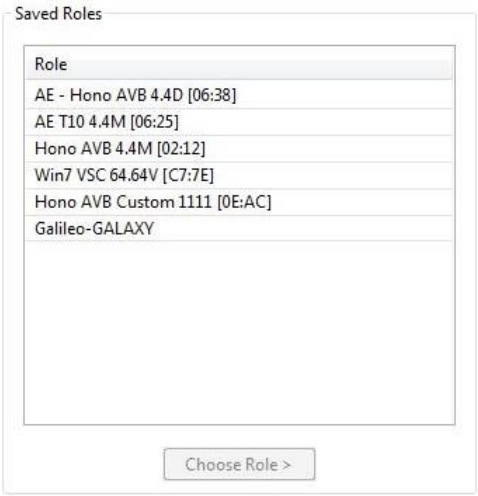


Figure 24. Load Preset Saved Roles

Roles are shown with the device name from which they were saved. You can apply a role to the same physical device from which it was created, or to a different device on the same network, or to another device on a new network. You can apply a role to multiple devices. You cannot apply multiple roles to the same device

When a role is applied to the same physical device, or a device of the exact same model, the configuration and routing should be replicated perfectly. If a role is applied to a different type of device, the success of the assignment will depend on the functionality of the target device.

9.7.2.3 Automatic Assignments

Hono AVB Controller will automatically assign roles to devices, based on the following rules:

- If there is a perfect device match (i.e. the device entity ID on the original network from which the role was created is also found on the target network)
- If there is a device name match (i.e. a device has been swapped out and renamed)

Note that if a physical device match and a device name match are both present on the target network, the role will be automatically assigned to the **physical** match. You can adjust these assignments manually as you wish.

9.7.2.4 Manual Assignments

To manually apply a role to a device:

- Drag the role onto the device, or:
- Select the role in the ‘Saved Roles’ column and the device(s) in the ‘Apply Role’ list, and click **Choose Role.**

9.7.2.5 Choose Roles

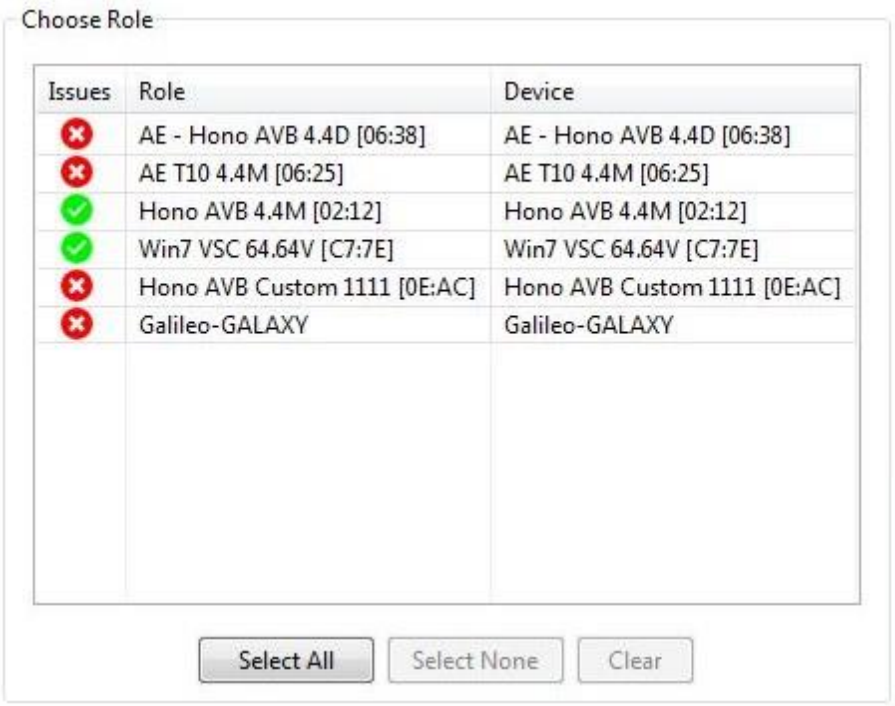


Figure 25. Load Preset Choose Roles

When a role is chosen (manually or automatically), the 'Issues' section will indicate whether there are any conflicts between the saved role and the device configuration: no issues, or issues . Clicking a Role in the list will update the Issues window at the bottom to indicate any errors or issues that may prevent you from applying a particular role for your current configuration.

9.7.2.6 View Issues

Figure 26. Load Preset Issues Window

9.7.2.7 Load Preset Considerations

Note that including the 'Sample Rate', 'Talker/Listener Formats', or 'Mappings' parameters will require the load process to disconnect and reapply connections to that device. If 'Talker/Listener Connections' is not selected, the disconnected connections will not be reapplied.

9.7.2.8 Applying the Preset

To apply the preset, choose the Role(s) you wish to restore and click **Ok**. Click **Cancel** to abandon the operation.

9.8 Lock a Device

IEEE1722.1 supports locking a device – preventing other controllers from sending state-altering commands to the device.

To lock a device, right-click on the device in the Devices View and select **Lock**…

To lock for one minute, click **Lock**… > **Temporary (1 minute)**

To lock until unlocked again, click **Lock**… > **Persistent (until unlocked)**

9.8.1 Lock State

The lock state icon in the Device View has three possible states:

- : Unlocked
-  : Locked by this controller
-  : Locked by another controller

10 APPENDIX

10.1 IEEE1722.1 Commands

These commands are utilized in Hono AVB Controller v.1.0.x.

All AudioScience AVB devices support these commands. Third-party devices may lack one or more of the following:

Command	Description
ACQUIRE_ENTITY	Used by a Controller to obtain exclusive access to a device (long-term lock). See Lock a Device.
LOCK_ENTITY	Used to provide short-term exclusive access to a device to perform atomic operations. See Lock a Device.
GET_STREAM_INFO	Used to get the current values of the dynamic information of a Stream, such as MSRP accumulated latency, Stream ID, etc.
SET_STREAM_FORMAT	Used to set the format of a Stream. See Setting Stream Format.
SET_NAME	Used to set the value of a name field within a descriptor. See Setting Name.
SET_SAMPLING_RATE	Used to change the sampling rate of an audio unit. See Setting Sampling Rate.
SET_CLOCK_SOURCE	Used to change the Clock Source of a Clock Domain. See Setting Clock Source.
REGISTER_UNSOLICITED_NOTIFICATION	Used to indicate to a device that Hono AVB Controller wishes to receive unsolicited response notifications. If this command is not supported by a device, state-altering changes made by another Controller will not be recognized by Hono AVB Controller during runtime.
DEREGISTER_UNSOLICITED_NOTIFICATION	Used to remove Hono AVB Controller from receiving unsolicited response notifications from a device.
GET_AVB_INFO	Used to get the dynamic AVB information for an AVB interface, such as the gPTP grandmaster id, propagation delay, etc.
GET_COUNTERS	Used to get performance variables and diagnostics counters from a device.
GET_AUDIO_MAP	Used to fetch the dynamic mapping between the Audio Clusters and the Listeners or Talkers. See Mappings.
ADD_AUDIO_MAPPINGS	Used to add mapping entries to the dynamic mappings between the Audio Clusters and the Listeners or Talkers. See Channel Mapping.
REMOVE_AUDIO_MAPPINGS	Used to remove mapping entries to the dynamic mappings between the Audio Clusters and the Listeners or Talkers. See Channel Mapping.

<end>