



## Installation and Configuration Instructions Two-way Divisible Conference Rooms, Version 3.1 Cisco Best Practices

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## Introduction

Use this document in addition to the Version 3 Two-way System Drawing which describes a 2-way divisible room, but the same concepts apply to N-way divisible; there is only one “primary” codec for the room in the center of the combined room and all others are “secondary”. Do note that where you see a 2-way DA to split HDMI outputs 1 and 2 (monitor connectors) from the Primary codec out to the actual monitor and the Secondary codec, you will need DAs with more output ports if you have more than one Secondary room and corresponding Codec so that each one can get a copy of the Monitor outputs of the Primary.

This document concentrates on tasks for the onsite installer and system administrator. This design supports use of several different screen configurations.

- The use of two screens in the front of the room is preferred for most installations. On Webex calls, both screens will show remote participants until someone starts sharing content, at which point the 2<sup>nd</sup> screen will show content. The setting for this is [Monitors: Dual](#).
- If the screens are different sizes – perhaps a projector for content and an LCD screen for people – then you can use the setting [Monitors: DualPresentationOnly](#). This guarantees that the larger screen will only show content during calls.
- You can use a confidence monitor collocated with the Presenter Camera. You would use a DA to run it off either HDMI 1 or HDMI 2 output from the codec – which means you need to decide in advance what you want it to show. Normally, you want the confidence monitor to show the active speaker from the far end participants for the best eye contact. If you use an HDMI DA off the HDMI 1 output, you will accomplish this, regardless of using [Monitors: Dual](#) or [Monitors: DualPresentationOnly](#).
- It is also possible to use only one screen – usually a projector – in each room. The system Drawing shows an option for single screen.



- This Divisible Room design does not support the “Triple Monitor” role. *Why?* We use HDMI 3 for a video tie line from the Secondary Codec to the Primary Codec; therefore it is not available for other uses. In the event that the customer definitely needs to use a triple monitor configuration, then it is necessary to add a video matrix switcher to the design, and use completely different programming.
- If you wish to be able to show a presenter side-by-side with an audience member, use the “Presenter QA Mode” feature of the macro (set PRESENTER\_QA\_MODE to true). Classroom Mode and/or Briefing Room Mode are not supported when using any Divided - Combined design. The programming for those room types uses a hidden macro that conflicts with any type of custom program, whether it uses the CE Macro Framework or a program on a control system. This is why the macro provided implements its own Presenter QA Mode with a custom touch device panel button labelled “Auto QA”

## Definitions

Here is the terminology we will use in this document:

*Primary Room* refers to the room that is used for the presenter when the rooms are combined.

*Secondary Room* refers to the auxiliary spaces that mirrors the Primary Room.

*Primary Codec* refers to the Codec Pro that drives the Primary Room. It is the only codec that makes calls when the rooms are combined.

*Secondary Codec* refers to the Codec Pro that drives the Secondary Rooms.

*Combined Mode* indicates that the wall between the rooms is open.

*Standalone Mode* indicates that the wall is closed, and each room operates independently.

*Trigger Zone* refers to the small rectangular area that causes PresenterTrack to start following the presenter. The presenter must look directly at the camera for about one second; then the system zooms in and starts tracking.

*Stage Area* refers to the entire zone that the presenter is allowed to roam about while being tracked with PresenterTrack technology. Typically, the maximum width of this area is 7 meters or 23 feet.

## Limitations

**It is important to note that *Classroom* and *Briefing Room* room types cannot be used in any Divisible Room scenario.** Briefing Room mode has very specific input / output wiring requirements which are incompatible with Divisible Room layer one architecture. Classroom mode makes use of its local SpeakerTracking camera, whether it is SpeakerTrack 60 or a Quad Camera. But the Primary Room Codec Pro cannot use the Secondary Room’s Quad Camera for Classroom mode, for the simple reason that it has no control connection to it. So – when the rooms are in Combined Mode, Classroom mode simply does not work properly. Furthermore, when you use the web interface to enable Classroom mode (under Settings / Room Types), it runs a hidden macro and restarts the macro engine.



The user experience of having Classroom mode when the rooms are in Standalone Mode, but not in Combined Mode, causes confusion for the end user. And even if the customer decides they want to use Classroom mode when the rooms are Standalone, the programming complexity needed to allow for an unexpected restart of the macro engine presents huge obstacles for any programmer. For these reasons, is it necessary to avoid using Classroom (or Briefing Room) Room Types completely.

### **WebRTC video calls**

It is not uncommon to use WebRTC from a Cisco codec to join a Microsoft Teams or GoogleMeet conference. However, there are severe limitations on camera usage: composed views are not supported (i.e. side-by-side mode).

Fortunately, Cisco has long used a feature called USB Passthrough, which was first introduced in the Room Kit Mini, and this feature enables the user to join any Internet conference using their laptop or desktop computer, with the Cisco camera and microphones appearing as USB devices. Many newer Cisco devices have built-in support for USB Passthrough, but the codecs used in boardrooms and training rooms do not have native support. However, we have developed a simple solution; see the next section.

## **Additional Features**

**USB Passthrough** – using a 3<sup>rd</sup> party USB capture device and macros provided by Cisco – can be used together with this Divisible Room design. There are separate instructions and documentation located at <https://roomos.cisco.com/macros> for using USB Passthrough. We have tested several different brands and models of capture devices, which will have native operating system support in RoomOS 11 (cloud version first, followed by on-premise). However, it is not yet known whether the native OS support will be compatible with this Divisible Room project; but it will work with macros.

There are several tested USB Capture devices that can be used – with macros – which are documented in that same link.

The design of USB Passthrough uses the HDMI 3 output of the Codec Pro to provide both cameras and microphones to the capture device. When the rooms are in Combined Mode, only the Primary Codec is used for USB Passthrough. You will note that the HDMI 3 output is available on the Primary Codec for this purpose. On the Secondary Codecs, HDMI 3 is a video tie line to the Primary, but it is not needed by the Divisible Room macros when the rooms are in Standalone Mode; therefore it can be used by the USB capture device instead. It is best to use a capture device with HDMI loop through (like the Inogeni) to simplify wiring.



## Section One – Plan and Elevation Drawings

As shown on page 1 of the system drawings, typically in the front of the room will be two screens – one for remote participants and one for content, and one Quad Camera, located below the two screens – see page 2 for the elevation. The Quad Camera uses SpeakerTrack technology to locate and zoom in to the participant in the room who is speaking. In the back of the room – or on a side wall – a presenter camera is located, which can use PresenterTrack technology to follow a roaming presenter, along with an optional confidence monitor.

Some people prefer to use a single LCD or projector screen in the front of the room, which is perfectly acceptable, and compatible with the programming provided with this complete system. Wiring for this is found on page 6. Pages 2, 3 and 4 show a typical front elevation using dual screens, and illustrate both the “Stage Area” and the “Trigger Zone” for setting up PresenterTrack. You will note on page 4 that when the rooms are in Combined Mode, the “Stage Area” can have different dimensions, since the presenter is likely to wander between the two rooms if the wall is open. This process is automatic, as long as the coordinates are loaded into the header of the Primary Codec Macro. See the separate document “How\_to\_Setup\_Two-PresenterTrack\_Zones.pdf” for detailed instructions on using different Zones for Combined Mode, including a different Trigger Zone if desired.

**Note:** When using PresenterTrack, try to avoid having the presenter stand in front of the screens that show remote participants. You will notice on page 4 that the Stage Area extends from the presentation screen in the Primary Room over to the edge of the “People” screen in the Secondary Room. [Why?](#) PresenterTrack uses object tracking to follow the presenter around; the presenter can turn around and reference a whiteboard or the presentation; they can sit down at a desk; they can move freely as long as they stay within the Stage Area. However, if the camera shows the screen with the remote participants, and there are only one or two people, the system might think they are local presenters in the Stage Area. For this reason it is best to configure the screens and Stage Area so that only the presentation monitor is visible to the camera.

For instructions on setting up PresenterTrack, download and view the latest Administrator Guide from the Cisco website: [DOCUMENTATION Collaboration Endpoint](#).

**Note:** The plan and elevation drawings show the Primary Room on the left hand side, but it can be the other way around. This is best determined by the physical layout of the room, keeping in mind that the presenter camera in the Primary Room is always the one used when in Combined Mode.

## Section Two – Layer One Physical Installation and Line Drawings

System schematics / one-lines

Refer to the pages 5-8 for this section.

### Pages 5-6 : Video Line Drawings

In these drawings you see all of the video components and how they are connected: Quad Camera, PTZ 4K



Presenter Camera, dual screens, and one content source. An additional confidence monitor can easily be added to the system. The Cisco PTZ 4K Camera – when used as a presenter camera – can use PresenterTrack technology to follow a roaming presenter. The Precision 60 Camera is also completely compatible with this design.

**Video Interconnects:** There are video interconnect lines and two HDMI splitters. The interconnects are used only when the rooms are in Combined Mode. HDMI outputs 1 and 2 from the Primary Codec drive the local screens – using CEC for power control, but also provide conference video to the Secondary Room when in Combined Mode. These interconnects enable people seated in the Secondary Room to see exactly the same video images as in the Primary Room. In addition, there is one HDMI line from the Secondary Codecs Pro HDMI output 3, going up to the Primary Codec HDMI input 3 – and this is the matrix-switched image from the Quad Camera in the Secondary Room. When in Combined Mode, this HDMI circuit is activated, enabling the Quad Camera in the Secondary Room to be transmitted to remote participants whenever necessary.

You will note the absence of 3<sup>rd</sup> party matrix switchers; all that is needed are two HDMI Distribution Amplifiers.

For single screen designs, even the HDMI DAs are not needed – see page 6.

Specific information on how this all works is below in Section Three: Theory of Operation.

**HDMI extenders:** Because HDMI cables by their very nature are limited in length, it is necessary to use some type of extenders for long HDMI runs. You will note we are recommending FSR Digital Ribbon Cable for long HDMI runs. These hybrid cables are passively powered, and can transmit 4K at 60fps, with 4:4:4 chroma sampling, at distances up to 328 feet. Typically, the distances needed in these rooms are 75 feet or less, and FSR cables at that distance are less expensive than active transmitter / receiver pairs. Because they are true HDMI cables, they support all HDMI protocols, like CEC, EDID, and ARC. The obvious advantage is that there are fewer active electronics boxes. In addition, for any additional PTZ 4K or Precision 60 Cameras in the design, we use input 6, which is 3G-SDI, using a micro-BNC connector. The Codec Pro ships with a small converter from BNC to Micro-BNC. If you are using a Precision 60 Camera, you can use Belden 1694A cable directly from the camera to the codec. For the PTZ 4K Camera, it is necessary to convert HDMI to 3G-SDI; we always use the Decimator MD-LX for this purpose. These converters can be used either at the camera end or at the codec.

Many integrators prefer Sound Control Technologies active extenders for Cisco cameras; they allow fewer wires to be pulled, provide power for the camera, and work in narrow conduit where UTP cable is a must. Vaddio also makes extender kits for Cisco cameras; however I am not aware of one for the Quad Camera.

One other option – the macro allows you to select which input on the Primary that you want to use for the video tie line from HDMI output 3 on the Secondary Codecs to HDMI input 3 on the Primary. You could, for example, use SDI input 6 instead for this tie line, which has the advantage of opening up HDMI 3 for another presentation source.

### Total number of presentation inputs

The design uses HDMI video tie lines, which use one HDMI port on the Primary Codec and two HDMI ports on the Secondary Codecs, assuming you are using dual monitors in both rooms. You will note that two 1x2 HDMI Distribution Amplifiers are required for dual monitor operation. We have specified Extron DA2 HD 4K PLUS because we know they work. If you use a different brand, please make sure it has the following capabilities:

1. Passes CEC commands on Output 1 to the screen



## 2. Passes embedded HDMI stereo audio on Output 2 – to the Primary Codec.

The number of available presentation inputs depends on how many PTZ cameras you are using. If you are using two PTZ cameras, you have just two HDMI inputs (#4 and 5) on the Primary Codec, and one input (HDMI #5) on the Secondary. For conference rooms that need several content sources, an external switcher can be used to increase the number of content sources. One of the most simple is to use an Extron SW2 or SW4 HDMI 4K, which has an automatic mode. If someone plugs a laptop into a higher-numbered input, it automatically overrides the lower-numbered inputs. Or you could use a Lightware switcher – 4 input or 8 input – which can talk directly to the codec using the CE Macro Framework and the Lightware L3 Library. This library is not built into the macros provided by Cisco; so it would take a programmer to add that functionality. Regardless of the brand of video switcher used, the Share Tray on the Cisco touch interface will show all of the content inputs, and even show which ones have sync and are ready to use. This is documented in the various Customization Guides which can be found here: <https://www.cisco.com/c/en/us/support/collaboration-endpoints/spark-room-kit-series/series.html#~tabdocuments>

### Audio Connections (page 7 of System Drawings)

Here we show a typical setup with Cisco Ceiling Microphones, and amplified wireless for the presenters. The Quad Camera loudspeakers are sufficient by themselves for small conference rooms, but can also be used in conjunction with external speaker systems..

**Important:** On the Primary Codec, add 12ms of delay to all loudspeaker outputs, including the Quad Camera. This assures that when in Combined Mode, the Primary and Secondary rooms will hear simultaneous audio, with no apparent latency, without affecting lip sync in the Primary Room. You can do this with Audio Console. [You can see screen shots of Audio Console for both Primary and Secondary Codecs later in this document.](#)

Standard 22 gauge shielded audio cable is used for analog audio connections, with the exception of the Cisco Ceiling Microphones, which use shielded CAT5e or CAT 6 cable to transmit balanced audio to the Codec Pro, with provided adapters to Phoenix. You will note that there is only one analog audio interconnect between the Secondary and Primary Codecs: this circuit is all of the summed Ceiling Microphones from the Secondary Room, enabling remote participants to hear people seated in the Secondary Room. This line is activated only when the rooms are in Combined Mode.

Conference audio is sent from the Primary to the Secondary Room via embedded HDMI audio in the first video interconnect line.



Figure 1: The cost-effective Cisco Ceiling Microphone rejects ceiling noise and is easy to install

Many of our customers use Cisco Ceiling Microphones, because they are easy to install, work very well, and cost about 1/3 the price of beam-forming ceiling microphones. The single condenser mic element has two boundary layers – the white acrylic above it and the clear acrylic behind it. Boundary microphones are very efficient at capturing audio; and the physical barriers in the Cisco microphone block ceiling noise as well as rejecting noise from behind the microphone. This makes them 180 degrees directional, with a forward pickup area of 14 feet / 4.25 meters, and a side-to-side pickup area of 18 feet / 8.5 meters. At a weight of just over four pounds, and dimensions of approximately two feet square, they are extremely easy to install, with included aircraft cables in 2 meter lengths for adjusting the height of the installed microphone.

Having said all of that, it is perfectly OK to use whichever 3<sup>rd</sup> party microphone systems the customer and integrator prefer. Normally, ceiling microphones are used because training rooms often have moveable tables, however if the seating is fixed, table microphones are even better for sound quality.

We use a business rule that when the rooms are Combined, only the wireless microphones in the Primary Room can be used. This keeps the design simple; however it is not difficult to enable all of the wireless microphones to be used if this is required (by adding appropriate electronics). In addition, the Presenter Camera and the laptops in the Primary Room should be used when in Combined Mode.

### **Ceiling Speakers**

It is common to use ceiling-mounted loudspeakers in conference rooms, but front-mounted speakers can be used as well. It is important to wire any speaker system in stereo. While it is true that it is not always possible to provide



true left/right imaging using ceiling speakers, the aural experience is much richer when wiring in stereo, for these reasons:

1. Program material, which is always in stereo, sounds richer.
2. Webex Meetings and other conferencing platforms often provide spatial audio, again improving the user experience.

Simply put, stereo audio always sounds better than monaural, and there is no reason to use mono in these conference rooms. In your home listening environment, you would not purposely use monaural audio.

Program material from laptops, room PCs, and other sources uses embedded HDMI audio into the codec. Lastly, it is common to use wireless microphones or podium microphones, and these can be amplified without needing an external audio DSP. The DSP built into the Codec Pro is quite robust and has a GUI built into the web interface of the codec.

### Wall Sensor and GPIO Connections (page 8 of System Drawings)

Before diving into this simple diagram, let's discuss system control briefly.

When in Combined Mode, normally the Secondary Room Navigator UI is locked out with a message to use the touch panel in the Primary Room. This prevents users from getting into trouble by changing settings, making calls, etc from the Secondary Room, which is strictly passive.

The GPIO connections between the primary and secondary codecs for controlling room divide/join and mute/unmute and standby control are now optional, you can disable the use of that cable using by setting the `USE_GPIO_INTERCODEC` constant in the macro to 'false'.

One page 8 we show an optional wall sensor – a type we use internally at Cisco. It connects to the GPIO system on the Primary Codec – to Pin 1, 12VDC, and GND. If you use a wall sensor, it automatically configures the codecs to be in Combined Mode or Standalone Mode, depending on whether the wall is open or closed. In the event that the wall sensor becomes inoperable – perhaps someone with a ladder knocked it out of alignment – there is a PIN protected Override panel on the Navigator.

However, the wall sensor is optional. The users can combine or divide the rooms from a simple panel on the Navigator user interface – no PIN required.

In any case – wall sensor or no wall sensor – the other GPIO connections between the Primary and Secondary Codecs are required. These three connections are communication channels so that the Primary can instruct the Secondary in a reliable, robust manner.

Some integrators use other wall sensor brands; this is OK but the advantage to the Omron E3JM-DS70M4 is that it does not require the use of an external control system.





## Section Three – Configuring the Codec Web Interfaces

### Codec Registration and Local Accounts

A key requirement is that you need IP access to both codecs, for both SSH and HTTPS. (The network admin must also allow HTTP messages between the codecs). If you are lucky, the customer will allow you to use your own laptop on their network, or allow you to use one of their computers. If you are unlucky, you will need an alternate method of accessing the codecs. Fortunately, there is a way.

### Using the link-local network for direct IP access to each codec

Starting with the Primary Codec, hook an Ethernet cable from your laptop into any of the auxiliary Ethernet ports on the Codec Pro. Don't use the LAN port – use any camera control or Touch 10 / Navigator port. Your laptop will get an IP address of 169.254.1.30 and a subnet mask of 255.255.255.0. (Your laptop will complain about no Internet access because this is a link-local network).

You can reach the codec with your browser at 169.254.1.1. You can also use PuTTY or your favorite SSH client to reach the codec at the same address. When you want to configure the Secondary Codec, you do actually have to remove your Ethernet cable from the Primary Codec and attach it to the Secondary. Because link-local networks are non-routable (by definition), you cannot connect any two codecs to each other using those auxiliary ports, **and you should never attach an auxiliary Ethernet port to a customer LAN.** *Why?* Each codec has a DHCP server for the camera control and touch 10 / Navigator Ethernet ports. This applies to every Cisco video codec going all the way back to the C Series. If you plug an aux Ethernet port into a customer LAN, the codec will try to provide IP addresses to devices that join the network. I think most modern networks will find this and disable the switch port, but I did once bring down the network in the office where I worked by plugging a DHCP server into the LAN. Oops.

### Creating local admin accounts

Whether the Codec Pro are registered on-prem (CUCM or 3<sup>rd</sup>-party call control), to the Webex Cloud, or even used standalone with H.323 IP address dialing, you **must** have local admin accounts on both codecs. This also means that you must find out from the customer how the codec is to be registered, if you don't already know. If the customer has already registered the codecs and done basic configuration, ask them to create an admin account on each codec specifically for your use. This must be a full administrator account, not a "user" or "integrator" account.

If the codecs are registered to the Webex Cloud, the admin can use Control Hub to create a local account on each codec for your use. If you already have access to the codec web interface – perhaps the codec is fresh out of the box – here is how you create additional user accounts. Let's start with a brand-new codec, fresh out of the box.

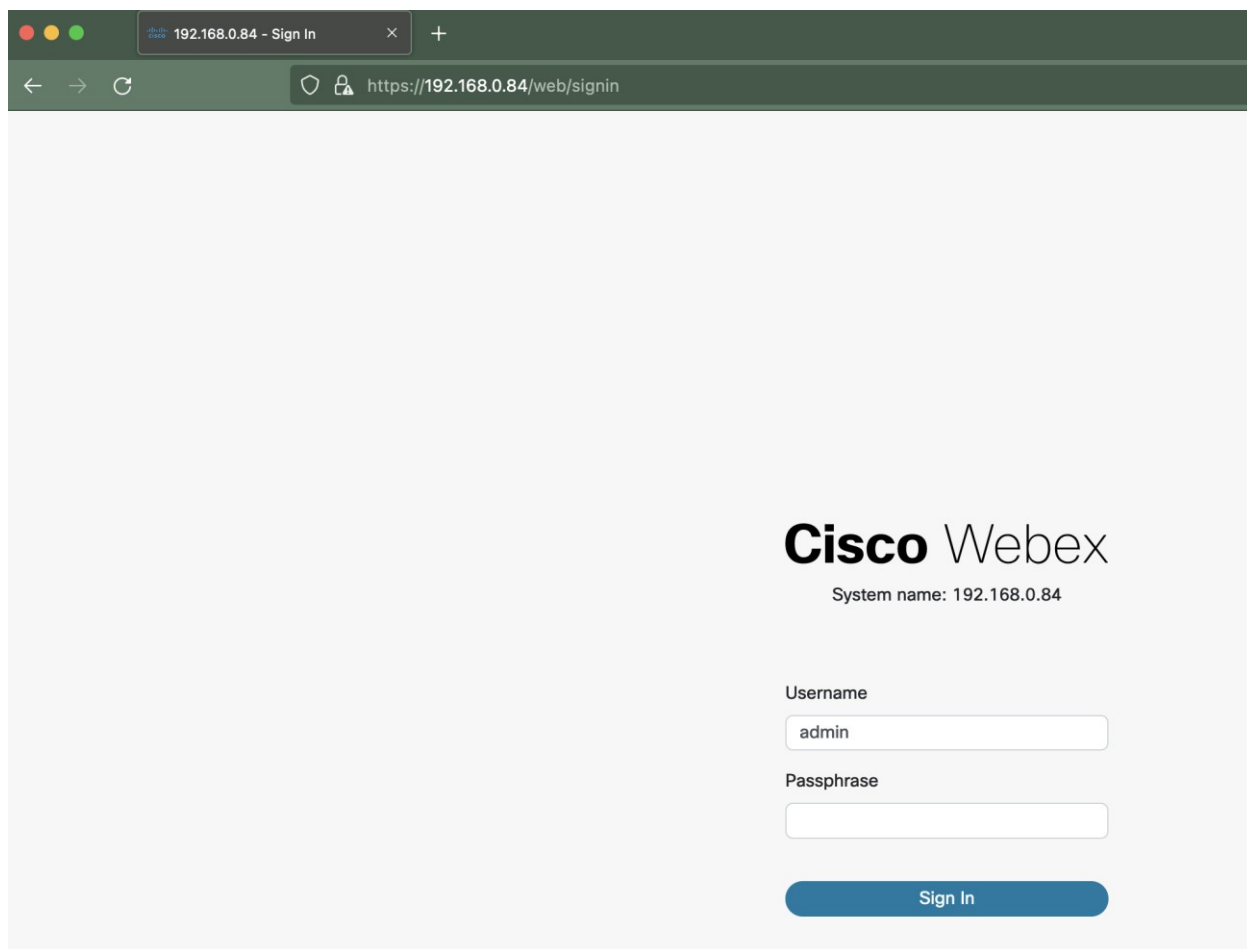


Figure 1: The login screen

With a brand new codec, or one that has just been factory reset, the user name is *admin* and the password is <blank>, which is to say no password at all.

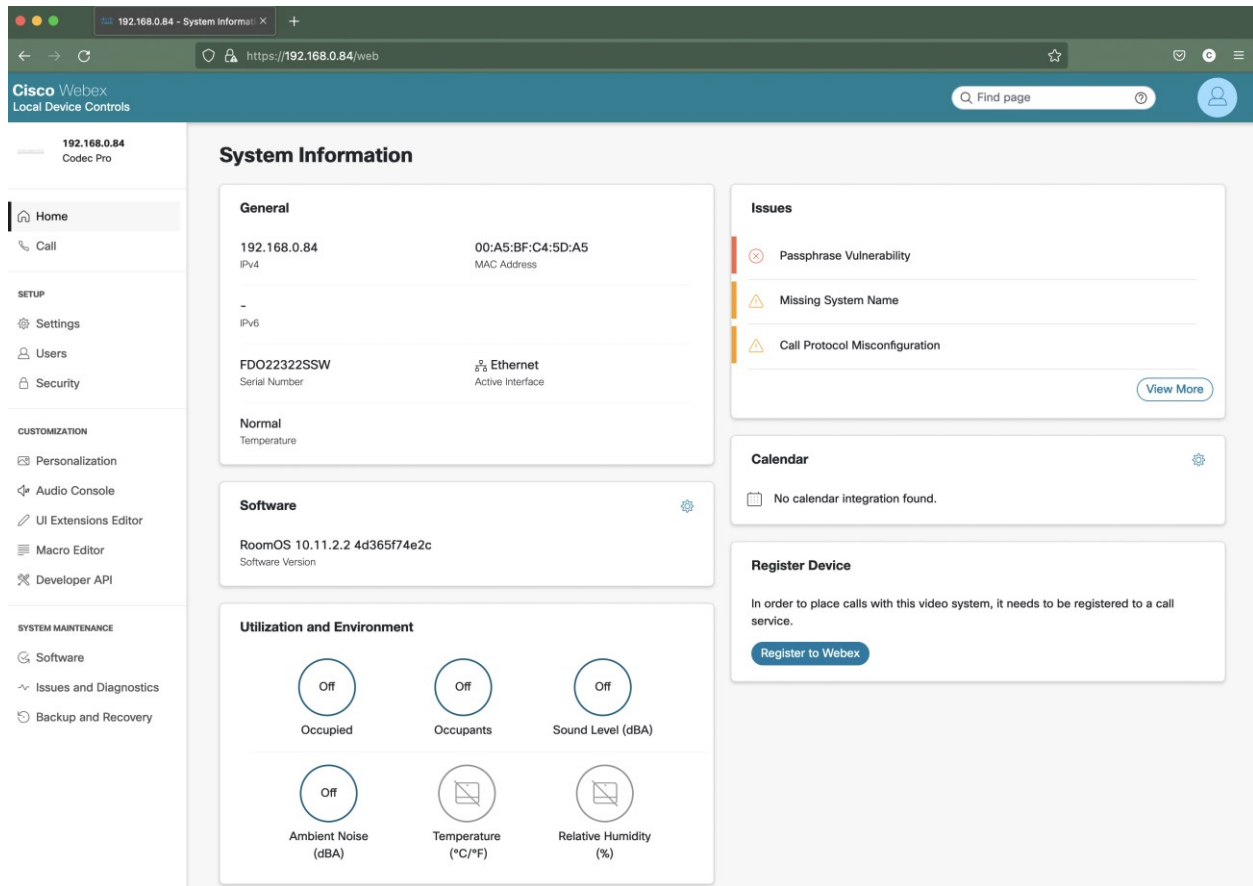


Figure 2: The Home screen

You will note several messages in the upper right hand corner. You can proceed with some important tasks before contacting the sysadmin to have the codec registered, **unless they use CUCM. If they use CUCM, you may as well have the sysadmin get the codecs registered now, and go get lunch.** Ask them to create a local admin account for you while they are getting the codecs registered.

If the plan is to register to the Webex Cloud, you should complete some important tasks now, before entering the 16 digit registration code.

Create two local admin accounts on both codecs for use by you – the installer – and by the CE Macro Framework.

To begin, click on “Users” on the left side of the web interface.

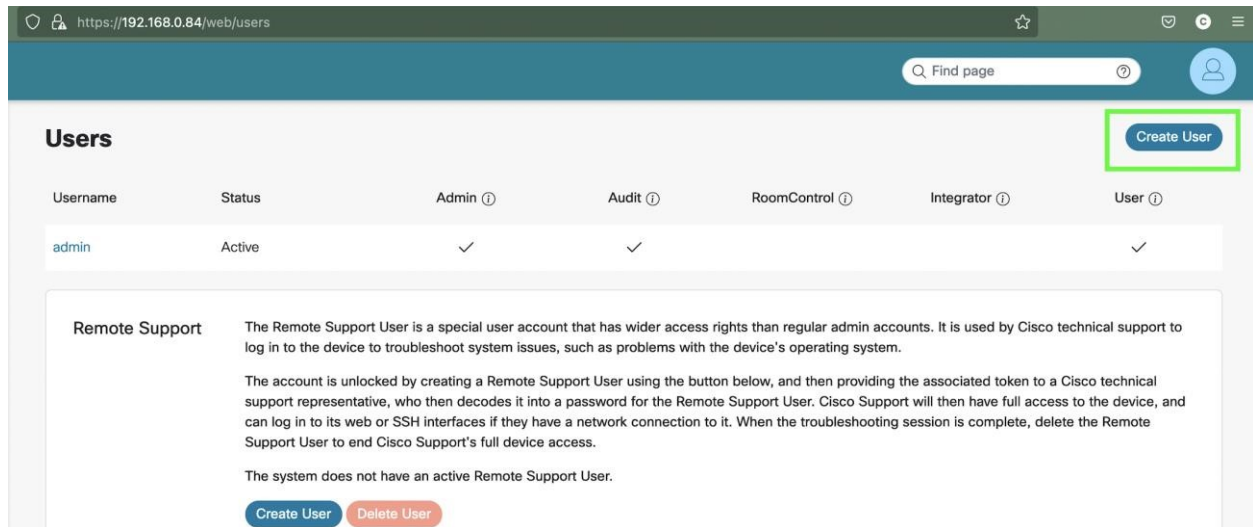


Figure 3: The Create User screen

Do not use the Remote Support section. Instead click on the “Create User” button which you see highlighted here.

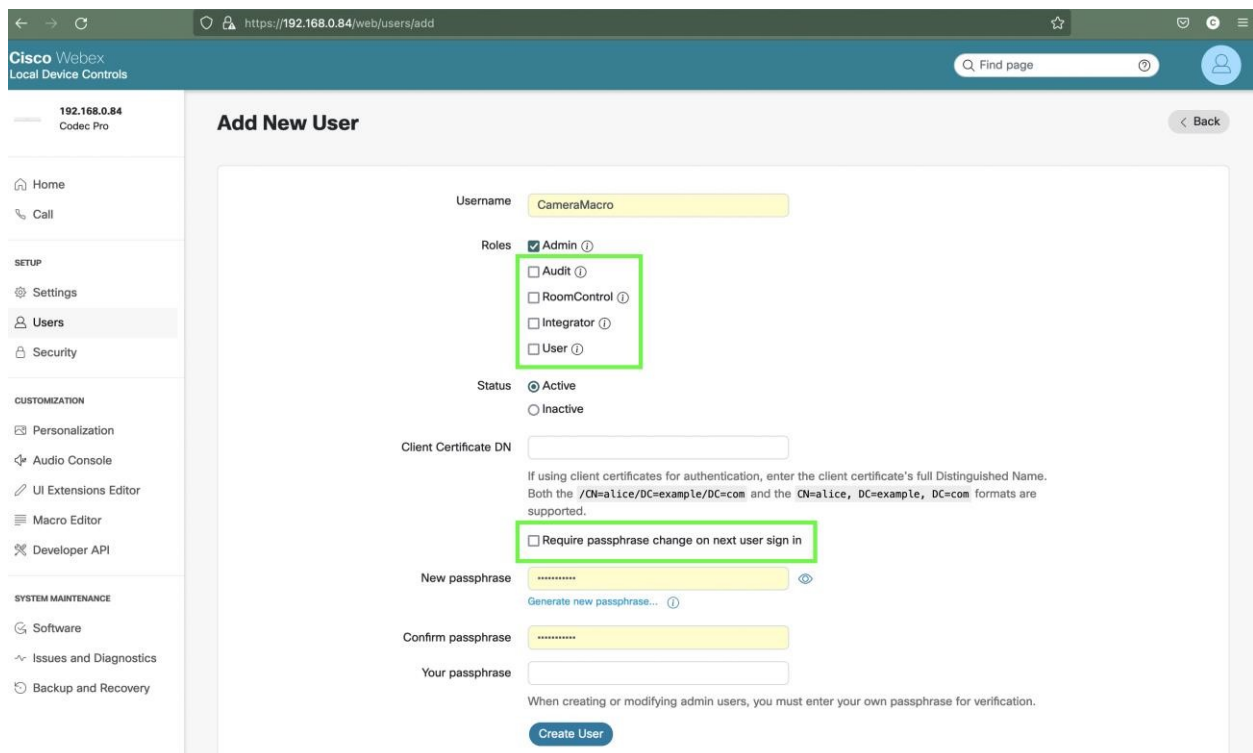


Figure 4: Creating User screen

Here I have created a new Admin user with these credentials:

Username: CameraMacro



Password: CameraMacro

IMPORTANT: Uncheck all Roles except Admin, and uncheck the “Require passphrase change...” box.

To complete the task, click on “Create User”. If you logged in with an existing account that has a password, you would need to include that in the “Your passphrase” field.

You can obviously use any username and password, but I always use this one for inter-codec communication. It is just a standard that I use.

Then, create one more Admin user for exclusive use by you and your team.

Registering to the Webex Cloud? You can do this now if you want, or later

From the Home screen, click on “Register to Webex”. You will need a 16-digit code for each codec, and you need to make certain the sysadmin has told you which one is for the Primary and which is for the Secondary Codec.

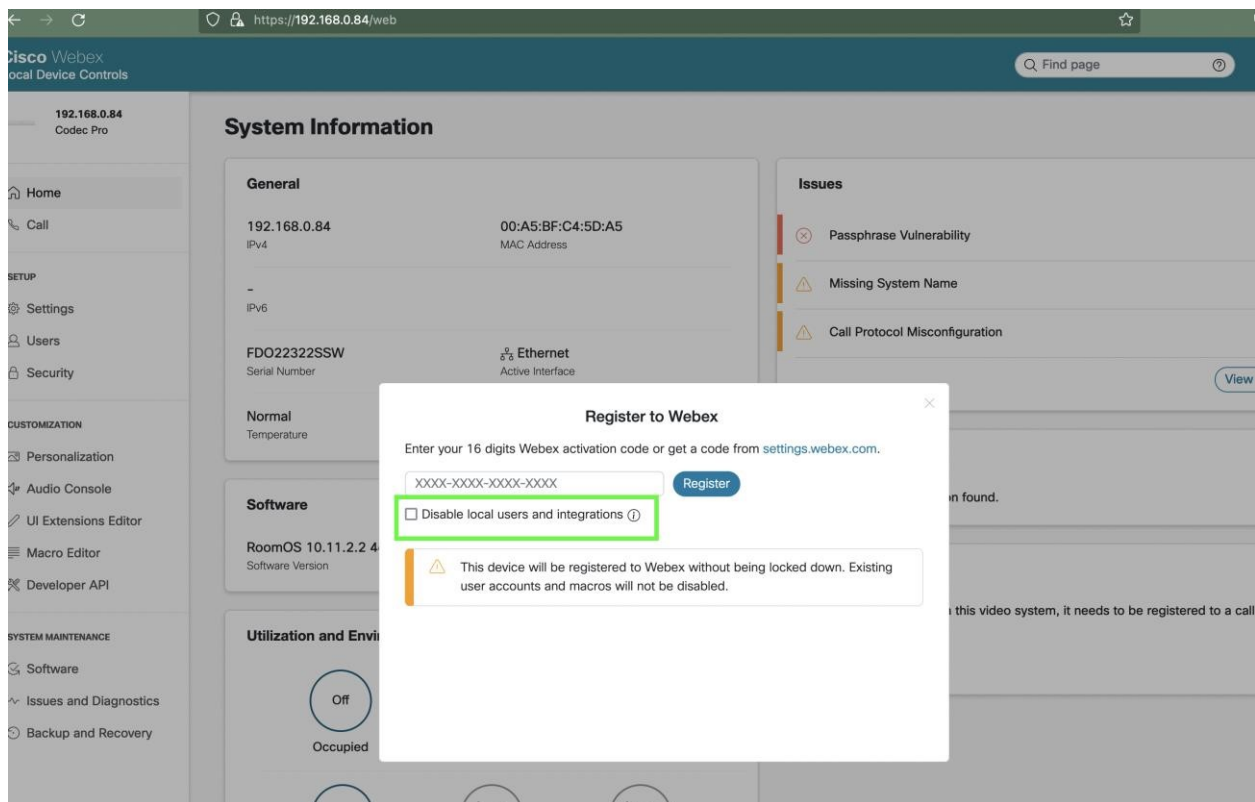


Figure 5: Register to the Webex Cloud

Make sure to uncheck “Disable local users and integrations”. Otherwise you will lose the users you just created.



## Fill in a System Name

If the codecs use CUCM, they will already be given a system name. Otherwise you should give it one. Just click on Settings on the very left hand side of the Home page, and you will see a “Configuration / SystemUnit” screen.

Ignore the CustomDeviceID unless you have explicit instructions for that field, and in the Name field, put something simple that is short and makes sense.

For example, “1794A Primary” indicates conference room 1794A and that it is the Primary Codec. Likewise, “1794B Secondary” would make sense for the other codec. You don’t need quote marks and spaces are OK.

## Web Interface Configuration - Standby

From the Home page, choose Settings on the left, and then scroll down the center section until you find Standby.

There are three major settings and concepts you need to understand.

1. Standby [Control](#) and [Delay](#): It is a good idea to leave the defaults, which mean that after 10 minutes of non-use, the codec will go into Standby mode. The Cisco touch interface will go dark and the screens will turn off. You can adjust the timer to be longer or shorter. If you turn [Control](#) to Off, the codec will never go into Standby mode unless you intervene from the touch interface, web interface, or API.
2. [Halfwake Mode](#): You can use digital signage automatically by entering the URL in the Signage mode section. Internally we use Appspace, but there are other providers as well. If [Halfwake Mode](#) is set for Auto, after 120 seconds of non-use the system will go into Halfwake. If you have a digital signage URL configured, the endpoint will automatically display digital signage until you use it again or set it to Standby. On the other hand, if you don’t use digital signage mode, you may find it annoying that the system goes into Halfwake when you are trying to get work done in the web interface (for example). In this case, set [Halfwake Mode](#) to Manual, and the system will not go into Halfwake unless instructed to via the API or web interface.
3. [WakeupOnMotionDetection](#): This setting will automatically bring the system out of Standby when someone walks into the room when set to On.

Carefully consider each of these features and set them as desired. The macros will adjust them temporarily – on the Secondary Codec only – when the rooms are in Combined Mode, but will reset them to their original values in Standalone Mode.

## Web Interface Configuration - Video

### Label and configure every video input on both codecs

From the Home page, choose Settings on the left, and then scroll down the center section until you find Video.

Among the various settings for each input connector, there is a Name field, which is extremely useful.



Configuration / Video Collapse All Expand All

Input

Miracast Mode Off

Connector 1

CEC Mode On

HDCP Mode Off

InputSourceType camera

Name Quad Camera (0 to 50 characters)

PreferredResolution 1920\_1080\_60

PresentationSelection Manual

Quality Motion

RGBQuantizationRange Auto

Visibility Never

CameraControl

CameraId 1

Mode On

OptimalDefinition

Profile High

Threshold60fps 1920\_1080

Connector 2

CEC Mode On

HDCP Mode Off

InputSourceType camera

Name PresenterCamera (0 to 50 characters)

PreferredResolution 1920\_1080\_60

PresentationSelection Manual

Quality Motion

RGBQuantizationRange Auto

Visibility IfSignal

CameraControl

CameraId 2

Mode On

Figure 6: The Video configuration section with correct settings – both codecs

The first task is to label each video input, even if it is not being used. In addition, set Visibility to Never for everything except local content inputs. This field determines whether the input will be shown in the Share tray.



## Primary Codec

For HDMI input Connectors 1 and 2, name them Quad Camera and Presenter Camera respectively.

For HDMI input Connector 3, use these conventions:

- Name: Secondary Cam (because it is the SelfView tie line from the Secondary Codec)
- InputSource Type: mediaplayer or other (*not* "camera")
- PreferredResolution to 1920\_1080\_60
- PresentationSelection to Manual
- Visibility to Never

If your only content input is on input 5, type "Laptop" or "Computer" or "Content" or whatever makes sense to your users and set Visibility to "If Signal". For the PresentationSelection field, use "Manual" – do NOT use Autosshare, Desktop, or OnConnect.

For any inputs that are actually not used, please name them as well. Type in "Not Used". You will be grateful later



## Secondary Codec

For HDMI input Connectors 3 and 4, name them TieLine 1 and TieLine 2. Inputs 3 and 4 are tie lines from the Primary, and allow the Secondary Codec to mirror the screens in the Primary Room.

Set InputSourceType: to MediaPlayer, set Quality to Sharpness, and Visibility to Never (IMPORTANT: You don't want the Primary room accidentally sharing video from the Secondary Room when they are in Standalone Mode). Make sure CameraControl is set to Off, Profile is High, and Threshold60Fps is Never.





Configuration / Video Revert Save Collapse All Expand All

Connector 3

CEC Mode

①

On

▼

HDCP Mode

①

Off

▼

InputSourceType

①

mediaplayer

▼

↻

Name

①

TieLine 1

▼

↻

(0 to 50 characters)

PreferredResolution

①

3840\_2160\_30

▼

↻

PresentationSelection

①

Manual

▼

↻

Quality

①

Sharpness

▼

↻

RGBQuantizationRange

①

Auto

▼

Visibility

①

Never

▼

↻

CameraControl

CameralId

①

3

▼

Mode

①

Off

▼

OptimalDefinition

Profile

①

High

▼

Threshold60fps

①

Never

▼

↻

Connector 4

CEC Mode

①

On

▼

HDCP Mode

①

Off

▼

InputSourceType

①

mediaplayer

▼

↻

Name

①

TieLine 2

▼

↻

(0 to 50 characters)

PreferredResolution

①

3840\_2160\_30

▼

↻

PresentationSelection

①

Manual

▼

↻

Quality

①

Sharpness

▼

↻

RGBQuantizationRange

①

Auto

▼

Visibility

①

Never

▼

↻

CameraControl

CameralId

①

4

▼

Mode

①

Off

▼

OptimalDefinition

Profile

①

High

▼

Threshold60fps

①

Never

▼

↻

Figure 7: Video configuration for inputs 3 and 4 – Secondary Codec



If your only content input is on input 5, type “Laptop” or “Computer” or “Content” or whatever makes sense to your users, and set Visibility for “If Signal.” For the PresentationSelection field, use “Manual” – do NOT use Autoshare, Desktop, or OnConnect.

For any inputs that are actually not used, please name them as well. Type in “Not Used”.

## Primary Codec

Then, go back and check all of the other settings for each video input that is not managed by the macro:

Connectors 4, 5 and 6.

Remember that any input sources that are used for cameras must have “Camera” as the InputSourceType. This is what allows them to be selected from the camera drop-down box on the Navigator or Touch 10. Also – for any cameras, make sure you use consecutive CameraIDs, and list the serial numbers for each camera in the Camera section of the Settings screen.

## Secondary Codecs

Again, go back and check all of the other settings for each video input – Connectors 2, 5 and 6. The same rules apply for cameras as for the Primary Codec.

## HDCP Content

HDCP content is supported on the Codec Pro on HDMI input connector 5 (it must be enabled in the web interface in the Video Input section), and on output connectors 1 or 2. Because of DCP rules preventing long-haul transmission of protected content, any HDCP content will be seen locally only. In order to support local HDCP content display while in Combined Mode, the Secondary Codec must receive the video signal on HDMI input connector 5, with HDCP Mode turned On. Since we already use tie lines going into HDMI input connectors 3 and 4, it would be necessary to add some electronics to support HDCP. If you wish to have two HDCP sources – one in the Primary Room and one in the Secondary Room, for example – then you will need a small matrix switcher that supports HDCP. In Standalone Mode, each codec would have an independent HDCP source routed to HDMI input 5; but in Combined Mode, the source in the Primary Room would be routed to both Codecs’ input 5 simultaneously. It is possible that a Lightware matrix switcher could accomplish this, with CE Macro programming making use of the L3 library, as mentioned above in this document.

## Both Codecs – stating again with some repetition

**PreferredResolution:** for all cameras, set this to 1920\_1080\_60, including Connector 2. For content sources, set it to 3840\_2160\_30 which is 4K. Even if you don’t think the customer’s laptops can do 4K, you should set it anyway. **Quality** should be Motion for all camera sources and Sharpness for all content sources.

**Visibility** is very important! This setting allows the Connector source to be seen in the Share Tray, or not. For any sources that you absolutely do not want shared set them to **Never**. Do the same for any Connectors that are Not Used. Connectors 3 and 4 on the Secondary Codec which are automatically set to **Never** by the macro.



For legitimate content sources, set them to “IfSignal”.

PresentationSelection is equally important!

Do not use Desktop or OnConnect for any divisible / combined rooms. Strange Navigator behaviors will occur if you use either one. Instead, use “Manual”.

Lastly, the Optimal Definition section is very useful. For cameras with good lighting, set the Profile to High. If lighting is poor in the room, use Normal. For content sources, set the Profile to High. Why? This setting will increase transmitted resolutions if set for High, and use lower resolutions if set to Normal.

Threshold60fps: set at 1920\_1080 for cameras and “Never” for content sources, unless you specifically want 60fps on a laptop in order to show videos.

## Web Interface Configuration – Video Outputs

The important thing here is to configure HDMI output 3 on the Secondary Codec with Resolution of 1080p60. This is the camera tie line from the Secondary to the Primary, and by definition the video signal will always be 1080p. HDMI video outputs 1 and 2 will be driving the local screens. If the screens support 4K, then set the resolution for 4K60 or 4K30.

## Web Interface Configuration – Audio Settings

For the most part, the macros take care of the audio settings. See the Audio Console section below.

However, you should make sure to configure all of the microphone inputs. On the Primary Codec, you can use microphone inputs 1 – 7 (#8 is reserved for an audio tie line). On the Secondary Codec, you can use all eight microphone inputs.

- For any mic inputs that are not used, set Mode: Off.
- When using DSPs or dynamic microphones, turn PhantomPower Off.
- When using Cisco Table Microphones, you can leave the Level settings at the default of 58. For 3<sup>rd</sup> party microphone systems, or Cisco Ceiling Microphones, use the VU Meters to set the correct levels.
- The macro will force a gain level of 18 on the Primary Codec, mic input #8, which is the audio tie line from the Secondary. During testing, if the levels from the Secondary mics need to be adjusted, you can do this from Audio Console. See Figure 18.

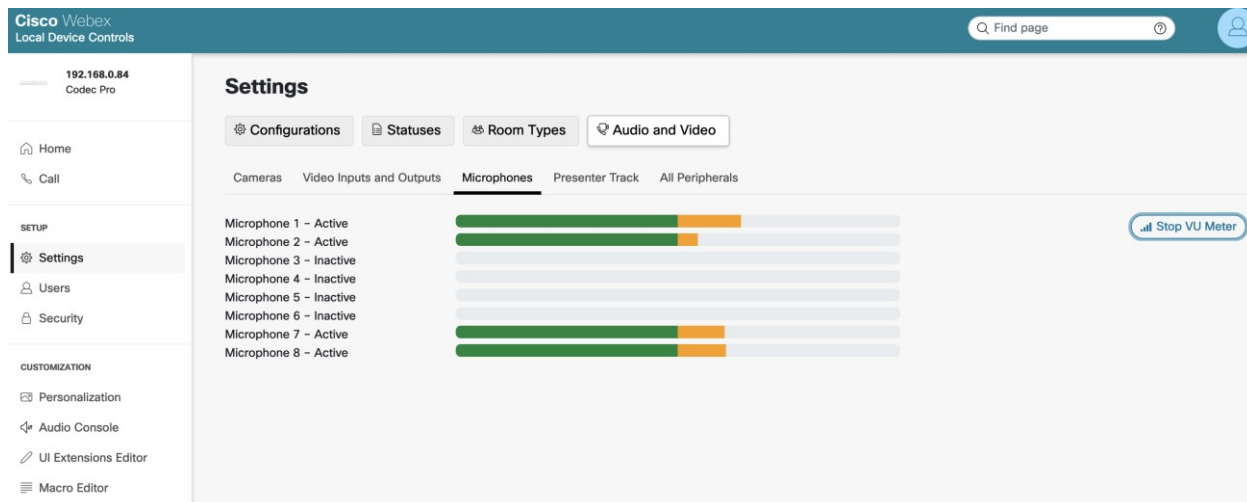


Figure 8: The VU meters

## Loudspeaker Systems

For very small conference rooms, the Quad Camera is sufficient, with a max output level SPL 90dB. It is also possible to augment the Quad Camera with ceiling speakers, which give very good results and also allow for sound reinforcement of presenter microphones. Any type of external sound system can be used – wall-mounted frontfiring speakers, ceiling speakers, hanging pendant speakers, etc. We strongly recommend wiring external sound systems in stereo, since this improves the aural experience for the users.

Line outputs 1 and 2 are defaulted to balanced line level at nominal +4dBu. The output levels are adjustable, and they can be set for monaural if necessary. There are a total of 6 line outputs, and on the Secondary Codec, line output #5 is reserved for use as an audio tie line. Audio Console can be used to apply custom routing to any line output, as well as to define up to eight parametric equalizers and apply them almost anywhere in the audio path.

## Audio Gain Structure

When using a Room Kit Pro with a Quad Camera, out of the box, the installer does not need to worry about gain structure. The Codec Pro volume level is defaulted at 50% (in the web interface and API), and the Quad Camera loudspeakers will sound just fine. The user can adjust the volume, via the Touch UI, as needed.

However, whenever an external audio system is used, the audio gain structure becomes more important. In fact, when using divided / combined conference rooms, getting the gain structure correct is absolutely critical. When I help installers during commissioning with divisible conference rooms, I estimate that more than 90% of them need help getting the gain structure correct.

**Why?** Because, in Combined Mode when using the Codec Pros' DSPs, each one is acting as a submixer for the other codec. For example, conference audio is generated by the Primary Codec, and sent over to the Secondary Codec via embedded HDMI audio. The Secondary Codec receives the audio on HDMI input #3 where the input level needs to be set correctly. Another example is in the other direction – all of the ceiling microphones (or table mics) in the Secondary Room are summed together and sent out Line Output 5, being received by the Primary Codec on



Mic input 8. The output and input levels must be carefully set; the macro enforces the correct input gain on Mic input 8.

When using 3-way and 4-way splits, as you can imagine, getting the gain structure correct becomes even more important. Fortunately there are some relatively simple rules:

- Change the DefaultVolume via the web interface: [Settings / Configurations / Audio / DefaultVolume](#) from 50 to 70. This will be reflected in the volume control on the Touch 10 / Navigator. This gives the echo canceler the best chance of working correctly.
- Test audio in each room individually first. Make a video call to a known good system, and with the volume control set to 70%, adjust the input gain on the amplifier until the audio level in the room sounds correct. If necessary, you can adjust the output gain on the codec Line outputs – typically Line 1 and Line 2 – up or down from the default of -4. The nominal gain on the Line outputs is +4dBu.
- Once you are satisfied with the audio levels in both rooms, you can combine them and test again. The sound from the far end should be equal in both rooms. If it is not, adjust the Secondary Codec's HDMI 3 input level as needed.
  - You will notice that there is an audible delay during this test, where one room does not quite match the other. As mentioned earlier you should add at least 12ms delay to all of the Primary Codec loudspeaker outputs. This will fix the perceived arrival time differences between the two rooms.
  - Make sure that you do *not* add any delay to the Secondary Codec loudspeaker outputs.
- The last test is again in Combined Mode. Assuming ceiling speakers, have one person speak in a normal tone of voice while walking back and forth between the audience portions of each room. The volume should sound consistent to your test person on the other end of the video call. If you need to make adjustments, use the Audio Console to adjust the gain of the tie line from the Secondary Line output 5 to the Primary mic input 8, by right-clicking the connector. This is illustrated in the Audio Console section.

The benefit of doing all of this work to tune the gain structure, is that during normal operation, the users can raise and lower the volume without worrying about artifacts or echo, so long as unity gain is properly setup during installation.

## Ultrasound

All Cisco video devices use ultrasound in the range of 20-22 kHz for pairing with computers, tablets, and phones. There are several useful applications used with pairing. When setting up divisible rooms, it is important to check for leakage of ultrasonic frequencies between the rooms when the wall is closed. A simple RTA application – like SpectrumView from OxfordWaveResearch for the iPhone – can be used to check for the existence of frequencies in the 20-22 kHz range. (You must first go to settings and set the Recording sample rate for 48000.)

With the wall closed, and the Primary Codec ultrasound volume set to zero, check in the Secondary Room for a signal. Your screen should look like this:



Figure 9: Ultrasonic frequencies

Assuming you see the waveforms between 20000 and 22000, walk over to the Primary Room and check again. You should see no waveforms, because the wall is closed and you don't want leakage.

The Quad Camera will transmit ultrasound. Care needs to be taken with external sound systems. For example, if the specs on the loudspeakers are up to only 17 kHz, ultrasound might cause a buzzing sound and you would want use a low pass filter (using Audio Console) to avoid sending ultrasound to the ceiling speakers.

If you do experience some leakage of ultrasound between rooms, you can adjust the ultrasound volume down from the default of 70 to something lower.

WakeUpOnMotionDetection: This is off by default. If you want to use it, turn it On.

## Web Interface Configuration – Other Settings

Wireless microphones: By default, only the Primary Room w/l mics can be used when the rooms are combined. If there is a requirement for Secondary Room w/l mics to also be used when the rooms are combined, just add in one RDL STM-DA3 (Radio Design Labs) for each w/l microphone in the Secondary room. It will allow you to split the mic signal for use in the Primary Codec when the rooms are combined. The macros need to be modified slightly to turn microphone inputs on and off, but this is not difficult.

In the web interface - Config / Video, this value is ILLEGAL: Monitors: Auto. You must change it. Most installations will use Monitors: Dual, or Monitors: DualPresentationOnly. But if there is only one screen in the room, then it would be set for Monitors: Single.

The current design does not support Monitors: Triple or Monitors: TriplePresentationOnly.



Make sure to set the MonitorRole settings on the HDMI outputs correctly.

#### LONG HDMI RUNS

You will note that we are specifying FSR Digital Ribbon Cables for long HDMI runs. They come in different lengths and can be found here: [https://fsrinc.com/fsr-products/product/p8k-digital-ribbon-cable/category\\_pathway-156](https://fsrinc.com/fsr-products/product/p8k-digital-ribbon-cable/category_pathway-156)

There are several reasons we specify them:

- a) They are the best hybrid fiber / copper HDMI cable, because they are powered at both ends and support wall plates.
- b) They do not have removeable connectors – best to stay away from those types of cables.
- c) They are less expensive and more reliable than active extender pairs.

On the other hand, the fiber component is fragile and care must be taken when pulling them. In addition, the attached HDMI connectors mean that narrow conduit runs are not feasible.

Sound Control Technologies makes excellent extenders for both Cisco cameras and Cisco microphones, using UTP cable, so there are alternatives.



## Section Four – The Remote Experience

The programming that is running on the Primary Codec makes decisions to automate camera behaviors during calls.



Figure 10: Side by side video

At the beginning of the call, and at other times, an Overview shot is chosen to send to remote participants. In a divisible conference room with two Quad Cameras, a camera preset is used on each Codec Pro (preset ID #30) and both camera images are sent side by side. This establishes to remote participants that there are two rooms with people in the conference, and allows them to see everyone.

This side by side Overview shot is also used at two different times: when nobody in either room has spoken for a long time, and if someone mutes the microphones – as if desiring a sidebar conversation.

At all other times, the cameras switch automatically.

*Instructions for setting preset ID #30 are at the end of this section, on page 23.*



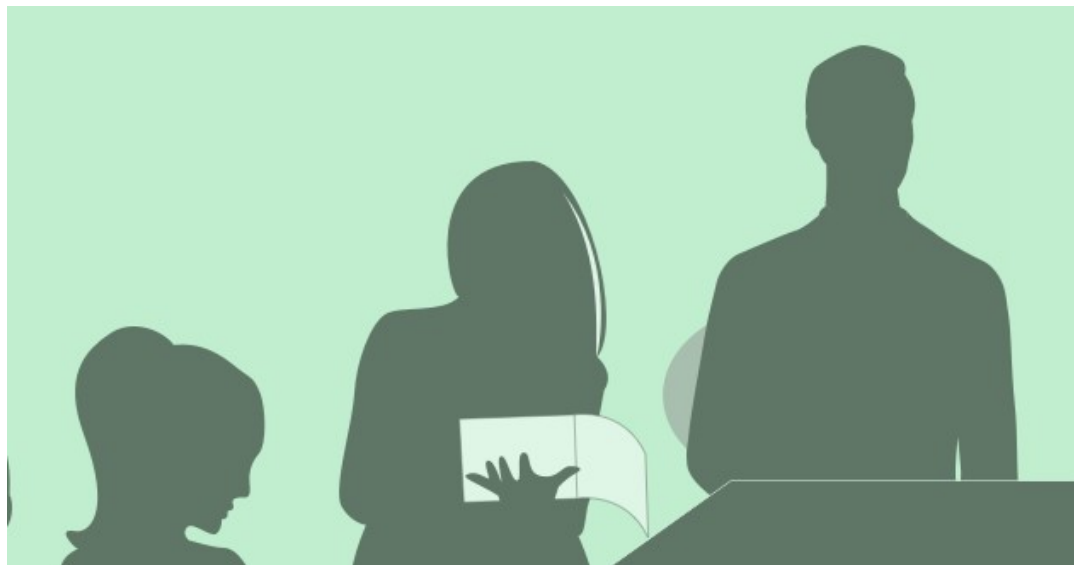


Figure 11: Primary Room camera

This image show what happens when someone in the Primary Room has started speaking. The main program running on the Primary Codec Pro determines that there is a person speaking in the Primary Room, and three things happen:

1. The Primary Codec enables its own Quad Camera instead of the side by side Overview.
2. The Quad Camera looks for the active speaker, and zooms in to that person.
3. In the meantime, the Primary Codec tells the Secondary Codec to enable its own Quad Camera, to be ready for the next shot.

If the person speaking is located in the Secondary Room, the Primary Codec then selects video input #2, which is the feed from the Quad Camera in the Secondary Room. To be specific, these things occur when someone is speaking in the Secondary Room:

1. The Primary Codec selects HDMI input #2 as the main video source.
2. The Quad Camera in the Secondary Room has already found and zoomed in to the active speaker.

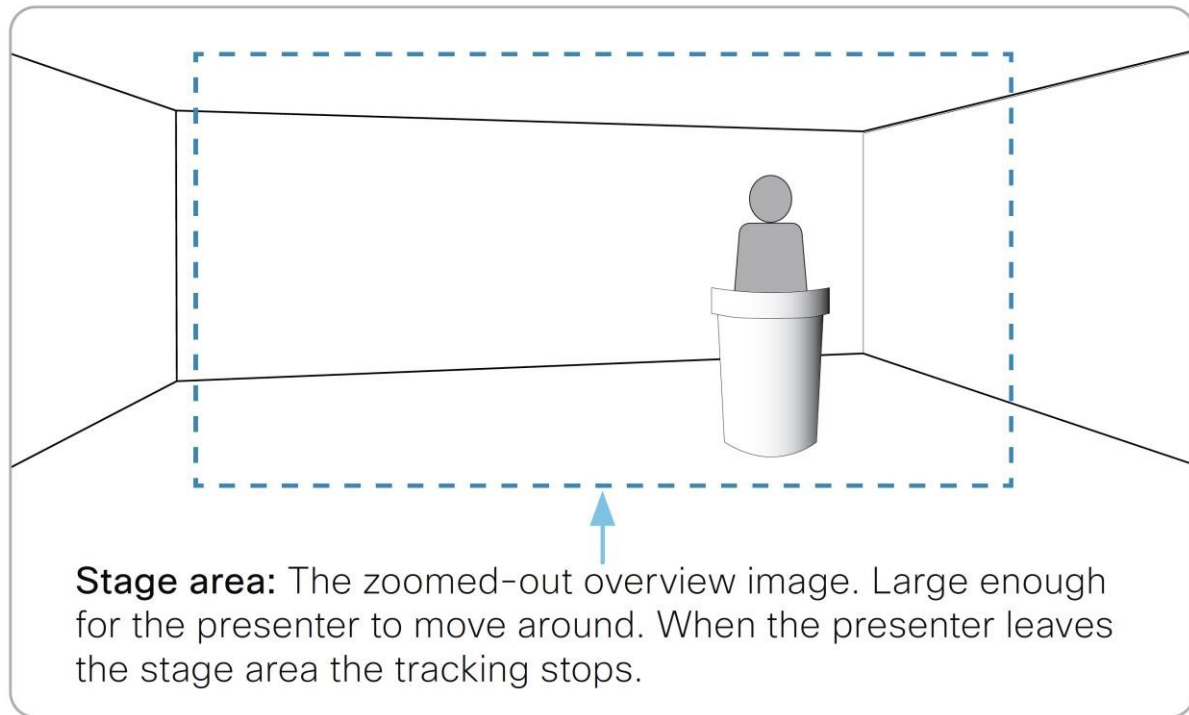


Figure 12: Presenter camera

The fourth and last camera behavior is when the presenter is leading the meeting. The Cisco PTZ 4K Camera is activated – either manually on the Navigator panel or automatically thru a podium or wireless microphone – and that camera image becomes the main video source. PresenterTrack technology allows the camera to track a roving presenter, and this feature can be installed using a simple Wizard in the codec's web interface. It requires no license or extra cost.

#### Instructions for setting Preset ID #30.

1. Open SSH sessions into both the Primary and Secondary Codecs.
2. Using the touch interface, select the Quad Camera and use the PTZ controls to adjust both cameras until you have a seamless shot across both rooms. Obviously, use full screen SelfView while you are doing this, on both codecs.
3. You can make minute adjustments to the position of each camera by using these API commands:  
[xStatus Cameras Camera 1 Position](#)  
 This will return numeric values for pan, tilt, and zoom, among others. You can adjust the pan, tilt, or zoom by small amounts using this API command:  
[xCommand Camera Position Set CameraID: 1 Pan: <xxx> \(or Tilt, or Zoom\)](#)
4. Once you are satisfied with the camera view, use the API to store the preset - *do not use the Touch 10 or Navigator to store the preset.*
5. Here is the API command you need to use on each codec:



*xCommand Camera Preset Store CamerId: 1 Name: Overview PresetId: 30*

### **Cisco-provided JavaScript**

Cisco is providing JavaScript code at no charge, as part of a larger effort to standardize two-way divisible room programming. However, this is considered sample code, under a license that can be found here:

<https://developer.cisco.com/docs/licenses>

Part of the wording of the license says the code is provided on an as-is basis, without warranties of any kind. This is true of all sample code that can be downloaded from GitHub or RoomOS.cisco.com. What this means is that Cisco does not own maintenance of the program and will not take TAC calls on the programming. As is normal in any custom AV integration, the AV integrator takes responsibility for correct operation of the entire solution, including the programming. The intent of Cisco-provided code is to standardize Boardroom solutions, reducing cost for both the AV integrator and the customer, while simultaneously using Cisco Best Practices in the design of the solution. The intent is that Cisco will provide operational code, but in all cases the integrator / programmer should be prepared to take ownership of the coding if there are issues. Fortunately we have several customers who will be testing the solution and providing feedback to our programmers directly.

### **Programming**

The CE Macro Framework is a JavaScript-based development environment that allows custom programs to run directly on the codec. Both the Primary and Secondary Codecs run two macros that enable the automatic operation of the system. In general terms, the programming provides the following logic flow:

- A default configuration is run on each codec every time it boots up. These configurations and commands set the codec up for proper operation, overriding certain settings that must not be changed by the user.
- In Standalone Mode, each codec runs a small set of additional configurations and commands to ensure correct audio and video routing for each room to operate independently.
- In Combined Mode, a different set of configurations and commands are run to enable both rooms to act as one. Some of the things that happen:
  - The Secondary Codec is put into DoNotDisturb so that it can't receive a video call.
  - The Navigator touch interface on the Secondary Codec is locked out with a message to use the touch panel in the Primary Room.
  - Audio and video routing are changed so that the Secondary mirrors the Primary's video and audio.
- In addition, there is a non-volatile memory macro on each codec. For example, the Primary Codec stores the current state – Combined or Standalone – for graceful recovery in the event of a power outage, as well as other variables and constants.



### **Project Management**

We highly recommend that the customer team or integrator engage an experienced project manager, in order to keep the project moving along and facilitate information exchange. This can only occur with proper and frequent communication.

### **Design Changes**

Please keep Cisco informed if there are any major design changes during project development, or even after installation and commissioning is complete.

## **Section Five – Audio Console Configuration**

This section of the document provides instructions and screen shots for configuring the Audio Console for each codec. If you are unfamiliar with the Audio Console, download a Customization Guide from <https://www.cisco.com/go/in-room-control-docs>.

Browser – Both a MAC user and a PC user have found that the Firefox browser works best in Audio Console. It also remembers your authentication into each codec, making it simple to log in.

### **Primary and Secondary Codecs**

The first task in Audio Console is to simplify things a bit. I do this for both codecs, by removing unneeded Input Groups.

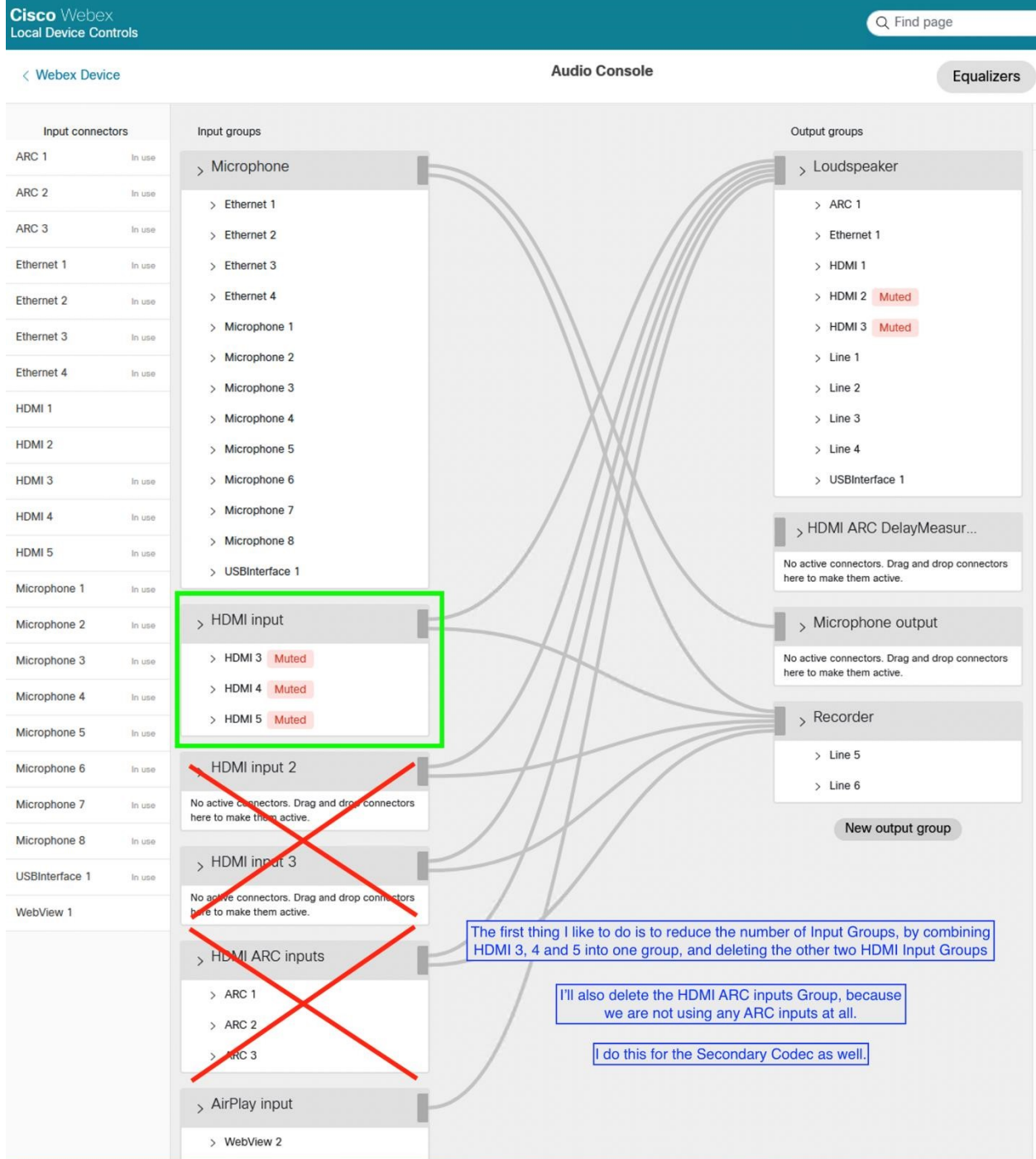


Figure 13: Primary and Secondary Codec changes in Audio Console

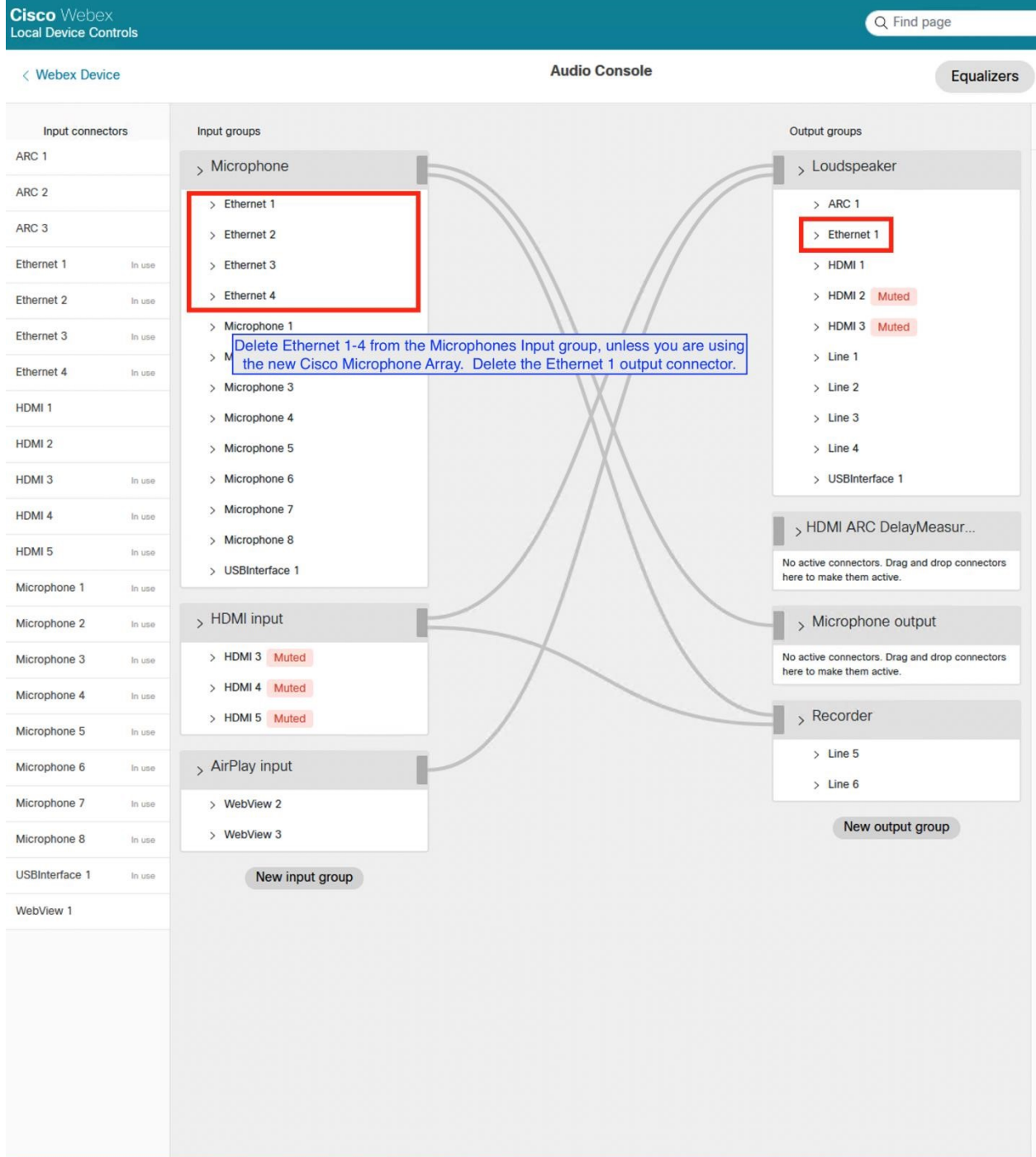


Figure 14: Primary and Secondary Codec changes in Audio Console



In the **Primary Codec only**, add 12ms delay to all loudspeaker outputs. This ensures both rooms will have synchronized sound when combined.

Cisco Webex  
Local Device Controls

Find page

Webex Device Audio Console Equalizers

Input connectors

- ARC 1
- ARC 2
- ARC 3
- Ethernet 1
- Ethernet 2
- Ethernet 3
- Ethernet 4
- HDMI 1
- HDMI 2
- HDMI 3
- HDMI 4
- HDMI 5
- Microphone 1
- Microphone 2
- Microphone 3
- Microphone 4
- Microphone 5
- Microphone 6
- Microphone 7
- Microphone 8
- USBInterface 1
- WebView 1

Input groups

- > Microphone
  - > Microphone 1
  - > Microphone 2
  - > Microphone 3
  - > Microphone 4
  - > Microphone 5
  - > Microphone 6
  - > Microphone 7
  - > Microphone 8
  - > USBInterface 1
- > HDMI input
  - > HDMI 3 Muted
  - > HDMI 4 Muted
  - > HDMI 5 Muted
- > AirPlay input
  - > WebView 2
  - > WebView 3

New input group

Output groups

- > Loudspeaker
  - > ARC 1
    - Mode On
    - Delay (ms) 12
    - Delay Mode RelativeTo...
  - > HDMI 1
  - > HDMI 2 Muted
  - > HDMI 3 Muted
  - > Line 1
    - Mode On
    - Level (dB) -4
    - Channel Left
    - Delay (ms) 12
    - Delay Mode RelativeTo...
    - Equalizer Off
  - > Line 2
    - Mode On
    - Level (dB) -4
    - Channel Right
    - Delay (ms) 12
    - Delay Mode RelativeTo...
    - Equalizer Off
  - > Line 3
  - > Line 4
  - > USBInterface 1
- > HDMI ARC DelayMeasur...
- > Microphone output

Add 12ms Delay to every output connector that drives a loudspeaker. Remember you can use the Quad Camera as a loudspeaker too.

Figure 15: Primary Codec ONLY changes in Audio Console





Next, add sound reinforcement to both codecs (optional).

Cisco Webex  
Local Device Controls

Webex Device Audio Console Equalizers

Input connectors

- ARC 1
- ARC 2
- ARC 3
- Ethernet 1
- Ethernet 2
- Ethernet 3
- Ethernet 4
- HDMI 1
- HDMI 2
- HDMI 3 In use
- HDMI 4 In use
- HDMI 5 In use
- Microphone 1 In use
- Microphone 2 In use
- Microphone 3 In use
- Microphone 4 In use
- Microphone 5 In use
- Microphone 6 In use
- Microphone 7 In use
- Microphone 8 In use
- USBInterface 1 In use
- WebView 1

Input groups

- > Microphone
  - > Microphone 1
  - > Microphone 2
  - > Microphone 3
  - > Microphone 4
  - > Microphone 5
  - > Microphone 6
  - > Microphone 8
  - > USBInterface 1
- > HDMI input
  - > HDMI 3 Muted
  - > HDMI 4 Muted
  - > HDMI 5 Muted
- > AirPlay input
  - > WebView 2
  - > WebView 3
- > Sound Reinforcement
  - Direct On
  - Mixer Mode Fixed
  - Mute Off
  - AGC Off
  - Channels 1
  - > Microphone 5
  - > Microphone 6

Output groups

- > Loudspeaker
  - > ARC 1
  - > HDMI 1
  - > HDMI 2 Muted
  - > HDMI 3 Muted
  - > Line 1
  - > Line 2
  - > Line 3
  - > Line 4
  - > USBInterface 1
- > HDMI ARC DelayMeasur...
- > Microphone output
- > Recorder
  - > Line 5
  - > Line 6

New output group

Draw a new connector line from the Sound Reinforcement Input group to the Loudspeaker group.

Add a new Input Group for amplified microphones. Per the system drawings, we are amplifying mics 5 and 6. Be sure to set "Direct" to On. These mics will now be amplified whether in a call or not.

Figure 16: Adding optional sound reinforcement in Audio Console





## Now, moving on to the Secondary Codec...

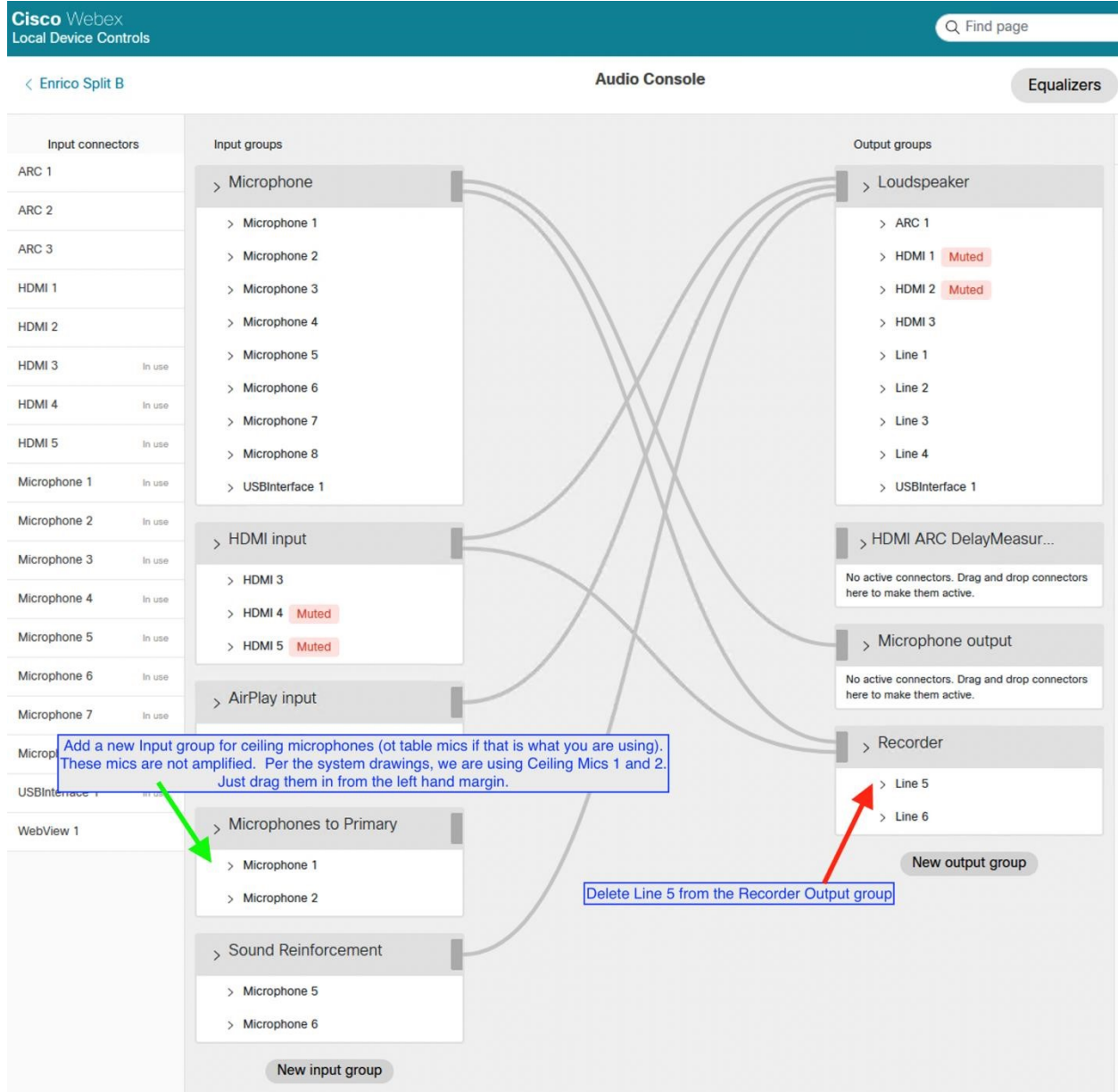
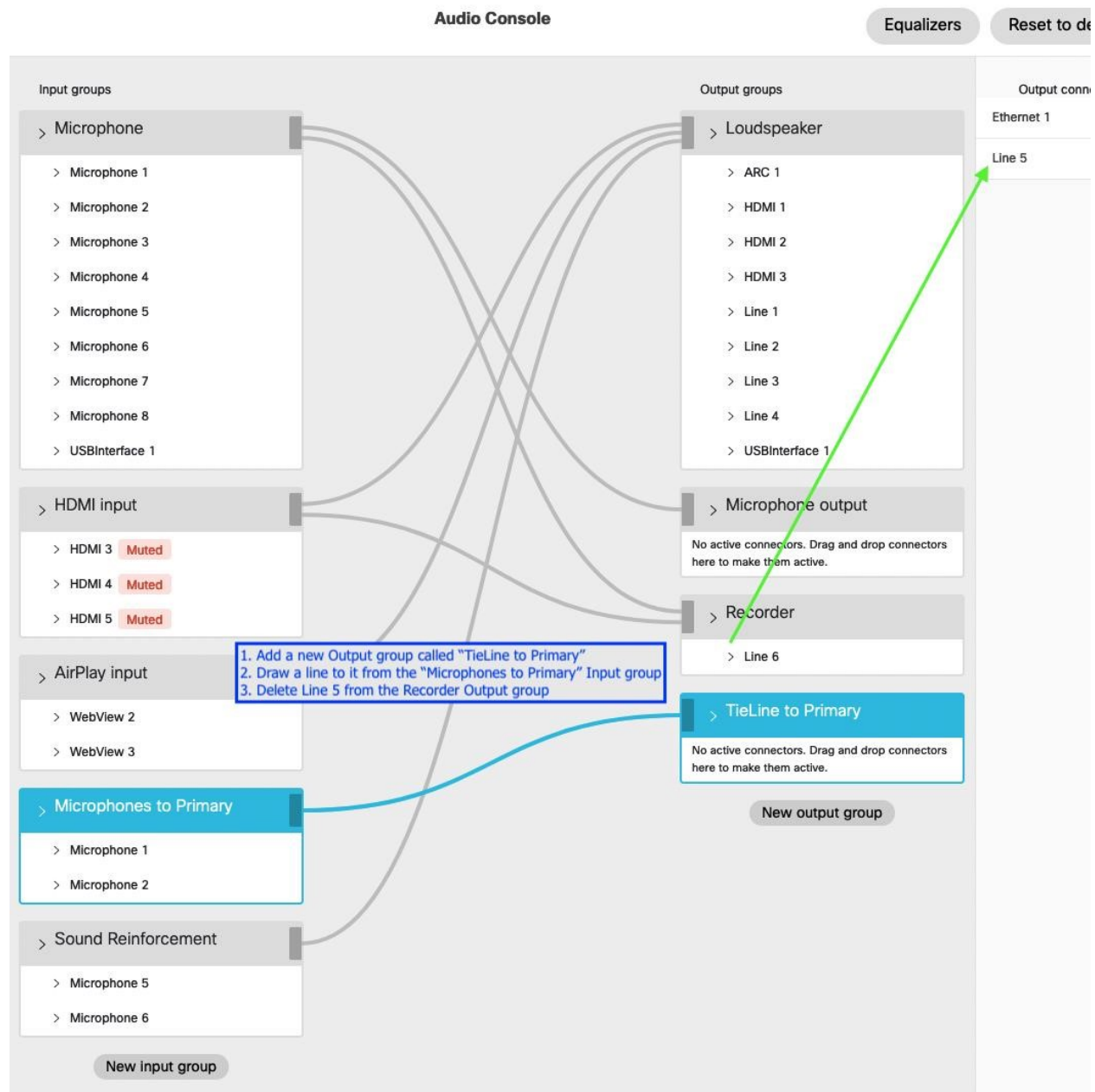


Figure 17: Secondary Codec changes in Audio Console

Add a new output connector and prepare to use Line output 5.



You may find you need to increase the gain of the connector you just added by right-clicking. Check the VU Meter on the Primary for Mic input #8 to test the levels. The volume of the Primary ceiling microphones, and the volume of the Secondary ceiling microphones, should sound the same to the far end when the rooms are combined. This is where you would adjust the level of the Secondary microphones if necessary.

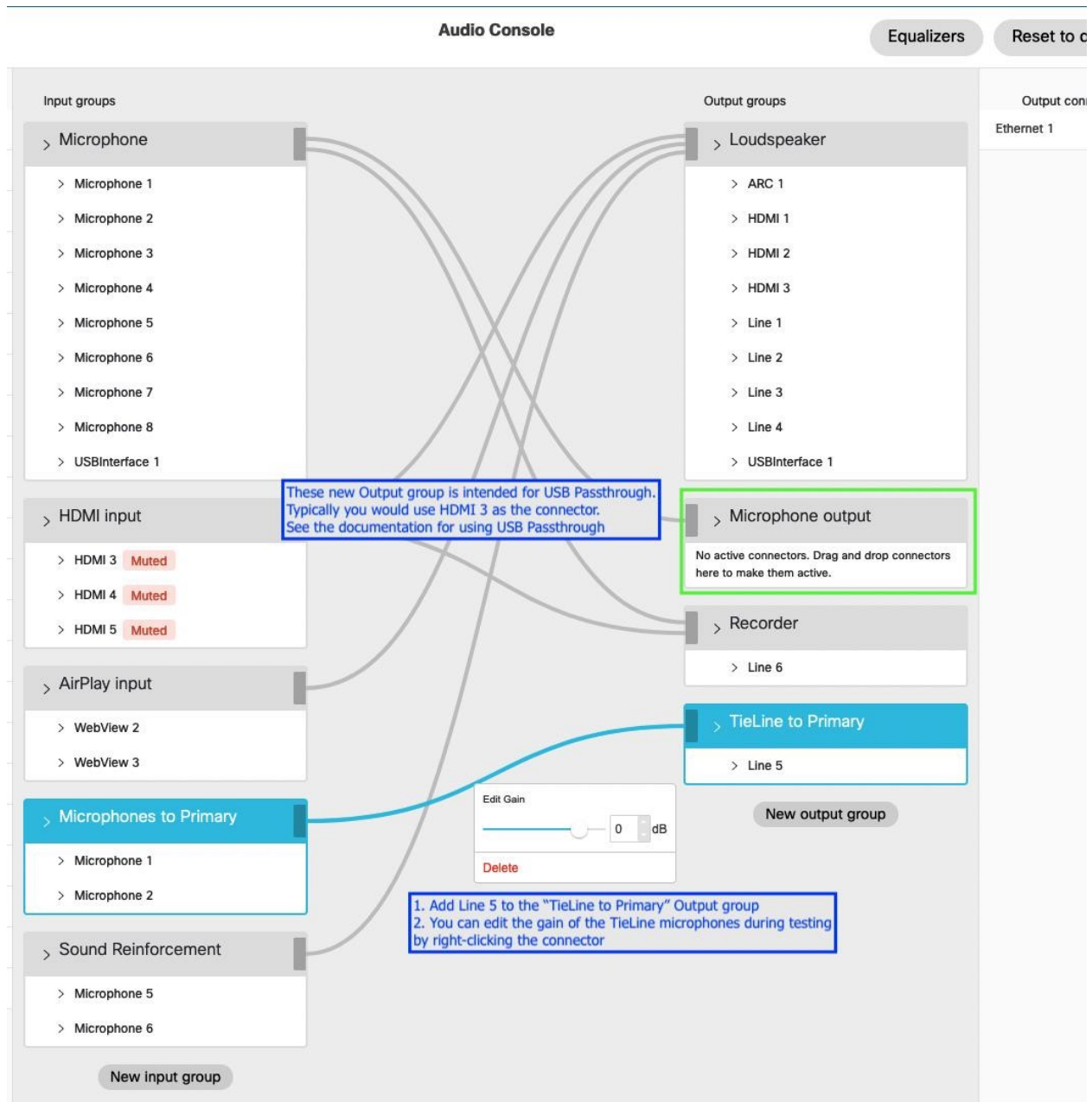


Figure 19: Secondary Codec changes in Audio Console – adjusting gain of microphones to Primary

Next, make some adjustments to the new Input and Output groups.

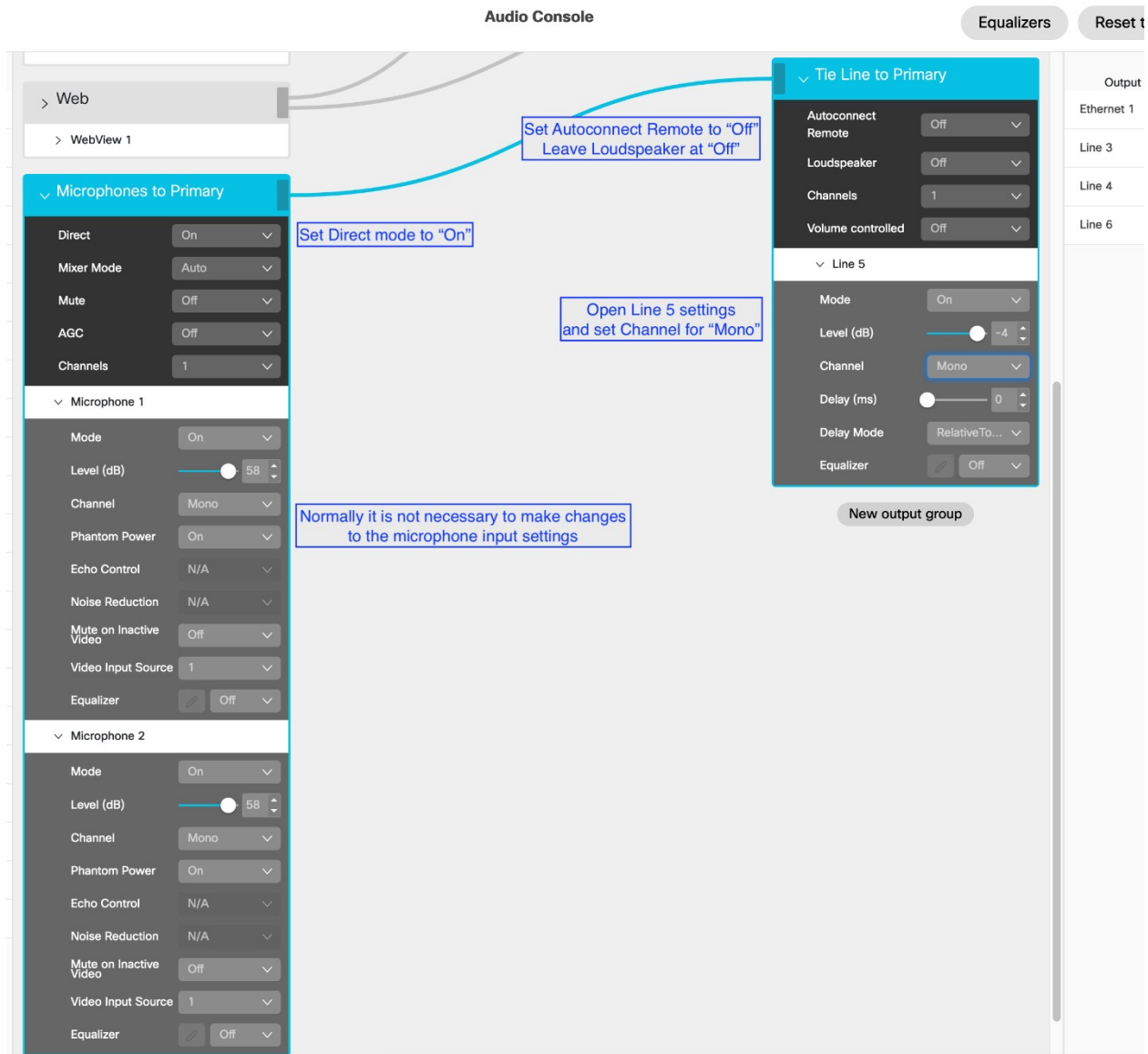


Figure 20: Secondary Codec changes in Audio Console

**Note:** In these Audio Console screenshots, we are following the Audio page in the system drawings. In those drawings, there are two ceiling microphones and two amplified microphones. Your installation may well have more microphones – just make sure you place them in the correct Input group for each codec. It is a best practice to turn off any unused microphone inputs in the web interface.

[Link: Return to Table of Contents](#)



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