Application Note

Integrating Polycom SoundStructure with the ATX and ATX SDK Immersive Telepresence Systems

Introduction

This application note describes how to integrate a SoundStructure C-series device with an ATX 300 and the ATX 200, 300, and 400 SDK telepresence systems, collectively referred to as an 'ATX system' in this application note. The SoundStructure Studio configuration required and the physical interconnect for successful integration is described. The example SoundStructure configuration file is available for download directly from Polycom's website [1].

The addition of a SoundStructure system to an ATX system enables an integrator to extend the capabilities of the ATX system through:

- Adding additional Polycom microphone arrays, analog microphones, presentation microphones, wireless microphones, push-to-talk microphones, telephony interfaces, overflow room support, additional loudspeaker zones, logic output applications, and more.
- Adding more in-room audio processing capabilities including equalization, adjustable noise reduction settings, custom microphone panning, gain sharing automixer, and dynamics processing to improve the in-room and far-end room audio experience

To add a SoundStructure system to an ATX system, first follow the ATX system Integrator's guide and configure the HDX 8000 codecs using the standard configuration tool [2]. Once the ATX system has been configured, then follow these steps.

1. Unplug the Polycom microphone arrays and the audio amplifier from the primary HDX 8000 codec
2. Connect the SoundStructure device to the primary HDX 8000 codec
3. Connect the audio amplifier to the SoundStructure device
4. Connect the Polycom microphone arrays to the SoundStructure device
5. Modify the example SoundStructure configuration file as necessary
6. Upload the configuration file to the SoundStructure system

These steps are described in detail in the remainder of this application note.

While any SoundStructure C-series device or system of SoundStructure C-series devices may be added to the ATX system, depending on the number of audio channels required, this application note and the resulting SoundStructure configuration files are based on a single SoundStructure C16 device. The solution presented in this application note also includes an optional ceiling-fill loudspeaker zone to improve the audio experience in larger rooms.

Supported Software Versions

This application note was tested with the HDX video codecs running firmware version 3.0.1 or later. The SoundStructure device is running firmware v1.3.3 or later and SoundStructure Studio version should be v1.5.0 or later.

When the SoundStructure system is integrated with the ATX system, video calls connecting with Cisco Telepresence Interoperability Protocol (TIP) mode is not supported.

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Step 1. Unplug the Polycom microphone arrays and amplifier

If the system is already wired with the Polycom microphone arrays connected to the HDX8000 codec, unplug the microphones and amplifier from the codec. The microphone arrays will be connected to the SoundStructure device in a later step.

Step 2. Connect SoundStructure to the HDX 8000 codec

SoundStructure integrates to the primary HDX 8000 codec using the Conference Link digital interface as described next. Because the Conference Link connection method does not require any of the analog inputs or outputs on the SoundStructure system, all the SoundStructure system's analog inputs and outputs can be used with additional microphones or other audio devices. The block diagram for this system is shown in Figure 1.
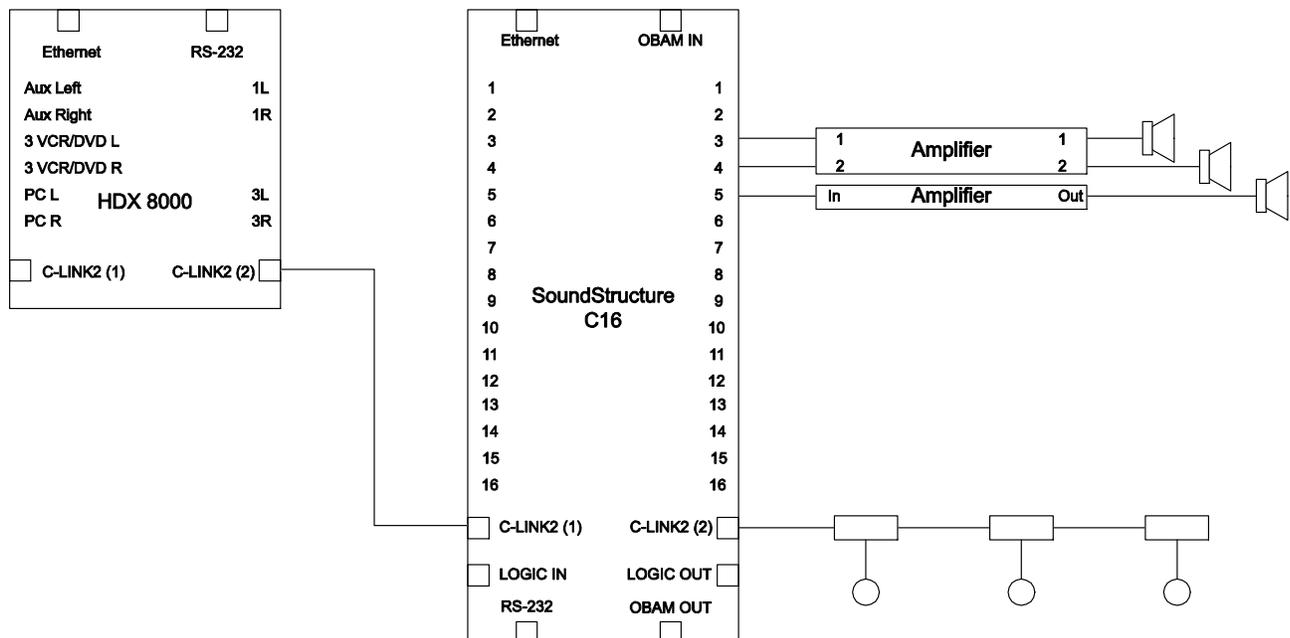

Figure 1. Block diagram for connecting the HDX8000 to the SoundStructure device.

The following steps describe how to connect the HDX 8000 codec to the SoundStructure using the Conference Link interface:

1. Prior to connecting the HDX to the SoundStructure system use the HDX web interface to navigate to the Admin Settings → Audio Settings → Audio page and enable the **Live Music Mode** option

as shown in Figure 2.
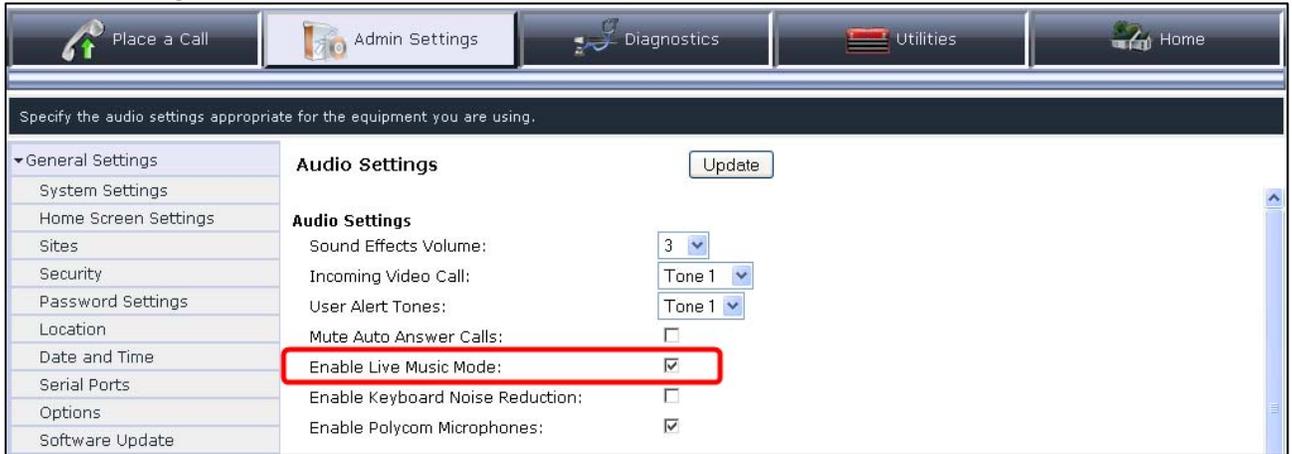
Figure 2. Enable the Live Music mode option on the primary HDX 8000 codec.

2. As shown in the Figure 3, connect the Walta Male to RJ45 Female connector (ordered separately, part number 2457-25646-001) to the 18" Clink RJ45 male to RJ45 male cable that is included with SoundStructure. More information about cables and accessories that may be used with SoundStructure may be found in the SoundStructure Accessory Guide [3].
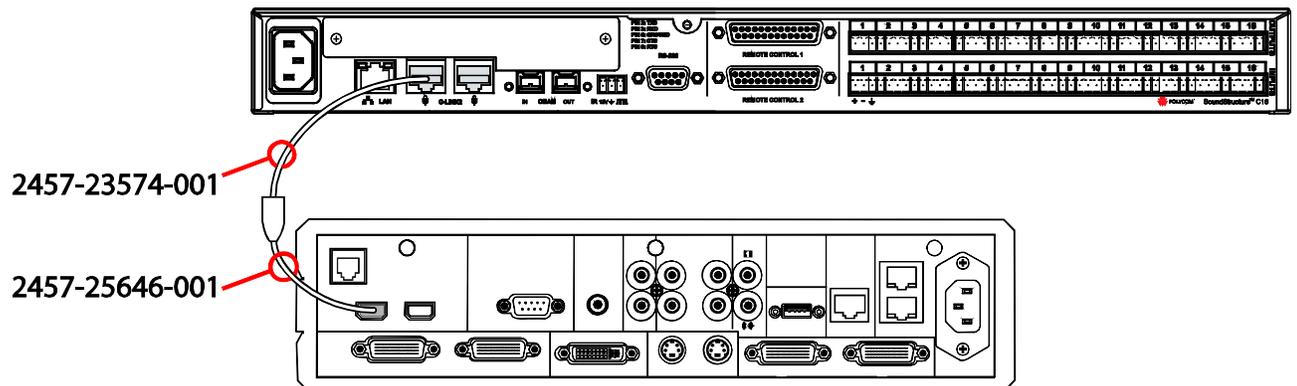
Figure 3. SoundStructure and HDX 8000 codec Integration interconnect using Conference Link.

3. Connect the RJ45 end of the resulting cable to the left rear Clink interface port on the SoundStructure device

4. Connect the Walta Male end of the cable to either Clink connector on the center HDX 8000 codec.

The Conference Link interface is hot-swappable making it unnecessary to power down the devices before connecting them. Once connected, the HDX 8000 codec will detect the SoundStructure device and the HDX 8000 codec will turn off its internal acoustic echo cancellation and with Live Music Mode option enabled, the far-end echo exterminator and keyboard tapping processing will also be disabled.

Step 3. Connect the Audio Amplifier

Two analog outputs are required to connect the SoundStructure device to the local room amplifier. In both example SoundStructure configuration files, the SoundStructure line out 3 (left) and line out 4 (right) connections are configured to connect directly to an external amplifier as shown in Figure 4.
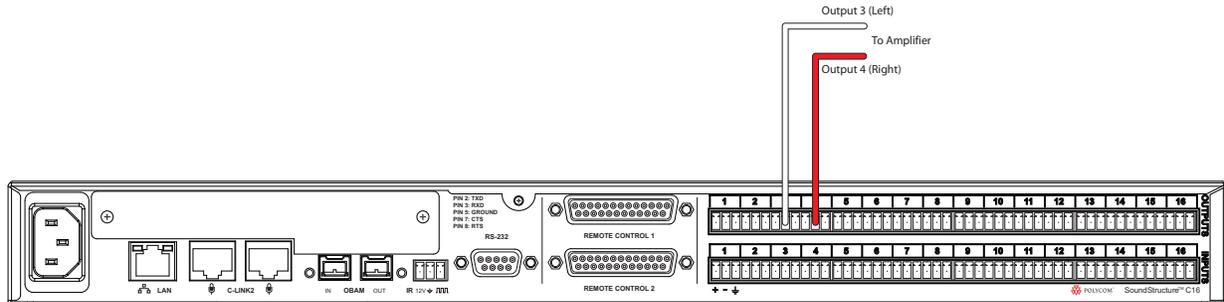

Figure 4.   SoundStructure connections to an external stereo amplifier.

Depending on the size of the room a ceiling fill loudspeaker can be used to make it easier for the local participants to hear the remote participants. The example SoundStructure configuration file supports a ceiling-fill loudspeaker on output 5 as shown in Figure 5.
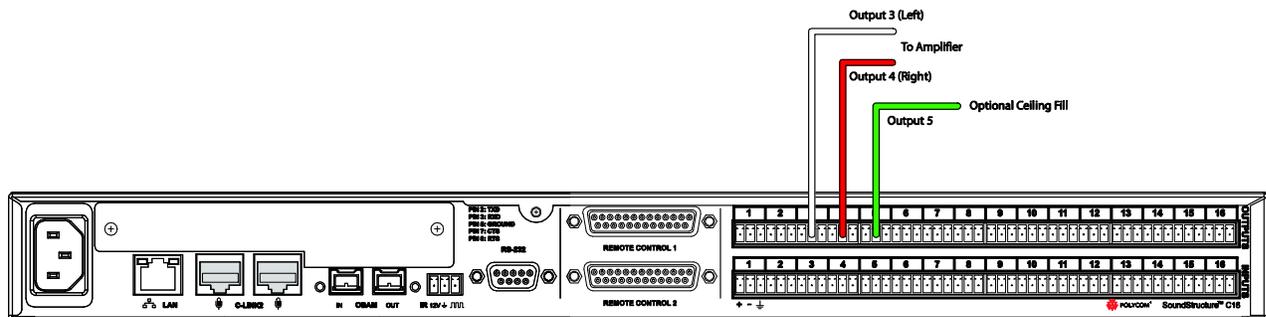

Figure 5.   SoundStructure integration to an external stereo amplifier and optional ceiling fill amplifier.

Step 4. Connecting Polycom microphone arrays to SoundStructure devices

Any style of microphone may be used with the SoundStructure when integrating to the ATX system. Since each analog input of a SoundStructure system supports full microphone processing, up to 16 analog microphones can be used with a SoundStructure C16. Instead of analog microphone inputs, the Polycom microphone arrays can also be used. Up to four Polycom ceiling microphone arrays can be connected to each SoundStructure device, subject to the following requirements:

- Each complete Polycom microphone array has three microphone elements and requires three available inputs on the SoundStructure device (see Figure 6).
- No more than four Polycom microphone arrays may be connected per SoundStructure device
- The Polycom microphone array cable wiring and cable length requirements are met

The first two requirements mean that a SoundStructure C8 with two full microphone arrays will be left with free two analog inputs; a C12 with four microphone arrays and will not have any available analog inputs; and a C16 with four microphone arrays and will still have four available analog inputs. When the Polycom microphone arrays are used with SoundStructure devices, the SoundStructure device's analog inputs associated with the microphone arrays inputs cannot be used at the same time as the inputs from the microphone arrays.

Table Mic Array   **Ceiling Mic Array**
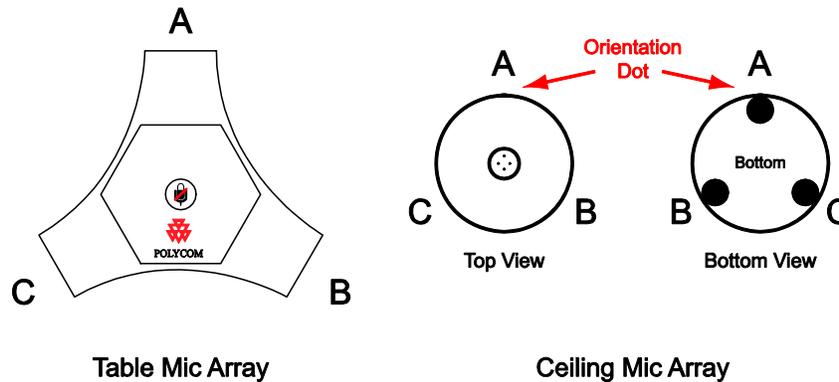
Figure 6.   Polycom table and ceiling microphone arrays have three microphone elements labeled A, B, and C.

Please note that while the SoundStructure example configuration file includes Polycom ceiling microphone arrays, Polycom table microphone arrays could also be used.

When using Polycom microphone arrays, the microphones should be connected to the SoundStructure device's right rear Conference link interface port and should be daisy-chained as shown in Figure 7. When the Polycom microphone arrays are connected to the SoundStructure device's right rear clink interface, the particular microphone arrays will be sequentially numbered within the SoundStructure configuration file with the first microphone array being the one closest to the SoundStructure device as shown in Figure 7.

For more detailed information on using Polycom microphone arrays with SoundStructure including cabling requirements and pin-outs, configuration details, and best practices for quickly installing and testing these microphones, refer to the HDX Microphones and SoundStructure Best Practices Guide [4].
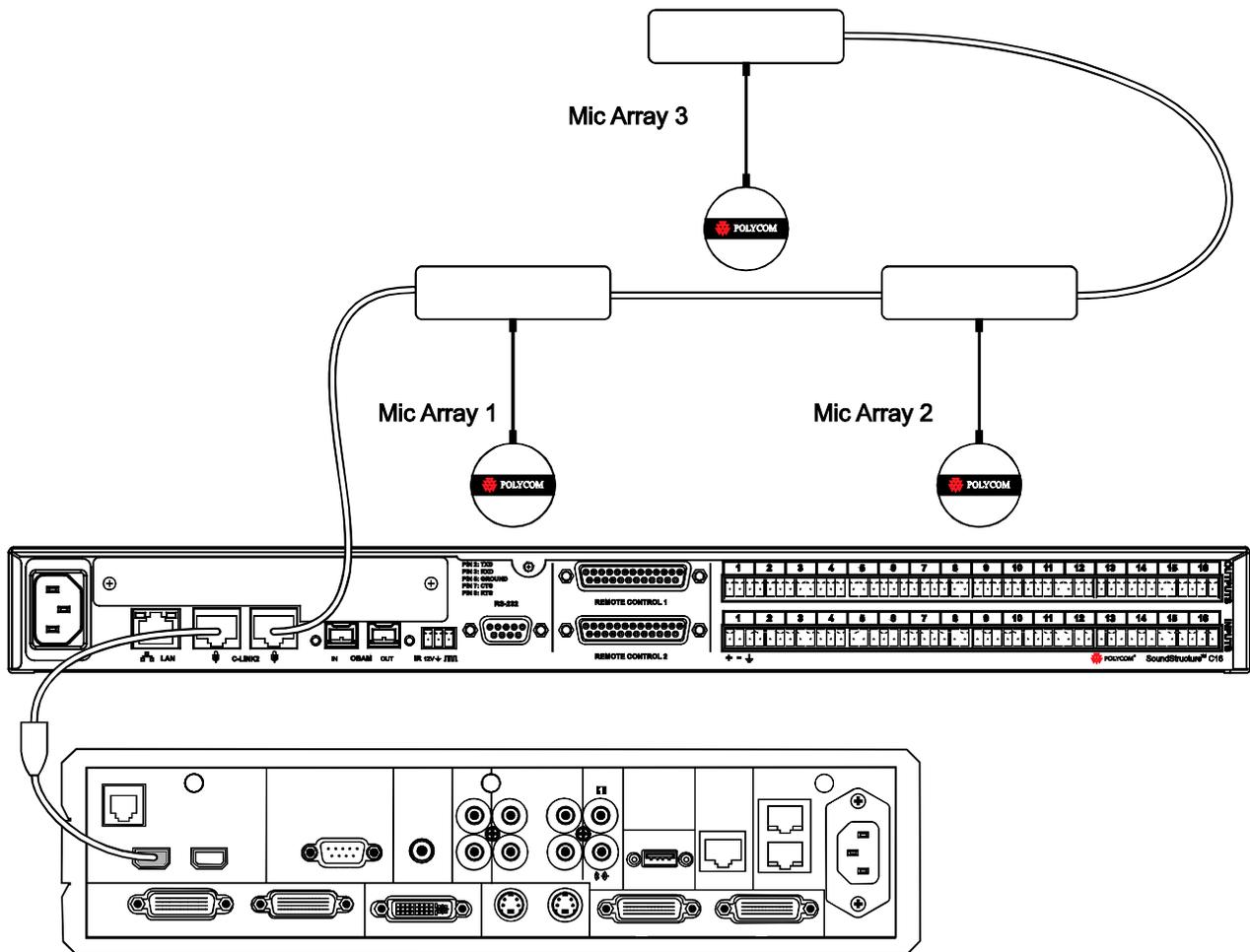
Figure 7. Connecting Polycom Microphone Arrays to the SoundStructure device.

Step 5. Modify the SoundStructure Configuration File

The example configuration file for integrating the SoundStructure with the ATX system is available online [1]. To upload the example configuration file to the SoundStructure device, follow the instructions in Section Step 6 *Uploading the configuration file* in this application note.

To better understand the configuration file settings, the following sections describe the configuration files in detail.

5.1 Removing Polycom microphone array elements

As described in the ATX system installation manual [2], the microphone arrays should be positioned with the orientation dot facing the front of the room. When the microphone arrays are oriented properly (shown in Figure 8), Mic Array 1 is positioned on the room left (camera right), Mic Array 2 positioned on the room right (camera left), and Mic Array 3 positioned in the center.

The microphone "A" element from each of microphone array has been removed from the example configuration files because, with proper orientation of the microphone arrays, the "A" elements are

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pointed directly towards the loudspeakers and displays and are not used in conferencing. To delete these elements, use the Edit Channels control to delete the "A" element of each of these microphone arrays from the SoundStructure configuration file. Once the "A" elements have been removed, only two microphone elements per microphone array remain for a total of six microphones. This means that any SoundStructure C-series product, including the SoundStructure C8, may be integrated with the ATX system and still support the three "two-element" microphone arrays.
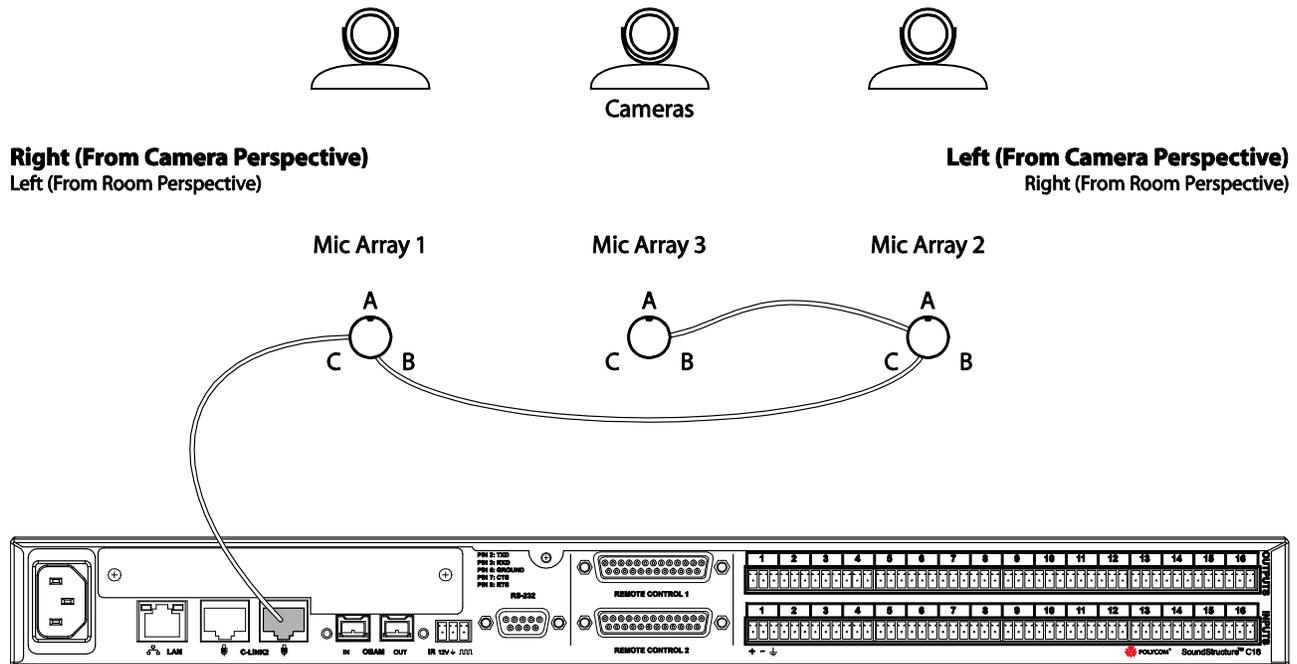
Figure 8.   Microphone array orientation and sequential positioning and element numbering.

Once the microphones are properly positioned and daisy-chained, the microphones will be used in the matrix as described next.

5.2   SoundStructure Matrix Settings

SoundStructure Studio can be used to view and modify SoundStructure configuration files. This section describes the matrix settings for the Conference Link method of integration between the SoundStructure device and the HDX 8000 codec. See the online training streams [5] or the SoundStructure Design Guide [6] for more information about creating a SoundStructure configuration file.

The matrix settings are shown in the following figure and the highlighted values are described in detail below.

1. The six microphone array elements (two elements remain per microphone array) belong to the "Mics" group and have a fader value of 6dB applied to ensure the microphone levels are in the proper range. While the names of the microphone channels in this example were chosen to help understand the physical position of the individual microphone elements, any valid name may be used.

2. The echo cancelled Polycom Microphone Array elements are panned to the left and right to the "Mics_Stereo_Panned" submix to create an immersive audio experience at the remote site.

The default stereo mapping shows that the Mic 1 C microphone is mapped completely to the left channel of the stereo submix. The remaining microphones are panned more to the room right/camera left because the microphones are positioned across the room from room left to room right with the final microphone Mic 2 B panned all the way to the room right. Please note that the Mic 3 elements B and C are shown in the middle of the room corresponding to how the microphones are installed the room. The details of how each microphone element is mapped into the stereo image is shown in Figure 10.

3. The "Mics_Stereo_Panned" is routed to the codec stereo signal of the HDX8000 "HDX Stereo Mics Out".

4. The audio inputs from the HDX 8000 codec are sent to the stereo "Amplifier" submix. Because the "Amplifier" submix is a stereo channel, the left/right stereo imaging is preserved.

5. The "Amplifier" stereo submix is routed to the local stereo room amplifier and is also attenuated by 12dB and sent to an optional ceiling fill loudspeaker system to provide a better audio experience in the local room.
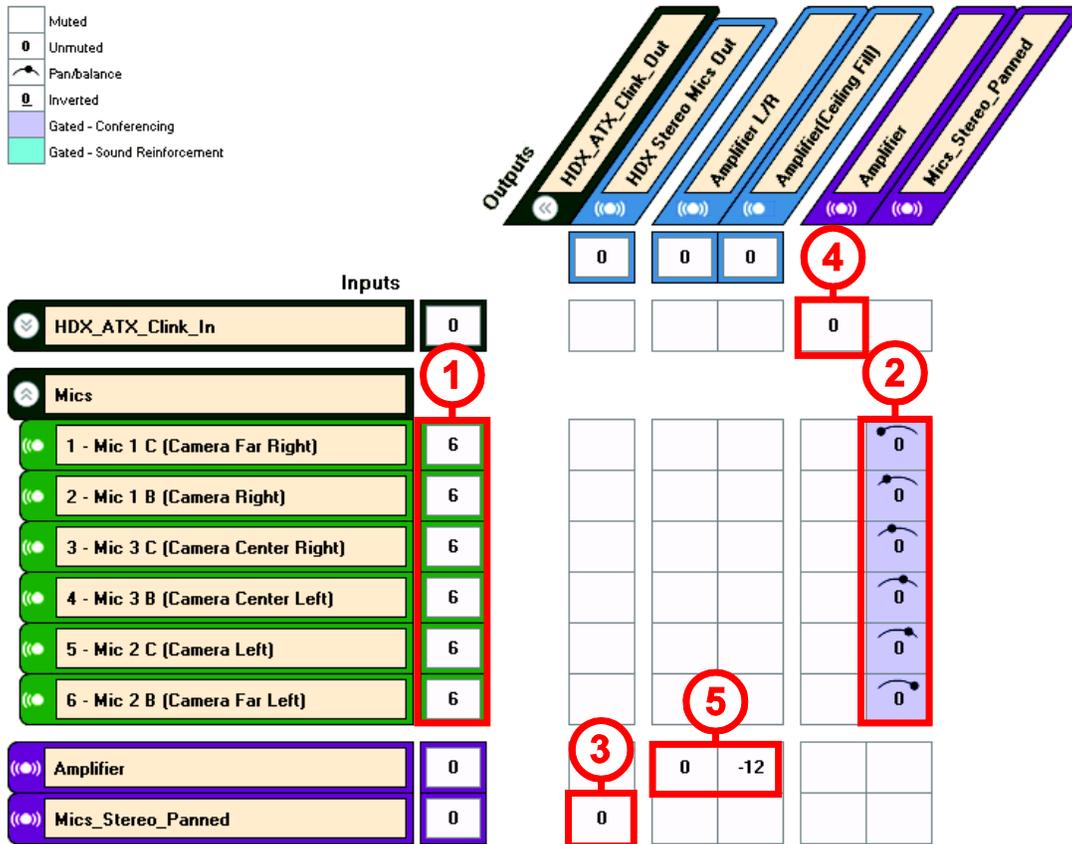

Figure 9.   The SoundStructure matrix page of the example configuration file with Clink microphones.
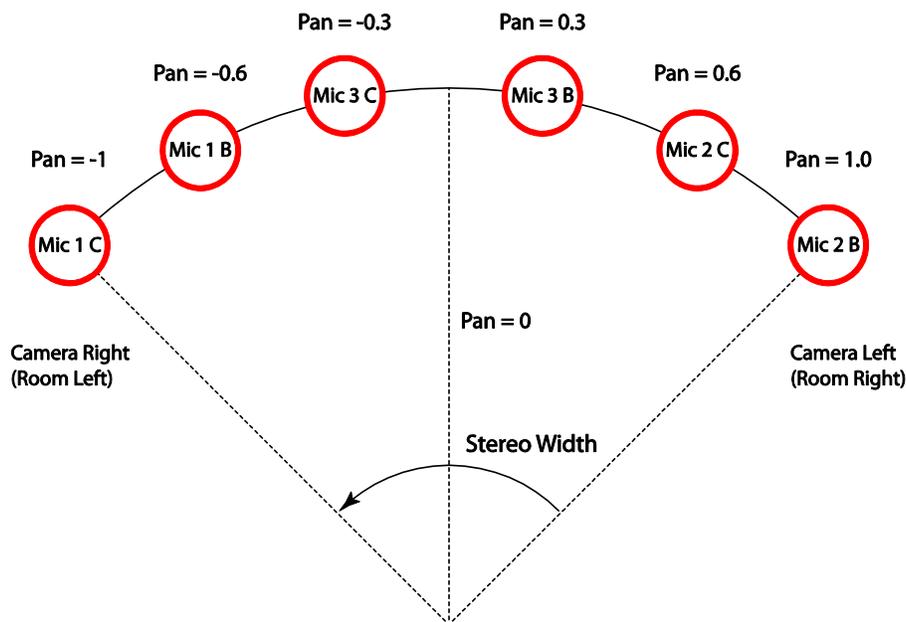
Figure 10. Panning position of each microphone element to create the stereo immersive image.

5.3 SoundStructure Channels Settings

The audio settings for the SoundStructure Conference Link connection method example are shown in the following figure and described in detail below. In this figure the microphone group has been collapsed and any changes made to the group will change the values for all microphones that are members of the group.

1. The Acoustic echo Canceller is enabled and the AEC reference for all the microphones is set to the "Amplifier" submix signal. This ensures that the acoustic echo canceller knows what audio to remove from the microphones when the remote talkers' audio is picked up by the local microphones.

2. The input fader on the HDX ceiling microphones is set to 6dB.

3. The output level to the audio amplifier channels is set to -10dB to be compatible with consumer level audio amplifiers (RCA connections). If the in-room amplifiers are professional grade amplifiers and support 0dBu or +4dBu nominal signal levels then these level settings can be set to 0dB or +4dB respectively. If the amplifiers use RCA signal connections, leave these values at -10dB to prevent overdriving the audio inputs on the amplifier.

4. The optional in-room ceiling fill loudspeaker output is delayed 10msec to allow the local participants to 'hear' the audio from the front of the room and have the optional ceiling loudspeakers provide some 'fill' without drawing attention away from the front loudspeakers. The optional ceiling fill is recommended for rooms that are larger than 20ft (6m) in depth from the back of the room to the front of the room. The delay is added to ensure the focus of the local participants is on the audio from the front display wall and not from the audio from the ceiling. The delay may be increased above 10msec if the ceiling loudspeakers are far from the front loudspeakers.

5. The user min value for the "Amplifier" submix has been set to -31dB to map the volume range from the HDX codec 0 to 50 into the range of -31 to +20 on the fader of the "Amplifier" channel.
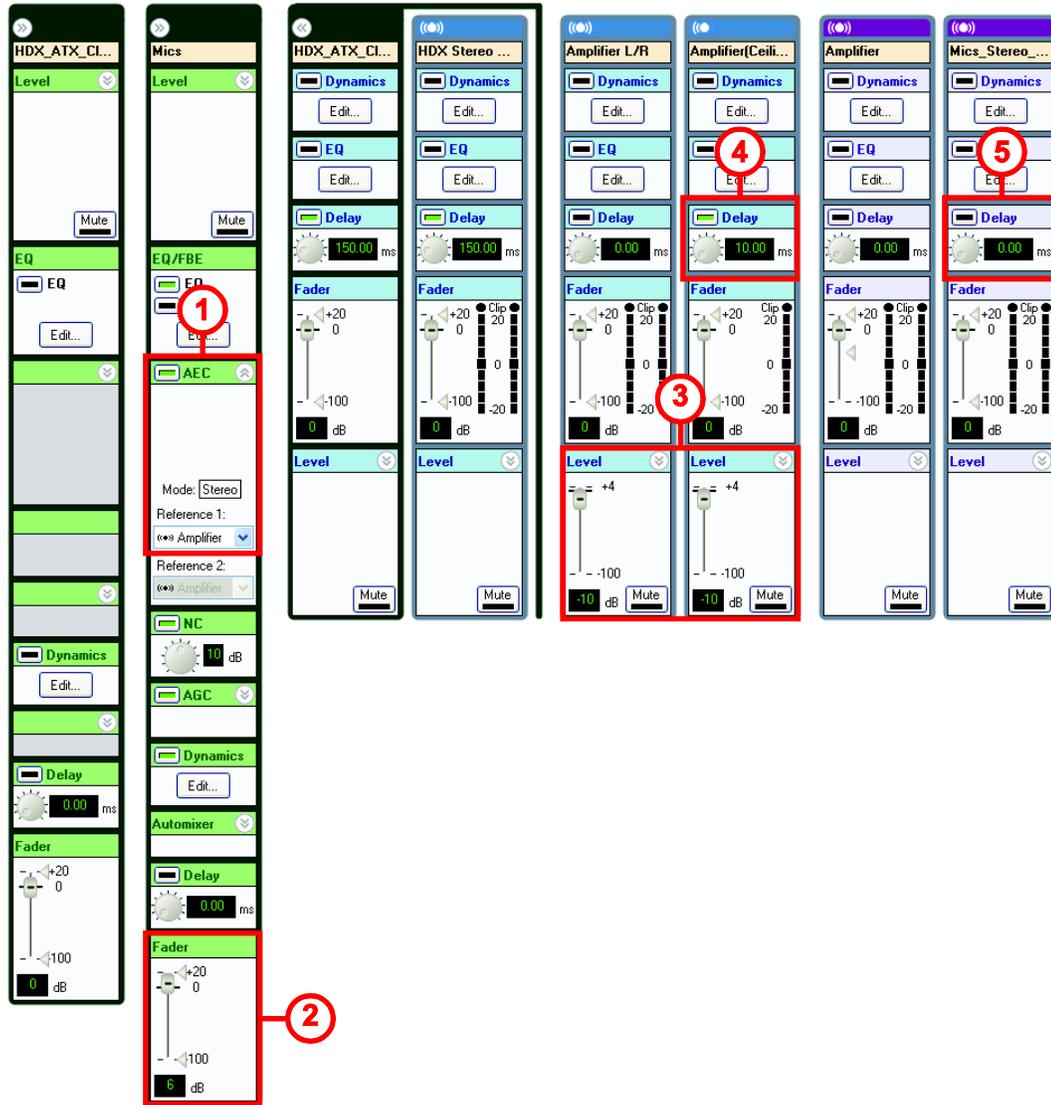

Figure 11. SoundStructure Channels page of the example configuration file.

5.4 Saving the configuration file settings

Once the audio settings have been adjusted to meet the application requirements, other settings such as static IP address, system name, RS232 baud rate, etc. may be set for the system by using SoundStructure Studio.

If there are other changes made to the configuration file, navigate to the preset page, and select the 'Save Selected' option to save any changes to the Power-On preset and, if working online, to save

permanently into the SoundStructure device. Finally, save the project to disk using the File Save option to ensure the latest version is stored.

Step 6. Uploading the configuration file

Once the desired project settings have been saved, the configuration file may be uploaded to the SoundStructure system.

To upload the project using SoundStructure Studio, choose the Connect menu and then select 'Search for Devices' option. This will open the Connect to Devices dialog box where the desired SoundStructure device may be selected. Devices may be discovered over the network interface or via the Serial connection. For detailed information about how to connect and upload projects to a SoundStructure system, see [6].

Select the desired SoundStructure system, select 'Send configuration to devices', and then click **Connect** as shown in Figure 12.
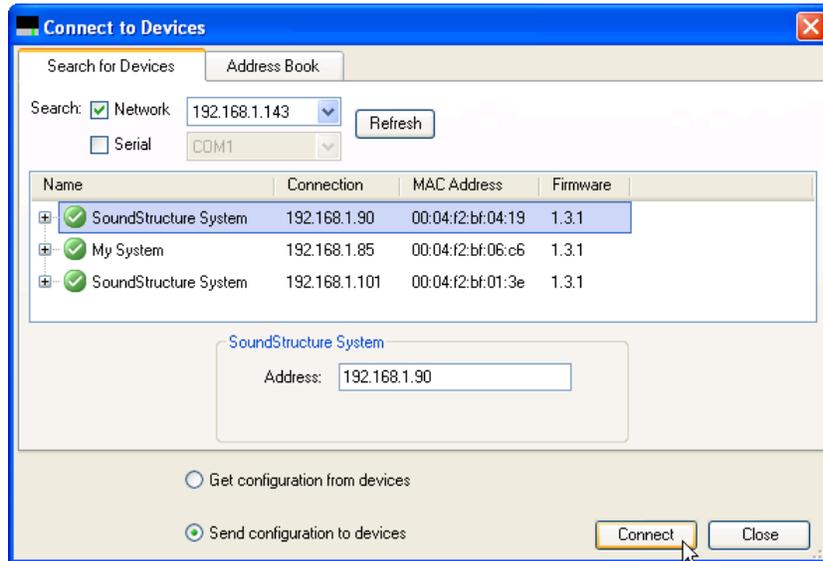
Figure 12. Connect to Devices dialog for sending a configuration file to a particular SoundStructure system.

If the target SoundStructure device does not match the SoundStructure C16 device used in the example configuration files, for example the discovered system is a SoundStructure C8 while the project was for a C16 or the project requires a telephony card but one is not installed in the device, then the Devices Mismatch dialog will appear as shown in Figure 13.

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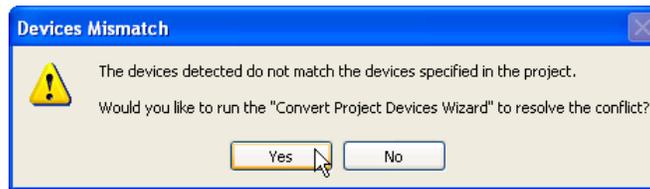
Figure 13. Device mismatch dialog starts the Convert Project Wizard to automatically convert a project designed for one type of SoundStructure devices to another type of SoundStructure devices.

Selecting **Yes** will direct SoundStructure Studio to modify the project to match the SoundStructure system that has been discovered. If the project doesn't fit into the target device(s) because it has too many inputs or outputs, then SoundStructure Studio will indicate that channels must be removed to fit into the target SoundStructure system.

If the project fits into the desired system without modification, select **Next** and then select **Finish** to have the project changed to match the target SoundStructure system. Finally there is an option to continue uploading the configuration or to remain offline and review the configuration for any signal wiring changes that may have been required to fit the project into the detected devices. If it was necessary to remove channels to make a project fit, it is recommended that the offline option is selected, the configuration wiring page reviewed, and then the process started again to upload the modified configuration to the target SoundStructure system.

If it was not necessary to remove channels, select **Yes** to continue online with the system and upload the configuration file. As SoundStructure studio uploads the project, it will check if there is a different IP address in the device than specified in the project file and prompt, if necessary, to allow the user to select which IP settings to be used for the resulting online system. The example configuration files expect to receive an IP address from a DHCP server on the network.

Once the settings have been uploaded, the SoundStructure system is fully operational and running with the settings defined in the configuration file.

6.1 Volume Control and Muting

When SoundStructure is connected to the HDX 8000 codec, no modification of the control system application is required for volume control and muting. Commands to the HDX to mute or adjust volume are communicated over Conference Link to the SoundStructure device. The SoundStructure events engine then maps those commands to muting microphones on SoundStructure or adjusting volume of the appropriate channels.

References

1. **Polycom.** SoundStructure ATX300 Installation Files. [Online] http://www.polycom.com.

2. —. *Polycom ATX SDK Integrator's Guide.*

3. —. SoundStructure Accessory Guide. [Online] http://www.polycom.com/global/documents/support/user/products/voice/SoundStructure_Accessory_Guide.pdf.

4. —. HDX Mics and SoundStructure Best Practices Guide. [Online]
http://www.polycom.com/global/documents/support/technical/products/voice/Best_Practices_Guide_SS_
HDX_Micro.pdf.

5. —. SoundStructure Training Streams. [Online]
http://www.polycom.com/support/voice/soundstructure/soundstructure_training.html.

6. —. SoundStructure Design Guide.

7. —. SoundStructure 1.3 Primer. [Online]
http://www.polycom.com/global/documents/support/setup_maintenance/products/voice/SoundStructure_1
_3_Primer.pdf.