

Planning Guide for Livewire

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INTRODUCTION

This planning guide will help you organize your AoIP (Audio over IP) studio requirements, and will serve as a primer for planning your studios. Before we get into the general concepts, we invite you to watch some of the Axia videos presented on the [Telos Alliance YouTube Channel](#). We have recorded a number of short videos that will demonstrate the simplicity of AoIP planning and implementation.

The Livewire network is just like your station computer network. Instead of linking computers, printers, scanners, etc., Livewire links all your audio inputs and outputs. Just like one computer can share a printer, with Livewire, sources available in one studio can also be accessed by other studios. In this way, Livewire becomes a huge router for all your audio signals. In addition, the levels of audio delivered to each device are precisely the same (although they are software-adjustable at each endpoint). No more distribution amplifiers!

Studios typically have a mixing engine which performs the actual audio mixing. It's connected to a control surface (audio console). Think of the control surface as a keyboard, and the mixing engine as the CPU. No audio passes through the control surface; audio inputs and outputs are delivered to the mixing engine for manipulation in the digital domain. Some mixing engines also have audio and logic I/O built in; if all the I/O (input/output) is used, an xNode audio interface can simply be plugged into the network using a CAT-5 Ethernet cable to provide additional inputs and outputs.

In the pages below, you will be guided to determine your signal flow for each studio, and tabulate all the inputs/outputs (I/O) for each studio and Technical Operations Center (TOC). These counts will determine the need for additional xNodes.

FACILITY PLAN

General Facility Concepts

Let's begin with some basic questions. First, how many studios will you have? Will they be 100% Livewire (including an Axia console), or will you be using existing audio consoles?

A preliminary floor plan will help you to graphically envision where your studios will be in relationship to each other, as well as proposed rack locations in order to determine where Audio Nodes and Ethernet switches will reside.



What is the physical distance between those studios, the technical operations center (TOC), and the Livewire gear? This information will be needed to determine the connectivity needed between the various Ethernet switches, your audio gear and any xNodes.

Audio Signal Flow diagram

A signal flow of the audio within your physical plant will help you determine the audio sources each xNode will host, the xNodes' destination assignments, and the source channel profiles for your Axia consoles.

Axia PowerStation and QOR console mix engines provide an array of Microphone, Analog, and AES inputs/outputs, which can be augmented, if needed, with Analog or AES xNodes, which can support up to 4 stereo (8 mono) line inputs and outputs per xNode.

Axia StudioEngine mix engines mix audio present on the studio network; they have no separate I/O and therefore xNodes must be used to provide audio I/O and GPIO connections.

Microphone xNodes can support up to four mono microphone inputs (with Phantom power, if needed) and four stereo line outputs (which can be used to supply external headphone amps).

A Mixed Signal xNode provides one switched Microphone/Analog XLR input, two Analog Line inputs, three Analog line outputs, an AES/EBU input and an AES/EBU output. Two GPIO (General Purpose I/O – for logic control) ports are also provided. Each port provides four opto-isolated inputs and outputs. We'll deal with logic GPIO later in this document.

- a) Determine number of Audio Sources- Any device that generates an audio signal is a potential audio source input TO the mixing engine or xNodes. Sources to consider are microphones, hybrids, codecs, CD players/recorders, digital audio workstations, audio processing devices, delay units, external monitor sources, and PCs equipped with audio editing software and the Axia IP-Audio Driver.

Count every stereo and mono source as one (1) source and record it on the form. If you are dealing with multi-channel devices, treat each output audio channel as one (1) source for now.

Use the table in the appendix to document all the sources required for your studios and your technical operations center (TOC). Keep the lists for your studios and tech center separate. Make notations on the type of sources: analog line level, mic level or AES digital.

- b) Determine number of Destinations per studio- Any device that needs an input audio source for recording, processing, monitoring, etc. is a potential source recipient FROM an Audio xNode or Mix Engine. Examples include feeds to amplifiers for monitor speakers, headphone feeds and cue speakers; audio processing, delay units, hybrid sends, hybrid

MOH (Music on Hold), codecs, etc.

These are considered “destinations” for Axia audio streams. Count every device needing a mono or stereo audio source as one (1) destination. If you are dealing with multi-channel devices, treat each input audio channel as one (1) destination for now.

Use the table in the appendix to document all the source destinations required for your studios and your technical center. Make notations on the type of audio required: analog line level, mic level, AES digital, etc.

Calculating the number of xNodes Needed

From your source and destination lists for your studios and technical center, you can now figure out how many xNodes may be required. Four sources and four destinations can be supported on one 4x4 xNode. On your lists, group like sources and destinations together: whether they are Analog, AES, or Microphone sources and Analog destinations. Do the math to calculate the number of xNodes. Don't forget to include a spare xNode or two.

Note that, when using PowerStation or StudioEngine console mixing engines, sources from a different location that are required in the studios should not be used in calculating the number of xNode input requirements for that studio.

Conversely, remember that sources connected to QOR.16 and QOR.32 inputs are NOT automatically available to the rest of the network (although they can be routed to the network) — QOR mixing engines have a configurable Livewire “gateway” that exchanges locally-generated audio with the rest of your plant's network. This gateway is configurable for 8-in/8-out operation, or for 12-in/4-out operation. Keep this in mind when considering the number of locally-generated streams you wish to use or make available from a QOR-based studio.

Use the table in the appendix to note what sources and destinations should be assigned to the inputs and outputs of the various audio xNodes or Mix Engines. This will be your “programming guide” when you begin to set up your xNodes for audio sources.

Channel Assignments

All audio sources on the Axia network need a channel number assignment — a unique identifier. This is so that the Axia system can generate a single and unique audio stream for each source that's provided by the various xNodes, PC's, and Mix Engines.

An easy way of creating channel numbers is to create a channel number based on the last octet (the last 3-digit group) of the IP address. Since each of your networked components (xNodes, engines, PC's with IP Drivers installed, Livewire enabled Telos gear, etc.) will have a unique IP address, it can be easier to keep track of your allocated channel numbers by having a relationship between these various numbers.



For example, if an Analog xNode had an IP address of 192.168.2.15, the four stereo input (“Source”) channel numbers associated with the xNode could be 1501 to 1504. Or, if you plan to use your xNode to originate mono sources, the eight mono input channel numbers could be 1501 to 1508.

This takes the last octet of the xNode’s IP address (15) and adds two more digits that signify the I/O port. This ensures that devices which must generate an Axia Source stream have unique channel number(s).

Of course, you can decide on whatever channel numbering scheme best suits your facility, but the key is that ALL audio sources MUST have a unique channel number to prevent any conflicts. This is analogous to saying “All networked devices must have unique IP Addresses. No duplicate IP addresses can be accepted on the network.”

The Axia audio console: What size will you need?

(If you are not planning to use an Axia console, you can skip this step.)

Fusion and Element are modular consoles, which allow you to configure the physical layout of the board as you like. You can build it with various types of modules in any order: 4 channel fader modules, 2 channel phone modules, 2-fader and standalone Master Monitor Modules (every Fusion or Element must have one of these modules installed), an Intercom module, and various models of single-channel-width pushbutton controls for external devices.

In the past, when an engineer designed a console for use in the studio he wanted to make sure that all sources the operator needed were available to him to select. Many felt that every source needed a dedicated channel, but this was not always practical as you would eventually have a massive console to accommodate all these sources. With Axia consoles, ANY channel can be assigned to ANY audio source you wish, and those assignments can be changed at ANY time. The channels are no longer dedicated to one specific audio source.

To determine the size of your console, ask yourself “How many audio sources does the console need to have available at the same time?” This is more of an arbitrary determination rather than a set formula, and you will need to base your design decision on how the current studio operates, how you feel the board operators will handle the new console, and any future expansion and change in operations you might foresee.

In the case of Fusion and Element consoles, it is often wise to specify a slightly larger frame than you think you might need, which allows the capacity for expansion by adding more modules at a later date. With iQ console, fader count per frame is fixed, but you can add an additional frame and faders at a later date.

With this in mind, AXIA offers a variety of console sizes, from our 6 channel DESQ or RAQ surfaces (ideal for voiceover or news studios) to 8 position Radius and IQ surfaces and on up to 28-position



mainframes for Fusion and Element. Utilizing multiple frames, Fusion and Element consoles can console of up to 40 faders in size.

GPIO / Logic Diagram

Along with the audio, you will probably need logic controls for other devices, including remote equipment starts, On Air indicators, profanity delay devices, as well as control of audio routing. To determine the remote control needs of the facility, think about what remote control functionality is needed in each individual studio.

The Fusion console requires GPIO xNodes to provide GPIO closures. The Element Power Supply provides eight logic ports, and the QOR32 engine (used with the IQ and Radius surfaces) provides eight logic ports; the smaller QOR16 engine (used with the DESQ and RAQ surfaces) provides 4 logic ports. Each port has five Logic-OUT and five Logic-IN connections, plus a single Common pin. Typically, a single port is assigned to a particular device, although PathfinderPC routing control software allows more flexibility in routing GPIO. In a facility with lots of remote starts, you can purchase additional GPIO nodes to supplement the ones in the Mixing Engine.

Make an account of the logic flow in your technical operations center (TOC). For example: satellite closures, Audio Server logic, centrally located items like an EAS Encoder; anything that needs remote control.

Keep in mind that, as with console fader count, specifying more GPIO capacity than you might initially need allows for simple future expansion. At the same time, don't over-order: remember, Livewire-compatible devices from Axia Partner companies often don't need physical GPIO ports, since their audio signals can carry associated logic as well.

Also ask: Will the Axia routing software, PathfinderPC, be used to route this logic flow? Or do you just need to connect these non-Axia items directly to one another, without routing? As your logic needs become complex, so does the system needed to support it, so it's best to clearly document your needs and flesh out a logic flow that will properly describe what you are attempting to do.

Designing the Axia Network

Axia is a local-networked audio solution that can also simultaneously route GPIO. The audio is routed as uncompressed, multicast audio streams, handled by multicast-enabled Ethernet switches designed specifically to properly route multicast audio packets. Here are some things to consider as you begin to design your network.

Ethernet Switches

Axia will require Ethernet switches to connect all the xNodes, Mix Engines, etc.— anything related to the Axia network. We recommend a large range of switches, as outlined at TelosAlliance.com/Axia/What-Ethernet-Switches-has-Axia-Approved. Here is a general overview:



- **Axia xSwitch** — This Axia-manufactured switch is comes pre-configured. Fast setup requiring only an IP address assignment. A convenient front panel display provides port link status, PoE (Power over the Ethernet) usage and SFP status plus system temperature. The xSwitch provides 8 10/100MBit Ethernet ports, - 4 with PoE. Two Gigabit ports are provided for trunking, both with RJ-45 (copper) and SFP (fiber) connections. The fan-free design means this switch can be placed adjacent to your audio devices. (See TelosAlliance.com/Axia/xSwitch)
- **Cisco 2960 series Catalyst switch** — For small-to-medium studios consisting of 1 or 2 studio consoles and some nodes, up to medium-sized networks designed as an audio router. There are various models of 2960 switches to choose from. Some will work well as stand alone switches for small networks, other models can work well as an Edge or Spoke switch in a Hub/Spoke designed Axia network. Please [review our website recommendations](#) for recommended models, or contact an Axia specialist for more assistance in determining a solution that suits your needs.
- **Cisco 3560X series Catalyst switch** — Gigabit switches recommended for medium-to-large network configurations. Typically this switch is used as the core or hub switch for a Hub/Spoke designed network with other Ethernet switches connected to it. By choosing the proper models, this series can support a good-sized Axia network. Please [review our website recommendations](#) for recommended models, or contact an Axia specialist for more assistance in determining a solution that suits your needs.
- **Cisco 4500, 4900 and 6500 series Catalyst switch and higher** — Recommended for very large systems. Please contact an Axia specialist for help in determining your needs for such a switch.

For notes on setting up some of these switches, please visit TelosAlliance.com/Axia/What-Ethernet-Switches-has-Axia-Approved and select the “Configuration” pulldown menu for Customer Service bulletins regarding recommended programming of these switches for use with Axia gear.

To request assistance with switch configuration, please [contact Axia Technical Support](#).

Network Topology

An Axia specialist will be happy to help you determine your basic network configuration needs. If you want to give it a try, here are some guidelines:

Determine an IP Address scheme for your network. Axia gear is a networked solution, so every piece of Axia equipment will require an IP address. We use a default IP address scheme of 192.168.2.x, with a subnet mask of 255.255.255.0.

This is not set in stone, and you can assign your network subnet any non-routable IP address scheme. For instance, Class B or C networks are acceptable (like 172.168.x.x or 10.0.x.x, subnet 255.255.0.0 or 255.255.255.0). If you are unfamiliar with IP networking, there is much information available to you on the Internet that can explain networks and IP address schemes.



Where will it make the most sense for you to install your network gear? This depends on your facility layout and your philosophy. Some engineers want all their network gear located in their technical operations center (TOC) for simple administration and security reasons.

Others want the switches located closer to the studios to reduce the number of cabling runs. Sometimes, rack space is limited and this determines placement. Remember that any additional PC's you wish to connect to the Axia network will also need a cable run of CAT-5.

You will also need to decide what gear will plug into which Ethernet switch. Axia Engines require CAT-6 cables for 1000Base-T or Gigabit links; audio xNodes and Mix Engines require 100Base-T copper ports. Cross connection from one Ethernet switch to another switch requires at least a Gigabit connection.

Proper load balancing on the switches is also something to consider: you don't want 10 per cent of your switches doing 90 per cent of the work! Think about what you'll specify as your "core" switch. This should be the most powerful switch in your network, as much of the traffic management for the entire network will rest upon it.

CHECK LIST FOR FACILITY PLAN

- Audio Signal Flow diagram created
- Axia Equipment locations identified (studios and xNode locations)
- Logic Control Flow diagram created
- Network switch layout and gear connectivity diagram
- IP Address Scheme for all gear
- Axia Audio Channel number Assignments to Sources.

PRE-COMMISSIONING YOUR AXIA SYSTEM

To be accomplished before the Axia Technician shows up at your door:

All the steps listed in the planning section should be addressed before proceeding further. Don't hesitate to contact your AXIA technical specialist if you have questions.

Have a plan, and have as much of it documented as possible. All of your audio equipment should be wired to appropriate xNodes, your Axia network should be wired together, and your xNodes should be configured with IP addresses, Sources and Destinations given unique Channel numbers.

You can test sources with the meters on the front of each xNode, or using a browser on a PC connected to your network. Verify that your sources are working and are properly connected to the Audio xNode inputs.

Make sure you have documentation on how your GPIO is working with the automation processes of your facility. If at all possible, provide those flow diagrams to AXIA before our arrival, so that your AXIA representative has a chance to review them.

EQUIPMENT AND WIRING INSTALLATION CHECK LIST

- Cat5e and Cat6 cabling installed, tested and fully qualified.
- Ethernet switches installed. IP addresses assigned. Switches properly programmed.
- Axia Equipment Racked. Audio devices plugged in and out to xNodes.
- Axia Equipment Programmed with IP addresses and Channel numbers assigned.
- Axia control surfaces and engines. IP addresses assigned.
- GPIO ports wired to devices.
- Pathfinder Server installed to server PC (if purchased)

Appendix – Printable Audio Planning Worksheets

Studio:

Location:

Audio Source	Type (Analog, Mic, AES)		Audio Destination	Type (Analog, AES)
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		9		
		10		
		11		
		12		
		13		
		14		
		15		
		16		
		17		
		18		
		19		
		20		
		21		
		22		
		23		
		24		



Audio xNode Configuration Worksheet

HostName:		IP Address:		Clock Priority:						
Location:		SN Mask: 255.255.		Clock Mode:						
xNode Inputs/Sources			Node Type:							
Name	Description	Channel Assignment	Shared?	Live Stereo	Standard Stereo	Surround	Disabled	Gain	Async/Sync	Notes
1 SRC 1									A	
2 SRC 2									A	
3 SRC 3									A	
4 SRC 4									A	

xNode Outputs/Destinations							
Name	Channel Selected	From Source	To Source	Surround	Gain	Notes	
1 DST 1							
2 DST 2							
3 DST 3							
4 DST 4							

GPIO xNode Configuration Worksheet

	HostName:		IP Address:	
	Location:		SN Mask:	
	Output assignments		Node Type:	GPIO
	Name	Description	Channel	Notes
1				
2				
3				
4				
5				
6				

