IP-Audio: It's not just for consoles anymore

Marty Sacks
Vice President, Axia Audio
Cleveland, Ohio
marty@AxiaAudio.com

Author's note:

Being one of the new guys at Axia, and having been away from the studio side of radio for a while, there's been a lot to learn about IP-Audio. While I was reading the manuals and talking to clients already using Axia gear, I was struck by the fact that there are many more uses for IP-Audio than just replacing consoles. Here's a bit of what I've learned.

JUST CONSOLES?

Having supplied over 250 IP-Audio consoles to stations of all sizes and formats, most people think of cool audio consoles when they think of Axia — I know that I did and I've come to find out that I'm not alone. In my first few weeks at Axia, most folks I've talked to comment about our Element or Smart Surface consoles.

What I am now learning – courtesy of our forward thinking clients – is that once you get audio into the Ethernet domain, you can do LOTS of things with it. This is because IP-Audio is easily transported via CAT-5 or CAT-6 cable, fiber or Ethernet radios. From the most basic needs to the most sophisticated, IP-Audio can be a great problem solver.

SNAKES

The most basic use for IP-Audio that I've heard of thus far is an audio snake. Snakes are useful at remotes and at venues of all kinds (including in-house performance areas); being able to move multiple channels of audio back and forth using a single CAT-5 cable makes set-up and tear down (and especially last minute changes) a breeze. This is really handy for folks who do outside set-ups, since the CAT-5 cable can be easily taped over and won't trip people. Or, use some extra cable length (it's cheap, not like multipair) and route it around the audience with no performance degradation.

In fact, one of the very first installations of Axia equipment was for exactly this application, at Clear Channel's WREO. They needed a way to move signals between adjacent buildings, and found that using Axia audio nodes linked with fiber, they could do just what they needed without having to trench in a conduit for multi-pair cable.

As you can see from Figure 1, it's a very simple setup: Axia nodes placed wherever signals must be transported to and from are connected to media converters, which are linked by fiber. Each audio node has 8 inputs and 8 outputs, well under the capacity of the 100 Mbit link, which can carry up to 32 stereo signals. If more than 8 bidirectional streams are needed, you'd simply add another audio node and an Ethernet switch to each end.

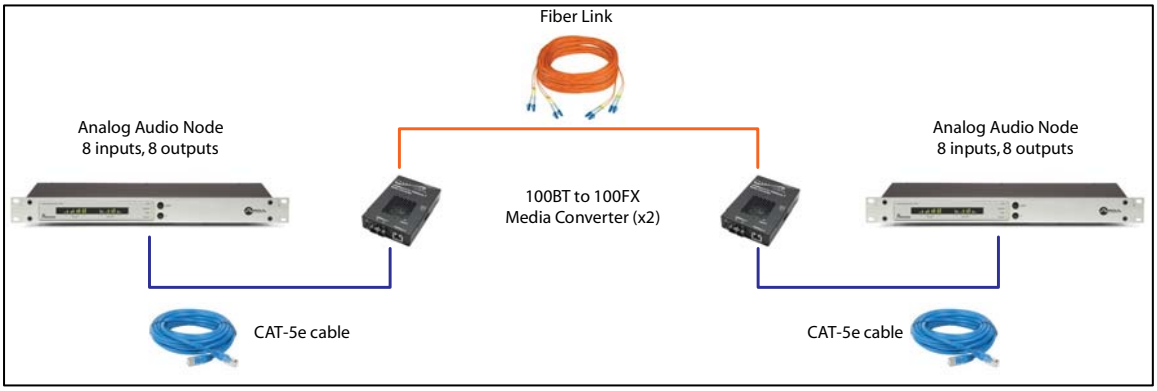

Figure 1

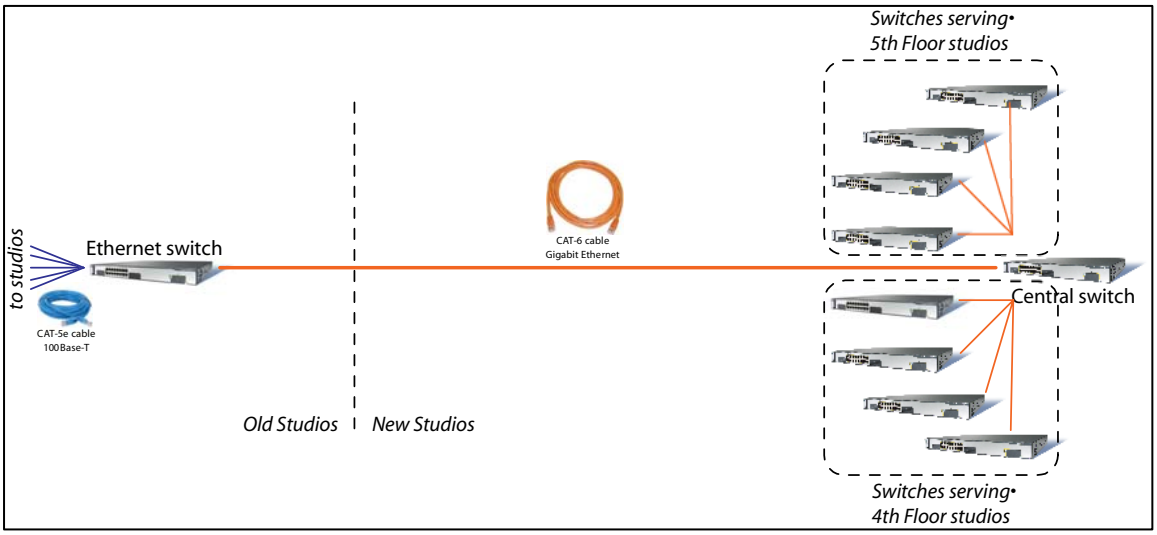

Figure 2

There's an interview with WREO's Chief Engineer, John Riccio, on the Axia website at www.AxiaAudio.com/news/features/wreo.htm with more detail on their installation, and more details about using IP-Audio snakes at www.AxiaAudio.com/mobility .

CONNECTING MULTIPLE FLOORS AND BUILDINGS

Another application clients keep telling me about is the interconnection of studios and tech centers in facilities that are spread over multiple floors or multiple buildings. One example of this is Minnesota Public Radio. Their new studios in St. Paul span two floors of a new building. Not only did these studios need to interconnect, they also had to be able to exchange audio with analog equipment in their old studios, located in the adjacent building.

Likewise, we have a number of clients that use Axia to interconnect their transmitter building with the dog house where satellite or RPU receivers or other electronics are located. Some have told me that fiber is an excellent connection method for this application, because it greatly reduces the potential for transmitted lightning damage — fiber doesn't conduct!

Let's look at the Minnesota Public Radio example first. MPR put a central switch in their new building, a load-balancing bladeserver from Cisco. The old studios that needed to connect to the new ones were located in an adjacent building with a shared wall, so a Gigabit Ethernet link was run from the central switch through the wall to an edge switch that served the audio nodes in the old studios. These nodes use CAT-5e to connect to their edge switch, which connects to the central switch in turn with CAT-6 (for Gigabit).

The central switch also connects via Gigabit to the edge switches on both floors of the new studio complex, as shown in the (much simplified) diagram above. (If you want to find out more about why and how MPR deployed IP-Audio in their new facilities, click on the link below to visit www.axiaaudio.com/news/Axis/Axis_2_view.pdf .)

As I mentioned, transmitter-to-doghouse audio links using IP-Audio are a perfect solution for solving lightning isolation problems. Cumulus

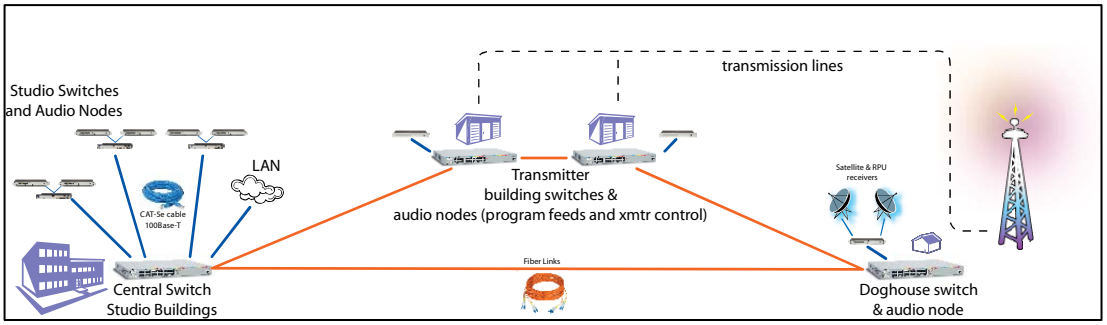

Figure 3

Media's Youngstown, Ohio facility is made up of on-air and production studios for 6 stations scattered across two buildings. Also on site are two transmitter buildings containing transmitters for two of those stations along with the STL and RPU gear for the rest, all attached to a 700-foot tower. The distance between the buildings is between 100 and 200 feet, and all are interconnected by copper in a triangle arrangement. Each building has a separate power feed as well. Lightning has been a recurring issue, not to mention simple surge and ground differentials.

The solution was to build a processing / data rack room and run fiber between that facility and the other studio and transmitter building, eliminating ground loop problems and helping attenuate lightning attraction, as well as breaking the conductive link between buildings.

A combination of bidirectional AES, analog, and Ethernet has to be carried over this fiber, and Cumulus engineers found, after extensive research of fiber-only systems, that an Axia installation's Ethernet architecture, combined with fiber links, could offer more flexibility than fiber-only systems.

As shown in Figure 3, Axia audio nodes and Ethernet switches equipped with GBIC (Gigabit Interface Converters) are placed in each location. Connecting all of the switches with fiber via the switches' GBIC interfaces creates an Axia network across all of the buildings. Not only does this allow sharing and routing of audio, device control and LAN traffic over a single optical link, it eliminates ground loop problems and effectively limits lightning damage to localized areas.

REPLACING SOUND CARDS

One of the applications that I found most unique is the ability to eliminate sound cards in a digital delivery system by using a driver that routes the audio playback, record and data/logic channels via the PC's Network Interface Card (NIC).

Clients have been reminding me that fewer new PCs include the PCI slots necessary to host sound cards and that the PCI standard is rapidly becoming obsolete as PC manufacturers move to other slot architectures. This is a question of obsolescence: what do you do with those expensive PCI soundcards when new high-end PCs have only PCI-Express slots? Do you replace the soundcards? Or do you live with the old PC because an upgrade would require soundcard replacement? Neither is a very appetizing alternative.

They mention the other drawbacks of audio cards as well: noise, for one. We all know that audio equipment is sensitive to RF, yet the audio cards our playout systems depend on are in one of the most hostile RF environments imaginable — the interior of a PC case! Even cards whose manufacturers claim superior S/N ratios will exhibit an elevated noise floor when exposed to the RF and EM interference generated inside a PC. Not to mention the eventual degradation of the card's components due to captive heating inside the PC case, which leads to component failure requiring (expensive) replacement.

Our clients also tell about the substantial amounts of money saved by not having to buy sound cards, and by not having to wire them. Not only that, there is also the savings realized by eliminating the cost of the router switcher port (or console input module) that would otherwise be needed for these sound card inputs, since once these audio sources are converted to Ethernet, they are universally available as IP streams and can be switched or mixed as needed.

Getting rid of sound cards and the wiring and inputs that go with them is a simple thing with Axia equipment. A Windows driver available from any of Axia's delivery system partners (a list is online at www.AxiaAudio.com/partners)is installed on the playout machines and provides 16 stereo input and output channels. There's also a single-I/O version for audio production workstations.

If you need to send the PC audio outside the network, i.e., convert it to analog audio, simply send the stream to the outputs of an Axia Audio Node, which supplies pro-grade, rack-mount audio I/O with outputs capable of +24dBm — specs much better than most commonly-available audio cards.

Implementation is very simple. Instead of wiring up multiple pigtails and balanced XLR connections, all you have to do is install the software on your playout computer (or have your delivery system provider do it for you) and connect the computer's NIC to the rest of the network. Once the connection is made, the Axia network detects the presence of these new audio streams. They can then be sent anywhere on the network. See www.AxiaAudio.com/soundcards for more details.

ROUTING SWITCHER

While the routing switcher is a pretty familiar sight, especially in larger markets, the IP-Audio application I was perhaps least prepared for is the ability to assemble an audio router switcher that

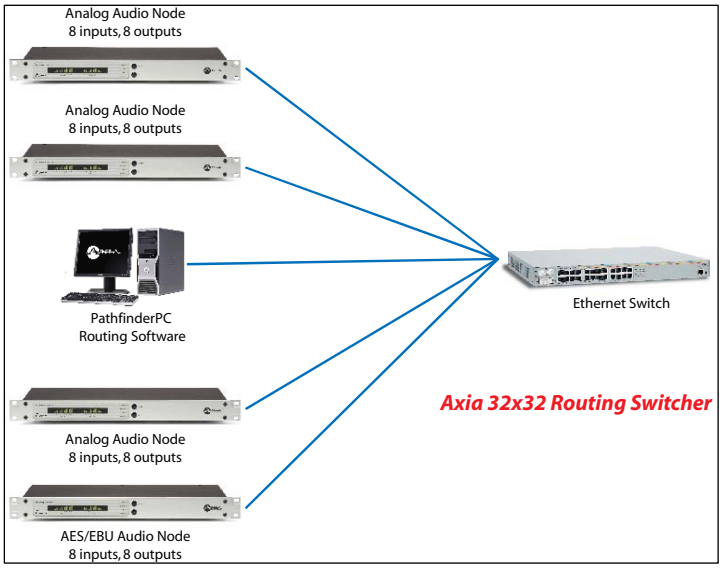

Figure 4

could be as small as 8 stereo inputs and outputs (analog and/or digital, with or without program associated data) that could scale to a very large system without huge jumps of costs or complexity.

You probably already know that with conventional routing systems you have to make a choice between the "small frame" and the "big frame" before you even wire one input or output. (This is usually also the point where a router purchase is nixed because of cost.)

Most of us are also aware of the need for multiple plug-in I/O cards, and the fact that cards from one system – sometimes even from the same manufacturer – can not be used in a different card cage. What I was not aware of until recently is that a very small Axia system can be affordably constructed and then expanded over time without ever discarding the original parts of the system. Literally, an Axia routing switcher can grow from very small to very large at a very predictable and linear cost.

To illustrate this point, let's look at the illustration in Figure 4. This shows how, using very little equipment, you can easily construct a 32x32 routing switcher with Axia components. In this illustration, you see 4 Axia Audio Nodes (3 Analog nodes and 1 AES/EBU node). Remember that each of these nodes have 8 stereo inputs and 8 stereo outputs. The nodes are quickly connected to a 100/1000Base-T Ethernet switch using inexpensive CAT-5e cable. You only need one Ethernet cable to connect each node to the switch, because each 100Base-T link has enough capacity to carry 32 stereo signals — all running at once! Automated routing control and scene changes are handled by PathfinderPC software running on a connected PC.

32x32 is a pretty respectable routing system, easily capable of serving two or three studios. Now imagine you have one already built and in service

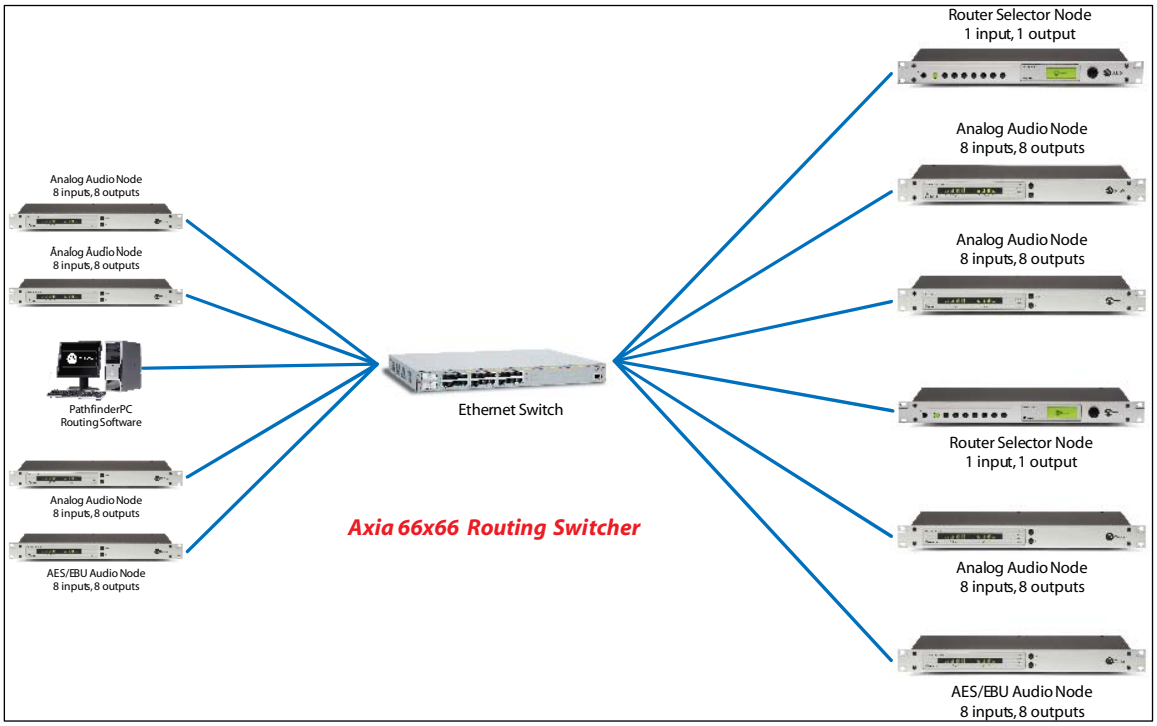

Figure 5

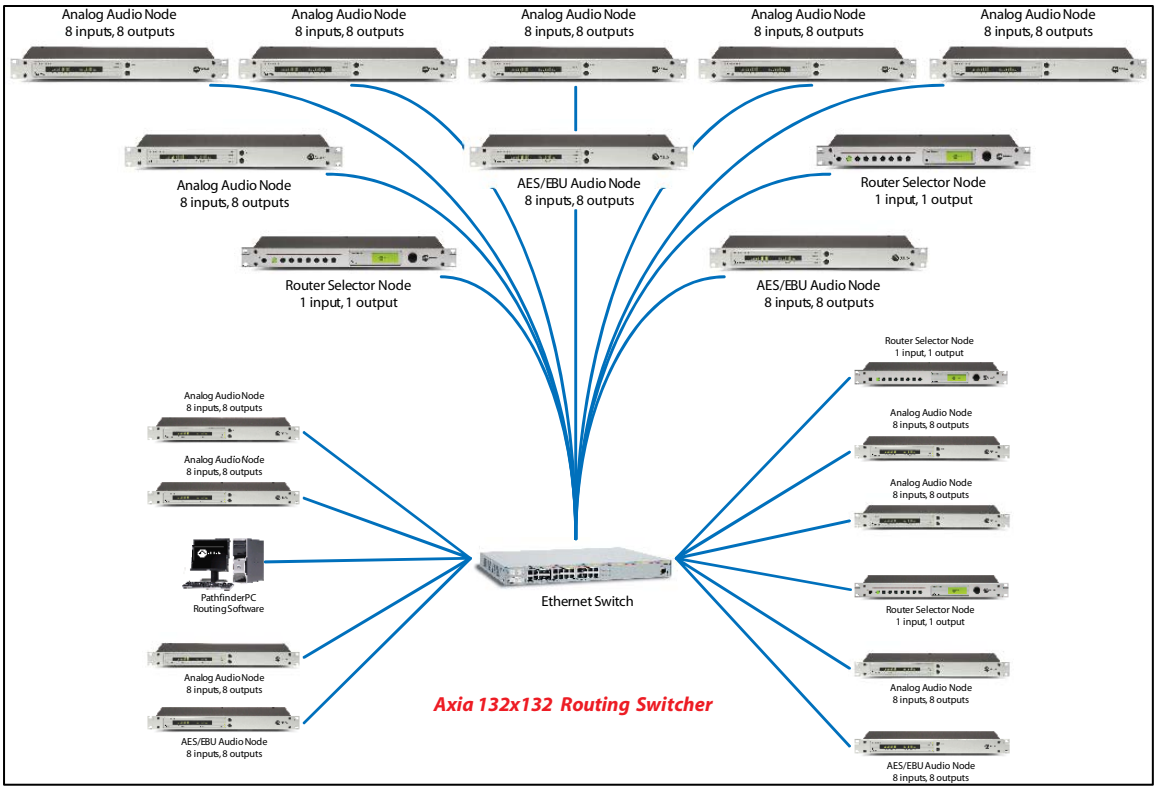

Figure 6

when you find out you're moving two more stations into your facility. Our clients tell us it's especially easy to add capacity to Axia routing systems because all you have to do is connect more nodes to the existing setup, again using standard CAT-5e.

As you can see in Figure 5, the original 32x32 system we built is still intact – we've just added more Audio nodes to the system to accommodate the increased routing demand – another 4 Analog nodes, an AES/EBU node and two Router Selector nodes.

Now you've doubled the size of the original routing switcher system to 66x66.

Imagine again that your company has acquired some more stations, and now you have to move to a new building. You need a larger routing system, too. As you've seen, it's easy to add capacity, so you just add some more Audio Nodes and your capacity is doubled again to a 132x132 router, as seen in the illustration in Figure 6.

As it's somewhat related, I think this is a good place to mention another neat benefit of IP-Audio that our clients have discovered: it's portable.

With traditional router systems, it's nearly impossible to re-use hardware in a new location. A different building means different card cages, different locations for inputs and outputs — not to mention all the expensive multi-pair cable you've just got to throw away.

Clients have found that with an Axia routing system, virtually the entire system can be taken with you if you move. Since all the Audio Nodes are rackmount devices that are placed wherever inputs and outputs are needed, you can simply take them with you and rack them in your new facilities; connect them with Ethernet and the entire system is online again.

UNCOMPRESSED STL

Everybody knows that the 950 MHz STL band is terribly crowded in all but the smallest markets. Hardly a month goes by where there isn't a story about a market where somebody was knocked off the air by another station turning on an STL, or where STL bandwidth is reduced by the frequency co-ordinator.

IP-Audio provides you with the ability to have multiple channels of bi-directional analog or AES audio (as well as GPIO) using Ethernet radios. These audio channels are uncompressed, so there's no intermediary coding artifacts to have to worry about. Best of all, the link can be easily reconfigured to add and subtract audio channels, which makes it perfect for HD Radio applications.

Bob Newberry, Chief Engineer of Clear Channel's Birmingham, Alabama stations, used IP-Audio to solve this exact problem. Bob told us that

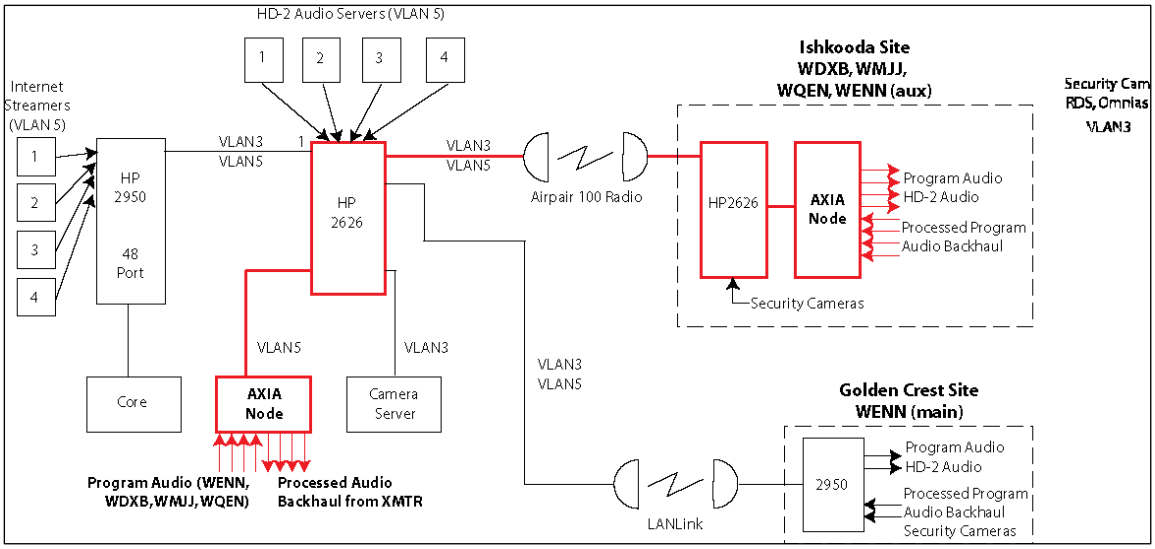

Figure 7

he used Axia audio nodes on either end of an Ethernet radio link to eliminate STL interference from other spectrum users and send 4 stereo channels of audio to his transmitter site, with room to add a couple more channels as needed (up to the bandwidth of his Ethernet radios). Figure 7 gives an excellent example of how Bob implemented his Ethernet STL system.

Bob's installation was recently featured as a Field Guide Report in Radio Guide. For details of the installation from Bob himself, check out www.AxiaAudio.com/news/clippings/Page16-RG-Apr06.pdf .

FACILITY-WIDE AUDIO MONITORING

You probably already know how expensive and time-consuming it can be to provide program monitoring capabilities to a building full of people. The cost of purchasing and installing speakers, line selector switches, amplifiers and wires to the various offices adds up quickly. As a result, the project ends up being either very costly, or providing less monitoring points than everyone had hoped for.

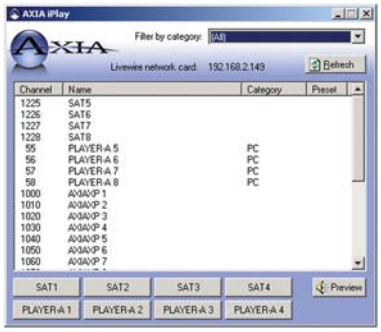

Figure 8

IP-Audio networks can provide monitoring around a broadcast facility for virtually everyone. Many of our clients use Axia iPlay software to do just that.

Here's how it works: iPlay is a software application that runs on Windows PCs. It can "see" the audio streams available on the Axia network, so anyone whose PC is connected to that network can monitor air – or any other available audio stream – using the speakers already attached to their computer. This allows GMs, Program Directors, salespeople, programming staff — *anyone* to listen to their choice of air monitors instantly, from any location, with no additional equipment to purchase and install or extra cable to run. Our clients tell me that the cost savings in speakers, amplifiers and switching hardware alone add up to a substantial amount of money.

WAYS TO "FOOL PROOF" YOUR PLANT

We all know that the more activities (routine and emergency) we can simplify or take out of the hands of operators, the more reliable our plants are likely to be. Our clients are making very creative use of several products we offer to do just this.

Router Selector Node

This tool allows easy selection of any source on the system. The eight front-panel push buttons help users quickly select frequently-used sources, while the "tuning knob" and display screen allow

selection from the entire list of network sources.

The Router Selector also provides a selectable amplified feed to headphones as well as analog/digital inputs and outputs. Some of our clients use the input to allow non-technical folks to get audio from external sources (think field recorders) into the system easily. We even have a client that uses a router selector node as a standalone dubbing station.

PathfinderPC

Clients describe this program as Axia's "Swiss Army Knife." PathfinderPC is a software package that can supervise any size Axia system. It can be programmed to automatically change routing based on time or event (closure). It has built in silence sense capability, which some of our clients use to activate alternate air chains. There's e-mail notification capability too – you can set up conditional routing scenes so that if, for instance, a primary ISDN feed gets knocked out, the system switches to backup and sends an e-mail to your Blackberry® telling you what happened.

PathfinderPC also works with customizable button panels on Axia consoles so that board ops can execute simple (changing satellite receivers) or complex (transferring program feed origination to another studio) switching functions with just one button-press. You can also use PathfinderPC to create a "virtual button panel" in software that runs on a studio PC; this gives users access to pre-programmed switching functions in software without allowing them "behind-the-scenes" access to the program itself.

iProFiler

Axia users have a unique way to integrate comprehensive audio logging into their networks with our iProFiler audio logging software. Based on the very popular Telos ProFiler logging software (www.telos-systems.com/profiler), iProFiler takes advantage of the Axia IP-Audio Driver to enable high-quality audio logging without sound cards. Instead, iProFiler receives up to 8 selected IP-Audio streams directly from the network and stores them as MP3 files at any bit-rate you choose, and uses GPIO start/stop triggers to control recording sessions. All this is done without any hardware except the PC itself, which requires just a NIC to connect with the Axia network.

iProFiler has a secure "listen line" capability as well, that makes it easy for PDs, consultants, etc. to log in remotely over the Internet and either listen live to audio as it's being recorded, or to archived audio via its Web interface.

High-Density A/D and D/A Conversion

A common problem in plants with a large number of audio sources is finding an elegant way to convert analog audio to the digital domain.

We've heard from several of our clients who have large amounts of analog audio generated by mics or other legacy audio devices that using Axia Analog and AES/EBU Nodes is an effective, space-saving way to convert analog audio into studio-grade digital, since Axia nodes use studio-grade A/D converters with extremely high specifications (for specifications on all Axia nodes, see www.AxiaAudio.com/components/specs.htm .)

An example: an Analog Node connected via crossover cable directly to an AES/EBU node provides 8 stereo A-to-D conversions, and 8 stereo D-to-A conversions, because each Node has 8 I/O ports.

Another example: substitute a Microphone Node for the Analog Node in the example above and you have studio-grade A-to-D conversion with built-in preamplification for 8 microphones, *plus* 8 stereo channels of D-to-A.

INTERESTING CONSOLE APPLICATIONS

Despite the title of this paper, I think I'd be remiss if I didn't point out a couple of unique benefits associated with IP-Audio mixing consoles that can help simplify life in the studio.

First, a console in an IP-Audio system makes the distribution of I/O, logic and backfeeds easier than ever. Sharing a standard audio connection in a traditional studio means two pairs for the stereo audio, another two pairs (at least) for machine control logic, and another two pairs for a backfeed or mix-minus. That's at least 6 pairs of wire for each audio connection, multiplied by the number of places you need to send it.

By contrast, an IP-Audio studio setup reduces the amount of wiring needed by an order of magnitude, because audio I/O, machine logic and even mix-minuses are all converted to digital streams, which are routed together in a single "bundle" of packets using Ethernet cable which can be shared with hundreds of other like signals. But elimination of wiring isn't the best part — there's also the fact that since audio, logic and backfeed are now part of the same digital package, you will *always receive the correct mix-minus* when routing remote or telephone audio. In other words, you can bring up a codec or hybrid on any console and it always works right.

Speaking of phones, IP-Audio also provides much tighter phone/console interoperability than has ever been possible before. With traditional consoles, phone operations have required outboard controllers – switch panels or phonelike devices – to control the hybrid. This interrupts the workflow in the control room, since the jock has to take his hands and eyes off the console to work another device. Drop-in control panels for consoles mitigate this somewhat, but these controls are often not adjacent to the audio faders themselves, and in any case require discrete wiring for audio, hybrid control and mix-minuses.

As noted previously, IP-Audio networks route I/O, control and backfeeds together, so the phone controller can live in the console, right next to the audio faders, and the console can receive audio, generate hybrid control logic and send mix-minus, all over the same Ethernet cable. Another benefit is that the hybrid itself doesn't need to be located in the studio anymore — it can be placed in the TOC or some other central rack room, safe from curious hands.

Finally, something I consider to be a very unique console application: the ability for two consoles to work simultaneously with shared sources. One large client (who've asked me not to reveal their name) told me that they intend to use the motorized faders available for our Element modular console to set up a "master/slave" relationship between control room and talk studio consoles.

This application is driven by a scenario in which talent in the talk studio wants to control their own levels for some audio devices. But the control room operator needs to keep control of the levels in order to "assist" the talent should they run their audio at the wrong level.

The solution: link the motorized faders on the control room and talent consoles, designating the CR as the "master" console, and the studio as the "slave." This allows talent to set levels as desired, but also allow the board op to override those levels as needed – something that can't be done with a traditional console setup.

TO SUM IT ALL UP…

…when I joined Axia, it was like drinking from a firehose. I found out in no short order that there was a lot I didn't know about all the things IP-Audio could do! Thanks to our clients, I've learned a lot in a very short time.

If you have questions about any of the applications discussed here (or if you've got one I haven't heard of yet!) please call or email me. I'd love to talk with you about this exciting technology.

Onward and upward!

Marty Sacks
Vice President
Axia Audio
216.241.7225
marty@AxiaAudio.com