

The Technical Case for the Intelligent Network:

What WheatNet-IP is
and what it can do for you.

Scott Johnson,
Systems Engineer

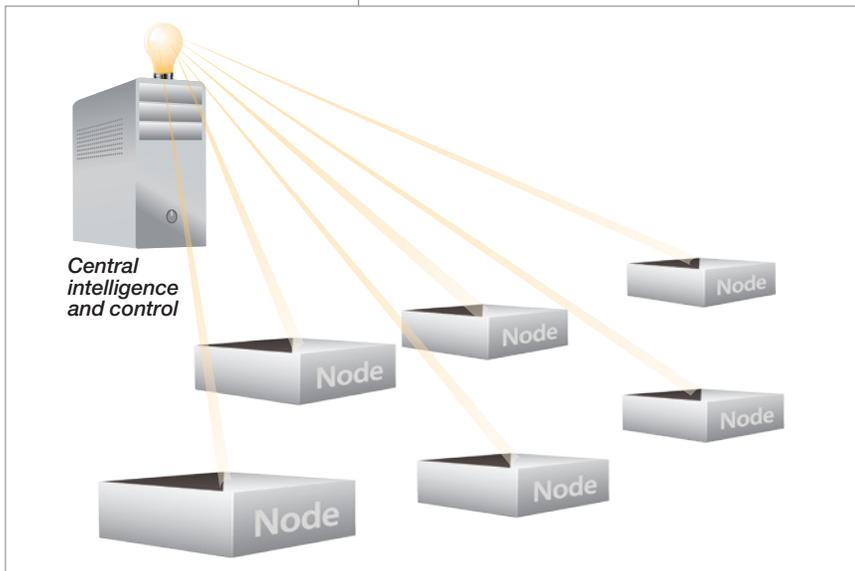
Foreword

In recent years, many broadcast facilities have availed themselves of the many advantages offered by networked digital audio technology. Digital audio networks offer endless routing flexibility, the ability to share resources, and substantial savings in maintenance and infrastructure costs over traditional facility designs.

In this paper, we will address the implications of taking this technology to the next level. We will explore the nature and advantages of intelligent networks, using Wheatstone's WheatNet-IP system.

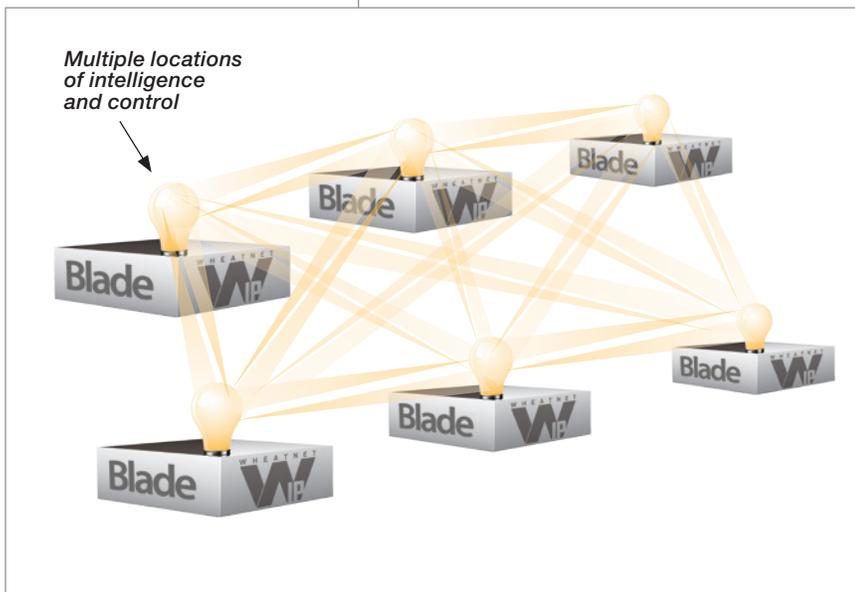
What is an Intelligent Network?

Until recently, AoIP networks were essentially traditional digital audio networks carried over a different communications medium. All right, it's a bit more complex than that, but the key here is that these networks consisted of networking equipment that, for the most part, did what it was told. A central controller, generally a PC, was the locus of much of the system's core intelligence, as shown in Figure 1.



This sort of network depends upon the intelligence of that single controller in order to perform most of its more complex functions. The individual nodes are mostly unaware of each other and don't communicate directly; instead, they use the controller as an intermediary to accomplish most tasks. The controller is, to some extent, a single-point failure exposure because without it, functionality across the network is compromised.

Figure 1:
Centrally controlled network architecture



An intelligent network, on the other hand, is a network where the system's core intelligence is distributed to each of its components, as shown in Figure 2. Each node has its own knowledge of itself, its place in the network, and the network as a whole. Each node in the network is capable, on its own, of getting things done, locally or anywhere else in the network.

It's not merely the presence of distributed intelligence, of course, that makes the network intelligent. Instead, it's the multitude of features and the wide range of functionality that are enabled by this kind of network structure that bring the network itself its intelligence. As we will see, distributed intelligence opens many doors.

Figure 2:
"Intelligent network,"
a network using architecture
with "distributed intelligence"

Applications of Distributed Intelligence

Intelligent networking and distributed intelligence are not new. The concept is used in many ways, most of which impact our daily lives. One of the most commonplace and visible applications of the intelligent network concept is in the system for which it was originally invented – the public switched telephone network.

In an effort to design a network that was largely self-configuring, self-healing, and efficient in its use of circuit capacity, Bellcore (the research arm of the old Bell System) developed a common language that could be used by these telephone switches to communicate with each other, and a method of carrying those communications over existing trunk circuits. In doing so, they created the first Intelligent Network.

Once this network was deployed by regional and local telephone companies across the nation and the world, its advantages were multiplied and became so important that the industry has never gone back. Intelligent networking became the enabling factor for many of the telephone features we take for granted today, such as caller ID, conference calling, call waiting, and missed-call callback. Today, Advanced Intelligent Networking is the backbone of our entire telecommunications system, including cellular (mobile), ISDN, landline telephone, and wireless data communications.

Benefits of the Intelligent Network

Because of its very nature, the structure of a network with distributed intelligence makes many unique features and functionality possible. It also facilitates things that are possible (but far from easy) with other types of networks. Because of the open communication between nodes on the network, advanced routing of audio and logic becomes a simple matter. Likewise, options are opened for sophisticated automatic control of the network and its connected devices, as well as for communication with automation and playout systems. Setup and management are greatly simplified, and reliability is dramatically increased as many single-point failures are eliminated. In addition, because each network node brings with it its own intelligence, scalability is assured because the system never runs out of processing power.



Figure 3: A Typical Blade

The Blade: An Intelligent Network Building Block

In the WheatNet-IP network, the basic unit from which the network is built is known as a Blade. While each Blade is a relatively small, thin unit that fits into a single rack space, there's a lot of technology, engineering, and power inside that sleek, all-metal housing.

Within each Blade is a dedicated controller which provides its own intelligence, enabling it to perform the Blade's functions as well to coordinate with other Blades in the network.

Also within the Blade is a 1000-base-T (Gigabit) network interface. This single network connection is used to send and receive audio, logic, and communications from this Blade to the rest of the WheatNet-IP network. Gigabit Ethernet provides very low latency while allowing the use of readily-available switches and infrastructure for connectivity.

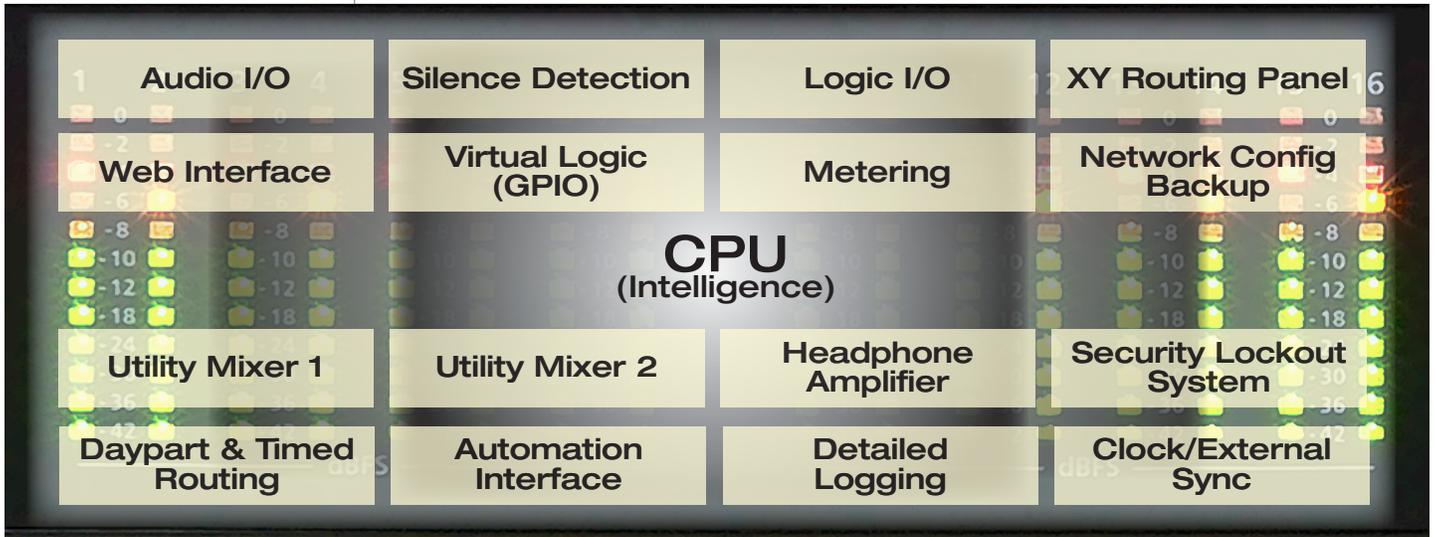


Figure 4: Blade Block Diagram

Each Blade has a control panel equipped with a rotary selector and a crisp, high-contrast alphanumeric display with backlight. This front panel interface has access to all local and remote resources.

On I/O Blades, there is an I/O section consisting of analog or digital inputs and/or outputs, switching facilities, and LED bargraph metering. On console Blades, there is also on-board digital signal processing (DSP) which provides mix-matrix, level control, and other resources needed by the control surface. These inputs, outputs, and console resources are interfaced to the network by the Blade.

Each Blade also contains two utility mixers whose inputs and outputs are made available both locally and to the network as a whole.

A logic (GPIO) interface is also provided within each Blade for connection of ancillary equipment such as ON-AIR lights, machine start and stop, tallies, remote microphone panels, and alarms. The front panel includes a headphone jack for monitoring of selected audio channels from anywhere on the network.

The Blade is fully functional as a stand-alone unit, and does not require a network or any other external equipment (other than audio sources and destinations) in order to function as a self-contained router

Simplified Setup

Initially configuring digital audio networks has the potential to be a very tedious, complicated process. After all, the network's got to be told about every component we're going to add to it, and each component's got to be told about the rest of the network. We've got to deal with IP addresses, and channel numbers, and priorities, right?

Wrong! Remember, WheatNet-IP is an intelligent network, so we can rely upon the system's core intelligence to handle most of its own configuration. When we plug a new Blade in, it will instantly recognize that it's been connected to a functioning network and configure itself into that network with almost no human intervention at all! All of its resources are instantly available.

Need to name sources and destinations, configure logic, and make default routings? Fire up a laptop and connect it to the Intelligent Network. You'll have the ability to set things up using a clean, easily-navigated user interface, and when you're done, you can unplug the laptop and put it away. Every Blade in the network has its own copy of the configuration of the entire network, continually updated.

What About Maintenance?

Setting up the WheatNet-IP network is easy, then, but what happens when something in your facility changes? As one might predict, with an intelligent network, it's almost anticlimactic. If another Blade is needed, we just assign it the next available Blade number (a simple, easy number: 1, 2, 3 ... you get the idea.) Then we just plug it into the nearest switch port and sit back ... but not for long. In a few seconds, the new Blade will discover the rest of the network, grab a copy of the full configuration, register and announce itself, and put all of its resources out on the network, ready for use.

What would happen in the very rare event that a Blade actually failed? (Let's say it was hit by lightning, given a drink of coffee, or stolen by spies from a competing station.) Here's the process for replacing it. First, get another Blade. Second, dial in the same Blade number as the zapped, drowned, or stolen Blade. Third, plug it into the network. Fourth, go and find a more difficult problem worthy of your skills, because that was so simple you'd almost let an intern do it. Almost.

Maintenance of an intelligent network is also far simpler because of the tools you have available for monitoring and troubleshooting. Every Blade is a routing panel, capable of accessing and switching every source in the entire network. Each Blade also has a headphone jack, so that you can plug in and monitor any of those sources. There's also quite a bit of diagnostic and informative data that can be displayed by the Blade's front panel at any time, and metering at each Blade lets you make go / no go decisions at a glance.

Routing: The Basics, Enhanced

WheatNet-IP has many sophisticated features that are enabled by its distributed intelligence. Before we even delve into those, however, let's address basic routing functions. Have you ever needed to rename a source or destination quickly? On some networks, this can be a big deal, requiring restarts, resets, or reboots to make the name change "take" everywhere in the system. With an intelligent network, we rename that resource once, and it is immediately updated throughout the network – right now!

Ever needed to make one quick connection on the fly, to connect two key resources together for an unfolding news situation or special event? With an intelligent network, you won't have to run looking for the nearest PC or routing panel, because every Blade actually is a routing panel! Just by dialing through sources with the convenient rotary selector on the Blade's front panel, you can access every source across the entire network, and make new routes at will. You can also activate preconfigured sets of routings, called salvos, that can create even more far-reaching switching changes.

Logic can be a hassle on some networks. Route the audio, and then route the logic. If you forget, things don't work. Wouldn't it be nice if the logic just followed the audio? With an intelligent network, it does. When you route a CD player to a console fader, the START button logic is routed right along with it, if you so desire. These logical associations reside within the Blades, and do not require a PC or controller to work.

We needn't stop at mere routing, though. Remember, each Blade is intelligent. Want to have an air chain switched to a secondary audio source if the primary one goes silent? Silence sensing and redundant path switching can be done within the Blade itself, requiring no external hardware or software.

When we introduced the Blade, we mentioned that each has two utility mixers inside. These are full-featured, stereo mixers implemented within the Blade's internal DSP. The inputs and output buses of these mixers are available as resources on the network, accessible anywhere. From simple features like summing, splitting, and level adjustment all the way through creating custom mixes under automatic control and performing fades and segues, the potential uses for these mixers are nearly endless.

Beyond the Basics: Scripting

What goes on in an audio facility obviously goes far beyond mere routing. Answering the need for more sophisticated automation are our Scripting Wizard, and BRAN* (Basic Routines for Automating Networks), our powerful, versatile scripting language.¹ With these tools, we can quite literally program the network to accomplish any task or set of tasks we might require.

The scripting wizard allows us to assign commonly-used functions to events in the system without doing any programming whatsoever. All that's necessary is to select the input to assign, then select from a list of pre-defined actions as shown in figure 5.

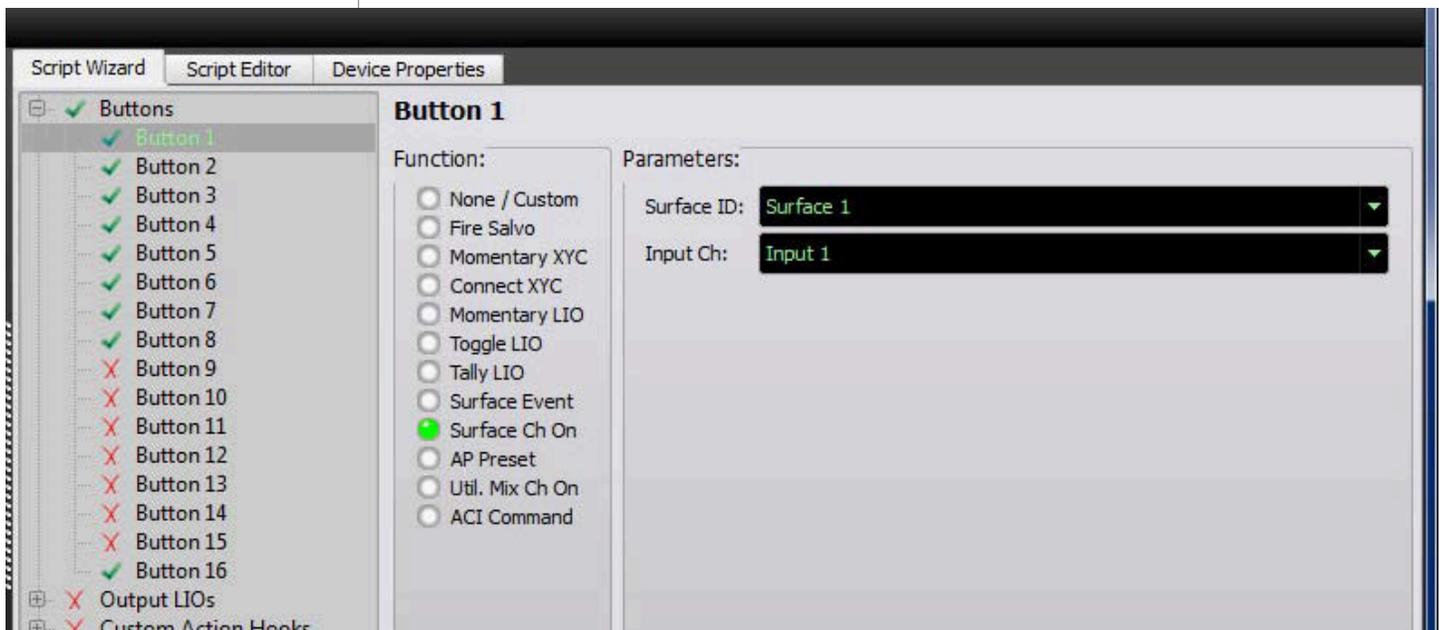


Figure 5:
Scripting Wizard Display

If the necessary functionality's not covered by these predefined options, you'll need to do a bit of programming, but thanks to BRAN, that's relatively easy, too. An integrated development environment comprising an editor, a source-level debugger, and a compiler allow you to write, debug, test, and implement routing, logic, and control routines whose variety is limited only by your imagination.

The intelligent network can also communicate with other devices by way of our ACI (Automation Control Interface). Through this protocol, which is made available to our customers and industry partners, external equipment such as automation systems, processors, and schedulers can send control messages to the intelligent network, or receive status and control information from it. Through this interface, equipment can be combined with our networking infrastructure to make it do things we never designed it to do, or even imagined it doing. Imagine receiving an EAS test and having the audio transparently switch to the air chain, the automation system pause, and your processing switch to a neutral preset without anyone touching a thing. It's all possible with the ACI.

* Bran is the outer shell or hull of a grain of wheat. BRAN will keep things moving smoothly, much as its namesake does in a dietary sense.

In Practice

Intelligent networks can revolutionize our workflow. They can facilitate the way we get things done now, and open the door to innovative new ideas that can help us work smarter, not harder. With wide-reaching impact, intelligent networks offer us benefits in the areas of flexibility, control, security, and efficiency.

Flexibility

Save on wiring and infrastructure.

Audio and control devices can be wired directly to the Blades. There's no need for punch blocks or patch bays; the network gets your audio to where you need it.

Every Blade has two built-in mixers.

Need a sub-mix right now, in this studio, for a special segment or program? It's available anywhere there's a Blade.

Multi-task your studios.

Any control room can be configured for production, on-air, imaging, or voice tracking at the touch of a button. You can even switch configurations automatically at a particular time of day.

One cable does it all.

Connect automation and production PC's, codecs, audio processors, controllers, and other devices directly to the network without installing specialized sound cards, A/D-D/A conversions, audio wiring, or control connections.

Feel free to be spontaneous.

WheatNet-IP likes surprises. Changing formats at the drop of a hat? Adding a studio? Putting together breaking news coverage on the fly? If you can get power and a Cat6 cable there, just plug in a Blade and your network will adjust and expand.

Check in from your browser!

You're in a meeting, and the computer in front of you has no Wheatstone software on board? Don't bother getting up. Point your browser to the web interface and do your thing. You'll have a full view of the entire network, and immediate control.

Who's minding the store?

Your Network Operations Center, with a connection to the Intelligent Network, can control and monitor the entire system remotely and take corrective action as necessary.

Control

The logic's in the box.

Every Blade has logic (GPI) inputs and outputs built in. Anywhere you need to send or receive audio, you can send or receive control and tally closures, too, without any external hardware.

Practice quality control.

Every blade is provided with front panel meters, a headphone jack, and the intelligence to make them useful. You can monitor and measure audio anywhere on the network from wherever you are.

“Oops” doesn't mean a trip to the station.

Turn on a channel, nudge a fader, dial up a new source, and go back to sleep. Remote access lets you do all of this and more, without leaving your home.

The ultimate remote control.

Got a 2-way or RF IFB transmitter? Route push-to-talk logic to it, right alongside the mic audio, and your producers can communicate with talent in ways they never imagined.

Security

Fault-tolerant, self-healing, robust.

WheatNet-IP can't be crippled by the loss of a single Blade or network segment. In the unlikely event of a network failure, the intelligent network will ensure that any device will stay connected to all devices it can still see. When the network comes back up, all devices will rejoin, automatically and seamlessly.

Silence is NOT golden.

WheatNet-IP knows that in radio, silence is the sound of money lost. Every blade has the ability to sense silence and take designated actions, such as switching to a secondary audio source – all without the use of any PC's.

Efficiency

The Swiss Army Blade

Every Blade has a number of built-in tools. You won't be buying utility mixers, hardware routing panels, or external logic interfaces unless you really want to, because they're already in there. Silence detectors, external switches, and summing devices are also unnecessary. There's no bottle opener, though.

Software, not hardware.

Our drivers and our partners' interfaces allow you to connect automation and production PC's, codecs, audio processors, controllers, and other devices directly to the intelligent network. One cable does it all – no audio wiring, no control wiring, and no external adapters.

What's a distribution amplifier?

A paperweight, that's what it is. Because the intelligent network allows you to send an audio signal to one place or a thousand with ease, DA's and their associated masses of wiring are history.

Consolidation? No problem.

Think nothing of sharing the same audio source, the same talent, or the same control room with one station, two stations, four stations, or more. Networked audio makes this sort of switching simple.

Bypass that console!

Is your automation occupying a console even when there's no live assist happening? With a Blade's utility mixer, you can combine all your automation computer's outputs into one feed and route it directly to the air chain, freeing up a studio for production or another station's use!

Conclusion

These and many other benefits afforded by intelligent networking make WheatNet-IP the clear, intelligent choice.