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by Greg Charles Manfroi

The author is chief engineer of WUIS(FM).

WUIS is a Class B FM public radio outlet for Springfield, Ill., and the surrounding area. The studios are on the campus of the University of Illinois at Springfield. Situated in the state capital, the facility also operates the Illinois Public Radio Network, serving Illinois public radio stations.

PD Sinta Seiber-Lane works in the new Studio A at public radio station WUIS in Springfield, Ill. Photo by Matt Penning

In 2006 General Manager Bill Wheelhouse had plans to move WUIS forward in all areas, including the technical setup. The CE position was open; I applied and was hired in April of that year. I'd known Bill for 10 years and knew we would have a good working relationship.

The genesis for the project was the questionable condition of the facility. When I arrived I was asked to make an evaluation of the studios and transmitter sites. The station was to receive equipment to install HD Radio at this same time.

The staff was top-notch; the facility was not. The complement of equipment was fine, but the wiring resembled spaghetti. The existing mixing consoles were 10 years old.

If we were going to rebuild from scratch, my preference was to install a digital routing system if possible.

About a year later the National Telecommunications and Information Agency's Public Telecommunications Facilities Program (PTFP) had grant money available for public radio stations to upgrade. We made our case with PTFP and they awarded a grant to us. It took nearly a year to come up with matching funds.

I was interested in an IP-based system, in part because I had to rebuild studios that were in place, and I would be working alone to save labor cost.

Construction time could be shortened by using Cat-6 cable and jumpers with Radio Systems StudioHub adapters. Also, at the time of my arrival, work on a performance studio was starting.

Greg Manfroi runs a check during the shakedown of the performance studio. Photo by Matt Penning

Project scope

The scope of the project included five radio studios, a performance studio and a Technical Operations Center.

At the time of our grant application there were only two IP systems shipping; I choose to go with Wheatstone and its WheatNet system. Everything but the circuit boards are manufactured in their factory. The power supplies are overdesigned rather than acquired from an outside source for reliability.

WheatNet-IP Audio consists of five hardware Blades; four handle I/O in various configurations and one is a digital mix engine. Blades are linkable units that talk to each other via Cat-5E/6 over Gigabit/1000Base-T protocol using Layer 2 or 3 Ethernet switches. I liked that each Blade contains the configuration of the entire system, for built-in redundant backup.

The WheatNet IP Navigator GUI is where users set up the Blades, AoIP drivers, system sample rate and NTP time source. The application installs on a computer that is plugged into the switch. This is also where sources and destinations for routing are created. The GUI setup includes logic I/O, the virtual utility mixers, silence sense and salvos. The GUI is intuitive. Configuration changes automatically are backed up on every Blade.

Wheatstone had recommended HP ProCurve or Cisco switches. I chose to use Cisco switches because the university receives favorable pricing on those products.

The Technical Operations Center, before and after. 'After' photo by Matt Penning

I needed a cable management system on a beer budget. I fabricated cable hangers from angle iron and garage hooks. I bolted each hanger to the steel truss members that support the building roof. I wanted to ensure none of the gigabit cables made any sharp bends that might cause performance loss. I used the EZ-RJ45 system of connectors and tool to terminate each Cat-6 home run.

I wanted to replace our old Electro-Voice RE20 microphones. They had aged to the point where each one had a different sound. I have a preference for condenser microphones but our old studios were not soundproof, and there were no funds to correct this.

Condensers would have picked up noise external to the studios. I e-mailed Heil Sound and inquired about the PR series of microphones they produce. In a few minutes Bob Heil himself called me and offered to send me a PR 30 and PR 40 microphone to try out. The PR 40 had good side and rear rejection that would be essential in our less-than-ideal rooms.

My plan was to make the performance studio control room a radio studio as well. This would allow me to get a tech core setup and one studio to go on-air with while I gutted the old studios.

Punching cable

I pulled and terminated my cables, punched down my logic and plugged in my StudioHub components. Then I followed instructions written by Wheatstone Systems Engineer Kelly Parker to set up the Catalyst 3560G Cisco switches. The commands to set up the switches were simple using HyperTerminal software. I gave each Blade an ID number.

On the Wheatstone Evolution E-6 control surface, I simply typed in the ID number of its engine Blade and programmed my sources and destinations.

I encountered a problem in which any dynamic microphone I used in the new studio had a 60 Hz hum picked up by the mic element. I located the source of the

Studio F: Old Is New Again

hum, a large transformer in a utility room across the hall. It seemed the coils in the dynamic mics were picking up an electromagnetic field from this transformer.

I tried a transformerless condenser mic. The condenser was clean. I purchased four transformerless condenser microphones for this room.

Fortunately this room was constructed properly and does not suffer from exterior noise leakage. Since the condenser and PR 40 mics had different frequency response curves, I needed to add some equalization to each mic. The Wheatstone E6 surface provides you with EQ, expander and compressor that you can apply individually to each source.

I locked the E-6 control surface display clocks to NTP provided by one of our NPR stream receivers.

There are two handy virtual mixers in each 88e and 88a Blade. I utilize one with our BE AudioVault automation. I also use one in a talk studio controlled by a Wheatstone GP-16P panel to switch different sources to the monitor speakers.

Before our first new studio was suddenly pressed into on-air service, it was placed into production use. Studio F is equipped to recover archived audio from legacy analog formats using equipment not quite lost to the ages.

I picked through the station's remaining reel-to-reel machines in storage. I found a Revox PR99 MKII with the heads still in decent shape, though the pinch roller had hardened and was falling apart. I found a new roller from an eBay seller in Germany.

In the course of this rebuild project, our first news director Rich Bradley announced he was retiring after 35 years. Rich started with the station in 1974 and instituted a reel-to- reel archive from the day the station went on the air in 1975.

In the midst of installing IP technology I dug out a copy of a Radio World article on tape baking by Rich Rarey of NPR. I used an old food dehydrator, lowered the temperature to 122 degrees F with a light bulb in series with the heat element and started baking tapes. For the first time in 13 years I was aligning a reel-to-reel machine to the dulcet tones of Robert Morrison. (I still have a head degausser.)

I installed a Wheatstone AoIP driver on the recording computer for this studio and started saving audio to a new server while I continued the construction project. The archive audio was used to create a retrospective broadcast of Rich Bradley's 35 years of service to the station.

Another piece of gear in storage was an Orban Optimod-FM 8000A that was used in the 1970s. I recapped it, removed the pre-emphasis, balanced the discrete outputs and I am using it for processing/protection on our standby STL.

— Greg Manfroi

Several days before the new Studio F was to go to air, a power strip shorted in the old air studio, taking it down completely. Suddenly morning host Karl Scroggin was thrust into the new studio. I pressed a button on the bypass switcher and he was back on-air.

Karl, an accomplished musician, liked the studio. He was impressed by sounds in the CD recordings he had never noticed in the old studios.

Then it was on to gut each of the old studios, and wire the furniture with conduit and junction boxes. (No consumer power strips allowed.) Next I dropped in the surfaces, Blades, cabling and sources, and punched down the logic connections. Each studio came up as planned.

I needed to turn a channel on and off on an E-6 surface automatically at the same time each night during construction and was able to have AudioVault do that through the Wheatstone network easily without any physical logic wiring.

All of the production computers use the Wheatstone AoIP driver. You can select up to eight stereo channels of I/O.

Anyone who has set up a peer-to-peer network and used HyperTerminal and an FTP client could set up this system. Now we have a facility that helps instead of hinder us.

In the middle of the project I added an HD2 channel carrying WXPN's eXPoNential format. Adding services and functions is easy now. University of Illinois students will have the opportunity to use present-day technology and be better prepared.

Radio World welcomes your facility story. Write to us with your idea at radioworld@nbmedia.com.

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