Radio
THE RADIO TECHNOLOGY LEADER

KQED(FM) Moves on the Mountain

The San Francisco station completed its transmitter site project after a four-year renovation saga

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FIND THE MIC AND WIN!

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VIEWPOINT

Prepare Now for the Spring Thaw (and Show!)

It's March. Spring is just around the corner, as is the spring NAB Show. Our March edition is the "warm-up" for the big annual event.

(If you haven't already put together your plans, it isn't too late: You can get an exhibits-only pass for free from your favorite equipment vendor; and since the show is a little later in the month this year, you still have over a month to get your airline tickets and hotel reservations.)

As part of our NAB Show preview, Chris Wygal has gone over the agenda of the 2017 Broadcast Engineering Conference and highlighted many of the sessions that are on the docket. There will be no other place on Earth that you can hear the likes of Philipp Schmid, Greg Shay, Paul Shulins, Mike Dosch, Jay Adrick, Robert Meuser, Ben Barber and others, all in one day. The BEC will be the place to be on Sunday, the day before the exhibit floor opens.

We normally cover new studio builds in our Facility Showcase series, but this month we're

CONTINUED ON PAGE 7

Radio
THE RADIO TECHNOLOGY LEADER

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featuring an extensive transmitter site build that was recently completed for KQED(FM) in San Francisco. There are several important lessons to be learned here. Sometimes, aspects of the project you expect to be the simplest end up being the most difficult and time-consuming. Any radio engineer who has built or moved a transmitter site will relate to this article, and I know you'll find this interesting, especially if you're about to embark on a similar build yourself.

About once per year, we cover the latest developments in AoIP technology as it relates to studio facilities. In this issue, we're covering all the companies you would expect and then some. If you're headed to Las Vegas so that you can study console systems, I suggest you start your research with this article. We've done a lot of the legwork for you.

AM synchronous boosters are in the news again, and Jeremy Ruck is back this month to explain just what they are and the fundamentals behind how they work. With a new Federal Communications Commission in place — one with a focus on the Senior Band — I think you're going to hear more about synchronous boosters for AM. This is a good to read if you want to get up to speed on the topic.

In FCC Update, Lee Petro discusses recent rule changes for the placement of FM translators that rebroadcast AM stations, as well as some recent public file changes.

Like many of us, the Wandering Engineer has moved around the country to make a career. "Broadcast gypsies move but 'Prairie Home Companion' always allowed me to catch up on the news back home," he/she writes in this column. I'd bet you may feel the same way. I first heard PHC over 30 years ago on a station that, sad to say, has since gone silent. As people who know what goes on behind the scenes — how the sausage is made — shows like PHC, and "The Grand Ole Opry" and the Saturday matinee broadcasts of the Metropolitan Opera — are that much more impressive and to me, exemplify what great radio is all about.

Thanks for reading Radio magazine — and don't forget your NAB Show plans!

Doug Irwin, CPBE AMD DRB | Technical Editor

Expanding FM Translator Contours for AM Stations

by Lee Petro

Everyone's done it at some point or another. A big Thanksgiving meal, too many nachos watching the big game, and relief is found by loosening the belt a notch or two. On Feb. 23, 2017, the Federal Communications Commission adopted rules to slightly adjust the waistline of FM translators used to provide fill in coverage for AM stations.

Previously, the FCC adopted rules to permit FM translators to rebroadcast AM stations. The FCC's current rules require the FM translator to be located at a transmitter site that is within the lesser of (i) the 2 mV/m daytime contour of the AM station, or (ii) a 25-mile radius centered on the AM station's transmitter sites. Subsequently, the FCC adopted procedures in 2015 to open four separate filing windows to permit AM stations to obtain authorizations for fill-in service by FM translators.

The first two windows permitted FM translators to make "major" changes to their facilities, change channels and move up to 250 miles to serve as a fill-in service for an AM station. The next two filing windows will permit AM stations to file for new FM translator facilities, with the Class C and D AM stations getting the first opportunity, and then a general window for all AM stations that had not yet submitted an application. The two remaining windows were intended to occur in 2017.

One proposal for which the FCC sought additional comments in 2015 was whether it should relax the siting restrictions to permit FM translators to operate from transmitter sites further away from the AM station's transmitter site.

One possibility was that the FCC would switch to a "greater than" standard when looking at the AM station's 2 mV/m contour or 25-mile radius, so long as the 60 dBu contour of the FM translator did not extend beyond a 40-mile radius. In response, some commenters had urged the commission instead to expand the 25-mile radius to 40 miles, or abandon the radius limitation all-together.

In the end, the FCC adopted rules to permit FM translators serving as a fill-in service for AM stations may be sited so that their 60 dBu contour must be contained within the greater of (i) the 2 mV/m contour of the AM station, or (ii) a 25-mile radius centered on the AM station's transmitter site. The FCC expressed concern that any further expansion of the fill-in FM translator siting restriction would lead to FM translators extending their service to areas outside the AM station's core service area.

PUBLIC FILE CHANGES

In other actions, the FCC eliminated the rule requiring commercial broadcasters to maintain public correspondence in a public inspection file maintained at the station's main studio. As discussed last March, the FCC adopted rules for radio stations to transition their public inspection files to an FCC-maintained online filing system. The transition is partially complete, with commercial radio stations in the top 50 markets with five or more full-time employees moving by last June, while all stations must complete the transition by March 1, 2018.

One category of documents was not included in the first wave, though. The FCC declined in 2016 to require that radio stations move correspondence from the public to the online public file system due to privacy concerns.

In the very first action under the regime of Chairman Ajit Pai, the FCC adopted a report and order eliminating that requirement. Instead, while the public may continue to call, write and send emails to broadcasters, the FCC will no longer require that broadcasters maintain these records in their public inspection file.

By eliminating the requirement, commercial broadcasters can complete the transition of their public file to the online filing system and will no longer be required to maintain a local public file at their station(s)' main studios.

PILOT PROJECT

One final note: Chairman Pai announced a pilot project in which he plans to release advance copies of the documents to be voted on at the next open meeting. The report and order modifying the FM translator rule discussed above was the first order released under this new process. The intended goal is to permit the public to "understand the nature and scope of issues under consideration."

While it will be helpful for the public to have an opportunity to see the draft documents, one concern worth noting is that the public will need to be more active in monitoring active proceedings to watch for last-minute lobbying efforts by interested parties with eyes and ears in Washington. In the past, these lobbying efforts were general in nature because the drafts were not public. With the drafts now being released several weeks before the FCC votes, lobbying efforts will be significantly more targeted, as interested parties will have a target to shoot at.

Petro is of counsel at Drinker Biddle & Reath LLP. Email: lee.petro@dbr.com.

DATELINE

April 1, 2017 — Annual EEO Public File Reports are due for stations located in Delaware, Indiana, Kentucky, Pennsylvania, Tennessee and Texas with five or more full-time employees.

April 3, 2017 — Broadcast Mid-Term Report (FCC Form 297) due for stations located in Texas with 11 or more full-time employees.

April 10, 2017 — Issues/Programs Lists for First Quarter of 2017 must be placed in/uploaded to stations' public inspection file.

NAB SHOW®
Where Content Comes to Life

NAB Show 2017: Technical Sessions of Note

by Chris Wygal

It seems like April approaches faster each year — even though this year's NAB Show is later than usual.

If you're attending the annual convention in Las Vegas, you've undoubtedly already made airline and hotel arrangments and you've registered for the convention itself.

But before you head to Sin City for full immersion in all-things-broadcast, make sure you know what engineering sessions are waiting. Recurring themes include IP, cybersecurity/IT, HD Radio/digital radio, STL tips and more.

Here are a few that I've picked out as being of particular interest to radio broadcast engineers. See the full schedule online at *http://nab17.mapyourshow.com/7_0/sessions/session-grid.cfm.*

Saturday, April 22
9 – 10:30 a.m.

BROADCASTERS: DON'T JUST GO IP, GO IT

Presenter: Kieran Kunhya, founder and managing director, Open Broadcast Systems

As expected, IP continues to dominate the discussion at the NAB Show. More and more broadcast infrastructure is IP-based; everything from in-studio AoIP architecture to STL systems. In this session, however, engineers are encouraged to consider an IT-based approach in order to reap additional cost benefits and to gain access to more functionality.

Saturday, April 22
1:30 – 3 p.m.

GROUNDING AND BONDING ARE FUNDAMENTAL TO RELIABILITY

Presenter: David Brender, national program manager, Copper Development Association

This presentation encourages a more rigorous approach to grounding and bonding techniques in electrically sensitive broadcast facilities. Brender says the National Electric Code sets forth, at best, minimal safety standards that often underserve the critical needs of broadcast systems. Greater attention to grounding and bonding is better for equipment and can prevent downtime — plus, it is a cost-effective measure with high ROI.

Saturday, April 22
1:30 – 3 p.m.

SATELLITE VSATS FOR BROADCAST STL

Presenter: Jim Dalke, CEO, Dalke Broadcast Services Inc.

Engineers still face the same age-old problems concerning STL installation. No line-of-sight to the transmitter location, no landline carrier available at the transmitter site for IP or T1 and sometimes, the 950 MHz spectrum is too crowded. However, there is a perfect storm brewing: Due to high demand, satellite services are becoming less expensive, plus, very small aperture terminal advancements are making satellite links more available to broadcasters. In this paper, Jim Dalke will present the usage of VSAT technology as a viable option to traditional STL installation hardships.

Saturday, April 22
5 – 5:30 p.m.

THE VOA MUSEUM

Presenter: Jay Adrick, technology advisor and consultant, GatesAir

Radio historians will enjoy the story of the Voice of America and radio's role in World War II. This presentation is a production of the VOA Museum in Mason, Ohio.

Sunday, April 23
9:30 – 10 a.m.

THE EFFECTS OF BIT RATE REDUCTION ON ACOUSTICAL WATERMARKS FOR RATINGS SYSTEMS

Presenter: Paul Shulins, Greater Media

Depending on market size, stations have the resources to employ the Portable People Meter, therefore tagging the market as a "PPM market." PPM encoding is important for ratings measurements, and it requires listeners to wear the meter on their belt. For the technology to work, PPM encoding is used. However,

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multiple factors are in play concerning the audio data bitrate and its effect on the PPM watermark. This paper will address the results of rigorous testing done using several stations in Boston.

Sunday, April 23

10 – 10:30 a.m.

THE COMING VIRTUALIZATION OF RADIO STUDIOS, OR KISS YOUR RACKS GOODBYE!

Presenter: Michael Dosch, director of virtual radio products, Lawo

We've all seen the miniaturization of radio broadcast plants. Studios are less involved with fewer and fewer moving parts. Automation systems pack a considerable punch in one little box. Dosch explains how technological advancements are allowing for even more of the usual moving parts to be virtualized in the studio and the rack room. This saves power and construction costs and a virtualized studio can be built faster than a traditional, physical broadcast facility.

Sunday, April 23

10:30 – 11 a.m.

FM/HD RADIO TIME, LEVEL AND PHASE ALIGNMENT

Presenter: Ben Barber, president/CEO, Inovonics

HD Radio is a beneficial advancement in radio technology primarily because it delivers a sonic improvement to the listener. However, if not implemented correctly, it can become an "ear sore" and potentially create tune-out. The mixing/blending between FM and HD caused by atmospheric conditions and geography are an unavoidable evil, but if delay time, audio level and audio phase alignment are executed perfectly, it will go mostly unnoticed by the listener. This presentation will offer solutions on how to perfect time, level and phase alignment.

Sunday, April 23

11:30 a.m. – 12 p.m.

INTEROPERABILITY OF FM COMPOSITE MULTIPLEX SIGNALS IN AN IP-BASED STL

Presenter: Junius Kim, engineering project manager, GatesAir

The availability of high-bandwidth IP paths has facilitated numerous options for STL consideration. Transporting FM MPX over IP is a viable method, but there are tradeoffs and benefits. Plus, many engineers want to look at STL topology in terms of how existing analog gear should, shouldn't or even can be used. This paper will present ideas for using legacy gear and current technology for FM MPX over IP.

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PRE-SHOWCOVERAGE

Sunday, April 23
2 – 2:30 p.m.

STL SOLUTIONS IN AN IT-CENTRIC WORLD

Presenter: Robert Meuser, CTO, Engineaux Inc.

Nobody needs to be reminded how IP has sunk its teeth into nearly everything involving broadcast. The IP takeover has left no facet of radio untouched, including — if not especially — STL technology. This presentation will discuss the wide array of options for radio content transport over IP.

Sunday, April 23
2:30 – 3 p.m.

BUILDING WEB SERVICES TO EMBED ONLINE DATA IN DAB+: ADS, SOCIAL FEEDS, NEWS AND MORE

Presenter: Roman Holzhause, research assistant, Anhalt University of Applied Sciences

Developments abroad in the DAB+ standard are allowing broadcasters to push more content to listeners. The goal is to make social media feeds, artist artwork, visual weather forecasts and several other features available to listeners. This will be accomplished by embedding web data into the radio signal itself, as opposed to the radio pulling data from elsewhere and combining it simultaneously.

Sunday, April 23
3 – 3:30 p.m.

TRANSDIMENSIONAL STEREO EMBEDDING: APPROACHING THE TARDIS EFFECT FOR FM AUDIO

Presenter: Hans van Zutphen, audio processor creator, Telos Alliance

In this presentation, "Dr. Who" fans will appreciate the parallel of the TARDIS to stereo FM audio processing. The idea is centered on producing an experience that affords the listener the benefit of a bigger-than-expected FM stereo image, but without the typically fatiguing effect of overly-processed audio. Technology is already in place that increases perceived loudness up to three decibels without degradation and while staying within legal deviation limits. These advancements have proven successful on all formats, from spoken word to pop music.

Sunday, April 23
3:30 – 4 p.m.

FASTER, CHEAPER AND BETTER: THE RAPID ADOPTION OF AES67 AND AOIP LETS YOU HAVE ALL THREE

Presenter: Greg Shay, chief technical officer, Telos Alliance

Despite its infancy, AES67 has grown quickly as an agent of change for AoIP interoperability and standards. Each April at the NAB Show, we see more available IP-ready gear and IP transport options. As engineers are beginning to rely heavily on data protocols that provide seamless integration between systems, AES67 begs for exploration and more understanding of its benefits. This paper will help engineers understand AES67 in the AoIP world and how it can also improve the performance of telephony and other communications systems.

Sunday, April 23
4 – 4:30 p.m.

SINGLE FREQUENCY NETWORKS FOR HD RADIO

Presenter: Philipp Schmid, research engineer, Nautel

As more and more broadcasters research possibilities for expanding their audience, translator frequencies are becoming less available. A single frequency network offers a solution to limited frequency availability by designing a fill-in translator that retransmits on the same channel as the main station. Broadcasters are also looking for ways to retransmit their HD Radio channels using single frequency networks. In this presentation, we will see lab results and real-world design requirements for building FM and IBOC SFNs, including proper synchronization techniques.

Wednesday, April 26
4:30 – 5 p.m.

IS YOUR NETWORK REALLY SECURE?

Presenter: Wayne Pecena, director of engineering, Texas A&M University/KAMU

We see all of our systems migrating, one by one, to IP-based platforms. The majority of our gear is plugged into a network switch or router that, most likely, is seen by and can see the internet. Plus, we may have some feckless co-workers who are unknowingly (and knowingly) inviting intrusions and hacks every time they check their email. In this presentation, we'll learn ways to monitor our IP networks and get tips and tools for optimizing network security.

Outside the Convention Center

by Emily Reigart

Let's face it. For some broadcast engineers, attending the NAB Show is about more than just what you can learn in a conference or see on the exhibit floor. It's about experiencing the world of Las Vegas outside of the convention center.

Whether this is your first NAB Show or your 30th, here are a few things you may want to check out in your off time.

RESTAURANTS

No matter what, you've got to eat. Las Vegas is no longer known as a town of mediocre all-you-can-eat buffets and run-of-the-mill Italian restaurants.

While those Bacchanalian feasts do still exist, the city is increasingly full of celebrity chefs and trendy restaurants.

Even if you're on a tight budget, it might be worth your while to check out one of the hot restaurants on and off the Strip.

SHOWS

Outside of its slots and poker tables, Las Vegas is known for good entertainment.

Big names headlining concerts around the time of the spring show include: Celine Dion, Steely Dan, John Mayer, Hans Zimmer, Backstreet Boys, New Found Glory, Donny & Marie Osmond, Kansas and many others.

Comedians and magicians are also a staple of the Sin City scene. Ray Romano and David Spade, Carrot Top, Criss Angel, X Comedy and many others take the stage the week of NAB Show.

Cirque du Soleil is also a regular on the Strip, featuring several different shows at various menus.

ACTIVITIES

If you're the adventurous type, it may be worth your time to venture to the Hoover Dam or even take a helicopter ride over the Grand Canyon.

Dune buggies and race cars are also available for those who want to take a spin and work off some pre- or post-show stress.

Perhaps killing zombies is more your speed? Say no more. There's Operation Zombie Apocalypse, a two-hour virtual reality adventure just for you.

more widespread, had the commission not considered them in the limited quantity of stations a licensee could possess.

BY POPULAR DEMAND

Some four decades later, the old concept of synchronizing AM transmissions became popular again.

The commission granted several experimental licenses, and it was soon evident that synchronous AM systems could be somewhat reliable and practical. The crude crystal and tuning fork generated signals transmitted over wire lines of yesteryear gave way to digital delay devices and later, frequency synchronization through GPS. The full eradication of interference and fading effects is impossible, but their deleterious impacts can be reduced to acceptable levels.

Despite the opening of a notice of inquiry into the technology, the commission terminated the proceeding in 1989 without issuing rules. In fact, in MM Docket 87-6, it was noted that, while promise was shown at the time, there was insufficient data to provide "reliable forecasts" of interference and other concerns. AFCCE and NAB essentially recommended that the commission continue to permit experimental operation, but that a rulemaking be "deferred" to gain more experience.

Now, nearly 20 years later, it appears that the FCC, and indeed the industry as a whole, is now ready to tackle this ancient concept, and perhaps finally enshrine its existence in the rules. The comment period for the proposed rulemaking, which is now closed, ran for 30 days beginning Nov. 29, 2016. Comments filed on the rulemaking support the concept, with the most detailed proposals and information being set forth by AFCCE and Kintronic Labs Inc.

When we think of boosters for FM stations, we consider their service contour as internal to the protected service contour of the main facility, such as the 60 dBu. The limitation on the contour radius on boosters, and commonly owned translators for commercial facilities as well, is necessary to prevent what would amount to a de facto extension to the authorized coverage area of a facility. Even so, the utility of a booster for an FM facility is generally considered as a way to alleviate coverage deficiencies due to intervening terrain, or other factors within a given contour.

Ultimately, the availability of accurate GPS time bases and digital delay equipment is what will make synchronous operations viable.

In the case of AM stations, coverage deficiencies can be more insidious and time variant

in nature. One of the big problems noted by Tom King, and others, is the continued rise of ambient electromagnetic interference. This issue, further exacerbated by the proliferation of electronic devices combined with a further sagging in the fidelity of AM receivers, creates a feedback loop, for which the confirmed route of escape may finally settle the chicken and egg question. To reach maximum usefulness, it may be necessary to consider synchronous boosters for AM stations that will (gasp!) extend the radius in certain directions of a protected service contour.

Of course, any extension of contours or service areas, if permitted, must not create a situation where interference is caused, or increased, to adjacent facilities. This does not seem to have been a problem with the experimental facilities operating thus far; rather, the effective extension of a service contour resulting from the presence of a booster may create benefits.

POTENTIAL SIDE EFFECTS

Like many pharmaceuticals, directional antennas can have side effects. The protection of stations in one direction, combined with the desire of maximizing coverage in others, leads to further areas having a subpar signal level, especially in the newer exurbs.

While a synchronous AM booster may be located outside of a primary station contour, its goal would be to alleviate deficiencies, rather than engage in sinister and nefarious machinations to acquire a larger slice of the pie. Perhaps a deviation from the conventional wisdom is necessary here.

Ultimately, the availability of accurate GPS time bases and digital delay equipment is what will make synchronous operations viable.

One thought process is that the frequency of carriers should be fully synchronized, and although the petition specified a limit of 0.2 Hz, much tighter tolerances can be achieved through applications of GPS. The second process considers an intentional offset of the carrier frequencies. The former addresses the time variant beat product between the two signals, while the latter adjusts the interval of what amounts to AM multi-path. It is hoped that the rules will provide sufficient freedom for licensees and their engineers to utilize, and tweak, the better scenario for their application.

And so, we see once again that history repeats itself. Upon searching the dusty annals of time gone by, we find that a novel concept is actually a rediscovered truth from long ago.

AM synchronous boosters have the opportunity, if authorized properly, to be another weapon in the arsenal of the broadcaster to stave off the continued decimation of the AM service. My hope is that time is they will not be felled by a regulatory axe.

Ruck is the principal engineer of Jeremy Ruck and Associates, Canton, Ill.

The number of ceiling joists had to be doubled to support the weight of the six interior fan coil units for the HVAC.

KQED's Four-Year Renovation Saga Was Worth It

By Larry Wood

It was the year 2012: Barack Obama was running for a second term in the White House; average gas prices went above $4 per gallon; the London Olympics were about to get under way. Hurricane Sandy would devastate parts of the east coast later in the year. And the San Francisco Giants would win the World Series.

Of even more significance to KQED(FM) was the order placement and subsequent delivery of a Nautel NV80 transmitter consisting of two NV40 transmitters combined with a switchless combiner. Our plan was to have the new transmitter installed in less than one year, and we thought the timeline would be easily achieved.

KQED(FM) is a 110 kW station at 88.5 MHz licensed to KQED Inc. in San Francisco. It started life as KXKX, a station run by the Presbyterian Church. It was purchased by KQED in 1969.

The programming on KQED(FM) has evolved through the years, but now consists of nearly 100 percent news and information. Programming from National Public Radio and Public Radio International is supplemented by local talk, public affairs shows and one of the largest radio news departments in the San Francisco Bay area.

If memory serves, during the 1970s, KQED had a 10 kW RCA transmitter feeding a 12-bay horizontally polarized antenna. In the 1980s, KQED(FM) changed the antenna to a six-bay circularly polarized ERI antenna and installed a Harris FM40K transmitter. (Two FM20K transmitters combined.) In 1997, KQED(FM) replaced the Harris transmitter with a pair of Continental 816Gs transmitters (rated at 22.5 kW), while retaining the combiner furnished by Harris. In 2003, KQED(FM) installed a Harris Z8HD transmitter and began broadcasting HD Radio using the auxiliary antenna for a space combined transmission system.

During the installation of the Harris Z8HD, it became clear the transmitter equipment had out-grown its space. The equipment racks were full, there was no air conditioning, and the FM combiner system and coax switches were actually located above the AC power generator, making repairs difficult and unsafe. In the summertime, the tube transmitters didn't mind the heat, but the Harris Z8 had problems when the room temperature would climb over 100 degrees Fahrenheit. (I didn't much like working in that heat, either.)

I became aware that a portion of one of the buildings on Mt. San Bruno was vacant, and it was about 50 percent larger than the space we had been using. It had several other advantages: It was closer to our main antenna, and it had better site lines to both our studio and the Sutro Tower, where our San Francisco television station transmits. Planning new IP microwave links would become easier suddenly. We had a very reliable 950 MHz link, and I was able to add a couple of unlicensed IP links to the studio, but the path was looking through trees that just a few years earlier were short enough not to matter.

In 2011, we contacted the landlord, American Tower, worked out a deal to move the KQED(FM) transmitter facility to the new location, and then began the actual process of planning, permitting, building and moving into the new location. We started working with architects and engineers to design a facility that would meet all of our needs at the time and, hopefully, those of the future for decades to come.

One of the first questions we addressed was whether or not we could get adequate utility power at the site. There were three existing 100 amp feeds to the room — much less than

A typical summer day in San Francisco, as seen from the KQED transmitter site on San Bruno Mountain.

we would need. We checked with Pacific Gas & Electric Company, our local utility provider, and we were assured there would be no problem with us installing a new 800 amp service to the existing main panel board, so we proceeded with the project.

Later on, during permitting, we needed a letter from PG&E saying we could proceed; but we learned that the person who had given us the assurance was now gone and her replacement saw things differently. As one would imagine, this turned out to be a big problem and proved to be the greatest source of delay on the project.

After having redrawn our plans to include trenching for 12,000 volt lines and a pad-mount transformer and then resubmitting our plans, we finally ended with the local PG&E engineer suggesting that we just connect to the existing main panel. It really goes to show how much you are subject to the competency of your utility representatives when it comes to new facilities.

While we were in the delay period, I just described, most of the equipment for the project was ordered. Early on, we decided to go with Nautel to provide the new transmitters. Looking ahead to the possibility of higher HD power ratios in the future, we ordered a NV80 transmitter and a switchless combiner. Our FM TPO is 36.75 kW and considering the loss of efficiency in the combined amplification when adding HD Radio, two NV40s were recommended by Nautel. (Note that Nautel has since replaced its NV line of transmitters with the GV line.)

We also ordered equipment racks, an ERI coax switch and patch panel rack, interior 4-inch coax and fittings, ERI/BDI power monitoring system for the main and auxiliary antennas and 4-inch Heliax to feed to our main and auxiliary antennas. We also acquired an SAS 32KD router; a Ward-Beck systems frame to house AES DAs, A to D and D to A converters; three 2200 VA

The Nautel AUI home page shows the basics such as the modulation level, the power level, the preset in use and user-selectable metering parameters. In this view we also see the RF spectrum, the MER constellation and a Lissajous pattern indicating left vs right audio.

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Radio
A supplement to March 2017
THE RADIO TECHNOLOGY LEADER

North Hall Map & Booth Listings

Exhibit Hours
Monday April 24, **10 a.m. – 6 p.m.**
Tuesday April 25, **9 a.m. – 6 p.m.**
Wednesday April 26, **9 a.m. – 6 p.m.**
Thursday April 27, **9 a.m. – 2 p.m.**

Check on-site program for changes and full list.
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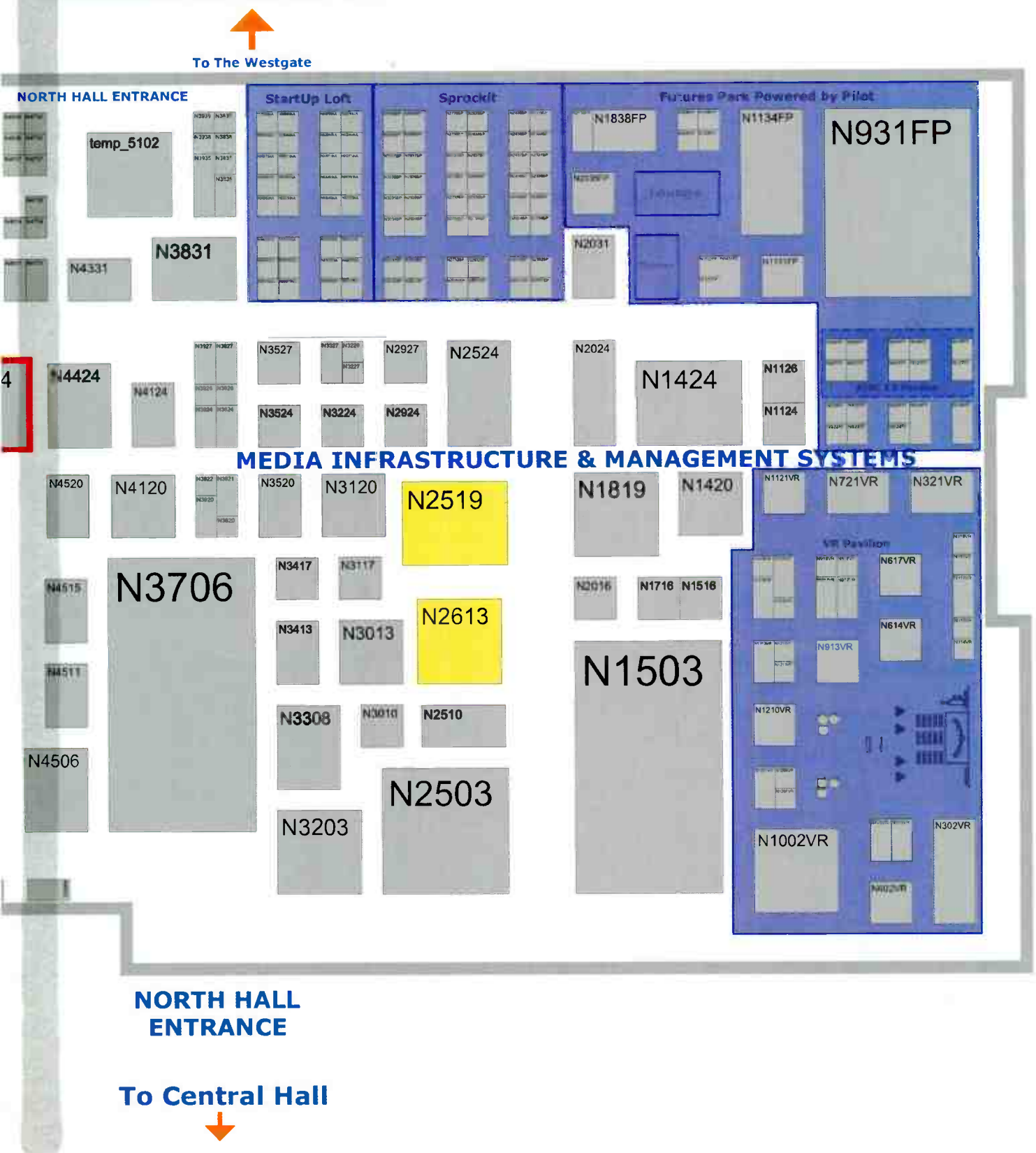

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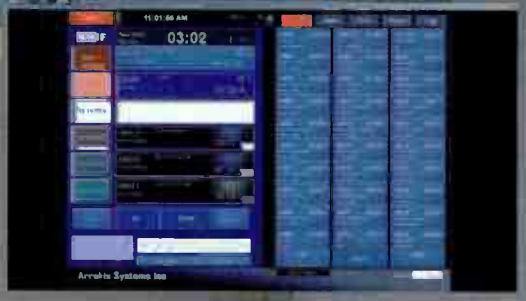

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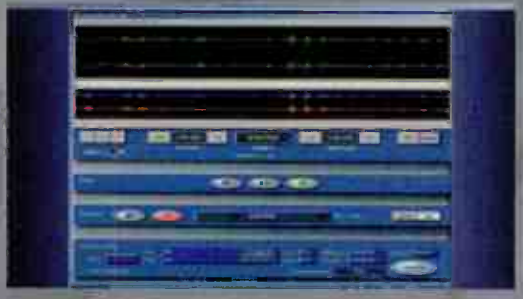

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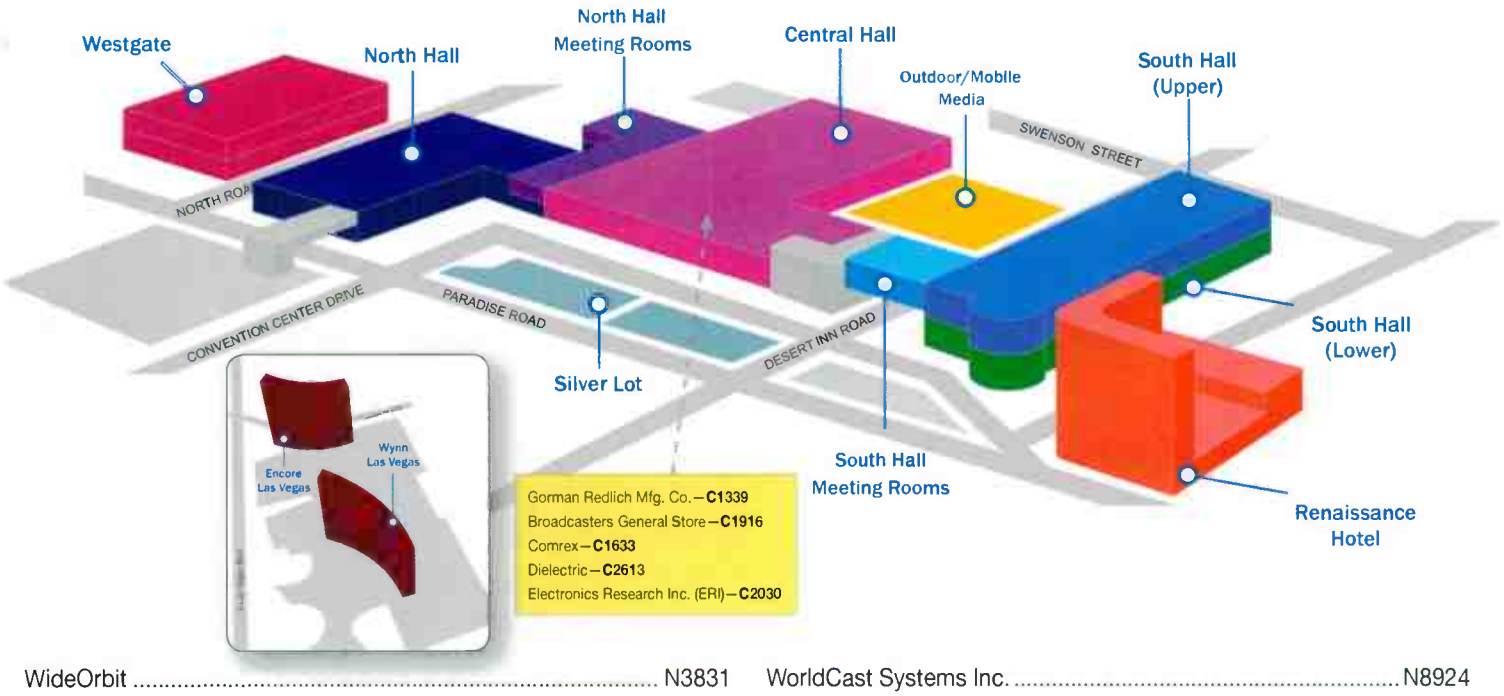
Las Vegas Convention Center Overview



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The KQED Nautel NV80 installation has a switchless combiner and aluminum hardline connections to patchfield, coaxial switches and dummy load.

UPSs and transfer switches (I just don't trust UPSs); a 150 kW Cummins generator and transfer switch; and an Avocent KVM system.

The transmitters, coax and equipment racks took up several parking spaces in the KQED garage for years before they were finally moved into place at the transmitter.

THE PROJECT GETS GOING

By late 2015, we had all the permits we needed to begin work. The general contractor was selected and things started happening.

In October, we began the first improvements to the space. The engineering firm decided we had to double all the ceiling joists to support the weight of the six interior fan coil units for the HVAC. Some additional demolition was needed, and the walls were sandblasted to prepare for the painting.

We hired a draftsperson to do a 3-D rendering of the project — money well spent, in my opinion. It showed us the spatial relationships between all the equipment and the HVAC plumbing, electrical conduit and lighting, RF coaxes and cable ladders. Despite being larger, our space is still relatively small, and we needed to plan the use every cubic foot of it.

Starting in February 2016, partition walls were constructed, in-wall conduit was placed, insulation for sound was added, drywall was hung and painted. By April, one new doorway and venting for the generator had been sawed into the building, and one old doorway had to be filled in with concrete block. Concrete pads were poured for the generator and the new main electrical service panel, as well as for the exterior HVAC condensers.

In May, the HVAC was installed. We have fully redundant systems, which may seem like overkill, but I am looking forward to not having to work in an 80 to 90 degree room during the summer. Having fan coils above equipment makes me nervous that a primary drain could get plugged, but we have "wet detectors" in the secondary pans connected to our Burk remote control, so we will be notified if the primary drain overflows. The secondary pans drain to the floor. The electrician also worked to get the conduit in before ceiling access would disappear due to the HVAC. This is how the 3-D model really helped the trades get their work done in the right order and without stepping on each other.

In June, the generator was delivered, and the electrician really started getting busy. Mt. San Bruno is just a few miles from the Pacific Ocean, and the salt carried onto the site is legendary. We wanted to be sure any equipment exposed to outside weather would be protected, and to that end, specified marine-grade finishing to all exterior HVAC units and stainless steel conduit, unistrut and hardware. The main 800 amp electrical feed was done in PVC coated conduit and fittings. This was a big additional expense, but there is a lot of conduit on the mountain that is rusting and needs to be replaced after only 20 years.

In July, the transmitters, combiner, RF switch rack and equipment racks were finally moved to the site. Installations began at once. By the end of the month, the new KQED electrical service panel was connected to the existing main panel. This required a power shutdown that affected one Entercom and two iHeartMedia FM stations, but all stations were covered by generators, and the engineers were most generous with their cooperation, though they requested we do the shutdown after

Aluminum hardline was used to connect a patchfield and two ERI coaxial switches.

midnight, just to be on the safe side.

By August, we were moving forward with final electrical connections to all the equipment. I didn't want to install any broadcast equipment in the racks until the electricians were finished.

One day while I was busy bolting racks, the electricians cut some conduit over the top of one of the two transmitters, and this resulted in metal filings getting into the transmitter. (Plastic covers had unfortunately been removed.) We vacuumed out what we could, but Nautel recommended we remove each power amp and turn them upside down to shake them out. These power amps are heavy, and each transmitter has 16 amps, so the work took two of us two days to complete. We did shake and blow out enough metal filings to make the project worthwhile and a couple of the larger pieces would likely have been a guaranteed short someday.

The takeaway from this is to keep the equipment covered! The electricians were highly skilled and did a great job, but they don't understand working around sensitive equipment.

A FURTHER DELAY BURDENS THE PROJECT

We did not want to remove the plastic covering from the transmitters and equipment racks until the HVAC was functional and fully tested in order to avoid nasty surprises like condensate raining down on our equipment.

Unfortunately, the HVAC manufacturer's representative found several problems in its installation and gave the contractor a must-fix list; but after repeated attempts to correct the installation, the first HVAC contractor was replaced by a new one.

During this two-month process, we began installing the equipment in the building by rolling up the plastic each day, never knowing when the HVAC work would commence. We also installed unistrut and other hardware on the building exterior to facilitate the

One spool of Heliax is carefully moved from the truck to a spot near the tower base.

installation of the many antennas, microwave dishes and IP links we would need.

We started the installation of the interior coax, interconnecting the transmitters, combiner, reject load, dummy load and ERI coax switch and patch panel rack assembly. Nautel supplied the 3 1/8-inch rigid line to connect the transmitters to the combiner and reject load, but it was determined we would need 4-inch coax for the rest of the interior plumbing.

ERI said aluminum line would be perfect for this project, due to its lower cost and especially its reduced weight. I have never worked with the rigid aluminum line before, and I was a little apprehensive, due to my experience with aluminum Heliax in the past; but so far I have nothing but good things to say about it. We hired a tower contractor with extensive experience in radio and TV coax work, and he brought in a field engineer to ensure the installation would be electrically correct — the system would be fully swept and the matching sections on the two ERI antennas (main and aux) would be individually tuned.

Once the interior coax was substantially complete, the tower crew began work on getting the 4-inch Heliax run to the antennas. Two spools of Heliax had been stored at a local drayage company for a couple of years and because they were 12-foot diameter, I was worried that they would be hard to get to the site and then on the ground where needed.

Fortunately, the drayage company sent a very good forklift operator, and he was able to drive the spools one at a time up the gravel access road to the towers and to set them where needed. The tower crew directed the delivery, and they knew exactly how to handle this big coax. Although I didn't do any of the actual work, I felt 20 lbs lighter at the end of the day knowing all was well with big coax and the crew handling it.

Finally, the new HVAC contractor finished its work, and the manufacturer approved it. The system was turned on and produced substantial amounts of very cold air. Normally, the AC would not chill the room to the ridiculously low temperatures, but for testing, they overrode the minimum set point, and we all put on coats, worked outside or sat next to a space heater.

Nautel wanted us to be sure to direct the chilled air to the rear of the transmitters and pull the return air from the top. To do this while keeping the ducting to a minimum, five fan coils wash the back walls with a good quantity of air, while the sixth unit cools the main building entrance area. The hot air rises and is pulled into the fan coil return input filters. This setup covers the equipment racks and transmitters quite well.

Transmitter wiring was, of course, a major part of the project. I punched a couple of holes in the transmitter to run wires directly into the control rack adjacent to the two transmitters and enlarged the wire pass through from TX-A to TX-B provided by Nautel. As much as possible, I wanted the wiring to be hidden within the transmitters and equipment rack and not brought out to the overhead cable ladder unless it was absolutely necessary.

Every wire had a wire number and a jack number making interconnecting them as easy as possible. The documentation from Nautel included wire numbers and was very easy to follow. Most of the interconnect cables are shielded CAT6 with RJ45 connectors. I personally prefer D connectors for control wiring; RJ45s just don't feel like a 20-year connector to me, but so far every connection has worked as it should, and I have provided full strain relief and support to keep the connections working as long as the life of the transmitter.

Turning a transmitter on for the first time has always made me a bit nervous. The Nautel SC1 controller had five presets loaded at the factory. Naturally, I started with the lowest power. It came up without any problems, and I let it run for 10 minutes. The dummy load was warming up the room, so I turned the HVAC on and let the warm air and cold air mix behind the transmitter, where the dummy load lives.

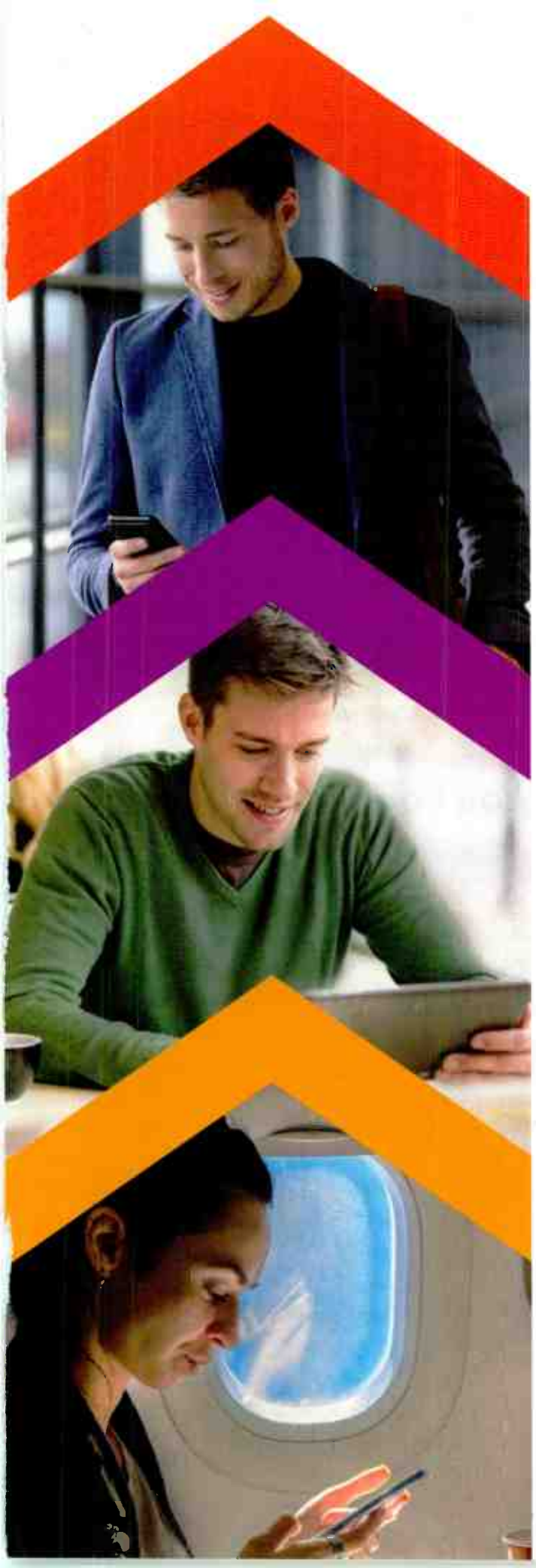
Then, I tried the low power HD preset. It struggled a bit. One transmitter was happy, but the other didn't want to come fully up. Most of the 16 power amps worked, but some of them just didn't want to go. I turned the transmitter off and back on, and it came up without complaint.

Next was trying it at full-power 36.75 kW FM-only and 36.75 kW FM and -20 dBc HD. In FM mode, the transmitter came up without a problem, but once again the 36.75 kW FM and -20 dBc HD took a couple of tries to get it fully going. I could now do the software updates to the two transmitters. The update from 3 to 4 is a bit complicated, but by following the instructions and writing down each parameter and reading, then making the changes as required, I could then replace the compact flash cards and complete the update.

For the next several days, I operated the transmitter as much as I could to get a feel for the controls.

With the switchless combiner, I can select either transmitter or both to the load. I expect this will come in handy for updates and maintenance. Also, a couple of times, one of the transmitters would decide to shut down and the switchless combiner would then automatically feed the working transmitter to the antenna (or dummy load). After a few remote tweaks in the timing of the transmitter ramp-up by Nautel, the transmitter now starts up completely fault-free.

Finally, it was time to install the Burk remote control at the new transmitter. Much of the new broadcast equipment at the transmitter is connected to the network, so I can log into every critical piece of equipment, with the exception of our Tunwall transmitter/antenna switcher. (I do not consider this to be a negative for the Tunwall, since I fully expect it to be 100-percent reliable and to never need updating.)



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We concentrated our first wiring efforts in audio, network and transmitter, and this meant the Burk and all GPI control wiring came last. It was a scramble getting it going. The Burk system had been running in test mode for years, but needed a whole new network configuration plan at the new location. The two Nautel transmitters had the Burk Plus Connect, so I could monitor and control them via SNMP. The Nautel SC1 came with a web interface, so I could log into it and control the transmitters, if necessary. Audio switching was mostly automatic using the Titus Labs 3-DRX.

FINALLY: THE CUTOVER

The tower crew assembled on a Saturday morning at the site to move the new coaxes, tune the antennas and remove the old coaxes running from the old building. Would it all go well?

Surprise — the male EIA bullets on the line sections didn't fit to the male bullets on the 4-inch gas barriers. We decided to remove the inners from the line sections and turn them around. This worked, but left a few screw holes to be filled with nylon screws. The inner conductors were fully supported on both ends, so I don't expect there to be any problems. This delay did mean a later start, but after lunch, it was time to disconnect the old line to the aux antenna and connect the new line in its place. The new line and the aux antenna were full swept and the VSWR showed a perfect 1 to 1.0. This antenna had been retuned by ERI when we first put HD Radio on the air, so I expected it to be good.

Now it was time to place our NV80 on the air for the first time. I have been involved in many new transmitter turn-ons before, but this was unique in my experience. I did the whole thing sitting in front of a computer. At the appropriate time I simple pressed the ON command on the Nautel SC1 controller web page and the Plate OFF command for the old transmitter on the Burk remote control web page.

Overall view of the tower supporting the KQED(FM) antenna

No running from transmitter to transmitter. No operating coax switches or moving coax in a big hurry. No talking to a person at a remote site to coordinate OFF and ON commands. It was the simplest and least dramatic transmitter switch of my career, but it was also the most significant and satisfying.

The NV80 came up to the preset power I selected. The KQED aux antenna is lower power than the main antenna. The preset I selected was 20 kW FM and -20 dBc HD. The transmitter worked perfectly, and after checking the reflected power to be sure the load was good, I gave the go ahead to start work on the changeover for the main antenna.

Time was slipping away, and we decided to finish the change-over on Sunday. I decided to keep the NV80 on the air into the aux antenna, rather than operate the old transmitter into the main antenna overnight for two reasons:

First, I wanted to be sure the Nautel would operate hour after hour without problems. I had only run it into the dummy load for less than two hours previously, due to the heat generated. Our HVAC could keep up with it running full ON, but the air intake into Nautel TX-B was around 80 degrees.

Second, I wanted to operate the aux antenna with RF overnight, just to be sure all the connections were capable of continuous high RF for long periods of time. To say I wanted to "burn it in" is not quite what I had in mind, but you get the idea. It is likely we will not need to use it again for some time, I just wanted to know it will work when we need it. Our coverage on the aux antenna is reduced (lower HAAT), and we did get several complaints, but I'm glad we did get to test it fully.

On Sunday, the tower crew got busy with the main antenna. It was connected and swept, just as the aux antenna was; VSWR was found to be 1:1.6 and was tuned to 1:1.1. I was happy with the tuning, and we were finally ready to go in the early afternoon. After the crew had removed the old coax and the tower rigging, I simply switched the Tunwall coax switch controller to route the NV80 to the main antenna and pressed the ON command on the SC1. Just as with the aux antenna, the NV80 came up without a complaint. I selected a Nautel preset for full power and all was well — 36.75 kW FM and -20 dBc HD into a six-bay ERI antenna.

At the end of that day I was tired, but quite pleased that the last of the major parts of this four-plus-year project were complete and everything was working as expected.

In the weeks since we put the new transmitter on the air, driving tests show the HD coverage to be significantly improved, as expected. I think it sounds better, as well, and most other station personnel agree.

This was a project of the many, not the one: Also working on this project were Phil Manley, Patrick Hatten and Steve Pinch.

Larry Wood is the chief engineer of KQED(FM).

AoIP Consoles and Systems

by Doug Irwin, CPBE AMD DRB

If you find yourself tasked with specifying and designing a new studio system based on AoIP control surfaces, and routers then you should make every attempt to get yourself to Las Vegas on April 22.

In the meantime, we've done some preliminary research for you. This article covers the basics of systems and standards offered by the various manufacturers of AoIP systems and devices. Read on — then plan your exhibit floor time accordingly.

Wheatstone's LXE is available in several different form factors including countertop, countertop sunken and split frames.

WHEATSTONE

Wheatstone introduced its LXE series of consoles last year at NAB Show. The LXE is a control interface for which every switch and rotary control is programmable to perform any desired function; the console architecture is completely customizable to end-user requirements.

ConsoleBuilder software allows every switch on the surface to be programmed for function, mode and even color (switches are RGB-LED illuminated). Multiple full color OLED displays on each panel show ongoing operations, and event recall allows for one-touch console reconfiguration.

The LXE-series GUI has pre-built screens for metering, clocks, timers, dynamics, EQ and buss assigns. All are touch-screen accessible to the end-user. The GUI is customizable using the ScreenBuilder-LXE software, enabling the user to drag and drop objects and define their functions via a wizard interface. Multiple custom screens can be stored to go with console configurations.

The LXE is available in several different form factors, including countertop, countertop sunken and split frames (which can actually be in different rooms). It can support up to 32 physical motorized faders, with full DSP processing available on all 32 channels. The LXE surface uses BLADE-3s for audio, control and associated logic, with a single CAT6 interconnecting cable.

The LX-24 table-top, modular control surface (operating in conjunction with the IP88E Mix Engine BLADE) comes with a built-in meter bridge featuring up to four sets of bright, high-resolution LED meters and circular LED displays for auxiliary send levels and pan control. The LX-24 is of a modular design and the modules that are hot-swappable. There are no electronics in the pan below the modules.

The LX-24 surface that can store and recall all user settings, and "Snapshots" of the LX-24's configuration can be saved and recalled at

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the touch of a button. Each input channel can be assigned to four stereo busses, plus four pre/post-selectable aux sends, a stereo CUE bus, four mix-minuses and the panel's own bus-minus. An LED source name display, an A/B source selector, and two programmable soft buttons are included and a SET button provides access to assignable controls in the master section.

Control room and headphone outputs with level control and source selection are provided, as well as two independent studio monitor outputs. Stereo CUE speakers are built into the meter bridge. Headphones and CUE are delivered to the surface right from the IP network. On-board VGA and USB Mouse connectors allow a monitor and mouse to be connected to the console for configuration and advanced console functions.

There are also more economical ways to get Wheatnet-IP in to your facility as well. Consider the IP-12 as one example. Each of its 12 input modules is equipped with an LED source name display and an A/B source selector; sources can be set via a rotary encoder in the master section. Each input module has access to four program busses, and has cue and talkback switches and a 100mm long-throw fader and lighted channel ON/OFF switches.

The IP-12 control surface connects via Ethernet to its audio engine, IP88CB console audio BLADE. This 1RU device holds all of the console's digital signal processing, input, output, and logic circuitry. It has no fans and may be located either next to the console or at a remote location. The master section offers control room, studio, and headphone controls with source selection, along with a built-in headphone jack and amplifier. Timer controls, a master talkback button and a built-in cue speaker with volume control are provided. The meter bridge has three stereo pairs of bright 30-segment horizontal LED bargraph meters, as well as an onboard timer with controls located in the master section.

Wheatstone BLADES are the 1 RU devices that interface the Wheatstone AoIP network with the outside world. I/O BLADEs convert audio and logic inputs to data streams for the network, and conversely generate analog, AES, and GPIO outputs, corresponding to data streams on the network, for use outside the network. The IP-88A-3 is the analog I/O BLADE; the IP-88D-3 is the AES I/0; the IP-88AD-3 is the mixed analog/AES BLADE; the IP-88M-3 is the mic level input BLADE; the LIO-48 is the logic I/O BLADE. Each I/O BLADE comes with a CPU and operating system giving the end-user the ability to configure features such as routable mixing and logic-follow-audio. They communicate with the network via gigabit Ethernet.

The complete interconnection of all the network devices is done by way of layer-2 (Ethernet) switches and Wheatstone maintains a list of Ethernet switches, by make and model, that are tested and approved for the WheatNet-IP network.

I have mentioned WheatNet-IP several times—just how is that defined? According to Wheatstone: "Wheatnet-IP is a network system that utilizes Internet Protocol to enable audio to be intelligently distributed to devices across scaleable networks."

WheatNet IP is AES67-compatible and furthermore "is unique in that it represents an entire end-to-end solution, complete with audio transport, full control, and a toolset to enable exceptionally intelligent deployment and operation."

WheatNet-IP Navigator is the control and administration software package for WheatNet-IP. Much of the basic configuration of WheatNet-IP can be done from a BLADE's front panel, but WheatNet-IP Navigator offers a more convenient way to do comprehensive system configuration, such as entering source and destination names, performing general system setup functions, programming salvos and macros, controlling audio paths, setting-up silence detection and managing failover contingencies, among other functions. As part of the system, WheatNet-IP Navigator continuously queries the network so that it's always showing the current configuration and status. Up to four copies of Navigator can run at the same time from multiple locations.

AXIA

Let's consider a large, medium and a small console from the Axia lineup.

The largest of the Axia control surfaces (or "consoles," if you prefer) is the Fusion, a modular console available in frame sizes that support eight to 40 faders in single or multiple linked frames. It can use the Axia PowerStation or StudioEngine DSP mixing engines, and connects to the Axia network with a single CAT-6 Ethernet cable, allowing the sharing of local audio devices (and their associated GPIO control) among multiple studios. Fusion has four stereo Program buses, four Send buses, and two Return buses.

A variety of module types are available, from fader-only modules to Call Controller modules with integrated multi-line controls for Telos multi-line phone systems. Fusion also features VMix (Virtual Mixer) channels, which allow for the combining up to five audio sources for presentation on a single console fader.

The Axia Fusion is a modular console available in frame sizes that support 8 to 40 faders in single or multiple linked frames.

Some of Fusion's other features include auto-assigned, auto-generated mix-minus on each channel; individual or group talkback for remote talent cueing; one-button off-air phone record mode; and up to 99 Show Profiles console "snapshots" for set, save and recall of console layouts customized to the working style of individual shows or operators. Built-in digital EQ may be applied individually to all audio sources.

New on the show floor this year will be the Telos Alliance IP-Tablet Software, designed specifically for use with Telos Alliance products by Livewire partner Jérôme Gahery from IP-Studio. The IP-Tablet Software provides for virtualization of control and hardware resources, while simplifying and aggregating control of several Telos Alliance devices. The software can also be used to manage user rights for device access, linking a user profile to his or her needs and access privileges. It can

Wheatstone's LXE GUI is customizable using the ScreenBuilder-LXE software.

replace an external monitor needed by an Axia Fusion or Element console. An optional machined aluminum panel fits right into any Fusion console, housing a 10-inch Windows tablet, just like a four-fader module taking up four console slots.

Consider the Axia iQ if you need an intermediate-size console. It can be used to build custom consoles of sizes from eight to 24 faders. A basic system consists of one iQ eight-fader main frame and one QOR.32 integrated console engine — a DSP-based mixing engine which incorporates analog and digital audio I/O, GPIO and a custom Ethernet switch. Faders and control capabilities can be expanded by adding one or more iQ Expansion Frames (up to a maximum of three frames per console installation).

iQ features three dedicated stereo Program buses, plus a stereo Utility buss that can be used for phone calls, off-air recording, or as a fourth Program bus. Automatic mix-minus is provided on each fader, plus talkback functions, a one-button off-air record mode, and show profile functions for instant recall of up to four pre-defined console "snapshots." High-resolution OLED program meters are switchable between VU and PPM metering styles.

For a small console, consider the RAQ console, with six rotary faders with OLED channel options displays; two stereo mixing buses and Preview (cue) bus; a high-resolution OLED meter display with switchable VU / PPM ballistics; and monitor/headphone controls for auditioning of Program buses or two assignable External monitor source selections. RAQ also features Axia's automatic mix-minus for phone callers and codec sources. RAQ will work in a standalone installation, but also networks with larger Axia networks. A RAQ control surface and a QOR.16 integrated console engine constitute a complete RAQ system.

You will still need to have an interface to various analog, AES or logic sources, and that's where the xNodes come in. These are half-rack devices (1 RU in height) that are available in analog, AES/EBU, microphone-level, mixed-signal, and GPIO versions to handle all the various signals encountered in today's broadcast environment. They're fanless, which means they can go in the studio. xNodes are Livewire+-, Ravenna- and AES67-compliant, and according to Axia, "every xNode not only

supports Ravenna audio stream interoperability, but also enables advertising/discovery of those streams natively, above and beyond AES67."

Axia also offers zero-configuration, purpose-built-for-broadcasting Ethernet switches inside of the PowerStation, QOR.32, and QOR.16 console engines. Another option is a standalone Ethernet switch custom-built for IP-Audio known as xSwitch; and if you want to build a conventional Ethernet network for your system, Axia provides a list of recommend switches from Cisco and Huawei.

Livewire+ is the protocol developed by Axia to convey low-delay, high-reliability audio over switched Ethernet. It complies fully with the AES67-2013 Interoperability Standard, allowing AES67 devices to connect directly to Livewire+ networks and exchange audio streams. Livewire+ is also extensible, able to incorporate future AES standards when they are ratified. Livewire+ is also backward-compatible with the Ravenna networking protocol. With Livewire+, a single Ethernet cable carries real-time uncompressed digital audio, device control messages, program associated data, and even routine network traffic.

Axia's PathfinderPC and PathfinderPRO router control software for Windows provide the tools the end-user needs to customize and command the Axia network. Another new product you'll see at NAB this year is the Pathfinder Core PRO Routing Control and Facility Management Appliance, which, according to Axia, was "... designed from the ground up to provide pro-grade routing control that gives the user easier, more intuitive control over audio workflows." A web interface means configuration and monitoring can be done from any device. The legacy Pathfinder software has been changed to include customizable user panels, automatic table generation, and virtual source routing.

PR&E VMXpress IP provides a means by which AoIP access is added to a new or existing Vistamax networks by allowing integration to AES67-compliant devices.

The Pathfinder Core PRO appliance is fan-free for silent in-studio deployment and equipped with dual Gigabit Ethernet ports and dual-redundant internal power supplies. It comes equipped with 500 crosspoint *and* 500 logic rules; for larger facilities, an additional license can be purchased, which adds an additional 500 crosspoints or 500 rules to a Core PRO system.

HYBRID SYSTEMS

While we talk about complete AoIP networks, it's important to consider that many TDM router/console systems offer up AoIP interfaces, thus giving their systems a hybrid nature. Let's take a look at a some examples.

Radio Systems Millenium IP consoles offer standalone functionality and Livewire IP-Audio network connectivity.

Radio Systems is a well-known manufacturer of consoles (and of course the line of StudioHub accessories). Their Millenium IP consoles offer both stand-alone functionality and Livewire IP-Audio network connectivity, meaning that Millenium consoles can communicate with any Axia device or any Livewire-enabled device. Any digital delivery system with an Axia iPlay driver can be connected directly to a Millenium Livewire console allowing for playback and recording of multiple audio channels with no audio card required in the playback computer. With the addition of Ethernet switches, multiple consoles can be networked together, and the system designer could make further use of Axia nodes for ingress and egress of analog and/or AES data streams. The addition of a Windows PC to the network will provide support for iPlay or the PathfinderPC system configuration or Windows Media playback.

Pacific Research and Engineering's VMXpress IP provides a means by which AoIP access is added to new or existing Vistamax networks by allowing integration to AES67-compliant devices. There are three analog models: eight stereo inputs/outputs, or eight stereo inputs/outputs plus 32 channels bidirectional logic control; or 16 stereo inputs/outputs. There are three digital models: eight AES/EBU digital inputs/outputs; or eight AES/EBU digital inputs/outputs plus 32 channels bidirectional logic control; or 16 AES/EBU digital inputs/outputs. The mixed analog/digital version comes with eight stereo analog inputs/outputs plus eight AES/EBU digital inputs/outputs.

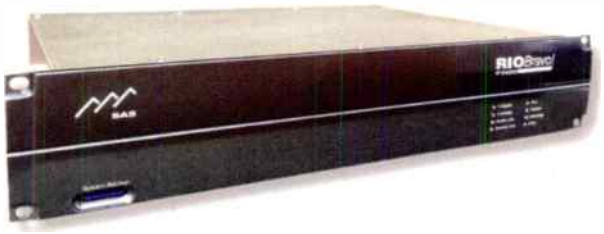
Interfacing VMXpress to a VistaMax, VistaMax Envoy, or VMConnect frame is done via Cat-5 using the VistaLink protocol. A VistaLink "cascade" connection allows two VMXpress devices (or one VMXpress and one VMQuadra) to connect to a VMConnected Network frame via a single cable run.

Perhaps most importantly, the VMXpress IP provides a bi-directional gateway between any AES67 and Ravenna device and the VistaNet Network. Interfacing VMXpress IP to an outside network is enabled via two RJ-45 connections: One connects to a VistaMax, VistaMax Envoy, or VMConnect frame via Cat-5 via the VistaNet protocol and the other RJ-45 connects directly into the AES67 and Ravenna network switch.

SIERRA AUTOMATED SYSTEMS

Sierra Automated Systems recently introduced the Rio Bravo which they refer to as an AoIP DSP Engine "studio-in-a-box." Rio Bravo IP Engines are networked using standard IP infrastructure and will also interface with an SAS 32KD Network. A cat5 is used to connect the Rio Bravo to one of SAS's control surfaces, such as the Rubicon, iSL, SL and MClass.

The Rio Bravo engine needs 2 RU of rack space and is designed to go in the radio studio where it will provide all the functionality normally required of a consoles system. It has



Rio Bravo IP Engines are networked using standard IP infrastructure and will also interface with an SAS 32KD Network.

six slots for installing a variety of hot-swappable I/O modules, such as analog, AES, AAC Encoded AoIP and microphone (input only) to support up to 96 discrete channels of audio I/O. There are an additional 24 resident on board outputs for common studio needs such as monitor and cue speakers, headphones and metering as well as other general purpose system functions.

Rio Bravo IP Engine consists of five digital signal processors that provide 64 mix busses, as well as effects, equalization, dynamics processing, silence and peak detectors for every channel. It has two RJ-45 jacks dedicated to network connections to an external network for communication with other devices via the Dante AoIP protocol, which also makes it AES67-compatible and ready for use with other AES67-compatible devices, as well as IEEE802.1 (AVB) compliant devices.

All configuration parameters are stored in the front panel-accessible SD card and are programmable using the built-in Web-based user interface, allowing for complete control and configuration of an entire system from a computer.

LAWO

Lawo is another well-known manufacturer of router and control surface systems, and they too have introduced products with AoIP interfaces. R3LAY is a Virtual Radio Mixer running in a virtualized PC environment with a multi-touch-enabled screen interface. It's meant to be used as a portable studio, with analog and digital I/O and 4- or 8-fader Virtual Mixer.

R3LAY connects with standard audio-over-IP hardware that supports the Ravenna/AES67 networking standard. It also features GPIO via

Lawo's R3LAY is a virtual radio mixer running in a virtualized PC environment with a multi-touch-enabled screen interface.

open-source Ember+ control protocol; it supports native PC audio (ASIO, WASAPI, WDM, MME); it can generate mix-minus (clean feed) with talkback; it has on-screen control of user shortcuts and mixer snapshots. There are plug-in software apps for processing, playout, codecs and phones.

The R3LAY "Radio In A Bag" package includes four- or eight-fader Virtual Mixer software, OnAir4 audio I/O interface and heavy-duty travel backpack; the user supplies a Windows 10 laptop.

Lawo has a line of control surfaces and audio engines, as well. As one example, consider Sapphire compact. It's available in either desktop or flush-mounted styles, either as a unibody frame or in splits. A 1 RU engine powers the control surface and contains the signal processing functions along with the audio inputs and outputs; as an option it is available with Ravenna/AES67 interface. Sapphire compact is available as 16 live sources with eight faders; or 24 live sources with 12 faders; or 32 live sources with 16 faders. (The engine supports a maximum of 48 mono sources active at the same time.) Outputs are formatted for stereo or a 5.1 mix.

VisTool 5.0 software is used with the Sapphire compact. It's designed to be the central screen for information and for interaction with users, offering a customizable touchscreen with an optimized software GUI providing full control over all of the relevant functions of a sapphire mixing console. In addition it offers access to channel DSP processes like EQ, dynamics and buss routings, input parameters and fader channel control.

Front view of the Arrakis Simple-IP-8.

ARRAKIS

Arrakis offers Simple IP, a 1 RU interface that allows AoIP sources and destinations to become available to the traditional console system based on analog or AES audio. Simple IP is based on the Dante AoIP system and is thus AES67 compliant. Using the Dante standard, Simple IP can send and receive audio to any other AES67 device, whether that is a console, switcher or other compliant piece of hardware.

Simple IP comes in two versions: the eight in/ eight out mono (or four by four stereo) versions, and the four-in/ four-out AES version. If your application needs more inputs

CONTINUED ON PAGE 39

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If It Ain't Broke, Then Keep on Growing

By Matt Wallace

It's been 11 years since Wallace Radio Syndication first implemented Barix audio-over-IP devices as its primary method of live program distribution.

Wallace Radio Syndication started off two years prior (in 2004) using satellite, but soon realized the expense was prohibitive. AoIP transport seemed to offer a solution to these cost barriers, as well as a providing a way forward to develop new business opportunities.

Our IP transition started with a simple web stream to get audio from A to B. We delivered our own live content: a 50-minute daily show (year-round) and a Friday night scoreboard show during football season. A total of 42 affiliates carried our shows.

While an impressive early example of AoIP for transport of syndicated program content, the point-to-point web stream created new work flow issues for each affiliate. Remember, AoIP was, at the time, an unfamiliar method of audio transport for most broadcasters. Affiliate operators struggled with instigating the web stream, and high latency affected both management of the signal at the station, as well as listenability. Few, if any, means of automating the process existed.

The challenge for Wallace Radio syndication was clear: How do we, as a broadcaster on the cutting-edge of a fledgling technology, reap the benefits that we identified, yet make it network-affiliate friendly?

WORD OF MOUTH

After exhaustive internet research produced only high-cost codecs, an engineer at a local small-market station turned us on to Barix.

In 2005, we first approached LineQ, which distributes Barix devices in the United States, with our idea of syndicating radio programming live using Barix. We were one of the first to use the boxes as an alternative to the usual satellite feeds that stations had been accustomed to.

LineQ understood this application, and we had a few different options and decisions to make. Our goal at Wallace Radio Syndication was to first implement the hardware and then to automate the delivery, just as the satellite systems had done before.

WHY THESE CODECS?

We chose the Barix Exstreamer 100 for our affiliate receivers for three critical reasons.

First, the price tag was far below competitive solutions.

Second, Barix understood and addressed the latency concerns of broadcasters under the hood of their hardware. This immediately improved listenability while eliminating affiliate labor headaches.

Third, and perhaps most surprising at the time, was audio quality. The knock on audio-over-IP at the time — and occasionally today, to a lesser degree — was that network transport cannot offer broadcast-quality audio. We disagree, as do our listeners and affiliates.

We also use the Instreamer 100s as our encoding platform from our studios. With some assistance from StreamGuys, a content-delivery network specializing in broadcast that acts as our bandwidth provider, we were, and still are, delivering audio to our affiliates here in the Midwest. At its highest point, Wallace Radio Syndication had 80 radio stations with Exstreamer 100 devices decoding and receiving our feed.

Our 2006 transition to Barix also made it possible to cost-effectively syndicate third-party programming, including North Dakota State Bison football, with 23 affiliates in North Dakota and Minnesota. Our programming today ranges from daily talk shows to sporting events.

TAKING ADVANTAGE OF AOIP ADVANCES

Finally, in our 10th year using Barix, we have decided to update the Barix firmware at all affiliates to reap the benefits of how AoIP, and Barix itself, has evolved in recent years. We had no reason to make the updates as things were moving along just fine, but admittedly we were in the stone age of firmware.

Barix Instreamers have been chugging away for Wallace Radio Syndication for over 10 years now.

We finally took the plunge and updated all of firmware in 2016. We still use most of the same Exstreamer 100 devices installed one decade ago — a testament to their operational reliability. They remain durable and long-lasting, providing exceptional total cost of ownership.

The faster signal processing and monitoring benefits of the latest firmware has been a big step up. Our network hub is in constant motion, with programming moving through most of the day and into evening. On a daily basis, we rely on Instreamers to deliver our primary feed as well as our off-site, fully redundant, backup feed. It's easy to know if something is amiss via alarm notification on our smart phones; or, by simply seeing anything other than a comforting, blinking, green light on the front of the device.

Over the last 10 years we've seen the bandwidth capabilities at radio stations skyrocket. We used to deliver a slightly lower quality audio feed to accommodate stations with less bandwidth; however, as bandwidth has become less and less of constraint, we can now deliver a CD-quality audio feed. The faster signal processing of Barix's latest firmware playing a major role in the execution.

In our world, the small rural markets are as vital as the larger markets. The luxury of higher bandwidths — and a reliable audio over IP transport network — give us that large-market sound and presence.

Matt Wallace is the chief manager of Wallace Radio Syndication, LLC

CONTINUED FROM PAGE 36

and outputs you can add more Simple IP interfaces. Simple IP interfaces with any of the Arrakis ARC or MARC series consoles.

Dante Controller is a free software application that enables you to route audio and configure Simple IP devices on a Dante network. It features automatic device discovery, one-click signal routing and user-editable device and channel labels, and works on MAC and Windows PCs. Once connected to the network, the Dante Controller interface will automatically detect each Simple IP connection within seconds. Dante will work with any Ethernet switch, but ones with Gigabit ports and QoS are preferred.

LOGITEK

Logitek will introduce new consoles and vMix virtual console software, all on an AoIP platform, during the 2017 NAB Show. A representative from the company told Radio that Logitek is "looking at the future of how consoles will be operated, especially by younger people who are accustomed to direct interaction with a screen."

"The need for huge physical consoles is becoming a thing of the past. There is more and more automation involved, so a greater level of integration between console manufacturers and automation providers is required," said Logitek President Tag Borland. "Future consoles from Logitek will reflect this tighter integration — they will be able to have a much smaller footprint than in the past but will be capable of accessing many incidental system features without taking up the space needed by older physical boards.

"Another important consideration for AoIP is redundancy. Logitek's systems have been offering dual paths for some time, which improves stability and reliability of audio delivery."

The NAB Show is the best opportunity — although not the only one — for U.S. broadcasters to see the many systems manufactured for radio, up close and personal. We've only scratched the surface here; each manufacturer mentioned has many more products than those mentioned in this article.

I hope this article has piqued your interest in one or more brands. Now it's up to you to read more, to make up your list of questions, and to hit the road come April.

RESOURCES

- www.telosalliance.com/Axia
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Growing Old on the Radio

by the Wandering Engineer

I first met Garrison Keillor in that most intimate of settings... on the radio.

My uncle had given me a Heathkit radio he had built. With a Heathkit, anyone with some free evenings could save money and build really nice equipment. The radio was ahead of its time — allowing the use of AM and FM independently to make up a stereo pair — and the local radio-TV shop sold me a surplus external chassis, four-tube, multiplex stereo decoder that required I leave a diddle-stick in the 19 kHz oscillator coil to periodically tweak it when the stereo image unlocked and began to rotate like the bed-spins in my headphones.

I put a used fringe TV antenna on my parent's roof that I could climb up and point, searching for the few signals on the FM dial. Stations in the 75-to-150-mile range faded in and out and fluttered when an airplane bisected the path. Stations beyond that range lasted only as long as the duct they were coming though remained, often an hour, sometimes from a thousand miles away.

"Prairie Home Companion" would mature a lot over the decades and leave the lone station of its birth to seemingly follow me as I redeployed farther away with each successive career move. It was a serious concern for me, and a great serendipity, that Keillor's coverage expanded just as I needed it to. Broadcast gypsies move, but PHC always allowed me to catch up on the news back home. I knew all those people from Lake Woebegone, though their names were different.

PHC was a gift to FM radio as FM struggled for relevance. Any AM station had better numbers than any FM, and my folks didn't like the tinny sound of FM as much as the warmth of AM. Any old direct tuned AM radio with dynamic speaker has a sound that, if not accurate, is definitely pleasing, even to our now Hi-Fi trained ears.

Keillor retired last year, and I'm maybe not that far behind. There are some signs. The soldering that used to be indistinguishable from machine solder is getting shoddier. The fact that I still think as Bob Pease (a favorite columnist in Electronic Design) said "My favorite programming language is solder" tells you a lot.

Rotary switches, circular dials, analog meters and CRTs: the provenance of the broadcast engineer. They make for a comforting environment even today.

My man cave, my happy place, is still the chilly shop in the basement. It has everything, and if it didn't or doesn't, I'll buy it. Proto boards and power supplies use up what space is left of a large collection of parts in little labeled drawers. There are also plenty of tiny embedded things with parts too small to work on. The bench mice and monitors go to a lot of places with a KVM. Forty-feet of data books are slowly being burned for heat, as it really is much easier to look up pinouts and specs on the internet, even for older traditional parts like 555 timers. I keep adding lights and making the old ones brighter. LEDs replace the CFLs that replaced the incandescents that melted plastic placed too close accidentally and burned my fingers when touched. I count six visual magnification devices, the oldest, best and my favorite, was my grandfather's favorite loupe.

It's comfortable, but not easy, to grow old in radio. Sometimes I turn on the Ham rig midday on 80-meters (which is all regional propagation during the day). A ham becomes an "Old Man," the standard greeting between hams since time immemorial, when he gets his "ticket," even if he is 12-years old. Women remain "Young Ladies" forever on Ham radio. The five-state discussion group covers what we all have in common — memories and health issues.

We are all growing older together. Prairie Home Companion will carry on, and reinvent itself, as will radio. I can't think of a better profession or obsession to grow in and grow old in than radio.

The Wandering Engineer is an industry stalwart who has been in broadcasting since the days of Marconi and Tesla. He gives his thoughts on the current state of broadcast engineering and the broadcast engineer.

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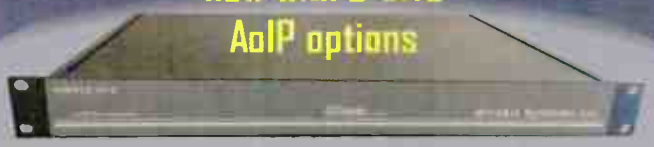

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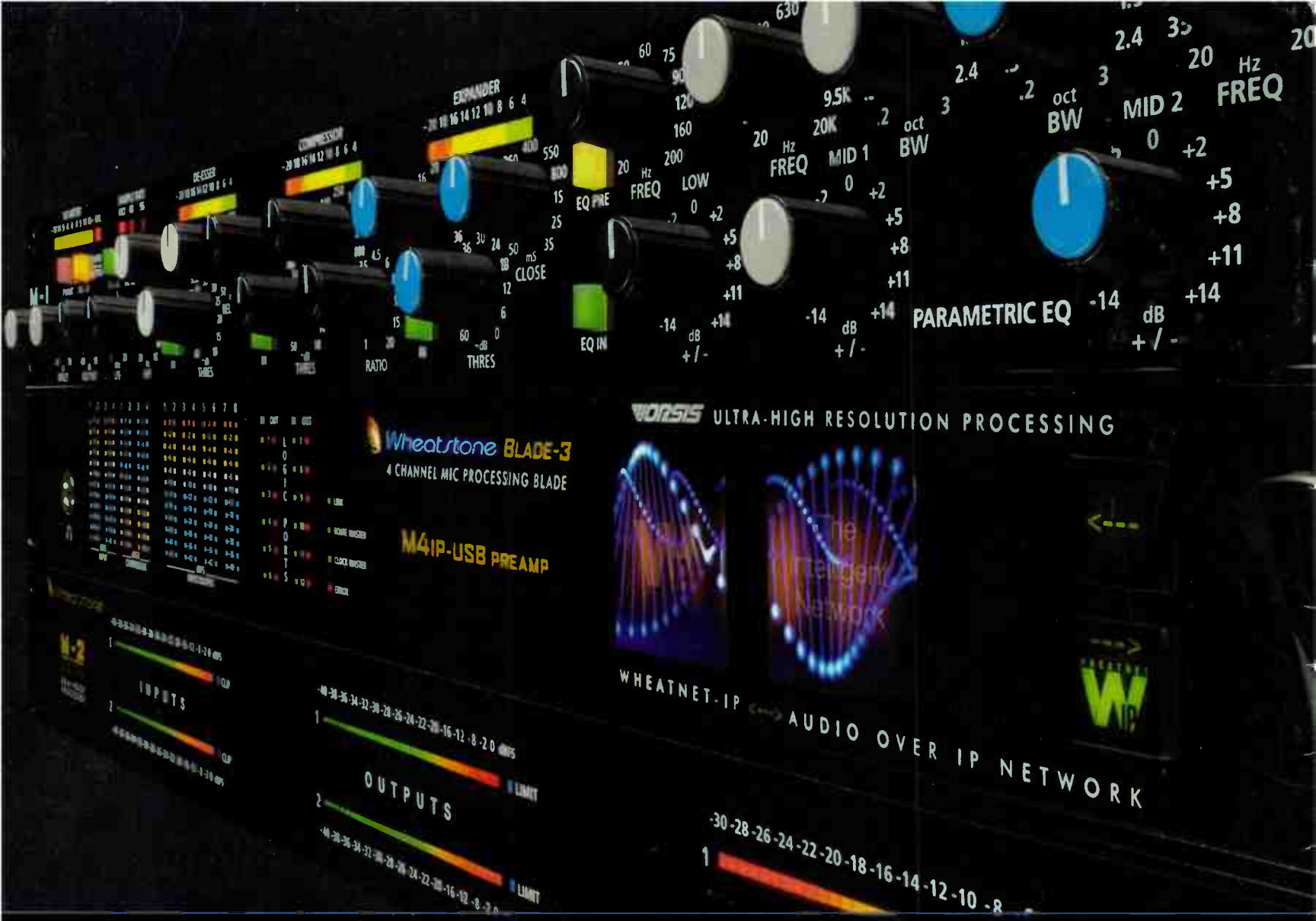

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