Radio

THE RADIO TECHNOLOGY LEADER

Station Consolidation

iHeartMedia Toledo pools its resources for renovation

SEPTEMBER 2015 | RADIOMAGONLINE.COM NewBay

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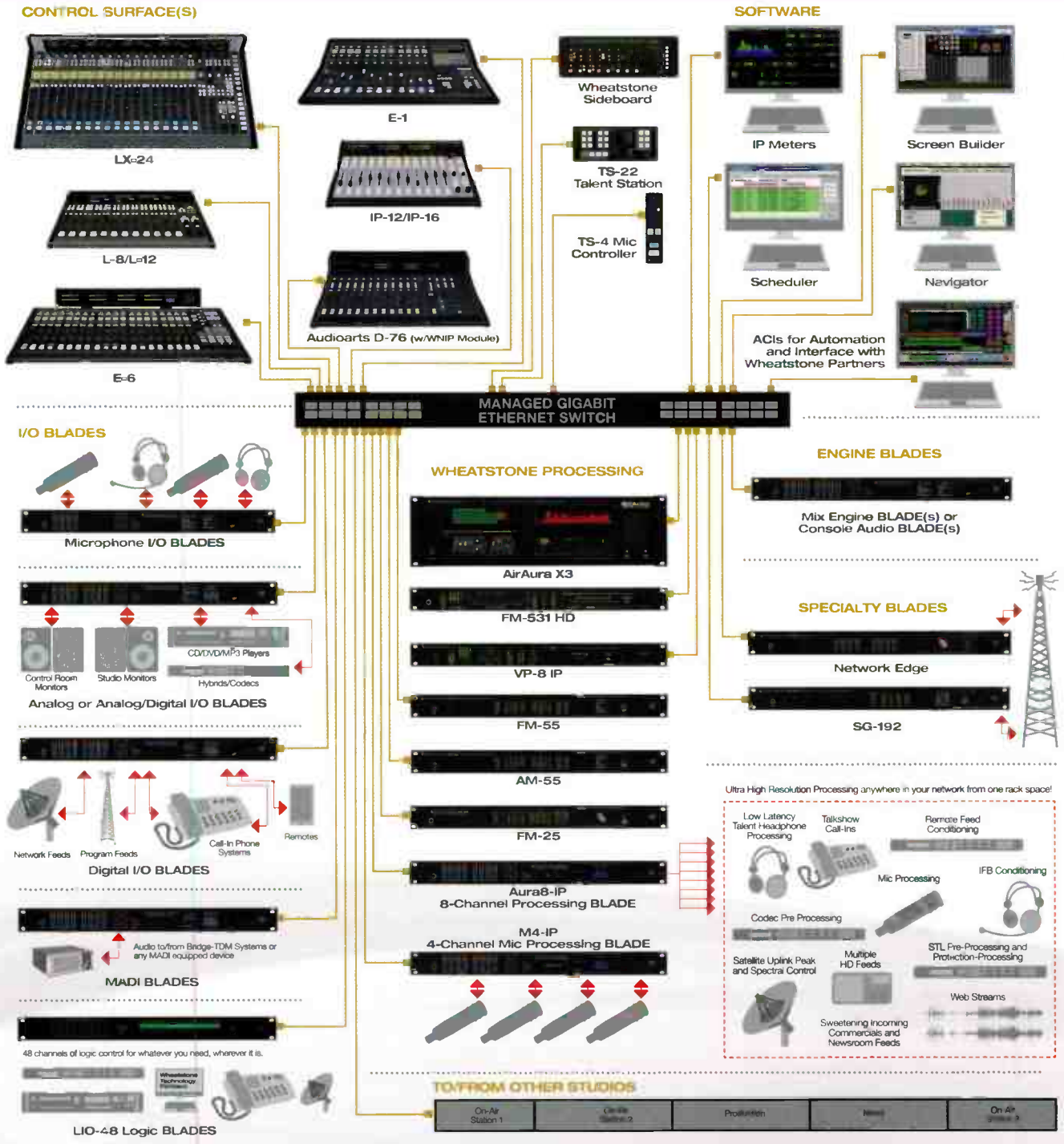

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No BS Guide to Radio Podcasting

Amateur podcasters can call them what they want, but between us broadcasters, we know those so-called subscribers are really listeners with earbuds and a cellphone.

No one knows those ears better than broadcasters. We know about good content and good sound. What's new to us are the codecs and the listening environments and devices used for podcasts. To explain what it all means, we asked our audio pros Jeff Keith and Mike Erickson to give us a quick sound check on podcasting.

For the entire story... INN26.wheatstone.com

Part 101 Wireless IP STLs Cheat Sheet

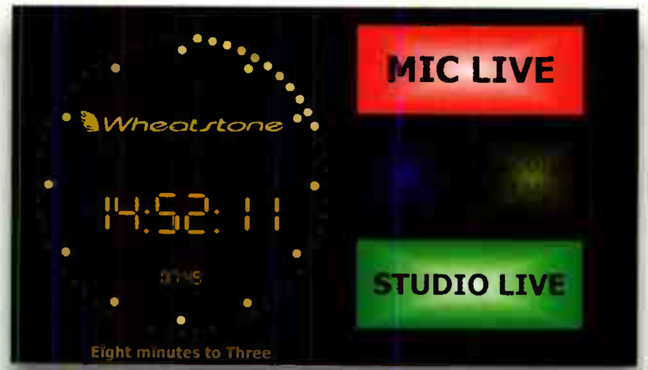
Part 101 frequencies have been used by businesses and others for some time. But not until 2011, when the FCC abolished the so-called "last link rule" precluding broadcasters from using these bands, did broadcasters have access to these frequencies for wireless IP STLs.

Licensed IP wireless systems (Part 101 6 GHz or 11 GHz) are useful as a main STL, such as when a station is moving and re-upping their STL in a market where 950 MHz frequencies are hard to get.

By putting up an IP link from the studio to the transmitter, your transmitter site immediately becomes part of your Ethernet network. "It's almost like from an IP standpoint, that tower is sitting as part of your building now," said Jeff Holdenrid, who specializes in wireless IP for broadcast and other emerging markets for DoubleRadius engineering firm. Jeff has installed dozens of wireless IP microwave systems with our WheatNet-IP audio network in the past five years, most averaging in the 20 to 25 mile range.

A WheatNet-IP IP88D BLADE into an IP wireless radio can run 8 stereo channels across a wireless IP link and still have enough bandwidth left over for video surveillance, VoIP, remote control and other periphery functions.

For the entire story... INN26.wheatstone.com



Not Just Any On-Screen Clock...

Our Kelly Parker ran across VClock made by Voceware recently, and thought it was pure genius.

There are plenty of virtual clocks that are merely numbers on a wall, or virtual clocks that are designed specifically for one broadcast group only. This virtual clock is different. VClock is flexible like a certain audio network we know, so it can transform from just a single clock to a network of clocks taking in information from different sites. Everything on it is configurable, complete with up to 32 lamps that are changeable and can be turned on / off or made to flash with external triggers (such as a "mic live" signal from a mixing console or a phone call). This clock also has an embedded web browser, which allows you to show any content that you like on VClock, simply by creating a web page.

For the entire story... INN26.wheatstone.com

Navigator: Manipulate WheatNet-IP's Very DNA

NAVIGATOR comes as a part of WheatNet-IP, so we don't always point out the kind of power it gives you. But wow is it powerful.

We've added some great how-to videos to shortcut your Navigator experiences. Check them out and start getting more out of your system.

Learn all about Navigator at... INN26.wheatstone.com

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Kramer, prepping his afternoon show on rocker WIOT (24-channel GatesAir Airwave console).

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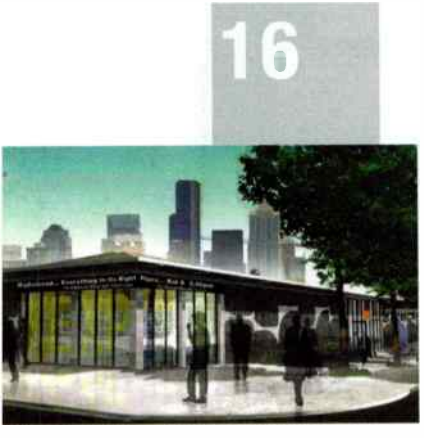
On the cover: A close-up of the studio microphone in an iHeartMedia Toledo on-air studio.



FEATURES

RADIO SHOW
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DEPARTMENTS

FIND THE MIC AND WIN!

Tell us where you think the mic icon is placed on this issue's cover and you could win a pair of Hosa HDC-800 dynamic stereo headphones. Send your entry to radio@RadioMagOnline.com by October 10. Be sure to include your guess, name, job title, company name, mailing address and phone number. No purchase necessary. For complete rules, go to RadioMagOnline.com

VIEWPOINT

Engineers Do Not Live By Transmitters Alone (But They're Interested in Them!)

September is the time of the year that broadcasters first begin to think about what we'll be doing at work next year. Operating expense budgets and capital budgets are probably on your radar.

Many readers recently completed our online Reader Survey, and I thank you for doing so. Here are a few takeaways:

- Engineers could really use more staff.
- Engineers need more help!
- Oh — did I mention engineers are overworked?

At Radio, we're paying attention to those needs and developing content that will help you out. Our 2015 Salary Survey also resulted in many of the same calls for help, by the way. Come back next month for an analysis of its results. (I can't wait!)

Another takeaway from the survey is that the number one topic of interest is the transmitter. (Surprise!) This month we're covering the topic extensively. I've put together some of the common reasons to buy a new transmitter, and separately, discussed some transmitter types and brands of which you should be aware.

We also have a new author this month, Rolin Lintag, who shares his ideas and strategies for going to management and making your case for what your station needs.

You also indicated that you want help with AM antenna arrays, so Jeremy Ruck has presented his troubleshooting methodology for directional (and non-D) antennas. All you need do is to read it and heed it. It's a great article you probably should read multiple times. We're trying to take the mystery of out AM antennas for you.

I've also learned that many readers are in markets 100 and below, and often work within tighter budgets, and you're not able to do all the things "the big boys do" (or so you think). I can tell you that the notion that major markets work under a "blank check" mentality is a myth. Many stations are built along the lines of iHeartMedia's Toledo, Ohio, cluster. Check out our facility showcase for this example.

This month we're primarily covering standards. Still, for those who do not live by transmitters alone, we have some new technology to talk about.

Mario Hieb contributed an article on the Seattle KEXP build, which has expanded the boundaries that define what a radio station is. Read it to see where we're headed.

For our Field Report, Chris Wygal dives headfirst into the world of LiveLook, software the helps you analyze what is going on with, and how to improve, audio-over-IP packet streams.

It's also time for the fall Radio Show. This issue features a map, exhibitor listing and some tech session overviews to help you plan your trip.

Lee Petro is keeping an eye on FCC actions; I've continued my series on emergency planning; and the Wandering Engineer wraps up this month's issue — are "Tiger Teams" really going to work? (Don't overlook SignOff; he's right inside the back cover.)

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Justify It: Tips for Getting Your Cap Ex Approved

by Rolin Lintag

The last generation of vacuum-tube AM transmitters lacked efficiency and makes newer solid-state replacements easy to justify as capital purchases.

It's that time of the year, when you need to prepare for the money side of engineering.

To some of us, budgeting is just another chore that we need to check off our list. However, others actually see it as a chance to get the financial resources needed to get the job done right and to be in a better position than the previous year.

The challenge is always how to justify the money you are requesting.

My objective in this article is to give you a few tips that have worked for me. You know your station better than anyone else, so you are in the best position to come up with the numbers. But there are a few principles that, if applied correctly, will increase your chances of successfully justifying what you need in engineering.

YOUR STATION IS A BUSINESS ENTERPRISE THAT NEEDS TO MAKE MONEY AND SAVE ON EXPENSES

The above statement is true whether your station is commercial or public. You need to remember that, although the engineering department may not have the means to make money for the station, you can implement measures that can *save* money. Money saved can be considered money earned.

Although we don't want to judge the book by its cover, a gift should be packaged well in order for the perceived value to be high.

Being effective is being able to achieve goals; being efficient is minimizing waste. Most of the time, we need to find a happy compromise between achieving goals and minimizing waste — between getting tasks done and saving on expenses. Sometimes a thing that we see as a must-have does not appear important to non-engineers. Bridging that perception gap is all that stands in the way between you and your funding.

Like Clockwork

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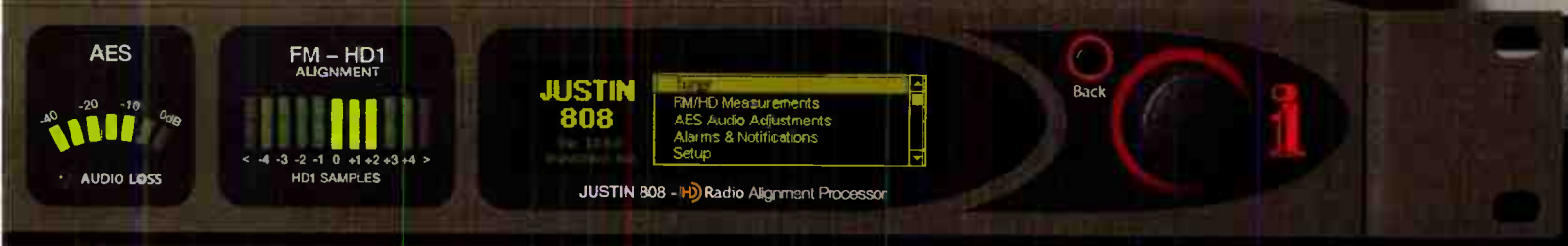


ANALOG FM & HD1 PERFECTLY IN SYNC

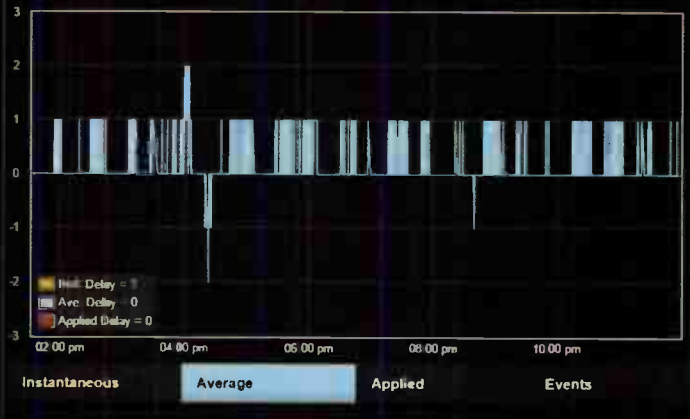
GETTING FROM HERE

Detail View

Typical FM/HD1 drift over a 24 hour period.

TO HERE

Detail View



Corrected FM/HD1 audio within ±2 samples over 24 hour period.

What are users saying about the JUSTIN 808?

"I found it (JUSTIN 808) to be very easy to set up and install, but most importantly, it gets the job of time and amplitude alignment done perfectly, so the blend is virtually undetectable."
– Paul Shulins, Greater Media Boston.

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TABLE 1	Older, solid state transmitter	Model X	Model Y	Model Z
Power consumption	23 kW @ 125% at 10.8 kW	17.4 kW @ 100% modulation 10k W	17.9 kW	18.3 kW @ 100% modulation
Air Cooling required	20525 BTU/hr for 10.8 kW RF @ 125% modulation			
Heat dissipation	6 kW max for 10.8 kW RF @ 125% modulation			
Overall efficiency	75% or better	83%	84%	82%

Put on the thinking cap of the business owner. If the station is your own business, what will you spend on and where will you save money? You will spend money on projects that improve the final product and save money on other areas. As a business owner, you want to invest in that which will bring in more money (more value to the product) and also that which will reduce expenses, to help realize a profit.

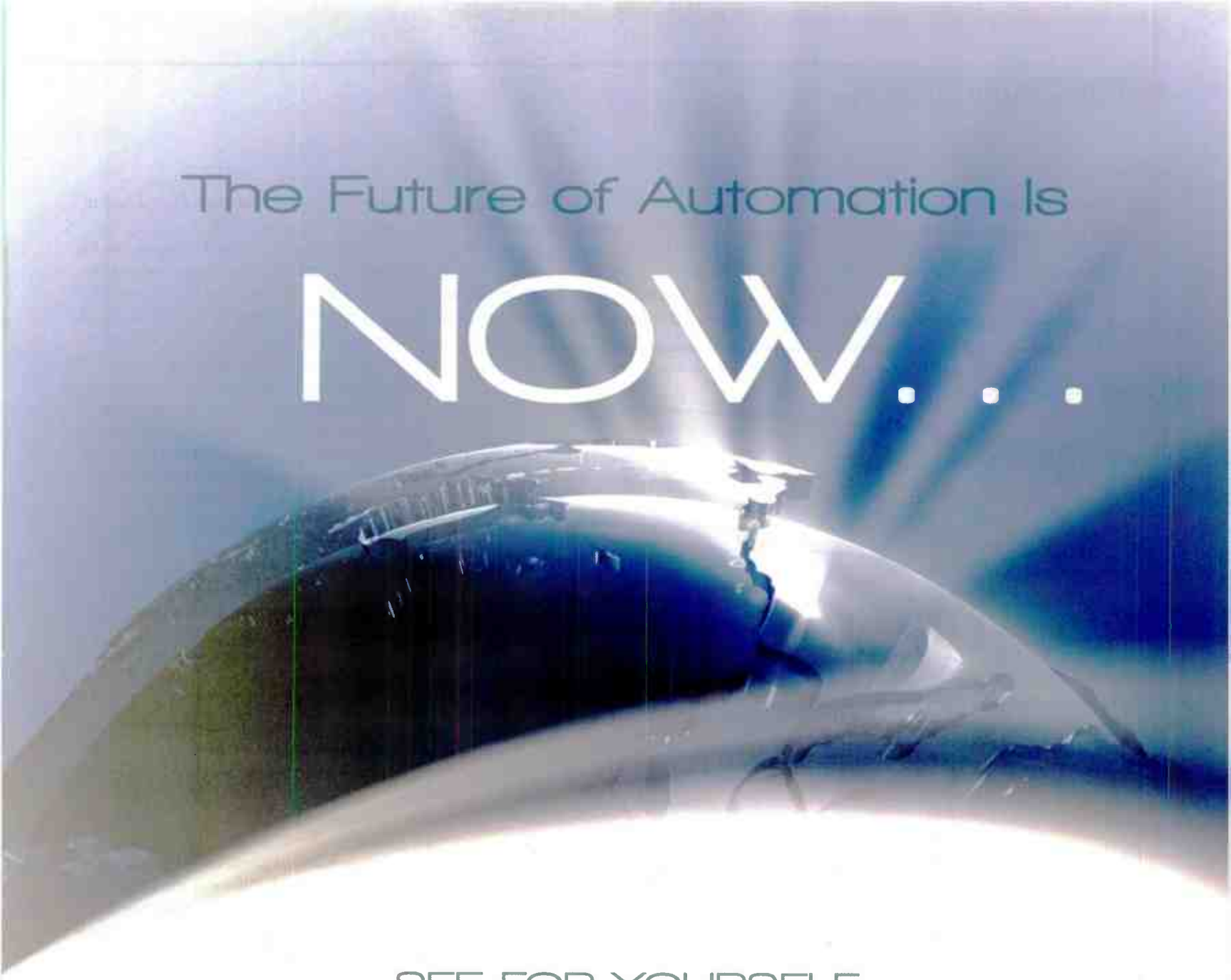
Table 2	Older solid-state	Transmitter X	Transmitter Y	Transmitter Z
Wasted electricity kW	12.2	7.4	7.9	8.3
1 month electrical cost at $0.33 per kWh	$2,899	$1,758	$1,877	$1,972
With required cooling added (multiply by 2)	$5,798	$3,516	$3,754	$3,944
Savings per year compared to Tx B		$27,384	$24,528	$22,248

There are at least two main accounts that are big items on the engineering operations expense budget: electricity and salaries. The cost of electricity is one expense where you can make a significant difference on the bottom line. When you show how your project can save on the cost of electricity, you can then demonstrate the benefit of the investment in terms of its rate of return.

TALK ABOUT INVESTMENT, NOT JUST EXPENSES

An investment makes money or recovers money. An expense is usually the last thing you want to have, but it's a "necessary evil" to keep things running. Nobody wants to hear about how money will go out of a business, in the same way that we are not fond of receiving bills to pay. Expenses need to be repackaged as investments in your dictionary. When describing your capital project as an investment, of course, you need data to make your point; when the numbers are right, facts will sell it.

That more-efficient transmitter is an investment to cut down on electricity cost, not only from an increase in overall efficiency, but also from a drop in cooling needs. If you have it, add in the savings in repair expense and even off-air time. In your capital



SEE FOR YOURSELF

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project, be careful to ensure that you get your investment properly protected by factoring in the needed Transient Voltage Surge Suppressor, correct grounding and cool/clean air management.

Let's look at an example now. Table 1 (page 10) shows the published parameters of four real 10 kW AM transmitters from different manufacturers. These numbers are straight from sales brochures.

These parameters are nothing but Greek to laymen. It is our job to make it understandable to business people, and this is why we need to express the benefits in dollars.

Table 2 (page 10) shows the computation for operating expense savings with respect to older solid-state transmitter. If you buy Transmitter X for $100k, for example, it will only take about four years for Transmitter X to pay for itself; or to put it another way, you could have bought the more-efficient Transmitter X from the wastage of operating the older solid-state transmitter over four years. Show your boss how transmitter X will not only pay for itself in four years, it will also save your station over $27,000 every year starting on the fifth year of operation.

Expenses need to be re-packaged as investments in your dictionary.

One word that I find is not helpful in justifying projects is the word "new."

"New" does not always mean better or more cost-effective. Rather than "newness," emphasize greater efficiency or "better maintainability."

Non-technical people do not use the word new the way we do. They may think that you are just being subjective — as in getting that new office chair because it is more comfortable than the old one. They don't get that when you say new equipment, that translates to better reliability, good maintainability, more efficiency or less problematic. As I mentioned before, just because equipment is new doesn't mean it won't create problems.

Ultimately, I advise not to using the word "new" at all.

Justifying a project for budgeting purposes not only requires understanding of engineering, but also being able to portray the deal in a way that you want it perceived — as an improvement that the station needs. Although we don't want to judge the book by its cover, a gift should be packaged well in order for the perceived value to be high.

Lintag is assistant chief engineer for KRON 4 in San Francisco, Calif. You may contact him at rlintag@kron4.com.

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- Secure access to your system

The Summer Warnings

by Lee Petro

The FCC released two orders that cracked down on nonconforming practices by licensees. The decisions should send a strong message to licensees to follow both the intent and the letter of the commission's rules.

CONSTRUCTION

First, a licensee in California faced a challenge by a competitor over whether a station's facility was constructed prior to the expiration of the facility's construction permit. The licensee had submitted a license to cover application and almost immediately took the station silent. Subsequently, a request for special temporary authority was filed, wherein the licensee indicated that the station had been constructed for testing purposes but then ceased operations. The licensee then filed its renewal application and an application to change the station's community of license.

An informal objection was filed against the both the renewal application and minor change application arguing that the temporary facility was never constructed and that the licensee lacked candor regarding the station's construction. While the objector submitted a Google Map image showing the lack of a tower site at the authorized location, the licensee noted that the photograph was taken two months before construction was completed. The licensee also provided sworn statements from the engineer affirming that the station was completed, and the FCC agreed with the licensee that insufficient proof had been submitted.

However, the FCC did note that the Communications Act requires a constructed facility be "ready for operation" prior to the expiration date of the construction permit. The FCC stated that "ready for operation" in this context means that a licensee cannot construct a temporary facility, operate it for a de minimis period of time, and then take the station silent while the license application is pending.

Instead, Section 1.65 of the FCC's rules requires that an applicant must keep the FCC informed of any substantial changes during the pendency of an application, and the cessation of service after confirming that the station was

DATELINE

Oct. 1, 2015 — Broadcast Mid-Term Report (FCC Form 397) is due for radio stations with 11 or more full-time employees located in Florida, Puerto Rico and Virgin Islands.

Oct. 1, 2015 — Annual EEO Public File Reports must be placed in stations' public inspection files for stations with five or more full-time employees located in Alaska, Florida, Hawaii, Iowa, Missouri, Oregon, Washington, American Samoa, Guam, Mariana Islands, Puerto Rico, Saipan and the Virgin Islands.

Oct. 1, 2015 — Biennial Ownership Reports (FCC Form 323-E) are due for noncommercial radio stations located in Alaska, Florida, Hawaii, Iowa, Missouri, Oregon, Washington, American Samoa, Guam, Mariana Islands, Puerto Rico, Saipan and the Virgin Islands.

constructed and ready for operation would be considered a substantial change of decisional significance.

Because this was an articulation of a policy of which the licensee may not have been aware, and in light of the licensee's full disclosure of the temporary construction in the STA request, the FCC concluded that the licensee did not lack candor. However, in processing the renewal application, the FCC noted that the station had been operating under a temporary site for 22 months and was silent for 10 months during its last license term. As such, it granted renewal for only a two-year period, rather than the standard eight-year term.

NONDIRECTIONAL DIRECTION

In another case, the FCC confronted the "optimization" of a nondirectional antenna, which resulted in a substantially directionalized antenna pattern.

The station in question is licensed to operate with 100 kilowatts, but was radiating more than 250 kilowatts of power in some directions. The licensee explained that the antenna was side-mounted and that side-mounted antennas were incapable of producing a real-world omnidirectional antenna pattern.

The FCC conceded that side-mounted facilities will not produce a fully omnidirectional pattern, but noted that the parasitic elements added to the antenna directly caused the antenna pattern to radiate more power in certain directions than was permitted under the rules even for stations licensed as directional antennas.

Thus, the FCC concluded that the parasitic elements were not installed to correct distortions caused by the side-mounted antenna, but rather to produce the directional pattern and the resulting antenna pattern ignores the expectation of other licensees that nearby stations will operate in accordance with the FCC's rules. It ordered the modification of the station's license to reduce the authorized TPO and reclassified the station's antenna system as directional.

INTENTION

These two cases illustrate the risks confronted by licensees that try to avoid compliance with the intent of the FCC's rules. In one case, a licensee constructed a facility that it apparently did not intend to operate on a long-term basis, and in the other case, the licensee constructed an antenna that far exceeded the reasonable adjustments expected when installing a side-mounted an antenna.

Given these decisions, the FCC appears to be sending a message that licensees must comply with the intent and the letter of its rules, and we all should take heed.

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

KEXP Expansion Plans Play to Station Strengths

by Mario Hieb, PE, CPBE

This conceptual drawing highlights the station's downtown location.

Alternative community radio station KEXP in Seattle is moving to a new broadcast complex at the Seattle Center Campus in the heart of Seattle's arts core.

Affiliated with the University of Washington, KEXP has been a staple of Seattle's music scene for over 40 years and will soon occupy a 28,000-square-foot facility in Seattle Center's Northwest Rooms Building, dating from the 1962 World's Fair.

KEXP has kicked off project to expand and upgrade their facility, which will be a gathering space for the whole community and will allow KEXP to expand their programming, forge new partnerships, continue to innovate and better support artists. Renovation on the building began in January 2015, targeting a scheduled move to the new space at the end of this year. Funds for the new facility were raised by an on-air campaign, augmented by foundation, corporate, local entrepreneur and local government support.

DESIGN

Programs at KEXP range from live air-shifts to live concerts to curating music artistry. The station broadcasts over-the-air at 90.3 MHz. and also via the Internet, providing additional live video feeds of the shows online.

The KEXP redesign project began when design firm Walters-Storyk Design Group and KEXP sat down and defined the scope of the

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The main entrance already features station branding.

project. Questions such as "how many studios?" and "what kind of equipment?" were discussed at the outset. Walters-Storyk then created architectural drawings, basic systems one-line drawings and acoustical designs.

Live music performances are an important element of the station's format. The building layout was designed with musician and engineer needs in mind while simultaneously considering fan comfort and line-of-sight. The 28,000-square-foot footprint includes a 1,100-square-foot live room performance space with an adjacent area for audiences of up to 50 attendees.

The new technical facilities will include:

- 400-square-foot on-air studio
- 1090-square-foot live room
- two production rooms
- two audio and two DJ Booths
- video edit rooms
- video control room
- two DJ Iso rooms
- a green room
- production/mastering
- open office space
- a library
- conference rooms
- a 4,500-square-foot reception area/audience space with a stage for live performances, adjacent to a record/retail store and a café.

Systems Integrator Mizzen Media (of Los Angeles and Nashville) has been retained by KEXP to assemble the new technical facility. Mizzen's management team has experience in large facilities projects, including NBCUniversal, DirecTV, Univision Radio of Los Angeles and Post Perfect in New York.

"The complete Mizzen shop drawing package includes conduit and connection box layouts, custom pin-outs, connectors, wire run lists, cable labels, a complete set of video, audio, control diagrams, rack elevations with heat loads, running/start-up power, floor loading and UPS configurations," says Mizzen Media Director of Engineering and Consulting Patrick Howley,


This summer, construction began on the new facility.

Other design professionals are involved in the KEXP project, including SKB Architects and Sellen Construction, and the project manager is Costigan Integrated.

SYSTEMS DESIGN

Just how do you build and test the new KEXP station while some of the equipment is still being used at the old facility? The answer is planning ... with a lot of design detail and the documentation to back it up.

To facilitate the design process, Mizzen Media has developed a powerful set of tools built on the AutoCAD platform. Co-founders Brad Murphree and Matt Hogan developed the company's systems design automation program: Robotic Operational Build, known colloquially as ROB. This workflow tool was created to automate the engineering design process and has been utilized in every project completed.

Mizzen Media creates template-based, semi-automated engineering drawings that are used to create a final drawing set. Once the detailed design is complete, Mizzen utilizes their software to extract detailed metadata from the engineering drawings to automatically populate wire run lists, cable labels and perform various calculations including power requirements, weight, heat loads, etc. This program is also backwards compatible, so mass changes can be made across the drawing set and deliverables reports without even having to open AutoCAD.

At the end of the KEXP kick-off meeting, Murphree documented the existing rack elevations with the ROB software and worked with KEXP Chief Engineer Jamie Alls to validate the existing connection drawings. Mizzen then began the process of refining the design of the new space by starting with CAD files created by the Walters-Storyk Group.

"Using our proprietary software, we began to overlay the conduit drawings, roof penetrations and then refined the furniture design to accommodate some equipment changes," says Murphree. "The connection drawings were next and some workflow issues were worked out while they were being done."

The KEXP design package isn't just a bundle of drawings and lists, but is the net result of an important exercise … building the facility on paper first. And the design package isn't used just in the design and construction phases of the project, but also in the commissioning and testing stages.

VIDEO IN RADIO

The new facility includes video edit rooms. In 2014 KEXP recorded 380 events/concerts and live streamed over one-third of those. The new facility will improve their ability to record video and stream the concerts, and in addition, the stage area will allow the public to participate.

The video system consists of pan/tilt/zoom cameras in fixed locations, complemented with operated handheld or tripod hard-mounted cameras. All video lines home run to a central video matrix and production switcher to be controlled from the video control room.

CHALLENGES

There were many exciting challenges with KEXP's project but two were of particular interest.

First, the radio station currently has 47 DJs. Engineers will be transitioning and training them in new technology, while making the changeover without scheduled downtime.

Second, each air talent has his or her own specific, personalized studio setup, so a system was created that is standardized yet simple and easy to manipulate and configure (intercom setups, etc.) The DJs have also been "hand spinning" their selections and the new workflow involves Dalet asset management with an interface to the Wheatstone products.

With building remodeling started, the next step is to finalize the integration plan, order equipment and other materials and then start assembling the gear. Installation began this summer.

What kind of equipment will KEXP be using? How did they get a jump on assembling racks and wiring equipment before building construction is complete? Will KEXP use the Space Needle as a broadcast tower? That's up next.

48-inch deep racks in the TOC house all the NexGen hardware, along with the GatesAir VistaMax router, and two Jelli programmatic servers.

is licensed to Pemberville with the transmitter site in Tiffin (about 40 miles southeast of Toledo). Additionally, one translator is leased from EMF (W235BH).

Gary Fullhart, market director of engineering and IT for iHeartMedia's 17 northwest Ohio stations, provided me with a thorough and entertaining account of the series of events surrounding the construction of the facility, which features six studios, four production centers and three techncial operating centers.

125 S. SUPERIOR STREET

While one of these six stations is Toledo's first (dating back to 1921), I'll stick to events beginning in 1998.

The owners of WVKS(FM), Noble Broadcast Group, purchased WSPD and WRVF (then WLQR) and consolidated the three stations into the WSPD/WLQR building in downtown Toledo. In 1999, Jacor Broadcasting acquired Noble Broadcast Group as well as Toledo's second oldest station, WCWA(FM), and WIOT(FM), whose studios were housed in a leased building two blocks away from the NBG's location.

After WCKY(FM) changed its COL from Tiffin to Pemberville, Ohio, all studios were scheduled several times to be consolidated into the WIOT/WCWA building in 2009. In the interim, however, Jacor was purchased by what was then called Clear Channel.

Subsequently, iHeartMedia has finally brought them all under one roof at 125 S. Superior St. in Toledo. The core of the facility, constructed in the 1940s as the transmitter site for WSPD(TV), made the property selection simple because it was owned by iHeartMedia.

THE PLAN

In 2012, approval was finally given to permit all the stations to occupy the WSPD/WRVF/WVKS facility — with the budget-dictated caveat that no existing walls could be moved, meaning all studios, technical operating centers and production facilities had to be retrofitted into spaces that were formerly offices.

RCS NexGen workstations are used throughout the facility for all music, spots and voicetracking.

Utilizing the management software program Microsoft Project, the renovations were designed by Gary Fullhart, Denny Moon, Bill Rossini

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and Eric Goldberg (engineering staff) and Dan Mettler (corporate staff). A few months into the project, Fullhart was promoted to chief engineer and continues to lead in that capacity.

Additional input was provided by Operations Manager Nathan Reed and Manager Kellie Holeman; Holeman decided which stations occupied which new studio spaces.

to shoot himself.

Soundproofing was addressed by doubling the sheetrock between individual studios and installing diffusing and selective frequency-absorbing panels in each control room to bring the isolation and internal sound management required to conduct multiple live programs with studios in close proximity.

Main TOC racks: Right racks are for each station with all switching, processing, EAS and STL gear. Left racks hosts support gear (file servers, phone systems, aircheckers, networking and satellite gear).

An architect was also contracted to satisfy building code requirements and construction was performed by local contractors.

PHYSICAL RELOCATION AND INSTALLATION

Some heavy lifting was required during the renovation.

As previously mentioned, the building was constructed in the 1940s before air conditioning was a regular consideration, so the roof required steel I-beams, installed to bear the weight of the prescribed new HVAC units.

Also, a former garage was designated as the site of one of the TOCs, and during the preparation of the space, they discovered that the concrete floor was not only sloped but it was more than 17 inches thick in some areas! That required several extra days of unplanned hard labor to remove and then pour a new slab.

Fullhart noted that the stations salvaged a macabre memento from the garage: a piece of wood with a hole in it that was made by a bullet from the gun a former sales manager had used

Each station's relocation was carefully coordinated. WCWA moved into what is now finished as "Production D," while its RMX console was removed and reinstalled in their new studio space. Once WCWA was moved, WIOT moved into the same Production D room, while its console was transferred to the new studio, and so on. Meanwhile, the space designated for WVKS's studio was gutted to the bare walls and rebuilt with new furniture and console.

Ultimately, the physical preparation of the new location was accomplished with only a month to spare before the deadline to vacate the leased facility was reached. Here's a peek at finished "TOC-2" facilities.

EQUIPMENT

The consoles for WCWA and WIOT are GatesAir RMX consoles; additionally six NetWave and one AirWave consoles are on air. One of the production rooms (used primarily for dubbing) employs a Mackie mixer. For a

Fox Sports WCWA, flagship station for the world famous Toledo Mud Hens minor league baseball team (GatesAir 24 channel Airwave console).

routing system, the GatesAir VistaMax with 96x96 analog, 96x96 digital and 32 logic ins/outs is in use.

For distribution of program content, all stations use Aphex Compellors, Sage Endec EAS gear and Broadcast Tools ADMS44.22 switchers. The STLs are a mixture of Moseley 6010s, Moseley Starlinks and one Moseley 606 with a DSP-6000 encoder system. Station WVKS(FM) also has a GatesAir Intraplex backup on a T-1 line to the transmitter site.

The newly built studios are furnished using GatesAir Quickline furniture. Finished studio WVKS(FM) is shown here.

STILL TO GO

The overall layout and design has proven to be easily modified after the addition of the leased translator W235BH to the operation in October 2014.

To date, the project has taken eight months. There are still four studios awaiting renovation, and upgrades are commencing as the budget allows. 0

Main workbench area, with access to the VistaMax router.

Greenhouse is an audio recording studio owner and a radio broadcast technician. He recorded the current music themes for National Public Radio's "All Things Considered" and has worked with the band KISS.

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AM Antenna Systems

by Jeremy Ruck, PE

The inside of an ATU or phasor should be clean.

It has been said that AM antenna systems are living, breathing entities. Just like a person or pet, each has its own personality, behaviors and idiosyncrasies. While the theory behind each antenna may be similar, they are individuals in their own right. No two are the same.

Let's face it: Nobody really likes going to the doctor. The person in the white coat is probably going to tell you what you have done wrong in the past few months, and hopefully, we, in our own way, will listen to the advice and take the necessary corrective steps. Not only should these visits keep your health on a straight and narrow path, but they also will provide a baseline of data where trends can be easily identified and addressed before the occurrence of a catastrophic event. However, even with the most fastidious approach, things can and do go wrong.

The AM antenna system really is no different. This month, we will look at the maintenance and troubleshooting of AM antenna systems. We are not going to delve deeply into the mathematics and theory; that topic requires multiple tomes of sagacious knowledge. The hope is that even the AM antenna neophyte will be more comfortable maintaining an AM antenna after reading this. In the end, a high degree of comfort will conserve scarce resources, and when a problem does occur, make the treatment more efficient.

The first step in any AM maintenance program should be the acquisition and preservation of historical data concerning the array. If diligent logs have been kept by your predecessors, then spend an afternoon reviewing this documentation. Look for any historical issues that may have plagued the antenna previously, including seasonal trends. If no such documentation exists, then it is not too late to start your own log.

Record a full set of transmitter parameters, paying special attention to forward and reflected power. On the antenna side, record the crank settings on the phasor, phase monitor readings, common point and base currents, and check to ensure that coils in each stage of the antenna system are marked as to tap location. After recording this information, make a general walk-through of the plant taking care to observe any locations or potential locations of damage and weathering, or unusual happenings. Finally, run the monitor points and record their values.

This information provides a snapshot of the condition of the antenna system. The data should then be compared against the prior proof of performance and the parameters listed on the license. Variances from the licensed data should be noted and corrective action taken, if necessary.

But do not start blindly turning cranks or moving taps, and above all, do not panic if issues are noted. Nowhere is this more true than with monitor points exceeding their authorized limits. While that condition can get you into trouble with the commission, a high monitor point is not always a call to action for aggressive array tweaking. Quite simply, some problems can be caused by strange phenomena and pursuing a logical systematic approach to the apparent problem will tend to present a solution quickly.

SOLVE PROBLEMS

The common point current, monitor points, phase monitor readings and base current ratios all work together to illustrate what is transpiring. In the case of the non-directional antenna, the number of measurable parameters is reduced, but so is the complexity of the potential problem. A significant variance in one parameter is not necessarily indicative of a major antenna issue.

The common point is the location where all of the branches in the antenna system come together at the phasor input. This point always has a strange impedance; therefore a trim circuit is employed to bring the impedance back around to something that the transmitter will like. Since solid-state transmitters are usually designed to operate into an impedance of 50 ohms, most common points will have that value of resistance, and maybe an ohm or two of capacitive reactance to balance out the inductance caused by the tubing in the cabinet.

A variance in the common point impedance will tend to result in high reflected power at the transmitter. This can be confirmed by operating the transmitter into a dummy load. If the high VSWR condition disappears, then certainly the issue is in the antenna system. A high VSWR condition, and by extension a change in the common point impedance, does not necessarily mean the pattern is "out." If the phase monitor agrees with the licensed values, but the high VSWR condition persists, the first item to check would be the common point trim circuit and the integrity of its components. If no issues are identified here, then we must dig deeper.

The current ratio indicated on the phase monitor should be within 5 percent of the licensed value, while the indicated phase angle should vary by no more than three degrees. If a significant variance is observed, rule out a problem with the phase monitor. To do this, take the reference tower sample and connect it to the appropriate phase monitor input through one leg of a tee. On the other leg of the tee, connect a short cable and then look at the other inputs of the phase monitor individually. You should see a current ratio slightly less than that indicated on the reference tower input and a lagging phase of a degree or two. Note that since you are splitting the signal two ways, the reference level pot on the phase monitor will have to be readjusted to get a 1.0 sample value.

If the phase monitor values agree with each

When inspecting the inside of a phasor, the transmitter power should be turned off.

other, then check the sample lines for damage, opens or shorts, as well as the sample loops or torroids, depending on the array configuration. For torroids, a test jig can be created where the torroids are mounted side by side for comparison. A single piece of copper tubing provides the source, and passes through each of the toroids. Remember that many toroids must be terminated if a source is present, otherwise they will fail; so do not forget 50 ohm loads for the components not being tested.

If phase monitor readings continue to show problems with phase or ratios (and if you know the monitor itself is working fine), then a real problem may exist with the system.

Further isolation of the issue can be accomplished through the use of current meters. Unfortunately, the commission removed the base current reading requirement for directional antennas, and many stations have allowed this tool to fall into disrepair. Base current ratios provide a third crosscheck on system health, and their importance should not be overlooked.

Nonseasonal changes in the actual base currents, with measured ratios in tolerance, may be indicative of a ground system issue under development. If the ratios change, and the meters are all known to be accurate, then a shift in the pattern has probably occurred. A very low base current at one tower may indicate an issue in that portion of the system, such as component failure or transmission line damage. To isolate the issue further, work backwards.

Most antenna systems will have jacks at the inputs to each ATU, as well as the output of the phasor at each transmission line. Checks of the currents at these locations will likely help to further isolate the problem. Current at the phasor output, but not at the ATU input, probably indicates a problem with the transmission line feeding that tower. Current at both locations, but not at the tower may point to a low impedance path in the ATU or with the tower itself. Through a logical approach, the other possible permutations can be considered and the potential location of the failure identified.

Once a general location of the problem is identified, component level troubleshooting may need to be employed. Careful visual inspections may be made when the station is operational,

as may checks with infrared thermometers or cameras if heating is suspected. However, any testing that requires physical contact or temporary removal of a suspect component must be performed only after the transmitter is shut down and properly locked out.

For inductors and coils, the surface should be clean, with no significant changes in appearance or coloration relative to other similar components. Taps should snugly fit on the individual turns, and in the case of variable inductors, the wipers should make good contact with no deformation or damage. While examining coils, look for signs of arcing that may be hidden. If it is necessary to move a tap or a crank, be sure to visibly mark the current location so you can return to it.

Capacitors tend to hide their issues. Visible copper in vacuum capacitors should be clean and shiny; discoloration is an indication of either oxidation (which will not happen in a vacuum) or high-voltage damage. Mica capacitors should not have any odd bulges or cracks in their surface. All capacitors should be value checked through an LCR meter, or preferably an RF bridge. Components with values outside the tolerance range should be replaced. Additionally, bridge measurements returning more than a couple of ohms of resistance should also trigger a replacement.

Static drain chokes will provide continuity to ground at DC but will present very high reactance at the frequency of operation. This mimics an open circuit, rendering them essentially invisible at the frequency of operation. A visual inspection of these components may identify or "dings" in the windings, which can reduce the reactance and render them useless. Similarly, lighting chokes bring the AC across the base insulator by providing a very high reactance value at the frequency of operation, but one that is low at 60 Hz. Verify that these have not failed.

One tip that will go a long way is cleanliness. Both the site and the components should be kept clean and free of debris. Cabinets should be inspected regularly to prevent colonization by vermin, and any uninvited guests removed with access points sealed.

Tower bases must be kept free of foliage and should be covered with crushed rock or gravel. The remainder of the site, especially where the ground system exists and wiring and transmission line run, should resemble the fairway at a golf course. Under no circumstances should trees and dense shrubbery be permitted to grow in these areas, as this will result in long-term damage and degradation to the antenna system.

In the end, the AM antenna is a paradox, but the combination of troubleshooting knowledge and historical data will allow a logical progression to be followed. Sure, that 3 a.m. call will still stink, but it won't strike terror into your heart.

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

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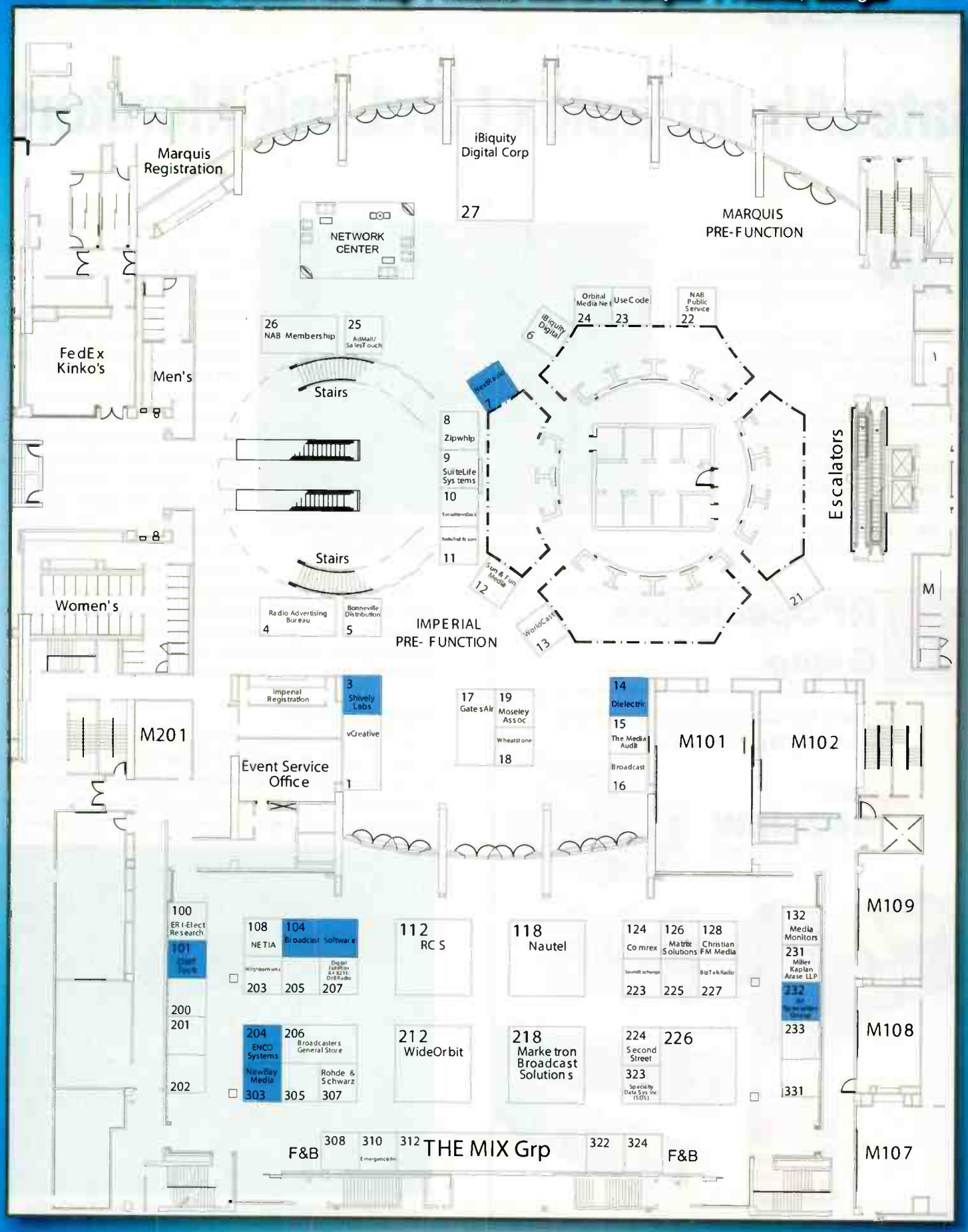


GatesAir Intraplex LiveLook Monitors

by Chris Wygal

What has the Internet not offered the broadcast world? This question can be answered by not paying the ISP bill.

At best, the lights would stay on. The automation may even play audio for a while. Everything else, however, would stop. Streaming? Gone. Show prep? Nope. Remote transmitter site monitoring? Out of the question. These are only three of the catastrophic failures that would ensue if the Internet stopped working.

As our reliance on Internet service grows, technology has followed suit. Twenty years ago, the notion of relying on Internet protocol to carry STL material was, at best, bizarre. While 950 MHz microwave systems, ISDN and T1 or even equalized copper lines are still in use, innovations from multiple manufacturers have allowed metadata and logic control to be packaged up with program audio and sent to transmitter sites via IP.

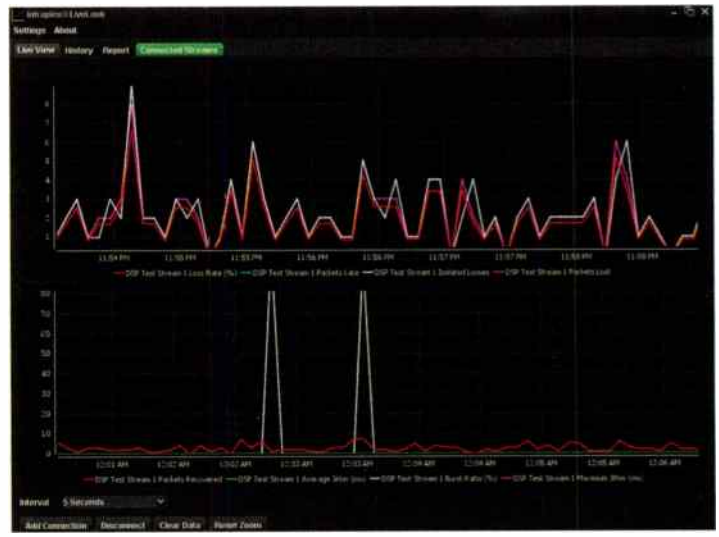
The History page is where users gather information from past Intraplex stream time segments for diagnosis.

GatesAir has played a role in this development. IP Link and NetXpress hail from the GatesAir Intraplex family of STL products both of which rely on IP connectivity. Intraplex behaves well on IP networks "local" and "wide" alike, but like any IP product, it is prone to suffer from loss-of-data. A little "how-to" help for improving Internet reliability is always welcomed.

This is where the GatesAir Intraplex LiveLook application comes in. Quick and easy to install, LiveLook continuously watches Intraplex data streams and offers suggestions on how to best diagnose quirky IP links. LiveLook also generates reports for analyzing past performance and sends alarms when IP data is compromised.

THIS IS WHERE IT'S AT

LiveLook is a Windows application that monitors multiple Intraplex streams at once. Data comes into LiveLook by pointing the software to the IP address of the Intraplex encoders or decoders. It then analyzes stream statistics by looking at the ingress and egress points of the stream. Ingress describes the stream situation when it hits the IP network. Egress



In Live View, user-defined "traces" are displayed in intervals.

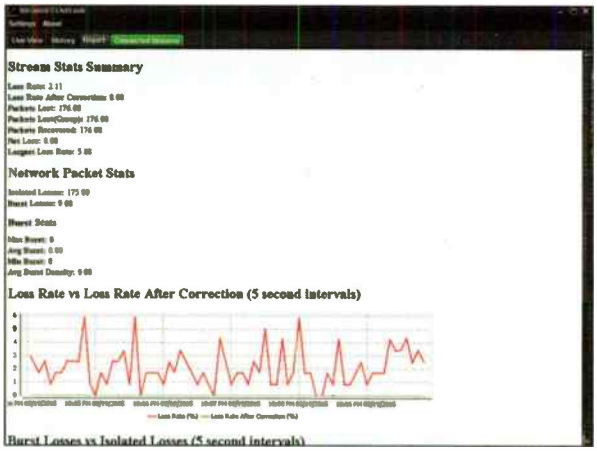
describes the effect that correction methods have on the stream.

Factors such as early, late or lost packets before and after correction, packet burst density and size, jitter buffer resets and delay and packets recovered by forward error correction are gathered and used to provide assistance toward error mitigation.

THIS IS WHAT IT USES

LiveLook uses the "burst packet loss model" to evaluate IP traffic performance accurately. Because of the critical real-time nature of AoIP, burst packet loss and problems such as "queuing delay" must be overcome.

The burst packet loss model also provides statistics concerning round-trip packet delay. By way of real-world application, IP STL paths that traverse across town, city-to-city or further will be routed through numerous routers along the way. What's worse is the IP route can frequently change due to IP traffic congestion. The information gathered from burst packet loss modeling provides suggestions concerning the best methods for reconstructing lost or missing data packets.

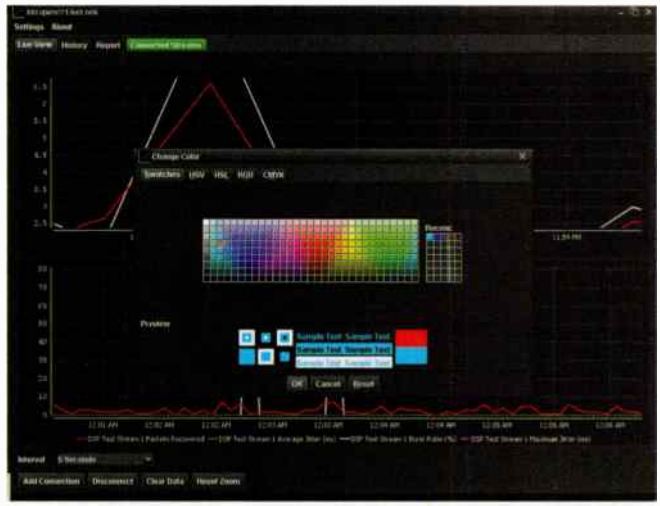


Reports are generated to show stream statistics and provide FEC and buffer suggestions.

THIS HOW IT DOES IT

When the software is launched and is looking at the Intraplex streams in question, the real-time glimpse of network performance is intuitive and rich with information.

On the Live View screen, two horizontal graphs work in parallel and gather stream statistics in intervals from five seconds to five minutes or in "packets per second" scale. Each interval adds plotted information to the traces on the graphs and what traces appear on the graph are user-defined. Nineteen parameters are available. Each graph can be easily configured to display up to four traces by right clicking on the graph and making the selections in a drop-down menu. Different colors can be selected for each trace. For example, the top graph can display loss rate, late packets, isolated losses and buffer delay. The bottom graph can simultaneously display packets recovered, average jitter and burst ratio. For a quick look at the statistics, mouse hovering over the traces will display the value at that point on the graph. Each graph should be defined by what



Colors are assigned to different traces for easier viewing of real-time statistics.

parameters are necessary to most accurately display the stream statistics pertinent to troubleshooting.

In addition to real-time graphing of the stream statistics, past snapshots can be captured to see how the stream behaved during a specific time period.

If Intraplex was compromised somewhere between 3 a.m. and 3:15 a.m. last night, that portion of the real-time graph can be pulled up to see if the IP network was the cause of the problem. These tasks are done on the LiveLook History page, which is where reports are generated. On the Report page, a summary is provided that shows detailed network packet statistics. The Loss Rate vs. Loss Rate After Correction chart indicates how effectively FEC and buffering settings are working on the Intraplex stream.

Most importantly, the report offers recommendations on how much FEC and time diversity is needed for the stream. LiveLook automatically or manually stores the stream data as CSV files and can be automatically "rolled over" anywhere between one and seven days. The files are viewable and cleanly displayed in Microsoft Excel.

THIS IS WHAT ELSE IT DOES

When LiveLook has plotted data on a graph for an extended period of time, the graph becomes less and less granular from a display perspective. By dragging and highlighting a desired area, the section will zoom in to within milliseconds of time. These graph views can be printed, copied and pasted or saved as PNG or SVG files.

When stream statistics deteriorate to within certain threshold percentages, LiveLook will generate email alarms to one email recipient by setting up familiar SMTP mail settings. Much like a trusty silence sense alarm, LiveLook is a valuable watchdog for Intraplex IP service reliability.

In spite of its challenges, the Internet has been a game-changer in the broadcasting arena. The inherent challenges however, require extra care when multiple systems rely on IP networks. Many broadcasters have taken the bold step of constructing STL paths and other mission-critical operations on the Internet, and GatesAir users can sleep well at night knowing their Intraplex backbone is being accurately watched, monitored and diagnosed by LiveLook.

Multiple traces can be selected and the color of each trace is selectable.

Let's Talk New Transmitters

by Doug Irwin, CPBE DRB AMD

A worthwhile strategy to consider is having two auxiliary transmitters, in addition to the main.

In many ways, the purchase of a new transmitter for your radio station is like the purchase of a house. It's expensive, obviously; it happens infrequently; it requires extensive due diligence; and finally, you need to be prepared to live with your decision for a long time.

In this edition, we're going to examine some ideas and techniques you can use to ensure you're making the best decisions regarding upcoming transmitter purchases.

ARE THERE REALLY ENOUGH GOOD REASONS TO BUY NEW?

There are transmitter models out there running fine after 25 to 30 years of service. Obviously, they have great track records — otherwise they would have been pushed out the door. The venerable Continental 816-series comes to mind; going back 40 years, the RCA BTF series is another.

This begs the question: Why should I get a new transmitter when the one I have works fine? And secondly, will new rigs work as well, over the long run, as my current one has so far? Those questions are easy to answer, unless you are dead set against taking advantage of new technology.

Reasons for buying new equipment include:

- Spare parts for old transmitters become harder and harder to source as time goes on, especially if the manufacturer no longer exists
- Older transmitters typically aren't very good with respect to AC input to RF output efficiency — thus they cost more to run
- Tubes, while still available, aren't cheap — thus adding to the cost of operation
- Older transmitters suffer from a complete lack of remote access — which is exceedingly important if you have multiple, far-flung sites to manage

If you have a transmitter that has been working reliably over a 30-year period, then the question about reliability of old versus new is answered easily: Your new one will not likely exceed the track record of the older one.

Ask yourself this, though: Will my 30-year-old transmitter be more reliable and easier to take care of than a new transmitter will be over the next 5–10 years? I would say, in the vast majority of cases, that answer is "no."

DIFFERENT APPLICATIONS CALL FOR BUYING NEW

There are many practical reasons for buying a new transmitter, including:

- Relegating the current main transmitter to backup status

- The need for more power output
- Simply adding a new transmitter to take advantage of more modern features or HD
- Adding a transmitter for a backup N+1 site

Let's examine each of those in turn.

ADDING A SECOND (OR EVEN THIRD) TRANSMITTER FOR THE SAKE OF REDUNDANCY

Each and every transmitter will experience a certain amount of downtime. I presume that your station management would like to remain on the air all of the time; so for that reason alone, a second transmitter is a necessity. If you currently have only one, then a reasonable plan is to relegate the "old" transmitter to backup status, and to put a new one in its place.

However, that project might not be quite as easy as it sounds, depending upon the circumstances, of course, because a certain amount of resources need to be available in order to accomplish this task.

You'll need space for the second transmitter; you'll need the electrical capacity; and you'll need a means by which you can switch to the other transmitter by remote control.

The addition of a second transmitter also represents a fairly large commitment to extra expenses, so if management balks for one of the following reasons, let me suggest the following responses:

"We understand the need for a second transmitter, but we can't afford to upgrade the building or the electrical feed." One way around this is to buy a transmitter physically small enough to fit into a rack that already exists. Likely, you'll have enough electrical capacity for this as well. Perhaps it will only have a 10 percent of the power capacity of your main—so this represents a big compromise on your part — but that's a lot better than being off-air. Alternatively, a second transmitter can live in a different location (see more on this topic below).

I doubt there is any particular item that has more potential to give you grief.

"We can't really afford a second transmitter — can't you just work on the main during overnights?" Sure you can — but you don't want to. No one does. It can be dangerous; it can ruin you for the next day; and frankly, it's an imposition on any employee that an employer shouldn't expect. It's one thing to do it on an emergency basis; it should not become standard operating procedure.

MORE POWER!

Sometimes stations move or change antennas or change antenna locations on the same tower. Each of these reasons could compel you to purchase a transmitter that has more output power capacity.

Another reason for buying a transmitter with a higher output capacity, even without the reasons specified above, is the "loafing" factor. You might find yourself a bit more relaxed if you know your new transmitter was designed to put out, say, 20 percent more power than you require of it. That will mean less stress on power supplies and amplifiers on a long-term basis.

NEW TRANSMITTERS HAVE FEATURES OLDER ONES LACK

I mentioned the RCA BTF-series transmitters. For logic, all it had were two mechanically latching relays representing filaments ON/OFF, as well as PLATE ON/OFF.

The question could be put: Do you really need any more than that for any transmitter? The answer, really, is "no."

If you were to look at old cars, though, for comparison purposes, you could make the same case: Older cars had the accelerator pedal, the brake pedal, the clutch and shifter. You rolled the windows down by hand and you used an actual key to start it, and to open the doors and trunk. We all know the newer car features that are commonplace nowadays. On one hand, we like them; on the other, they also break sometimes.

There's a balance between complexity and trouble-free operation. It's the same with modern transmitters.

Probably the most important addition to modern transmitters, from the perspective of the engineering department, is remote access. If you are responsible for sites that are spread out geographically; if you take care of the IT aspects at the station along with the studio gear; or if you are a one-man (or one-woman) department, then you need all the help you can get. The last thing you need to do is to take time to visit the transmitter site for information you could have easily gotten via IP access.

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Another common feature in newer designs is built-in redundancy. With a vacuum-tube transmitter, you essentially have one amplifier element and one power supply. A failure in either knocks the transmitter off-the-air. Newer designs make use of multiple power supplies and multiple power amplifiers — and the failure of one (or more) doesn't take the transmitter all the way off-the-air. Clearly, that's an advantage for the station and the engineer who maintains it.

Ten years ago, during the initial rush to put FM-band HD Radio stations on-air, it was common to buy another transmitter for nothing but the IBOC power. A -10 dB coupler was a common way to inject the IBOC power in to the main antenna; alternatively, an auxiliary antenna was used for the HD transmitter by itself.

Today, common amplification is readily available, and transmitters that do it still maintain fairly good efficiency. If you are adding HD Radio, a new transmitter with common amplification represents the path of least resistance.

ADDING A N+1 SITE TO YOUR BAG OF TRICKS

In two prior articles, I've espoused the benefits of alternate transmitter sites. (See *radiomagonline.com/misc/0082/build-better-backups/36019* and *radiomagonline.com/deep-dig/0005/trends-in-technology-alternate-transmitter-sites/28299*.)

All manner of things can happen at a transmitter site, many of which are out of your control. Most of those can be remedied with an alternate transmitter site. I'll stay off my soapbox here, except to say that, in the event it isn't practical to add a second transmitter at your current transmitter site, you should consider putting one somewhere else. If you happen to have multiple FM stations, an N+1 system can potentially become a backup for all of them.

An N+1 site needs more than just a transmitter, of course; it will need to be geographically situated so that it can serve as an aux for (hopefully) all of your main sites, from an allocations standpoint. You'll need an antenna that can accommodate all the frequencies you have; and finally, you'll need some sort of STL to make it all work.

This particular application really highlights the need for remote access of transmitters. The N+1 site will likely be used in emergencies, and the last thing you want is to actually have to go there to put it on-air. No system is really complete without full remote control capability, most (if not all) of which is going to be provided by IP communications.

There are many individual items at a radio station at times called "the most important piece of equipment we have!" I doubt there is any particular item that has more potential to give you grief. Therefore, planning for the purchase of transmitter is one of the most important things you will do.

What's on the Transmitter Market?

by Doug Irwin, CPBE DRB AMD

Brand loyalty plays a big part in transmitter purchases. Experiences play a major role in the development of loyalty or its antithesis.

You should never habitually ignore a brand, especially before a major purchase. Models are introduced regularly with new features, some of which could change your attitude, should you learn about them.

That's one reason why a trip to the NAB or Radio Show is so useful. But you can learn by speaking with colleagues about what they are using. If a your friends raves about "the new box," it makes sense to check it out.

Let's take a sampling of what is available now.

Broadcast Electronics offers transmitters in four power ranges. The largest single-tube transmitter line is the T-series; the range is between 20 and 40 kW. The S-series offers a completely solid-state solution in the 4 to 20 kW range; the solid-state C-series range is from 500 W to 5 kW.

The STX-10 is the newest solid-state FM transmitter in BE's transmitter line. It requires 22 RU of vertical space in a standard rack (30 inches deep) with 70 percent AC-to-RF efficiency. STX-10 makes use of hot-pluggable power amplifier modules and power supply modules. If you are planning to transmit HD radio, you would then equip the STX-10 with a STXe 500 exciter. While considering remote access, keep in mind that the STX 10 can be accessed from any PC, tablet or smartphone and is also SNMP V2 and V3 compatible. STX-10 can also be used in an N+1 system, or in a single frequency network, due to a delay feature in the exciter.

BE produces two lines of AM transmitters, as well: the A series (500 W to 10 kW) and the E series, at 2.5 or 5 kW.

Continental Electronics continues to offer the 816R line of FM transmitters and the 816-HD and 816-HDR lines (HDR meaning "HD-ready"). The 816R line covers the power range of 11 to 40 kW, using the same three-bay design for the last 30 years, with the 4CX15000A, the 4CX20000E or the 4CX25000C (depending upon power level) driven by the solid-state IPA.

The 816HD family of transmitters is based on three different analog FM + HD power levels: the 816HD-20 for power up to 20 kW; the 816HD-25 up to 25 kW of power, and finally, the liquid-cooled 816HD-28L for applications up to 30 kW of analog power.

Transmitter	FM@1% HD	FM@4% HD	FM@10% HD
816HD-20	20kW	18kW	12.6kW
816HD-25	25kW	23kW	17kW
816HD-28L	28kW	27kW	19kW

Note: 1%HD = -20dBc (dB below carrier), 4% HD = -14dBc, 10% HD = -10dBc

Continental Electronics

- All the individual preset configurations (frequency, power level, HD power program audio input)
- Dynamic RDS scrolling
- New oscilloscope instrumentation
  - Unique MER instrumentation
  - RF and audio spectrum analyzers
  - Monitoring and control to the sub-module level
  - Logging of all events
  - SNMP support
  - Email notifications

Nautel's newest transmitter line for FM is the GV series. It's completely solid-state and of modular design, so that failures in one (or more) PA modules, or power supply modules, or the user interface itself, will not take the transmitter completely off-the-air. All GV Series transmitters include Nautel's Advanced User Interface with 17-inch touch screen monitor and IP access; so whether you are in front of the transmitter or at some other location, 100 percent of the AUI is available to help you manage the transmitter. With the AUI, you can configure and then monitor the following:

The real-time measurement of modulation error ratio provides the ability to diagnose issues such as interference with the MP3 carriers near the analog signal due to FM analog signal over-modulation.

The chart below shows analog and analog + HD power for the GV line:

	GV3.5 *	GV5	GV7.5 *	GV10	GV15 *	GV20	GV30N	GV30 *	GV40	GV60	GV80
Analog Only	4.13	5.5	8.25	11	16.5	22	33	33	44	66	88
-20dB Hybrid	3.75	5	7.5	10	15	20	30	30	40	60	80
-14dB Hybrid	3.38	4.5	6.75	9	13.5	18	27	27	36	54	72
-10dB Hybrid	2.5	3.3	5	6.6	10	13	20	20	26	40	52

ANALOG POWER OUTPUT (kW)

Nautel

Nautel has a line of AM transmitters as well, known as the NX series, at the 5, 10, 25 and 50 kW levels.

If you read the "Justify It" article, then the following will be especially pertinent:

	NX5	NX10	NX25	NX50
ANALOG	5 kW	10 kW	25 kW	50 kW
Efficiency	86%		88%	

Nautel

These figures represent overall efficiency (AC-to-RF) but don't include modulation. When you make your comparison chart, try to make it as close to "apples vs. apples" as you can, to be fair.

The NX series also includes the Nautel AUI, meaning that all local control and configuration can be done from anywhere you have IP access.

GatesAir has an extensive line of FM transmitters. Let's take a look at the Flexiva line. It's scalable, for power levels between 5 kW and 80 kW. A 10 kW version needs 16-RU of vertical space in a rack. A common 1800 W power amplifier module is used as a PA, or as an IPA. PA modules and power supply modules are hot swappable.

Some of the Flexiva's other important features are as follows:

- Continuously variable speed fans optimize cooling; redundant internal cooling fans draw air from front to rear with ducted air options available
- Digital Ready: FM, FM + HD Radio, HD Radio only
- Maintains power up to 1.5:1 VSWR. Proportional VSWR fold-back for safe operation at reduced power into marginal loads (icy antenna, etc.)
- Global control and monitoring via IP; the remote graphical user interface works with any PC, tablet or smartphone
- Full SNMP network control and monitoring support
- Diagnostics and setup via an easy-to-use front-panel control
- N+1, Dual Transmitter and Main/Alternate and with automatic switching capability

It should also be noted that GatesAir introduced the Flexiva FLX range of liquid-cooled transmitters for FM and digital broadcasters. The design incorporates a heat-to-liquid transfer that removes heat from the RF plant "without excessive air conditioning, helping broadcasters cut monthly utility costs and establish a greener plant. The transfer itself cools the air in the RF plant, moving transmitter heat to the outside via a liquid-to-air heat exchanger with redundant fan systems," according to GatesAir. Further: "To obtain maximum efficiency, the liquid-cooled design, in most installations, integrates low-noise pump modules within the transmitter to further reduce its already compact footprint. Two fully redundant cooling pumps operate in a closed-loop design, with auto-changeover capability in the event of a failure to ensure proper and constant transmitter cooling."

GatesAir continues to offer AM transmitters. The DX line is still available, along with the 3DX series.

Take a look at the efficiency chart on the following page.

Output Power - Max Watts	FAX5K	FAX10K	FAX20K	FAX30K	FAX40K
Nominal Power	5,000	10,000	20,000	30,000	40,000
FM Analog Power Range	500-5,500	1,000-11,000	2,000-22,000	3,000-33,000	4,000-44,000
FM+HD -20 dBc	5,050	10,100	20,200	30,300	40,400
FM+HD -14 dBc	4,679	9,358	18,250	27,375	36,500
FM+HD -10 dBc	3,630	7,260	14,132	21,000	28,000
HD Only -20 dBc	2,000	4,000	8,000	12,000	16,000
HD Only -14 dBc	1,850	3,700	7,400	11,000	14,800
HD Only -10 dBc	1,550	3,700	6,200	9,300	12,400

Gates Air

Overall AC Efficiency	
3DX25	85% or better at 25 kW, 87% typical
3DX50	86% or better at 50 kW. 88% typical
3DX100	86% or better at 100kW, 88% typical

Gates Air

N+1 OPTIONS

Most of the VHF FM transmitters mentioned to this point can be operated in a N+1 fashion, meaning that, when connected to a broadband VHF antenna, they can have their operating frequencies changed "on-the-fly" and thus become backup transmitters for a cluster of FM stations.

Smaller, lower power transmitters to consider for N+1 operation could be:

- Nautel VS-series
- GatesAir FAX series
- Broadcast Electronics STXe series

In the low-power domain we have other manufacturers to consider. For example, BEXT offers the XL series (1k and 2 kW versions in 2-RU of vertical space).

Its salient features include:

- Fast access to settings and all readings from front panel via menu display and via IP or USB
- Telemetry and remote control connections
- User manual and tech documentation accessible from front USB port even when unit is not powered
- User programmability allowing for N+1 backup to multiple stations
- Proportional Auto-Foldback of output power in the event of excessive VSWR
- Adjustable power output from 0 W to full power, with soft-start control
- Includes low pass/harmonic filter and meets or exceeds all FCC and CCIR requirements
- Optional built-in, stereo generator w/ fast audio clipper

Another option for lower power would be the Crown E-250 (manufactured by Ecreso). The power level might seem a little low, but even 250 W is much better than being off the air.

Some of the E-250's features are:

- 2-RU vertical space required
- Built-in stereo generator that can use AES or analog inputs
- Silence detection and failover to alternate audio input
- Dynamic RDS encoder
- Full-set of GPIO
- Remote access via IP, using Web browser of SNMP

This was not meant to be a comprehensive list of every transmitter out there, but I hope you've gotten some ideas. I hope you undertake some research of your own.

RADIO SHOW

Produced by NAB and RAB

Tech Sessions Overview

WEDNESDAY, SEPT. 30

10:30 a.m. - 11 a.m.
1 p.m. - 1:30 p.m.
2 p.m. - 2:30 p.m.
Location: *The Innovation Stage in the Marketplace*

Ask the FCC

FCC District Director for Atlanta Doug Miller will answer attendees' questions about broadcast operations.

2:30 p.m. - 3:30 p.m.
Location: *M101*

Modern Transmitter Architecture for FM and HD Radio Broadcasting

Rohde and Schwarz will offer ways to reduce factors associated with the cost of transmitter ownership.

THURSDAY, OCT. 1

9:15 a.m. - 10:15 a.m.
Location: *M103/104/105*

Radio Futures: New Developments for the Connected Car

Auto manufacturers have found that telematics is a key driver for new car sales. Consumers want to remain connected when driving. The challenge for designers is connectivity, safety and security. This panel will discuss the thinking and research going into telematics and the place that radio will occupy in vehicles of the future. The panelists are Ford Motor Company's Scott Burnell, Cisco Systems' Andreas Mai and AT&T Mobility's Joe Mosele. The session will be moderated by Radio World Editor in Chief Paul McLane.

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12 p.m. - 12:30 p.m.
Location: *The Innovation Stage in the Marketplace*

New Monitoring Capabilities for Measuring Watermark Quality

Learn how some broadcasters are beginning to correlate watermarking quality with other metrics to gain insights into their operations. 25-Seven Systems' Geoff Steadman presents this session.

1:30 p.m. - 2 p.m.
Location: *The Innovation Stage in the Marketplace*

Nielsen PPM Encoding Update

Join Nielsen's Matt O'Grady and Arun Ramaswamy as they share further details about Nielsen's planned enhancements to the company's audio portable people meter critical band encoding technology and the new encoding monitor that will be available in 2016.

2:15 p.m. - 3:15 p.m.
Location: *M301*

After AT&T and T-Mobile: Next Steps for NextRadio

Presented by Next Radio President Paul Brenner and Emmis Communications Chairman of the Board Jeff Smulyan, hear what's on the horizon in the effort to activate the FM chip in smartphones and learn more about how


Jim Peck

NextRadio is leveraging the momentum with listeners and advertisers.

2:15 p.m. - 3:15 p.m.
Location: *M103/104/105*

The Future of Music Listening

This panel will provide an update on music licensing policy and legal debates, including pre-1972 sound recordings, the ASCAP and BMI antitrust consent decrees, streaming fees, and the broadcast performance royalty. It will be moderated by Wilkinson Barker Knauer partner David Oxenford. The panel consists of U.S. Copyright Office Deputy General Counsel Sarang Damle, NAB's EVP of Government Relations Curtis LeGeyt, Recording Industry Association of America Chief of Digital Business and General Counsel Steve Marks, Pandora Director of Government Relations Katie Peters and BMI's SVP of Music and Licensing Mike Steinberg.

2:30 p.m. - 3 p.m.
Location: *The Innovation Stage in the Marketplace*

Modern Streaming Audio: Leveraging New Technologies to Attract Today's Listeners

This presentation from Telos Systems software engineer Ioan Rus explores developments impacting your stream's quality, reliability and features, including Adaptive Streaming, new coding choices, improved pre-processing, cloud-based software and advanced streaming software UIs that tailor to your station's workflow.

3:30 p.m. - 4 p.m.
Location: *The Innovation Stage in the Marketplace*

NAB Labs' Focus on Radio

NAB Senior Director of Advanced Engineering David Layer will present an update on NAB Labs' recent activity regarding AM all-digital testing, Modulation Dependent Carrier Level (MDCL)/HD Radio compatibility, market research regarding activating the FM chip in smartphones and FM multiplex generation using single sideband-suppressed carrier (SSB-SC) subcarrier. Bring your questions!

3:30 p.m. - 4:30 p.m.
Location: *Marquis C*

FCC Experts Talk Radio Regulation

Key FCC agenda items include revitalizing AM radio to activating FM chips to regulatory requirements, including putting public files online, as well as political advertising issues. FCC Commissioner Michael O'Rielly will give the opening remarks. The session will be moderated by NAB SVP/Deputy General Counsel Ann Bobeck and NAB General Counsel/ EVP Rick Kaplan. The panelists are FCC Media Bureau Assistant Chief of the Policy Division Robert Baker and FCC Media Bureau Audio Division Chief Peter Doyle.

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The Beauty of Tiger Teams

by the Wandering Engineer

These pictures, while adorable, don't quite cut it as a welcoming committee for those who visit the commission's headquarters.

In most endeavors, like banking, manufacturing or pharmaceuticals, a reduction in regulatory force would be greeted with elation. Not so for the tenants of the RF spectrum.

When the FCC leadership moved to save 2.5 percent of its operating expenses by closing some field offices, the response was instead great despondency and many petitions to keep the offices open.

The process was the same one used in the whole of the government and industry: Hire a consultant to advise you to do what it is you want to do. It's not that leadership doesn't believe they don't know the right course; they simply need a consultant to validate the decision and take the heat if it turns ugly.

STANDARD SOLUTIONS

Any good broadcast engineer knows that, when it comes to big things like link budgets and AM directional array design and tune-ups, you do your own design and then hire a consultant to hopefully give you close to what you calculated. Sure, they will throw in more connector loss and lower S/N to fudge a bit more overhead into the system in case you only use low quality, rusty components, but that's another reason to hire a consultant. They have the courage to ask for more than you need under the guidelines of "good engineering practice."

So when the consultants advised a reduction in field offices — not an outright closure of all of them as a way to recoup that $9 million needed for the 2.5 percent savings but to something that leaves a few field offices and "Tiger Teams" — they were simply advising a standard solution.

Trust me, I've some experience with these problems, and my go-to solution always incorporates Tiger Teams. They are a thing of magic. By definition, they are the best of the best, fully empowered to do whatever needs to be done. The whole world would be Tiger Teams if only there were that many "best of the best" and all our problems were big enough to warrant them.

So, the consultants did the consultant thing: interviewed a bunch of FCC field engineers, asked them what they did, minute by minute. They probably thought the calls, from broadcast engineers, public safety radio managers and the like, were simply odd interruptions in flow of the day for these commission employees. Field engineers, of course, are there to catch the bad guys violating rules — and usually not-that-big-of-a-deal rules. Things like EAS and kilowatt CB amplifiers or the overuse of "emergency non-directional daytime — Friday night football power." Really, a Tiger Team can drop out of a black helicopter when there's some clueless kid keying up on an aircraft frequency at the end of a major runway with some stolen HT they got at the pawn shop.

Nine million dollars. The cost of flying a B-2A Spirit Stealth Bomber for 53 hours. Or 11 cruise missiles. There are a lot of things government does that can be questioned, but there are also a large number of things that work pretty well. In a world where spectrum is sold for billions, it seems silly to take such a bargain-basement approach when it comes to keeping it clean.

I doubt I can get a Tiger Team to come in to find those cheap offshore Wi-Fi access-points in that warehouse on the edge of town, which takes out the SFN and my Garmin.

I doubt I can get a Tiger Team to figure out how to comply with the latest confusing requirement from the commission.

It's instructive to go to FCC headquarters in Washington. There is a double glass door with a tiny lobby, a board featuring children's drawings for some charity purpose, and that's it. No one to say hello to, no literature, no history of radio. Without an appointment to see someone, you shouldn't be there. It is the least exciting and most isolated government entity you can imagine.

It's not good when the FCC lawyers win out over the FCC engineers.

Fortunately they are located close to the D.C. fish market. I suggest that if you go to see the FCC, you walk another 2,000 feet to where you can get some great clam chowder, shrimp, maybe a lobster, and look out over the water at the Washington that inspires — and matters.

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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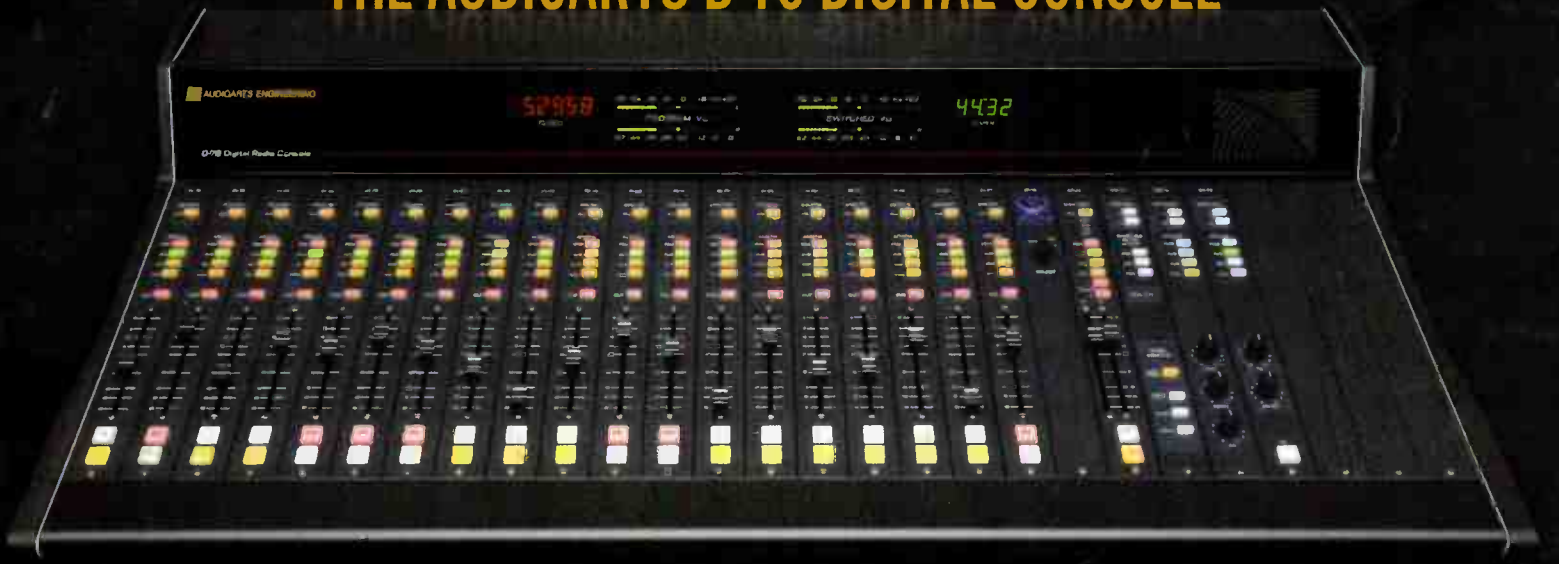

The Audioarts D-76 console has all the practical style and rugged functionality of the beloved D-75 standalone console, a staple in radio studios for the past 15 years, but with modern necessities such as an RJ connector system for all your I/O.

The D-76 is a tabletop, modular console available in a 12-channel or 20-channel frame, and includes StudioHub+ RJ45 connectivity.

Sporting a sleek new profile, the D-76 comes standard with ample mic preamps, plenty of stereo busses, and a comprehensive monitor section that provides separate feeds to control room/headphone and studio monitor outputs — plus headphone jack and built-in cue speaker.

It has four stereo busses, dual-domain outputs, sample rate conversion on all digital inputs, and interchangeable input module daughter cards for easy analog-to-digital conversion in the field.

Its modern design features backlit controls and meter bridge with full-scale, bargraph digital peak plus VU metering and automatic timer and clock.

Individual plug-in modules make installation and service a breeze. The D-76 can be ordered with an optional SUPERPHONE module, which supports two callers. It can also be ordered with the optional IP-76 plug-in module for interfacing to the WheatNet-IP Intelligent Network.

This new console has everything you have come to expect of an Audioarts console — like ease of use and rock solid reliability (including a KILLER power supply, built by Audioarts).It is laid out in a sleek new design that is both affordable and practical for modern radio stations of all sizes.

Contact Audioarts Engineering for more info on the D-76 Digital Audio Console.

- Modular hot-swap plug-in design
- Optional IP-76 module provides connectivity and additional I/O through WheatNet-IP network
- Optional SUPERPHONE module with dual caller support
- StudioHub+ RJ45 connectivity
- Inputs can be analog or digital, depending on daughter card installed
- Any combination of analog and digital line inputs
- Input channel A/B source select
- External rackmount power supply
- Universal opto-isolated mic and line control ports on all input modules
- Sample rate conversion on all digital inputs
- Optional dual failsafe power supply
- Digital clock (can be slaved to ESE time code)
- Cue function and auto-dropout
- Connectorized faders and monitor pots
- Connectorized channel ON/OFF switches
- CR and Studio Monitor outputs with separate four-buss source selection plus independent external 1 & 2
- Both Program and Switched VU meter pairs
- Four microphone preamps standard, with option for four additional
- Digital timer with autostart and manual control
- Two on-air tally relays
- Built-in headphone amp with concealed output jack
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