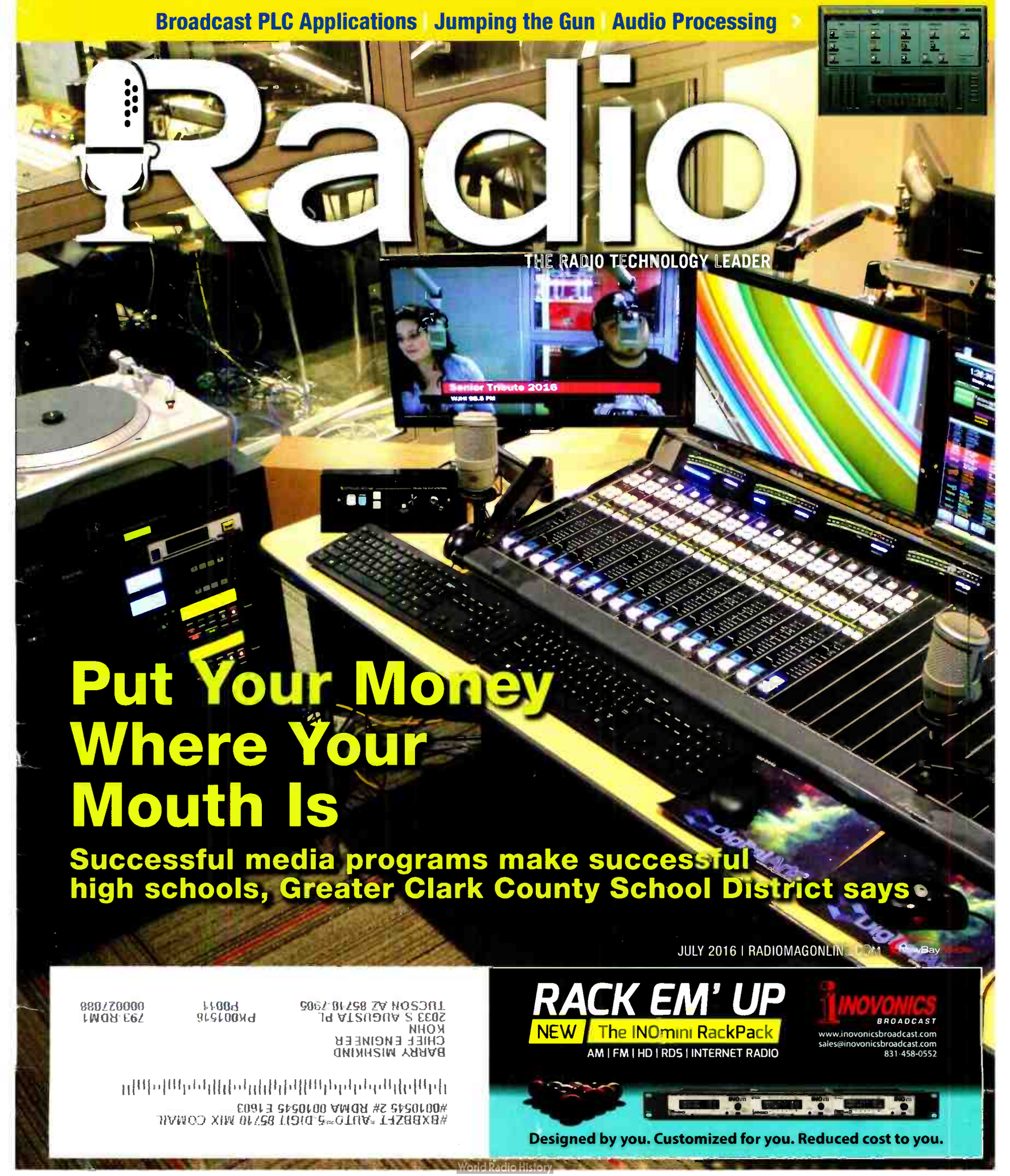
Broadcast PLC Applications | Jumping the Gun | Audio Processing

Radio

THE RADIO TECHNOLOGY LEADER



Put Your Money Where Your Mouth Is

Successful media programs make successful high schools, Greater Clark County School District says

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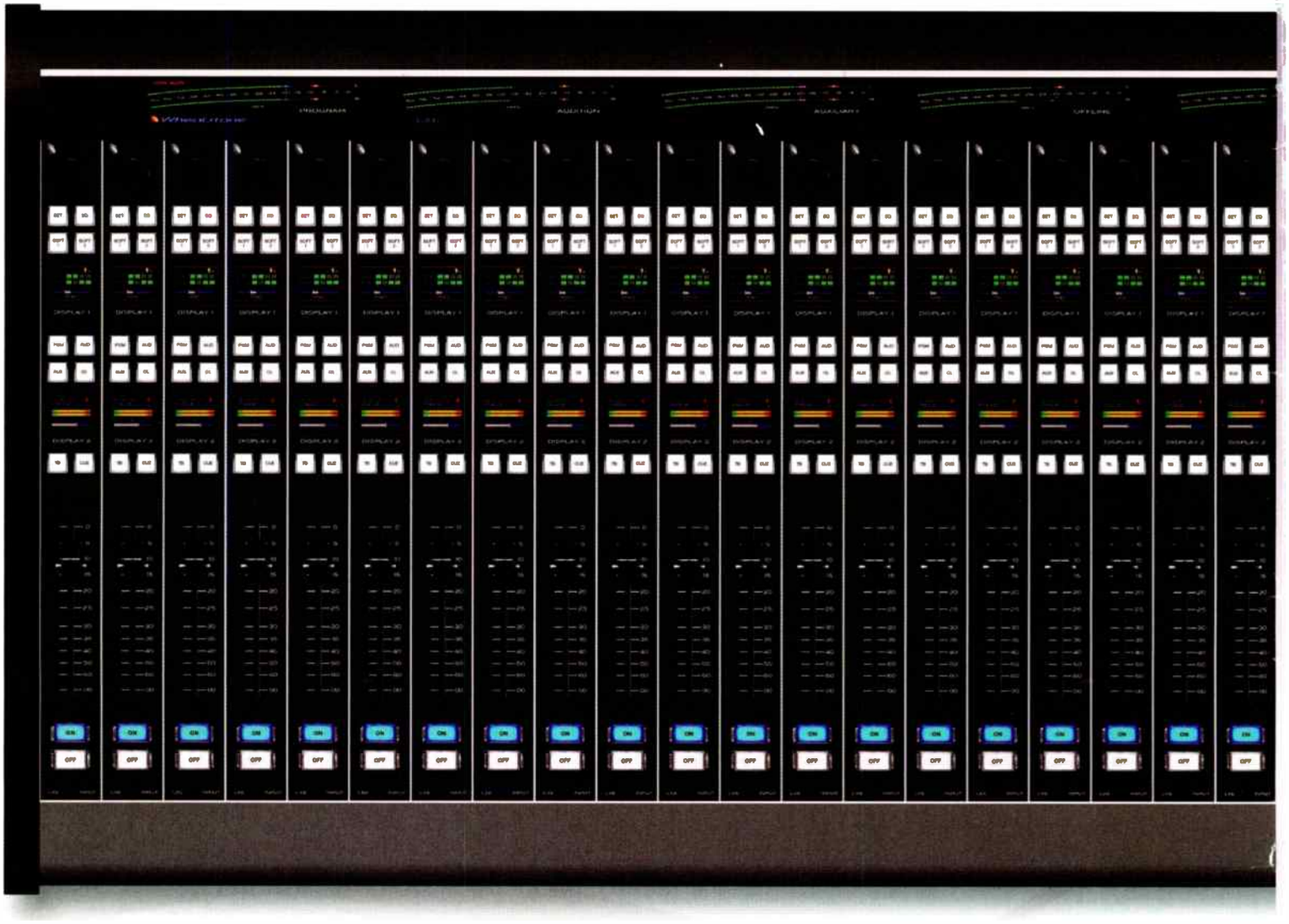
LXEvolved



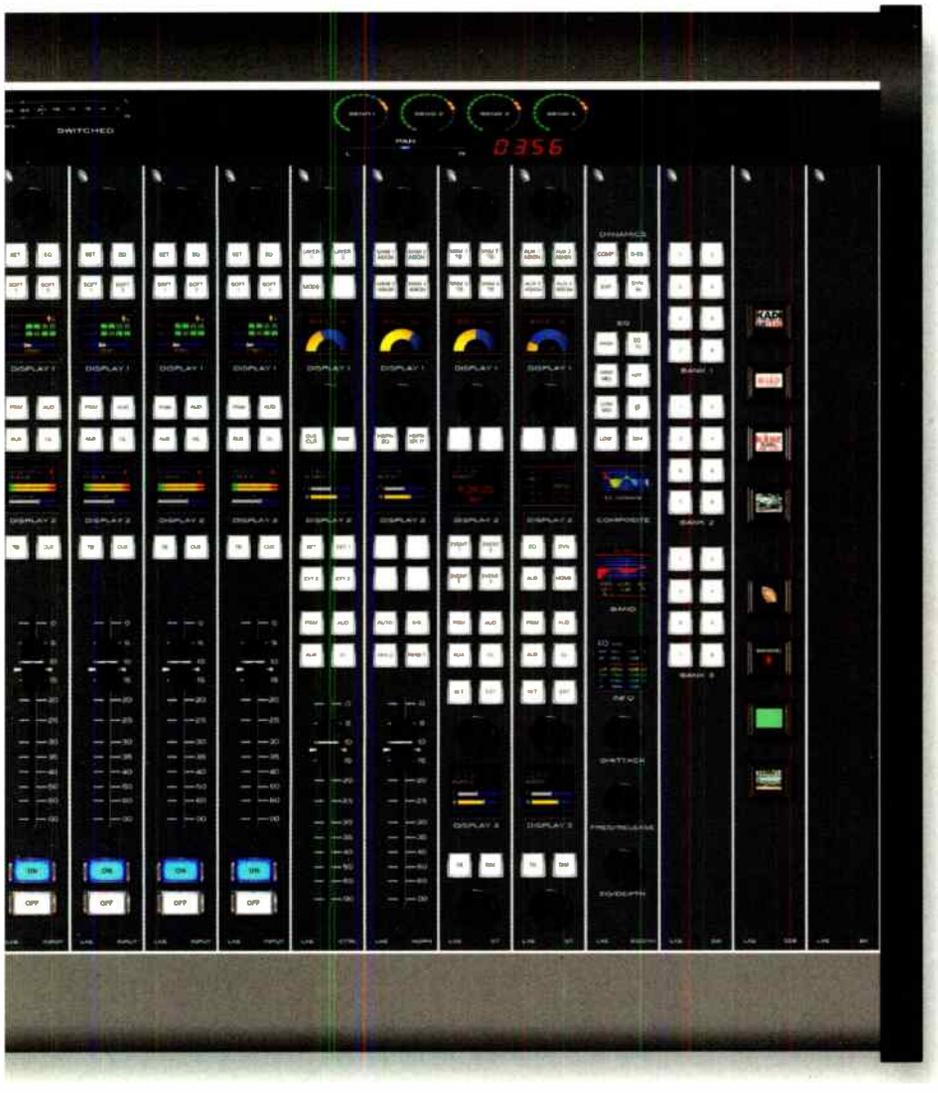
The Evolution of LX Radio Control Console

Wheatstone's new LXE console brings control surface configuration to a new level. Going far beyond the usual "any source to any fader" network concept, the LXE is a fully flexible control interface, where every switch and rotary control is programmable to perform any desired function. This means console architecture is completely customizable to client requirements, and limitations to functionality are no longer a factor. Physically compact, the LXE is available in several different form factors including countertop, countertop sunken, and split frames (split sections are not confined to one room, they can actually be in different studios).

Any Way You Want It

ConsoleBuilder software allows every switch on the surface to be programmed for function, mode, and even color (switches are RGB led illuminated). In fact, built-in software allows every button to be scriptable, letting you create powerful macros for as many controls as you want. Multiple full color OLED displays on each panel keep pace with ongoing operations, and event recall allows painless one touch console reconfiguration at the press of a button. With its inherent control flexibility and ability to access thousands of signals (sources and destinations are limited only by the size of the network) the LXE takes facility work flows and audio control to a new level.

LXE is the recipient of NewBay Best of Show Awards from Radio World and TV Technology



The World At Your (Motorized) Fingertips

The LXE can have up to 32 physical motorized faders, with full DSP processing available on all 32 channels. Surface(s) interface seamlessly into the WheatNet-IP Intelligent Network, and utilize BLADE-3s for audio, control and associated logic data flowing on single CAT6 interconnecting cables. The system can ingest and convert virtually all audio formats: analog, microphone, AES/EBU, SPDIF, AoIP, MADI, SDI and even AES67. Loudness metering, phase control, and full EQ/ Dynamics are included.

All New Graphical User Interface

LXE's new GUI is has pre-built screens for everything you normally use – metering, clocks, timers, dynamics, EQ, assigns, and more. All are touch-screen accessible with gestures you're used to using on your smart devices. And, the GUI is just as customizable as the LXE surface. Using our ScreenBuilder-LXE software, you simply drag and drop objects and define their functions via a simple wizard interface. You can store multiple custom screens, if you like, to go with your custom LXE setups.

THE ALL NEW LXE BROADCAST AUDIO CONSOLE

Wheatstone

BROADCAST AUDIO PERFECTIONISTS®

TABLE OF CONTENTS

The WJHI studio facility is a prominent fixture in the 5,000-seat gymnasium at Jeffersonville High.

FEATURES

COLUMNS

DEPARTMENTS

On the cover: WJHI's on-air room 1 features a Wheatstone LX-24, Neumann 705s and a Sony hi-res USB turntable.

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 **Hosa CBT-500 Audio Cable Tester**. Send your entry to radio@RadioMagOnline.com by **Aug. 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*.

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VIEWPOINT

Sit Back, Relax and Learn

We find ourselves in the middle of the year already; time to take vacations and, hopefully, to relax in the heat.

As Tech Editor, one of my goals is to help you improve your career and work-life balance. If you're new to Radio, take a look at back issues and get caught up; we're in the process of helping you make your work life easier. We're all about getting rid of the things that make your job tough and replacing them with things that make it easier.

Will it happen for you overnight? Probably not.

Will it require tons of money? Nope.

It will take some planning; it will take concerted effort; and it will take focus. Most of all, it will take time. The people who contribute to this magazine are right there with you, working in this field, coping every day, just like you. Stick with us and feel free to remind friends and colleagues that we're a resource.

IN THIS ISSUE

It's not such a good idea to seek forgiveness in lieu of permission, at least when it comes to dealing with the FCC. Lee Petro shares a cautionary example in this issue's FCC Update.

Even if you are new to the engineering field, you likely know that there is more to "processing" than just the final processors that feed transmitters. This month, we're featuring an article that explores other processing needs around a radio station: program levelling, caller audio and mic processing. If you ever wondered how some stations maintain that "wall of sound" effect, then read this.

Automation of transmitter site features has been a big theme in Radio over the last year, and we plan to continue it. This month, we're starting a series on Programmable Logic Controllers: What they are, learning the basics of their use, and then how to put what you learn in to practice.

There has been much talk about the need to introduce new blood to the broadcast engineering field. In the July issue, we feature another training ground as our Facility Showcase: Clark County School district's LPFM stations in Jeffersonville and Charlestown, Ind. These stations were developed with students' employability in mind. Reading this article should make you more optimistic about the future.

Don't put down this issue of Radio without reading the meandering thoughts of the Wandering Engineer. He/she considers the future of and what, if anything, can be done to inject some life into the senior band and community broadcasting.

Doug Irwin, CPBE AMD DRB | Technical Editor

Radio
THE RADIO TECHNOLOGY LEADER

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Programmable Logic Controllers: Applications in Broadcasting

by Dennis L. Sloatman

Programmable Logic Controllers have been used for decades by utility companies, chemical plants and industries as diverse as cement, food and paper.

These smart and robust devices are popular because they can control any function, whether analog, discreet or a combination of the two. The benefits of PLCs include extreme reliability, fast operation, low power consumption, easy maintenance and modular design. PLCs can not only handle complex logic operations, but they also can be easily re-programmed — with no costly and time-consuming re-wiring. Most importantly, PLCs are designed to be directly installed in an industrial environment without custom interfacing.

PURPOSE-BUILT

Many broadcast engineers have built custom boxes for control applications using relays, relay sockets, diodes, capacitors, wire, terminal strips or connectors. These devices serve a purpose, but by nature are limited: they can only be used for one purpose, aren't easily modified and are time-consuming to build.

This article discusses how a PLC can replace the custom-built box by providing an off-the-shelf, multi-purpose, self-contained and easily reconfigurable solution for many critical applications.

The good news is that all of the necessary components — PLC, CPU, I/O and cabling — are available from a variety of vendors at

CONTINUED ON PAGE 12

AUDIO-TECHNICA

BP40 Large-Diaphragm Dynamic Broadcast Microphone

Patented Floating-Edge Construction and Optimized Capsule Placement Ensure Commanding Vocal Presence

The BP40 broadcast vocal microphone offers a rich, natural, condenser-like sound from a large-diaphragm dynamic design. The microphone, intended for use in radio, overdubs, post production, podcasting and other broadcast applications, features Audio-Technica's patented floating-edge construction. This new, innovative design eliminates the ridge from around the capsule, resulting in maximum diaphragm surface area and uniform diaphragm tension — a quality that can be lost as the glue dries on typical diaphragm-to-ridge adhesion schemes.

The optimized diaphragm performance is further aided by a humbucking voice coil that prevents the electromagnetic interference that is all too common in today's studios with their computer monitors and other electronics. Additionally, the BP40's capsule has been placed back a bit from the end of the housing, enabling the mic to maintain a commanding vocal presence, even when the speaker is not right up on the microphone. The housing incorporates a multistage windscreen to provide superior internal pop filtering.

Since it is intended primarily for close-up vocal work, the BP40 features a hypercardioid polar pattern to keep the sound focused on the intended sound source. The mic's excellent off-axis rejection helps generate clear, articulate vocal reproduction — reproduction that can be further tailored by employing the mic's switchable 100 Hz high-pass filter to combat excessive low-end response and provide additional pop protection.

With rugged, all-metal construction, the BP40 is built to deliver long-lasting, dependable performance in professional broadcast environments. Yet, with a body fashioned after the peaks and valleys of a waveform, the mic also doesn't skimp on style. The BP40 comes standard with the AT8483 adjustable swivel mounting clamp that fits 5/8-inch 17-threaded stands and also includes a 5/8-inch 27-threaded to 3/8-inch 16-threaded adapter. The AT8484 shock mount, designed especially for use with the BP40, is available separately to provide additional protection from noise, shock and vibration. The BP40 has a U.S. street price of $349, and the optional AT8484 shock mount has a U.S. street price of $99. ■

www.audio-technica.com/cms/wired_mics/d38854ca3f6290c0/index.html

2016 NAB SHOW

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Radio

ESE

ES-410, GPS-Based Frequency Standard

Get Synched! Eight High-Stability 10 MHz Outputs

The ES-410 is a GPS (Global Positioning System) based frequency standard that generates a stable source of 10 MHz and 1 PPS using GPS satellites as a reference.

The unit provides 10 MHz in both Sine Wave and Square Wave (5 volt logic) form. Four Sine Wave and four Square Wave outputs are provided. The 1 PPS output is a 50 percent duty, 5-volt logic signal, positive-edge coinciding with the UTC seconds change. An ESE TC90 Time Code output is also provided for driving remote time displays. Two front-panel LEDs indicate when the ES-410 is locked to GPS and when power is supplied to the unit. A USB interface allows configuration of the Time Zone and other parameters, and outputs the time. The unit is housed in a black anodized aluminum desktop enclosure. ■

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TIELINE THE CODEC COMPANY

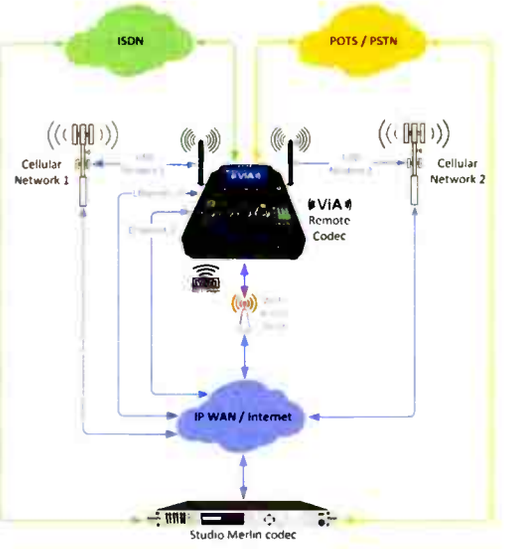
ViA Portable Remote Audio Codec

The Remote Revolution Is Here...

You imagine, we create … It's time to reimagine remotes with the definitive remote codec of our generation. Tieline's revolutionary new ViA portable codec sets a new standard in wireless remote broadcasting and will fundamentally change the way you perform live remotes.

Picture yourself or an announcer taking your codec to a remote site, powering it up and tapping a single button on a color touchscreen to get connected — just like making a phone call. Wouldn't it be great if remotes were that simple? Well now they are — with ViA.

Remotes without limits: Our mission is to empower you with the technology to go live where no broadcaster has been before, and make it simpler. To achieve this, ViA delivers more IP choices and backup options than ever before.



Connect using dual LAN Ethernet ports, or two USB modems, or use the on-board Wi-Fi module to connect over Wi-Fi. Insert an optional POTS or ISDN module and the codec is instantly transformed to connect over alternative network transports. This means you can configure primary and backup connections over different network transports as required, or use them as your IFB circuit.

Fuse-IP and SmartStream PLUS: Tieline's proprietary Fuse-IP data aggregation technology lets you bond any IP interfaces you choose, including:

- Two USB modems, or
- On-board Wi-Fi, or
- Dual Ethernet LAN ports.

Imagine the peace of mind knowing you can bond two USB modem data links from different telcos and let Tieline's Fuse-IP technology automatically manage the data capability of each link! Tieline understands flexibility is paramount for remotes, so you can even bond a USB modem with a Wi-Fi connection, or bond two Ethernet connections.

ViA also includes Tieline's SmartStream PLUS dual redundant streaming software, which sets the benchmark for redundant IP streaming over the public internet. Some manufacturers charge thousands of dollars for IP management software like SmartStream PLUS as an optional extra, however Tieline believes high performance and rock-solid reliability is an essential part of each and every broadcast, so you get it for FREE! Nobody likes a traffic jam, least of all broadcasters dealing with IP packet congestion! With Tieline's SmartStream PLUS and Fuse-IP technologies, as well as automated jitter buffer management and error correction strategies, you can be assured of trouble-free motoring on the information superhighway!

Program and Communications: ViA seamlessly integrates with Tieline's Merlin and Merlin PLUS audio codecs to transmit high fidelity, full duplex stereo program audio with a separate bidirectional IFB circuit. As an example, you could use a USB data modem to broadcast your main program feed and another USB modem or Wi-Fi to transmit your IFB circuit. Now that's flexible!

Key Features:

- Three balanced mic/line XLR inputs.
- Three headphone outputs.
- Support for digital AES3 in (stereo) and AES42 Mode 1 and Mode 2.
- Stereo auxiliary input (analog/digital).
- Dual Gigabit LAN ports.
- Dual USB ports.
- Module slot for optional POTS or ISDN module.
- Four relay inputs and four opto-isolated outputs.
- Stream high-fidelity audio using 24-bit, 48 kHz linear audio, Opus, Tieline Music or MusicPLUS, LC-AAC and HE-AAC v.1 and v.2, AAC-LD, AAC-ELD, aptX® Enhanced, MPEG Layer 2, G.711 and G.722.
- Remotely control and configure ViA from anywhere with an internet connection using the HTML5 or Java ToolBox web browser GUI.
- More features added free in progressive updates.

Join the #ViARevolution: For more information visit *www.tieline.com/via*, like our Facebook page, and follow the #ViaRevolution @Tieline on Twitter. ■

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www.tieline.com

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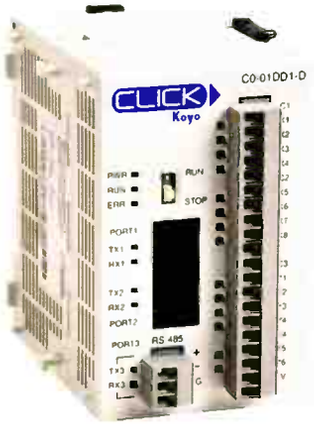
extremely low cost. Here are three examples of inexpensive PLCs:



Click PLC features eight logic inputs and six relay outputs

Why not use an Arduino or the Raspberry Pi instead of a PLC?

TECO PLC with 12 logic inputs and eight relay outputs

I've been asked this question by people looking for inexpensive and easy-to-develop solutions for everything from antenna switch controllers to smart thermostats. I own several versions of these wonderful devices and think they're great for hobbyists who experiment with robotics, media servers, email servers, etc. I do not, however, believe that an Arduino or Raspberry Pi has any place in a commercial radio plant.

My reasons for making this statement are as follows:

The Arduino and the Pi are light use/general

A Direct Logic PLC, featuring eight logic inputs and six relay outputs

purpose devices. They are not designed to control heavy current/high voltage loads or to function in a high-EMI environment. For broadcast use, they must be equipped with a sufficient power supply and a custom protective enclosure. Both devices require considerable wiring and development time before they're operational. Furthermore, the long-term reliability of an Arduino or Pi in an industrial setting is not well established.

In contrast, PLCs are specifically designed and built to address all of these issues and more, right out of the box.

DETERMINISM AND RTOS

Current broadcast remote-control products can place a backup transmitter on the air, switch to an alternate audio source in the event of a failure and automate the testing of standby transmitters. Though useful, these devices are still basically PCs running Windows-based software — suffering from all of the well-known Windows issues.

Using a PC operating system to control broadcast functions is problematic by definition.

Both the Windows and Linux operating systems are not real-time, nor do they operate deterministically. "Determinism" describes the manner in which the operating system responds to events.

Windows, for example, prioritizes its event handling. If a Windows system is heavily tasked with processes, the order of method prioritization can delay its reaction to an external event — consider how your PC slows down during a software update. Now consider how unacceptable this delayed response would be during an emergency shutdown command or a critical overload condition. Adding a faster processor, bus speed and memory to the controlling PC may give the illusion of a real-time response, but these enhancements offer no guarantee that the OS reaction time to a worst-case event will be improved.

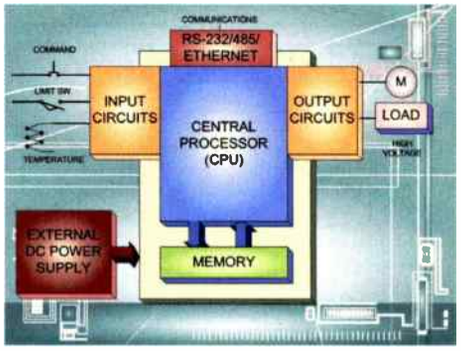
Using a dedicated PLC to control broadcast functions avoids these pitfalls. The PLC response time to an event is in the low millisecond range, which is virtually real-time. Many PLC devices also have interrupt-handling capability, which allows the engineer — not the operating system — to determine the priority of critical event management.

THE PLC ARCHITECTURE

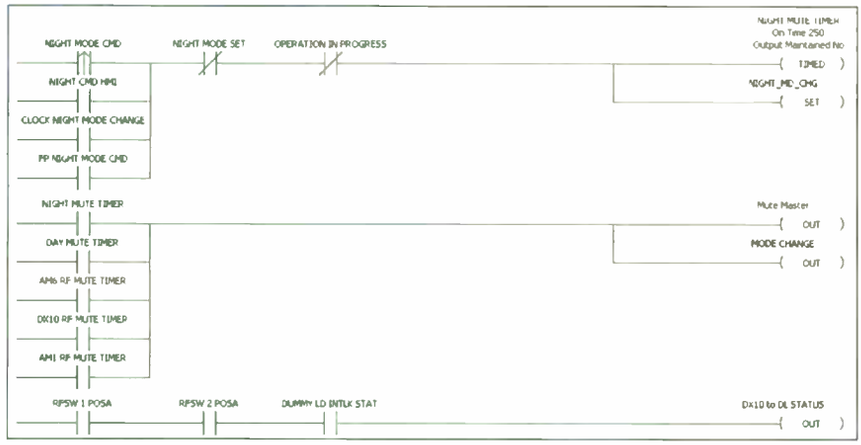
In order for a device to be considered a "computer," it must have a CPU (central processing unit), memory and I/O (input/output) capability. In this respect, the PLC is a true computer. It employs an ARM processor (advanced reduced instruction set microprocessor), input/output circuitry and internal flash memory. In general, the PLC includes serial data communication ability for Ethernet, ASCII and ModBus*. It can signal external systems like monitoring panels (for human/machine interface), or even other PLCs.

The PLC comes housed in a durable enclosure. It usually features easy DIN-Rail mounting and OLED or LED lighting for operational status display.

At right is a block diagram of PLC architecture.



PLC Internal Architecture



Example of a PLC Ladder Logic program

PROGRAMMING THE PLC

Today, the most popular PLC programming language is Ladder Logic. For those familiar with electronic systems, Ladder Logic programming looks similar to an electrical schematic.

In Ladder Logic programming, the world consists of "contacts" and "coils," which is a throwback to the early days when actual input contacts and relay coils were used. In reality — and this is important to remember — these terms are nothing more than memory locations which are written to and read by the CPU during the scan of the ladder program. During the scan process, the CPU sequentially reads the state of the inputs — or "contacts" — stores the information and acts on it.

In addition to contacts and coils, most PLC CPUs includes a large assortment of timers, counters, comparators, latch functions, sequencers, ramp generators and PID (Proportional Integral Differential) function blocks. Modern PLC firmware uses many familiar programming constructs, including for-next loops, data array handling, subroutine and interrupt handling, error handling and sophisticated math functions.

Clearly, a PLC is far more than a simple box of relays! These devices are so capable and flexible that there are virtually no constraints on an engineer's imagination when building an application control design.

THE HUMAN INTERFACE

PLCs are equipped with an "HMI," or Human-Machine Interface.

This is a user-friendly graphical display which allows the engineer to both access the internal registers of the PLC and to virtually view the entire PLC-controlled facility or process:

HMI DISPLAY

The displays are available with touch-screen capability and come in a variety of screen sizes, color depth and resolution, an example is shown here.

Communication between the HMI panel and the PLC is via interconnecting serial cable.

For more demanding applications, an engineer may create a custom interface on a Windows platform using SCADA (Supervisory Control and Data Acquisition) software. Although I earlier faulted Windows for not being a real-time operating system, that issue isn't as relevant when discussing PLC interfaces. In this instance, the Windows software is responsible for monitoring the system, making programming changes, and providing the display. The actual event handling occurs at the PLC level, which is virtually real time.

PLC PROGRAMMING SOFTWARE

Many PLC vendors supply free Windows programming software with their device. This software uses the familiar drag and drop method to move objects onto the program area and then set their properties. Although the procedure is familiar to those who have programmed in the development environments of Visual Basic or C++, please note that no programming experience is required in order to program a PLC. The application-building software provides an intuitive layout that does not require a programming background. To assist in the learning process,

many PLC programming videos are available on YouTube.

Once the PLC program is finished, it's compiled and transferred to the PLC's CPU via the serial connection to the programming port (Ethernet ports are also available on many PLCs for this purpose.) PLC compilers are very good at catching errors, which reduces the risk of future errant or unexpected behavior. Engineers who have taken a programming class may remember writing their first program, usually the "hello world" routine. PLCs have the equivalent "hello world" beginner's program: trigger an input to turn on an output. Once that is mastered, the engineer can expand the program to add timing, AND/OR functions and combinatorial logic.

APPLICATIONS OF PLCS

PLCs are an excellent choice for controlling a whole range of broadcast functions. Any application which requires an output to be logically controlled by input changes (discreet or analog) is a good candidate for control by a PLC. Here are some examples of PLC applications I've employed in my career:

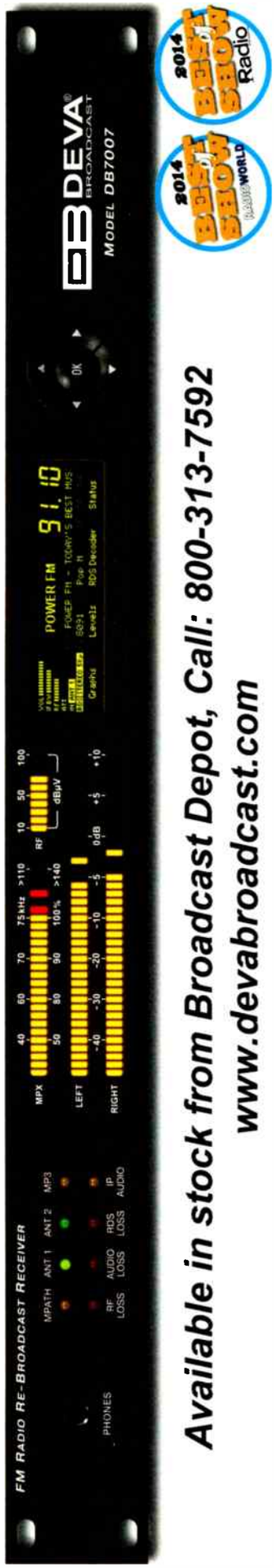
- AM directional switch controller
- FM antenna switch controller
- STL/T1 switcher
- Audio path switcher
- Automatic transmission line nitrogen pressurization controller
- Time of day control (i.e., "smart timer")
- Smart thermostat (environmental control) for a transmitter site
- Home sprinkler system controller

OK, that last application may be off-topic, but a PLC also does a great job as an irrigation system control!

This article is the first in a multi-part series about how to use PLCs in the broadcast industry. In part two of this series, we'll explore a how to build an application using a simple design and generic PLC programming. We'll then advance to intermediate-level applications. Employing a PLC to control functions at your site(s) can simplify your job and reduce stress. So, stay tuned to learn more.

Sloatman is the vice president of engineering and information technology for iHeartMedia Los Angeles.

FOOTNOTE: **ModBus (sometimes referred to as "ModBus RTU") is a serial communications protocol originally published by Modicon (now Schneider Electric) in 1979 for use with its PLCs. It's the de facto standard PLC communication protocol – openly published and royalty free. All PLCs can use ModBus for signaling external controllers, such as motor controllers.*



FCCUPDATE

Jump the Gun, Jump Into the Fire

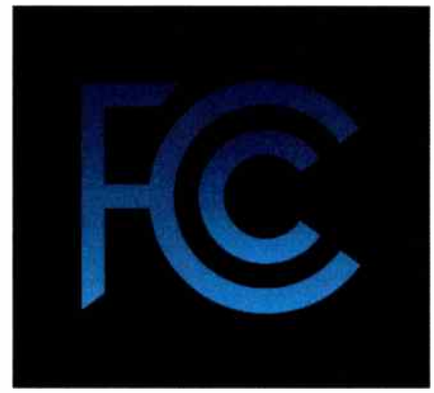
by Lee Petro

A recent decision by the Media Bureau of the Federal Communications Commission provides a good reminder of the commission's lack of tolerance for violations of the rules, even when the violator says "Mother May I?"

This reminder comes to us from upstate New York, where two commonly-owned entities sought to swap stations with a third licensee. The transactions would have been permissible, except for the intention of the parties to execute a time brokerage agreement to permit the parties to effectively commence operating as if the swap had occurred upon the submission of the assignment applications with the commission.

Executing a TBA simultaneously with an asset purchase agreement is a common practice and is usually noncontroversial. From a business perspective, the buyer has a goal to protect its interest in the station(s) to be acquired, and the seller still maintains ultimate control of the station(s), which the commission requires, and the seller can recommence the day-to-day operations, should the commission refuse to grant the assignment application or if the buyer doesn't show up at closing.

If the agreement contemplates that the broker will control 100 percent of the airtime of the station, though, the commission will attribute the ownership of the station to buyer upon the commencement of the agreement. And that is where the licensees in New York ran into problems. The broker/buyer already had an attributable interest in the maximum number of radio stations in the radio market, and the commencement of the TBA caused the broker/buyer to exceed the maximum number of stations under common control.



Recognizing this conundrum, the assignment applications filed with the commission contained a temporary waiver request, asking for authority to implement the combined control of the stations. The buyer noted that the commission had granted waivers in connection with other transactions, and that the need for the waiver will end when the commission grants the assignment applications and the parties consummate the transaction.

Throwing significant shade on the transaction, the commission denied the waiver request, and imposed a forfeiture of $20,000. The commission focused on the fact that, while the buyer filed a waiver request, the parties implemented the TBA without waiting for the commission

to actually consider the waiver request, and the parties did not provide any justification for why it was necessary to implement the TBA without waiting for word from the FCC that the waiver request would granted.

As such, the commission found that the parties violated the multiple ownership rules, and reminded FCC licensees that "business expedience is not synonymous with the public interest."

However, the commission did throw a lifeline to the parties. While the assignment applications were dismissed, it was done without prejudice, which means the parties could resubmit the applications and either wait for the commission to grant a waiver request for the TBA to be implemented during the processing of the applications, or the parties could just avoid the implementation of a TBA the second time around.

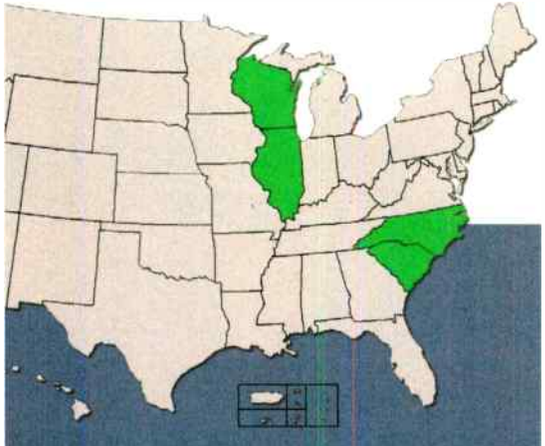
In any respect, the decision is a good reminder for anyone doing business with the commission to wait until it approves a request/application before moving forward.

BRIEF NOTE

Speaking of moving forward, the commission implemented a new electronic filing system for rulemaking proceedings on June 20.

For those of us who remember sitting at Sun microprocessor portals at the commission's reference room at 1919 M Street to pull comments from the Record Image Processing System, this new system reflects a significant step forward. The new system permits full-text searches within documents, and developers can create applications through APIs. Q

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



DATELINE

July 10, 2016 – Issues/Program lists must be placed in stations' public inspection files.

Aug. 1, 2016 – Stations in California, Illinois, North Carolina, South Carolina and Wisconsin must place their Annual EEO Public File Reports in the station's public inspection file.

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NO Hybrid required

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- BOTH balanced and unbalanced inputs and output for flexibility

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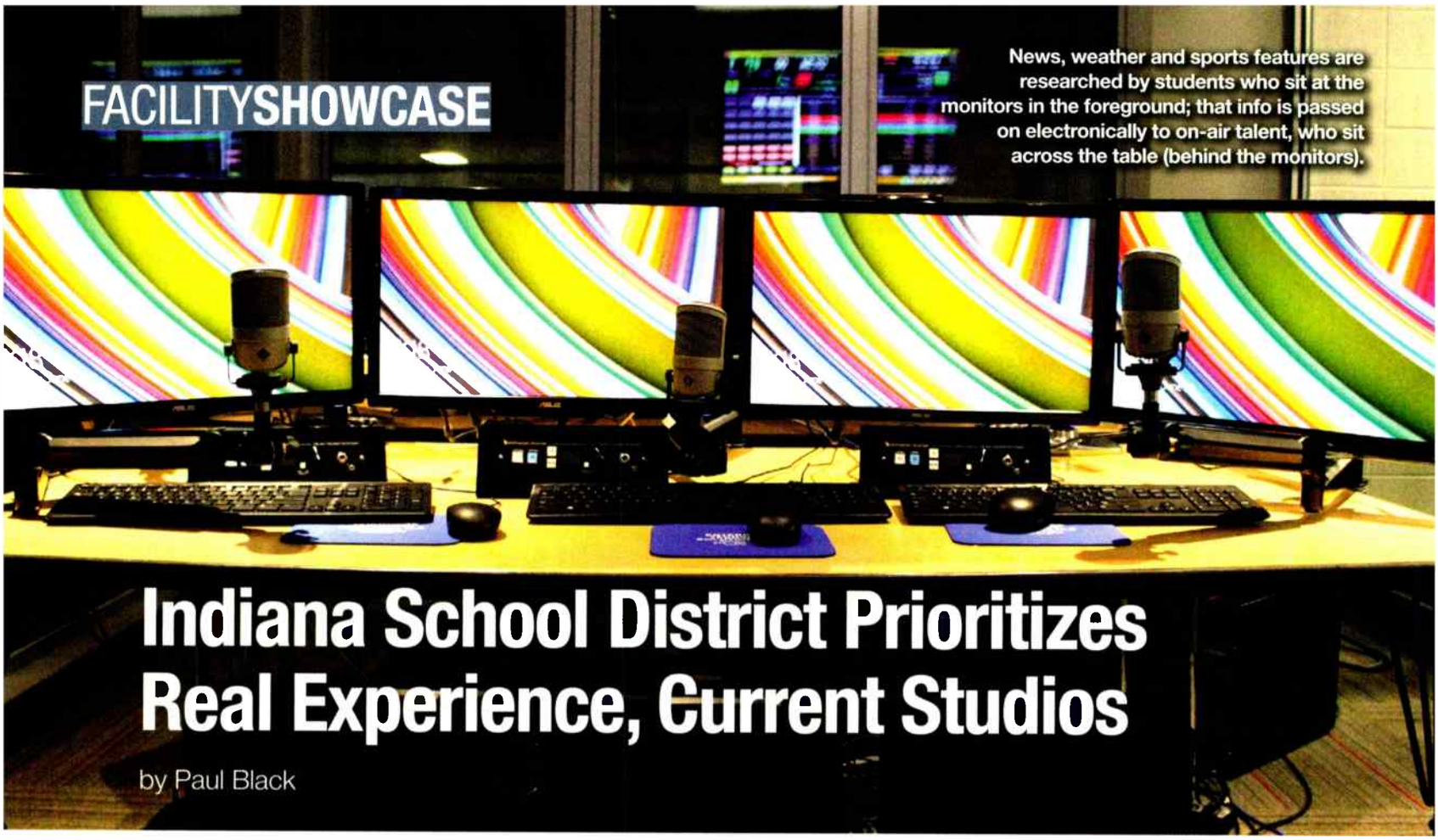
list price $1,099

*USB sound card supports USB HID compatible PCs



News, weather and sports features are researched by students who sit at the monitors in the foreground; that info is passed on electronically to on-air talent, who sit across the table (behind the monitors).

Indiana School District Prioritizes Real Experience, Current Studios

by Paul Black

Many educational institutions across the country have begun to realize that students need to be in an environment that will teach them what it's really like to work in an industry, preferably one with up-to-date equipment. Often, when schools do this, broadcast students who work in these facilities can find jobs in radio and television right out of high school.

In Jeffersonville, Ind., the Clark County School District operates three separate high school broadcast studios: One at Jeffersonville High School, another at Charlestown High School, and a third at New Washington High School. At Jeffersonville and Charlestown High Schools, television studios were also constructed to feed the local PEG channel.

The school district began its search for a frequency for both Jeffersonville and Charlestown early in 2014, in part because of the vision of Superintendent of Schools Dr. Andrew Melin, who has a broadcast background himself. Melin believes that successful high schools have successful media programs and has backed the plans with this in mind.

Thanks to an inter-local agreement with the city of Charlestown, a radio facility was built at the Charlestown High School in order to provide man power and equipment for a new on-air LPFM license owned by the city. Funding for the project was provided by local donations and use of a bond issued by the Greater Clark Building Corp. No referendum from the voters was required for this.

Tim Dench has been a teacher for over 42 years in both Kentucky and Indiana, and he also served as the project designer and manager for the equipment installation, in addition to teaching radio and TV production .

"WJHI, and WPMQ in Charlestown, represent an opportunity for our student to prepare for careers in the broadcast industry by working in a modern, state-of-the-art facility," said Dench. "They also have a chance to participate in providing important local information to the people of our communities. We're very pleased that our high school stations fulfill an important need in the Jeffersonville, Charlestown and New Washington area."

The Clark County School District Board of Trustees decided it wanted to train its students the best way it possibly could. Therefore, rather than go the traditional route of used audio consoles and playback equipment, older computers and software that had long been obsolete, the district decided to purchase new studio equipment from Wheatstone.

"Darrin Paley at Wheatstone was a tremendous help to us," said Dench. "He worked with us to provide drawings and specifications necessary for what we had in mind. By the time we had decided on everything, the system was basically designed, and all we had to do was facilitate the installation," said Dench. "We never really hit any serious difficulties in implementing the equipment. Everything went together beautifully."

EQUIPMENT AND PLANNING

Each of the facilities have identical on-air and production rooms supported by smaller edit rooms. Six Wheatstone LX-24-2416 consoles are used for the control surfaces, the only LX-24s owned by a U.S. high school station. In addition, Wheatstone IP 88-3E/3AD/3A BLADE servers, plus M4-IP mic processors round out the control room equipment.

All the Wheatstone elements commonly connect through Cisco 3560CX-12 Ethernet switches. Wheatstone's emphasis on IP equipment that's compatible with existing IP products made the

Cisco switch an easy choice for connectivity back to the common control area according to Dench.

Modern studio construction techniques were used extensively throughout the facility, including raised floors to facilitate wiring, separate HVAC systems for year-round operation of the studios, studs in the walls offset on six-inch centers with acoustical insulation between them, and triple-pane glass for studio soundproofing.

Custom-designed board op tables are also in the works. Several LED-lit tables are being built by students and staff, adding even more professionalism to the slick studios.

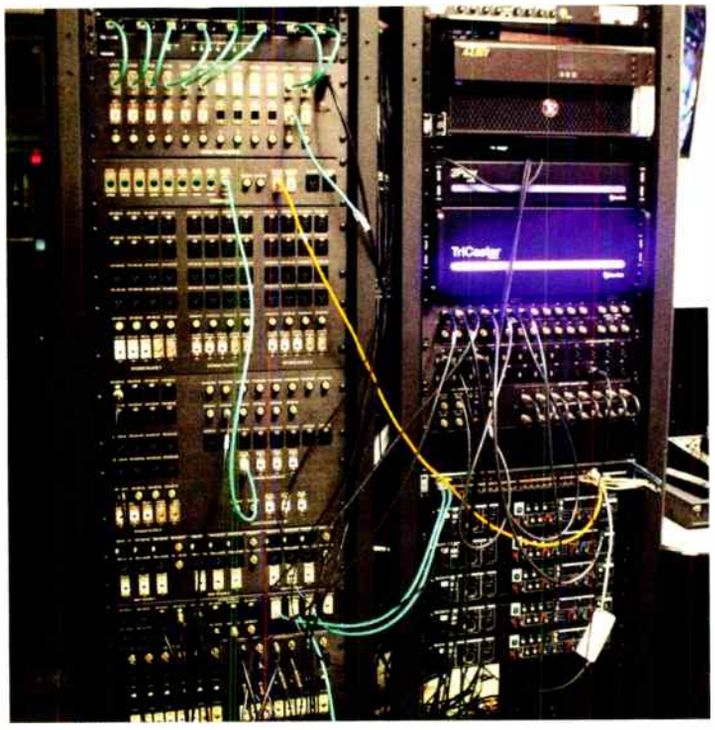
ON-AIR PROGRAMMING

The studios also provide audio to two full-time LPFM facilities. Under the call letters WJHI at 98.5 FM, which is licensed to the Clark County School District, the Jeffersonville High School facility provides news, information and coverage of local high school sporting events to the Jeffersonville community.

The other station, WPMQ(LPFM) at 99.3 is licensed to and owned by the city of Charlestown. The Charlestown High School facility normally feeds this station. However, the third Wheatstone facility, located at new Washington High School, allows students at that school to send their program audio to WPMQ also.

There are over 20,000 songs in the stations' music library. This allows students to design programs with just about any genre of music.

Enterprise Technical Solutions President Dave Dryer served as the integrator for the construction of the facility.



The wiring rack is the central nervous system of the entire facility. This rack includes KVM switches and Cisco switches for the AoIP network, as well as the TV production equipment and PEG channel server.

Each radio studio has identical racks. The racks were intentionally made to be shorter in order to maintain sightlines.

"WJHI is the most flexible, technically advanced and unique design/install for radio and TV studio that I've ever been involved with," said Dryer.

TOWERS AND ANTENNAS

Jason Bennett, owner of FM Expansion, LLC, was contracted for the erection of the towers and installed the transmitter equipment in rooms in existing buildings at Jeffersonville and Charlestown. The Jeffersonville

The WJHI transmitter rack

tower, for WJHI, was erected at the high school, and the Charlestown tower, for WPMQ, was built at the Clark County School District vehicle facility. Nautel VS 300 transmitters were chosen for each station. Audio processing is done by internal Orban card in the Nautel transmitter.

At Jeffersonville, a Shively 4-Bay half wave spaced Versa2Une antennas was used. The Charlestown transmitter site has the same antenna, but in a 2-Bay version.

The STLs for both stations are Barix 500 series units. EAS compliance is achieved through Digital Alert System DASLP-FMR low-power FM decoders with built-in receivers.

This screenshot shows the DJB radio automation system at work.

AUTOMATION

"Our automation system is DJB Radio. We chose them because they are industry veterans with a vast depth of experience and knowledge of broadcasting," said Dench. "They helped us design a state-of-the-art facility that allows for teaching, right through to the execution of on-air content. Their system allows for students to browse, play, edit and record audio, and build their shows from their very own desktop position, while keeping the on-air isolated for rock-solid reliability.

"This system allows me, as a teacher, to have every student involved in a radio production, all at one time. I have never had a radio system flexible and powerful enough to do this. Keeping students engaged is one of the keys to our success."

Dench went on to say that the DJB Radio system is very easy to learn and understand, even to students with no prior experience. The flexibility of the system has allowed the design to be the exact system the schools needed.

"The level of support through DJB Radio has been incredible," said Dench. "These guys know broadcasting. When I call them, they are available and always talk to us on the appropriate level. Some sales and tech support people talk over your head, or they don't really listen to you. Not with DJB Radio. They're always ready to help and have even offered some tips that I never would have thought of on my own."

The system integration between DJB and Wheatstone had never been done before. All consoles have starts and stops, tally lights, on-air signage and can control routing of audio. At a touch of a button, an operator can switch studios either for maintenance or simply for shows.

During the day, Studio #1 is typically used, since it is visible in the school area. At night, Studio #2 is used because it is visible from the gym/activities area of the school. This maximizes the station's exposure to potential supporters (it also functions as a kind of VIP skybox during games) and showcases the station to the community.

Mike Moore, the mayor of Jeffersonville, is one such avid supporter of the station.

"I'm excited to see Jeff High School's pursuit of a radio station. This makes me proud to be the mayor [supporting] a progressive educational opportunity our children will be undertaking," said Moore.

Thanks to the efforts of the Clark County School District, students can take advantage of an education in broadcasting second to none. It's expected that many students will continue on to college to study broadcasting and communications, while others may go straight into the industry.

"We wanted to make a statement with this radio and TV station," said Dench. "This program benefits not just the schools and the students, but the entire community."

This project shows how community groups and school districts, working together, can create opportunities not just for students to learn how to work in the broadcast industry, but also benefit those in the surrounding area simultaneously.

EQUIPMENT LIST

Equipment list for WJHI and WPMQ

Adobe Creative Software
Alienware computers
ASUS computer monitors
Blackmagic Design 4K Micro Studio Cameras with remote control
Boostr Digital Displays Remote Sports Desks
Bose Surround System
ClearCom IFB and Intercom system
Cisco 3560CX-12 Ethernet Switches
Cisco Phone System
Editors Keys Backlight Keyboards Adobe Edition
Ergotron monitor arms and brackets
Eventide BD600W Broadcast Delays
Inovonics 730 RDS Encoder
Inovonics 635 for Off Air Monitoring
Inovonics 402 RDS Sign Driver
Inovonics LED Sign
JK Audio Remote Mix 4 sports field mixers
Mackie HR 824 Audio Monitors
Mid Atlantic Racks
Neumann BCM 705 Microphones
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Samsung 75-inch LED HD TV/Monitor
Sennheiser HME 26-II sports headsets
Smith's Laminating Shop custom student work stations
Sony MDR 7506 Headphones
Sony PS-HX500 High Resolution USB Turntables
Stanton C402 CD Players
Tascam SS R200 Digital Player/Recorders
Tascam CDR 200 Digital Player / Recorders
Wheatstone LX-24-2416 Consoles
Wheatstone IP88 Series BLADE Servers
Wheatstone M4-IP 4-Channel Mike Processor
WheatstoneTS-4H Talent Turret
Whirlwind Custom Engraved Rack Plates and Patch Panels

Transmitter Sites

Barix 500 as STLs
Digital Alert System Model DASLPFMR
Nautel VS300 FM Transmitters with Internal Orban Card
Shively 4-Bay half-wave spaced Versa2Une antenna (at Jeffersonville High School)
Shively 2-Bay half-wave spaced Versa2Une antenna (at Charlestown)

Don't Just Fix It in the Mix: Audio Processing

by Doug Irwin, CPBE AMD DRB

When we talk about audio processing, normally, we refer to the final, on-air processors for AM or FM or HD Radio.

There are plenty of other processing needs around a radio station: The need to make studio microphones sound more consistent, mic to mic; the leveling-out of caller audio; keeping audio going back to a remote broadcast consistent; and last but not least, the "gain-riding" function for program audio outputs. While many staffers may think you can "fix it in the mix," it's more effective to avoid relying on that method.

Let's consider some different contexts that may require processing.

The dBx 286s is an economical option for general processing needs.

The Orban 6300 is a good choice, especially when protecting analog radio STLs.

AGC FOR STL TRANSMISSION

For FM stations, it's common to have the final audio processor and stereo generator at the transmitter site. The diminishing cost of high-speed IP connectivity coupled with multiplex transmission via IP is changing that, but that's topic for another time.

Many stations still use T1 shelves, or digital radios, or a combination thereof, to get their audio to the far end. The dynamic range of both types of systems is high enough so that AGC is not needed in many cases. In practice though, two effects are often encountered:

- Level inconsistencies in the program outputs
- Program audio levels that are too low for consistent PPM encoding

I find it aggravating that a majority of board ops (at least half of them) cannot effectively do something as simple as riding gain on a console. Though, with the wide dynamic range of a typical digital STL, this isn't as much of a real issue as it is an annoyance. The inconsistent PPM encoding is a serious issue; it's important to have consistent and high levels going into a PPM encoder. While the original PPM encoders didn't have a way of indicating that, the new generation does.

If you are using a channel that has limited dynamic range and emphasis, then consider using a processor with pre-emphasis peak limiting ahead of it. This is not as common as it once was; the most likely application would be a monaural, analog STL radio.

The **Aphex 320D Compellor** is probably the most well-known, general purpose AGC and limiter found around radio stations. It's a wideband device, well-suited for "gain-riding." The 320D's limiter acts on peaks that shoot beyond average program levels making them easy to handle for any analog or digital recording

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system, or (non-emphasized) transmission channel, such as that provided by a typical T1 codec, IP codec or digital radio STL.

The **Inovonics 261 Utility Processor** is an all-inclusive system for general audio normalization and level management. It combines the functions of gated, gain-riding AGC, dynamic range compression and independent broadband and high-frequency program peak limiting. The 261 features AES-digital and L/R analog inputs; digital and analog outputs are available simultaneously. Digital input sample rates are detected automatically, while multiple output sample rates can be easily selected from the front panel.

The **Orban 6300** includes analog and dual AES3 digital inputs and outputs; the digital input and digital outputs have sample-rate converters that can operate at 32 kHz, 44.1 kHz, 48, 88.2, and 96 kHz. The pre-emphasis characteristic and output levels are separately adjustable for the analog and digital outputs. The 6300's outputs can be independently configured to be the output of the AGC or the output of the multiband compressor/limiter, all configurable to use or bypass look-ahead limiting. This makes the 6300 well-suited for driving an STL.

The practically-ubiquitous Compellor has proven itself over the years as a classic.

AGC FOR TALKBACK AND MIX-MINUS APPLICATIONS

For more than 20 years, we've had the capacity for talkback from the studio to a remote broadcast location because of the duplex nature of ISDN, and now because of IP.

As someone who has done more than his fair share of remotes, I can tell you that inconsistent levels in talkback are annoying at best. It's bothersome to continually have to raise and lower PA levels because of lack of level management at the far end. (This is an unfortunate symptom of the board op problem I already mentioned.)

For talkback purposes, a fast-acting AGC and limiter combination is good, especially if the talkback audio interrupts a program feed. For the mix-minus feed to a remote, a fast-attack, slow-release style of AGC is effective. This AGC would, of course, be placed ahead of the transmission path back to the remote site.

I mentioned it earlier, but the **Aphex Compellor** is a common choice to fulfill the gain-riding needs of talkback and mix-minus functions.

The Rane DC22s is a general purpose leveler to fill a number of needs around a radio station.

CALLER AUDIO

While it is true that the most-up-to-date telephone systems for caller audio include audio processing, let's face it — you may not have one. Perhaps you are a generation or two back. If so, you may want to consider some audio processing in line with the receive direction, as well as the send direction.

When 2G cellular communications came in to being, and PCS phones were introduced,

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In addition to AGC the 261 has emphasis limiting, making it a good choice for protecting radio STLs.

caller audio took a major step backwards. There is no comparison between today's cellphones and the old analog cellphones or landlines; however, since nearly everyone calls the station today via their 3G mobile phone, we're left with a problem to solve.

What can be done to help make caller audio better? Processing with some (or, hopefully, all) of the following features can help:

- **Fast attack and release AGC followed by hard limiting.** You'd be amazed at how much you can hammer caller audio.
- **Multiband EQ.** It's true that most of the caller audio will be in one or two bands at the most for an EQ. Use a parametric EQ following the hard ACG/limiting I described above.
- **Gating and downward expansion.** Background noise from the caller can be diminished with downward expansion. With older hybrids you may also find that having downward expansion helps out with feedback reduction in the typical "speaker-phone" mode where your jock uses an open mic, and the caller audio comes through a cue speaker.

compressor/downward expander system (the channels can be slaved) with balanced inputs/outputs via XLR or T-R-S connectors.

MICROPHONE PROCESSING

I'm an advocate of mic processing used in moderation. The reality is that most jocks want to maintain a certain sound in their headphones, and many will feel uncomfortable if they don't hear it.

My experience is that for a jock to sound good on-air (meaning on a radio) nothing is more important than the right microphone; however, in many, many cases, jocks can't listen over the air and end up hearing just the local mic and mic processor combination. So if you want to keep them happy, this is something you should try to accommodate.

The Jupiter series includes all the functions needed for mic processing, and includes an intuitive UI for configuration.

For the send-to-caller audio, you'll likely find that downward expansion also helps. This will be a needed feature in a mic processor, which we'll discuss below.

The **dBx 286s** is an economical choice for processing caller audio. It's designed to be a mic processor, but 1/4-inch TRS Line Input can accept balanced/unbalanced signals from your telephone hybrid. You can use insert jack to interface between the preamp inputs (mic or line) and the signal processing sections to "loop out" to external processors (such as EQ). Separate threshold and ratio controls on the Expander/Gate are useful for mitigation of noise in the open speakerphone mode.

The **Rane DC22S** comes to mind as well for this particular application; its two-channel compressor/downward expander system (the channels can be slaved) with balanced inputs/outputs via XLR or T-R-S connectors.

At minimum, mic processing features should include:

- Variable gain input stage
- AGC
- Parametric EQ
- Downward expansion
- Variable gain output stage

The VOCO 8 is an 8-channel mic processor in a 2 rack unit package, with Livewire and AES67 compatibility.

A common mistake is that too much low-frequency EQ is used to satisfy many jocks. This gets back to the issue of what they sound like in their own headphones versus what they sound like over the radio.

When tweaking up mic processing, I like to find whatever pleasing characteristic I can in a jock's voice and emphasize it with parametric EQ. Set AGCs so that there is some "action" during speech. Remember that you can get away with a high compression ratio on voice.

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The higher you go, though, the more you'll need to use make-up gain on the output.

Downward expansion can be very helpful, if you happen to have multiple people in a room that sounds lively, or if the mics are physically close together so that they essentially bleed over between one another. Set your downward expansion threshold so that when jock B is talking, jock A's mic has been turned down by the downward expansion feature.

From an operational standpoint, I find it very distracting for the talent if I have to go in to a studio to adjust mic processing either while they are doing a shift, or even if we have an appointment.

This is 2016. Mic processors have remote access. In fact, this feature makes it much easier for both parties. I would only remind you that, from wherever you adjust the mic processing remotely, make sure you can hear the feed prior to any delay. Trying to make tweaks, and then waiting to hear them after the delay period just doesn't work too well.

The **Omnia Voco 8** contains eight microphone preamplifiers, each switchable to line-level analog, four stereo AES/ EBU inputs (eight mono), Livewire+/AES67 AoIP inputs along with Line level analog, AES/ EBU, and Livewire+/ AES67 AoIP outputs. Its processing features include de-essing, a three-band noise gate, a four-band EQ, three-band AGC, and peak limiting. It also comes pre-loaded with factory presets designed for male or female voices. Set up and configuration can be done via its Ethernet port (the Omnia Remote Gateway software works with Microsoft Windows XP SP3, Windows 7 (32 and 64 bit), Server 2008 R2, and Debian Linux), or alternatively, via the front panel, which includes a combination rotary encoder, navigation joystick, and pushbutton control.

The M4IP has all the mic processing features mentioned and, while meant to be part of a Wheatnet IP system, can also operate independently.

The **PreSonus RC 500** is a single channel, with solid-state mic preamplifier with three-band semi-parametric equalizer (with switching relays for hard bypass), with a front-panel 1/4-inch instrument and rear-panel XLR microphone and line inputs with Input Select switch. It also features a VU meter with selectable output level/gain reduction display; an analog insert with balanced send and return, and balanced output on XLR and 1/4-inch TRS connectors.

Symetrix is another well-known manufacturer of processors. The Jupiter series comes in three different input/output options: **Jupiter 4** (four in, four out), **Jupiter 8** (eight in, eight out) and **Jupiter 12** (12 in, four out). Inputs and outputs are analog, using 3.81 mm terminal blocks. Nominal output level is +4 dBu with 20 dB of headroom. Configuration is done via an embedded webserver; processing features include variable input and output gain; de-essing; multi-band EQ; downward expansion, compression, and peak limiting.

The **Wheatstone M4IP-USB** is a four-channel DSP-based BLADE-3 voice processor with four completely independent channels of voice processing in an IP-networked rack unit. The unit combines four microphone preamps, four channels of embedded microphone processing (with a four-section equalizer with high and low shelving EQ and two bands of fully parametric EQ, high and low pass filters, and de-esser and expander functions). Also included are four stereo AES digital outputs. It can be used in a WheatNet-IP network, or independently. The M4IP-USB is also AES67 compatible. The preamps and processors are accessed and controlled from any point on the LAN via its Windows-based GUI.

HEADPHONE PROCESSING

A dozen years ago we often didn't use profanity delays (at least on music stations), and HD Radio hadn't shown up on many radio stations. Jocks typically listened off-air and heard exactly what everyone else was hearing.

Today, we have delays set up in a serial fashion: Profanity delays are followed by STLs that might contribute some delay, followed by the HD delay.

The bottom line is that listening over-the-air is not nearly as common as it once was.

Perhaps the most negative effect of this is jocks can no longer accurately hear how their mix sounds to listeners. Music beds can be too low or too high, drowning out other sources, or one song fades out and gets buried by the intro of another.

I know I railed on poor board-operating earlier, but the reality is that these jocks can't hear what they're doing. What would be very helpful would be a headphone processor that emulates the over-the-air processing to the degree that a mix could be heard by the person running the board, allowing them to properly mix sources so that listeners can hear everything clearly.

The RC500 is a single-channel strip, meant to provide a vintage feel, but with a modern design inside.

The rear apron of the RC500 indicates its straight forward simplicity.

I have made attempts with various late model audio processors (all DSP-based) that I'm told have delays too short to be noticed by those talking through them. In practice, I have not found this to be true. We've resorted to older generation digital processors (20+ years old) and older analog FM processors to end their useful lives as headphone processors.

I'd like to hear from engineers in the field who have conquered the headphone processor problem with a newer DSP-based device. Email *radio@radiomagonline.com* with your ideas. We'll feature the solutions in an upcoming article.

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Lowering the Bar for Community Radio

by the Wandering Engineer

The thing about pirates is that they love radio. They literally will pay to do it.

We all know the official line. Pirates interfere with real broadcasters and maybe other services. Back when the Federal Communications Commission had field offices, they put some effort into shutting down pirates. It's a scene out of a B&W Prohibition-era mobster movie… the Feds come in and shut down the speakeasy while the patrons scatter and the movie goers cheer on the bootleggers.

Commissioner Michael O'Rielly wrote: "[Pirates] are not cute; they are not filling a niche; they are not innovation test beds; and they are not training grounds for future broadcasters. If broadcasting were a garden, pirate radio would be poisonous crabgrass." He was neither right or wrong; but expressing a value judgement.

When he penned,"In practice, pirate radio causes unacceptable economic harm to legitimate and licensed American broadcasters by stealing listeners," he voiced broadcasters' fear. Pirate radio is often more fetching than commercial radio. Of course, internet radio and satellite radio steal listeners too, but that's deemed acceptable economic harm.

Then there is interference. The broadcast bands are buttressed on the principal of "acceptable interference." Obviously, pirates look for "open" slots on the dial. There's not much point in broadcasting on an "occupied" frequency. In the next round of rule relaxation, those are the slots that probably will get the next wave of commercial station permits.

If punishing and eliminating radio pirates were just about preventing interference, we'd want purveyors of cheap LED lights (and other RFI devices that have wiped out far more RF spectrum than any buccaneer has) to do hard FCC time.

Getting a license is an arduous task. You could compete with the equity firms to buy one. You could hire engineering and legal service and attempt to squeeze in a slot. Or you could become an engineer and a lawyer and DIY; in any case, it takes a pile of money, time and patience.

Some pirates would become community broadcasters, if they could.

Operating a station is no small task either. The rules require a minimum number of hours, staffing, type accepted EAS gear, etc.

Here's other thing: Some pirates would become community broadcasters, if they could.

One brush with a pirate station sticks with me. For some time, I'd been listening to a very rural station on and off. The big stations that served the area had all moved into the city, leaving only the unwanted backsides of their "rim shot" receivable. Truthfully, I didn't know the station was illegal. Eventually, an FCC inspector shut them down, but he also hooked them up with an engineer and a lawyer, and after a year or so off the air, they were back with more power and call letters of their own. The volunteer staff, the community announcements, the quirky playlists and patter are compelling.

We talk about the value of community radio, but we have made it virtually illegal. There are any number of high schools, churches, bunches of folks with a studio in the attic that would be on the air for a few hours here and there.

We say that "all broadcasting is local," yet most stations today are jukebox servers or syndicated content, with some local ads and sometimes a liner sounds like it could be local.

I love radio. When I travel, I scan for the locals. Like peculiar regional restaurants, they each are an experience, if not a gem. They're not easy to find, but well worth the effort. I'd like to think that radio is more than corporate cash flow.

I'd like to see the de facto prohibition on those who would broadcast locally lifted at a level somewhere above Mister Microphone and below the fortunate with a license and the critical mass to make the required full use of that spectrum.

It's not entirely magical thinking. Check out *http://recnet.com/lpam*, where you'll see some proposals.

The concept is to lower the technical barrier for a community low-power AM station to simple, ultra-conservative criteria on the expanded AM band and specify an easy to build, safe, transmission system. The regulatory part is a simple application. The operating requirements are to the point where a school or church or group of volunteers can put on a station that covers a small town or large neighborhood.

I posit that three things would transpire. First, the "white hat" pirates go to LPAM. Second, AM is revitalized, as there is once again attractive content to find there. And finally, commercial radio would get better as competition in the free world seems to inspire.

There is absolutely no reason LPAM won't work. The obstacle to adoption originates from broadcasters, and it isn't our better angels at work. Rather, it's commerical broadcasters' fear that an AM station with a 30-foot antenna and power levels that can barely shock you will take a big notch out of our revenue. And that would be the ultimate embarrassment to our industry, if it did so.

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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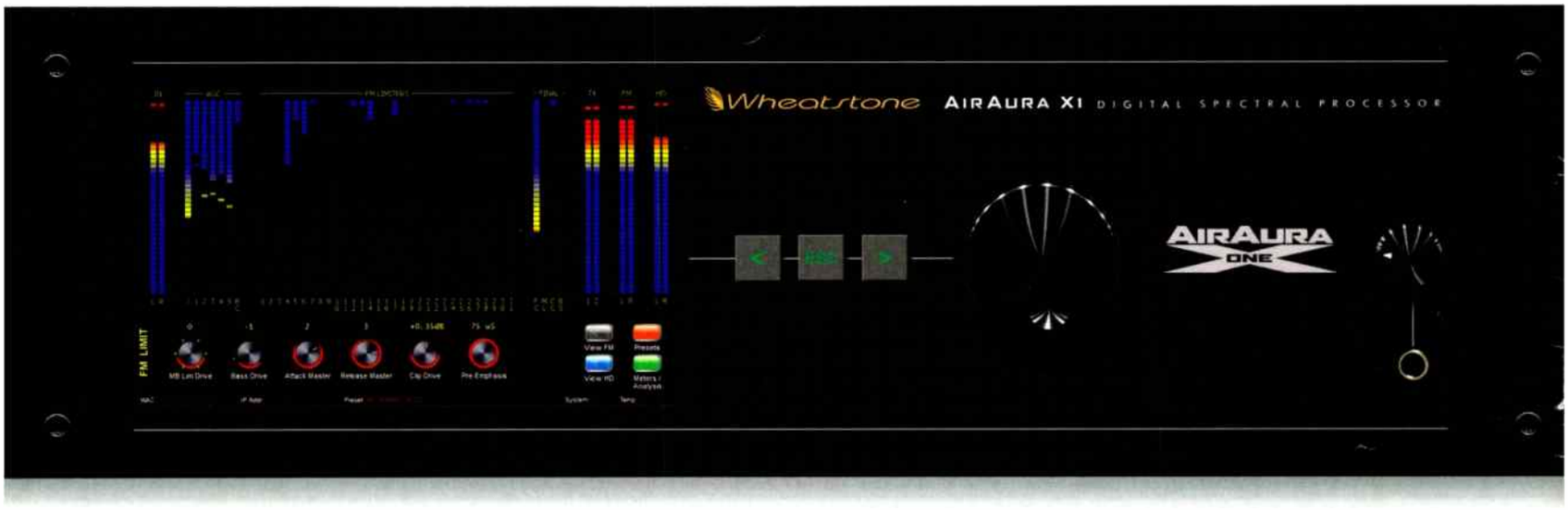

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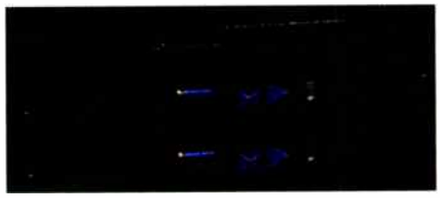
Cruising Main Street

Beasley's new WheatNet-IP remote studio near historic Las Vegas' Fremont Street is a modern throwback to the days when listeners and artists could walk into any radio station on Main Street with a request or a record album.

"It's sort of like being back in high school again when everyone cruised (downtown) Fremont street with their radios turned up," says Tom Humm, who was raised in the area and is now the Vice President and Market Manager for Beasley Media Group, Las Vegas.



Above: The two BLADE-3s and the VMI that power the virtual console pictured in the top photo (created with Screen Builder)

Below: Lamar Smith, Beasley Las Vegas Regional Engineering Manager, and Mike Cooney, VP of Engineering and CTO of Beasley Broadcast Group, standing outside the studio.

The new Beasley Media/ Cox Business Broadcasting Studio built for Beasley Media Group's five Las Vegas stations sits adjacent to a busy amphitheater in Downtown Container Park, the area's newest shopping and entertainment center constructed of cargo containers stacked on top of each other. With the help of a fiber optic communications link sponsored by Cox Business and our WheatNet-IP audio networking, the group can seamlessly link its new remote studio to its main studio on Durango Drive some 15 miles away.

For the entire story... INN24.wheatstone.com

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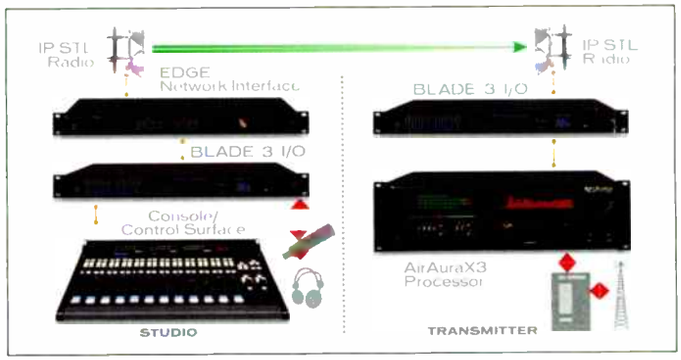
1. Reduced latency. This is the time delay through the processor, end-to-end. An unfortunate aspect of digital systems is that such delays are endemic and cumulative, so any opportunity to reduce them must be seized. It is particularly crucial where presenters are involved: any significant delay can be seriously disturbing to them, and even short delays can produce comb-filter coloration when the talent's own voice, heard via bone-conduction, mixes with the headphone audio. This colors their perception of what they sound like. Mess with an artist's self-perception at your peril. In short, running at a super-rate halves the conversion times - the major source of latency in a processor - shaving a big chunk off the delay.

For the other two reasons... INN24.wheatstone.com



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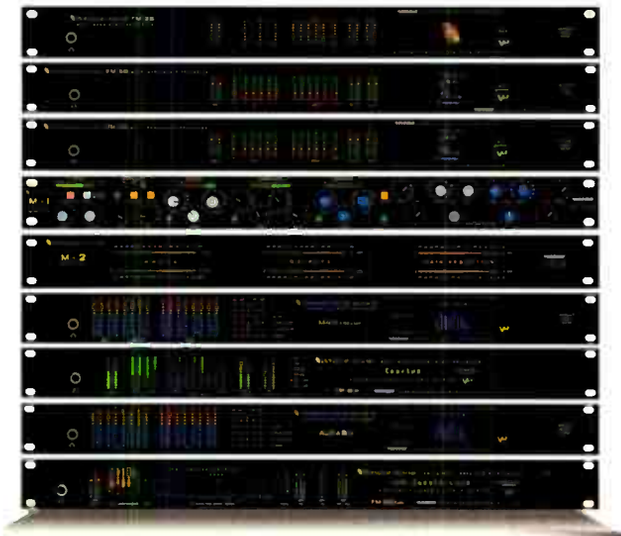

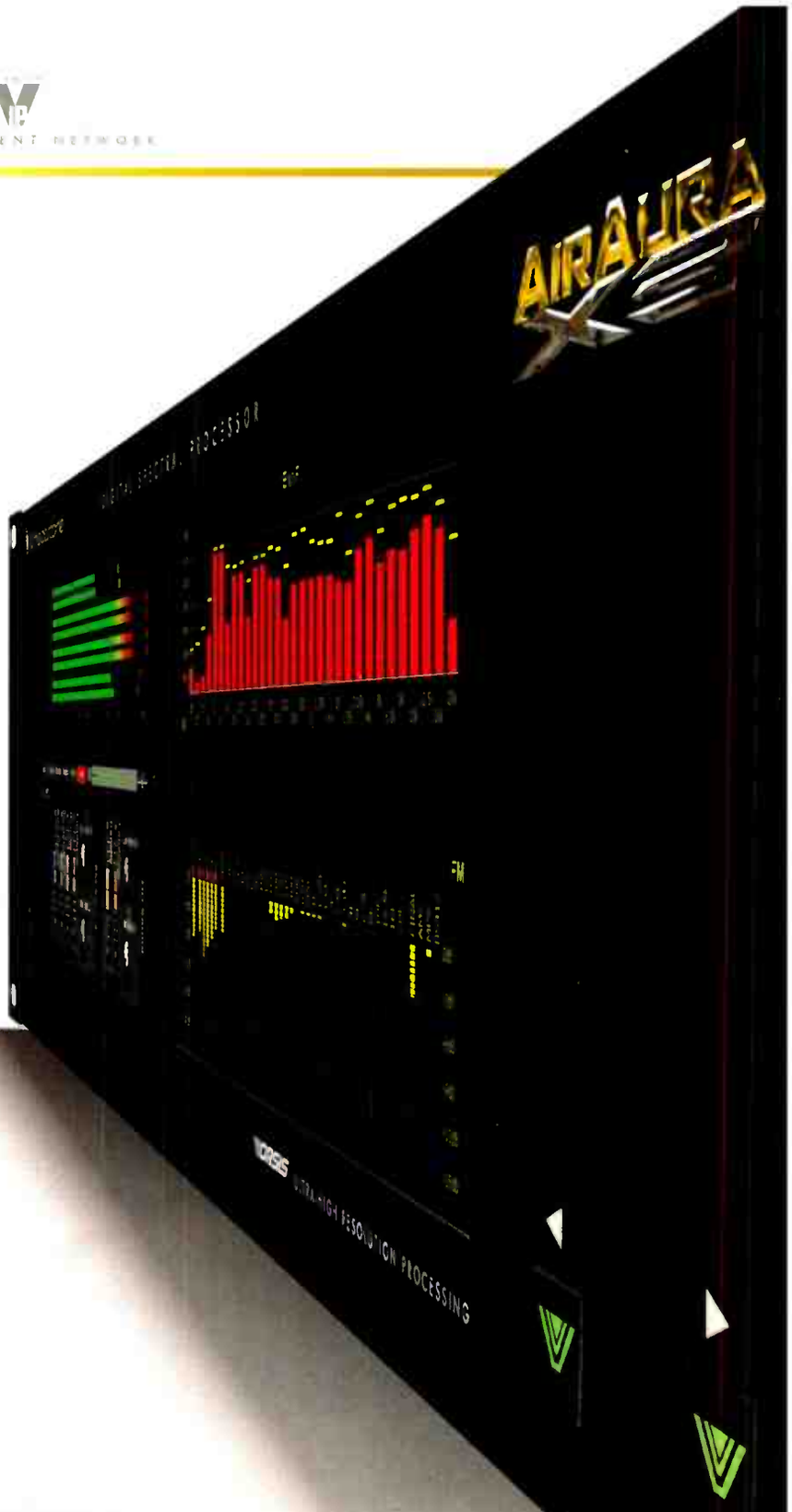

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OWWR Station Manager Joe Manfredi shows off Studio A.

COLUMNS

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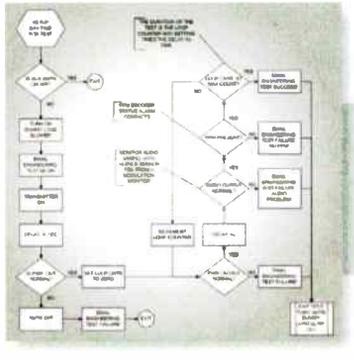

DEPARTMENTS

On the cover: OWWR's Studio C features an Arrakis Arc-10U, three ElectroVoice RE-30s, JK Audio Innkeeper 2 Digital Hybrid, two Tascam CD-01Us, Behringer U-Control UCA202, Behringer Truth B2030A studio monitor and a Behringer Powerplay Pro-8 HA8000 headphone amplifier.

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VIEWPOINT

Summer Is a Good Time To Plan for the Unexpected

"Proper prior planning prevents perplexing problems." I learned that axiom from one of my middle school math teachers; I wonder if he ever worked in our field. That phrase has stuck with me. If you want to succeed in this line of work, the key is preparation; and in this edition of Radio, we're presenting a couple of articles that will teach you how to plan and to prepare for those times that you are away, or otherwise occupied with other projects.

July is vacation season. I'm looking forward to some hard-earned down time. I work in a department; I know many engineers don't. When I'm away, someone else picks up the slack. If you're a "one-man (or -woman) band," leaving town can be a hard thing to do. After all, who will cover your station(s) in an emergency? If you invest the time in some of the techniques we're explaining this month, then I can tell you, from my own experience, that it's much more likely that you can spend time away without being bothered continually by phone calls.

Recently, we offered up a survey that many readers filled out online — I thank all of you who did. Probably the biggest take-away I got from the results is that there are many beginners out there who read Radio, some of whom left comments for us.

Let me give you a couple of examples: "How about a series of articles for beginners to teach them about various subjects?" and "Love to read more beginner articles on AM directional arrays and how to care for them...." Radio is the magazine for radio engineers who are really into the effective use of technology, but we appreciate those of you just getting into the business, as well.

We will be featuring articles in the coming months for beginners in our field. Watch out for those. In particular, we'll be addressing more AM radio topics, such as directional antennas. Please visit *radiomagonline.com*; we're starting up some new online features geared toward beginners.

Even before our survey, though, I received a comment from a reader to the effect that our Facility Showcase series almost invariably covered a shiny, new major-market facility. As I have frequently written, there's no monopoly on good ideas; smaller facilities often have many great features that we want to tell people about. Perhaps more importantly, we need to expand the category to include different types of broadcasters, since that category is no longer limited to the over-the-air media. This month, our facility showcase covers Old Westbury Web Radio, a facility in upstate New York.

Jeremy Ruck is back with a very informative article on the Longley-Rice propagation model and how it applies to our work. Lee Petro discusses EAS rules updates this month. Both of these articles are important for radio engineers—veterans and beginners alike.

Dennis Sloatman is an industry veteran, known to many of you, and a top-tier expert in the field of site automation. We've got what, I hope, is a thought-provoking article about techniques in automated testing at remote transmitter sites. This follows a theme that we're trying to spread among our readers: How to be in two places at once.

The Wandering Engineer has his own opinions on where the industry is headed when it comes to transmitter maintenance. "Take whatever they say with a grain of salt" are his words to live by. Check out his column, and you'll see what I mean.

The reader survey is over, but you can always send us comments by way of *radio@radiomagonline.com*.

Thanks for picking up Radio again this month. I know you'll enjoy it.

Doug Irwin, CPBE AMD DRB | Technical Editor

Radio
THE RADIO TECHNOLOGY LEADER

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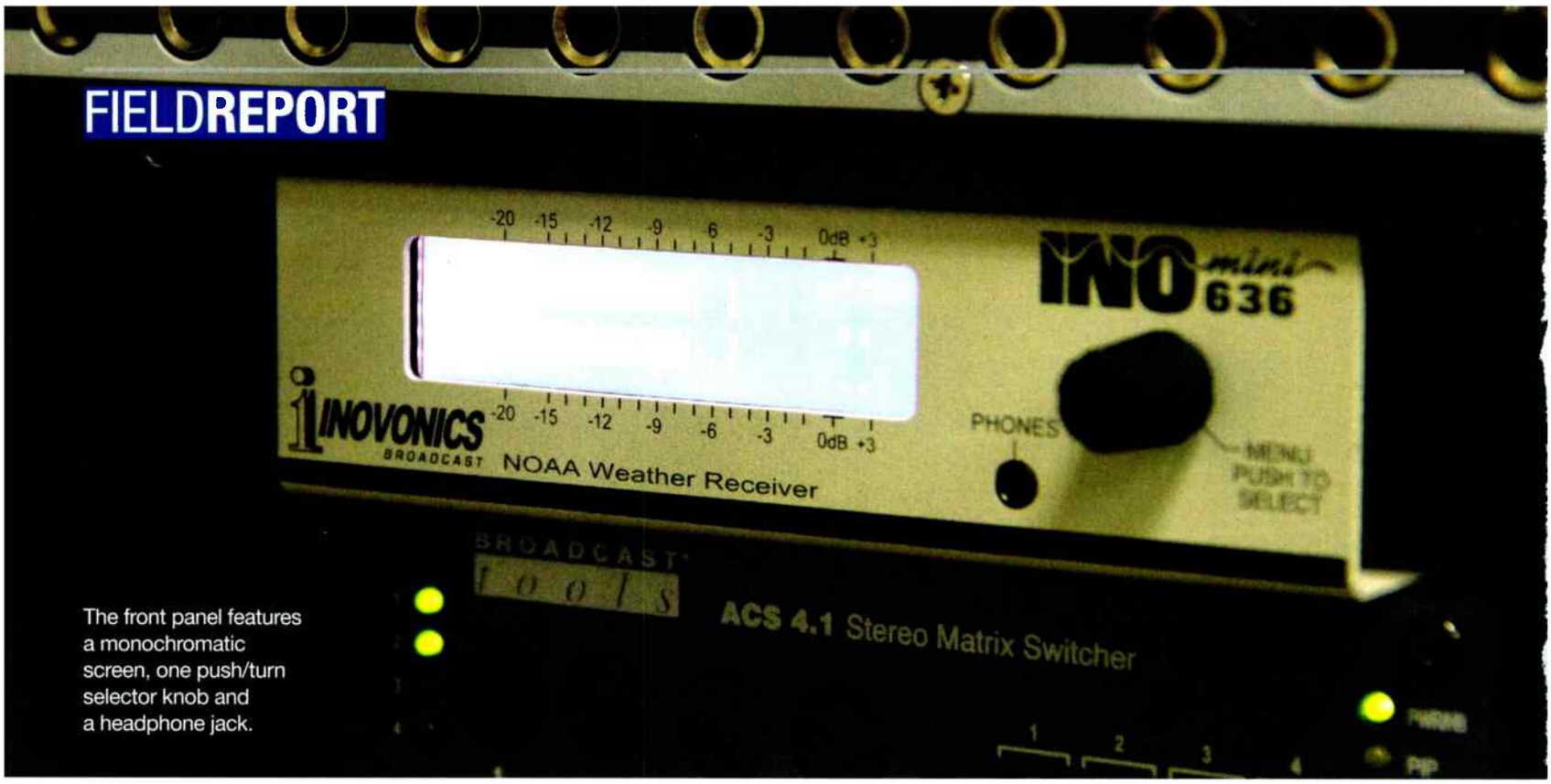

The front panel features a monochromatic screen, one push/turn selector knob and a headphone jack.

Inovonics INOmini 636 NOAA Weather Radio

by Chris Wygal

Generally speaking, a radio broadcast engineer is responsible for multiple moving parts around the facility. And as radio continues to evolve, we find ourselves more responsible for items such as network reliability, and less responsible for demagnetizing reel heads.

MORE INFO

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One thing, however, has always been a critical part of the broadcast operation: The emergency alert system. With that in mind, the EAS encoder/decoder must be able to reliably and intelligibly receive emergency alerts when dangerous conditions arise outside. The INOmini 636 NOAA Weather Radio from Inovonics provides certainty that radio listeners will stay informed and safe.

HERE COMES THE STORM

When the wind kicks up and dark clouds roll in, EAS alerts are expected. Proper National Weather Service repeater monitoring not only has compliance implications, but it is also a matter of thoughtful service to the listening audience.

A NOAA weather receiver that introduces considerable noise floor problems and poor reception and output levels is at risk of creating unintelligible alerts that could be exacerbated by downstream monitoring stations. An LP-1, for example, is a critical link in the EAS process and originating clean EAS alerts is extremely important.

The breakdown of this process was exemplified during the national EAS (EAN) test conducted in November 2011. Many stations reported having retransmitted garbled, imperceptible audio. Many of the messages had degraded to the point that header and EOM information could not be decoded. The INOmini 636 is built with "automatic intelligibility enhancement" that greatly improves weather station audio and ensures that no extra noise is added to the signal chain.

THE FRONT PANEL

The INOmini 636 front panel is loaded with an easy-to-read monochromatic screen and one push/turn selector knob. The screen displays alarms, menus and all functions and settings. The INOmini 636 will tune to the seven U.S. and Canadian weather radio frequencies. The tuned frequency, as well as carrier strength, audio loss alarm, audio levels, signal-to-noise

ratio and "weather alarm" are conveniently displayed. The carrier strength display and SNR display allow for proper optimization of reception and antenna placement. The front panel also includes a 3.5 mm headphone jack for convenient monitoring.

The EAS encoder/decoder must be able to reliably and intelligibly receive emergency alerts when dangerous conditions arise outside.

THE BACK PANEL

The chassis for the INOmini 636 takes up one-third of one rack space, allowing for several units to be rack-mounted efficiently. There are two parallel 12-volt power connectors that allow for "daisy-chaining" up to three units using one power supply. An F-connector accommodates a 75-ohm antenna line. Analog and digital AES outputs are available on XLR connectors. Interestingly, even though the weather radio material is monaural, analog output is available on left and right XLR connectors. This eliminates the need to split or bridge a single output. The digital AES output has a 44.1 kHz fixed sampling rate. The INOmini 636 has three alarm relays that will close in the event of carrier loss, audio loss and during the 1050 Hz alert tone. This is a perfect solution for using the INOmini 636 to trigger other alerting devices during weather events.

STUDIO TEST

Using critical-listening monitors, the INOmini 636 performs excellently. The attention to audio quality and reception is immediately noticeable. "Perfect Paul" sounds clean and well processed. The noise floor is virtually unnoticeable and the overall sound of the weather station is full.

Improving the limited audio bandwidth made available on weather stations is not feasible. Improving noise floor, however, and providing the tools to diagnose reception and tuning guarantee that no impurities are added to the weather station audio.

For stations that want to provide a quality weather alerting service to their audience, the Inovonics INOmini 636 is a must.

Wygal is the programmer and engineer for Victory FM at Liberty University, Lynchburg, Va.

This Is Not a Test — EAS Rules Updated (and Enforced)

by Lee Petro

In November 2011, the Federal Emergency Management Agency initiated the first nationwide test of the Emergency Alert System. A subsequent report of the test results demonstrated that, while the system was fundamentally sound, there were some necessary corrections in order to maximize the distribution of the alert while minimizing public confusion.

In June of this year, the FCC adopted rules it believes will minimize future confusion relating to nationwide tests, and established a timeline for implementing the new rules. The FCC believes that the changes can be implemented through software updates to existing EAS equipment.

The most significant change is the adoption of a nationwide location code. EAS alerts include a header code, which includes information on the type and location of an emergency. When the 2011 nationwide test was conducted, the notification included the location code for Washington, D.C. That made sense, as the message was originating from the president. On the other hand, in areas outside the Beltway, some EAS equipment rejected the emergency notification since the emergency was deemed to be occurring outside of the participant's location.

In light of this electronic NIMBYism, the FCC created a new location code for nationwide alerts: 000000. Based on submitted comments, the FCC determined that the adoption of the "six zeroes" will be a relatively inexpensive solution, with the National Cable & Telecommunications Association estimating that the nationwide code could be implemented by the entire cable industry for $1.1 million. The FCC estimated similar costs for broadcasters.

While the necessary changes to the EAS equipment are relatively simple and can be implemented through software or firmware updates, parties sought to delay the implementation deadline for the new requirement for a period of 12 months. For example, AT&T argued that it will need to engage in substantial testing of the equipment to ensure that it does not fail during future nationwide tests. As such, the FCC doubled its original six-month implementation period and will require EAS participants to come into compliance within 12 months after the new rules become effective.

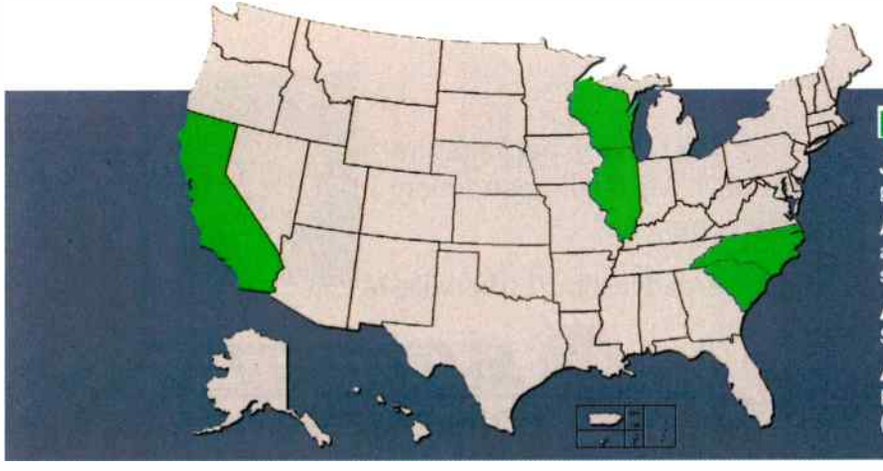
The FCC's other significant action involves the development of a reporting system for nationwide EAS tests. The EAS Test Reporting System incorporates the temporary reporting system used during the November 2011 test, along with the updated filing information required under the new rules. In particular, ETRS will pull information regarding the reporting party from other databases where possible.

The new system will also permit batch filing, so that larger EAS participants can submit one report that would cover multiple facilities. Finally, while not tremendously innovative, the new system will permit the participants to review their filings before submission and to receive confirmation of their submissions.

The initial reporting requirements will not go into effect until six months after the effective date of the new rules, or the launch of the new system, whichever is later. Subsequently, EAS participants must submit their "day of test" reports within 24 hours after any nationwide test, and the remaining portion of their report within 45 days after the test.

Update: In my December 2014 article, I noted that a Nashville radio station accidently triggered a cascading false EAS notification on AT&T's U-Verse systems. The alert was caused by the airing of the November 2011 nationwide alert, which was picked up by other EAS participants. In May, the FCC reached a settlement with iHeartMedia whereby iHeart is required to pay $1 million for the violation. Overall, the FCC has imposed forfeitures of more than $2.5 million in the past year for improper use of EAS tones.

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



DATELINE

July 10, 2015 — Issues/Program lists must be placed in stations' public inspection files.

Aug. 1, 2015 — Stations in California, Illinois, North Carolina, South Carolina and Wisconsin must place their Annual EEO Public File Reports in the station's public inspection file.

Aug. 1, 2015 — Noncommercial stations in California, North Carolina and South Carolina must file Biennial Ownership Reports with the FCC.

Aug. 1, 2015 —Radio stations with 11 or more full-time employees in North Carolina and South Carolina must file a Broadcast Mid-Term Report (FCC Form 397) with the FCC.

Use Technology to Discover Problems Without a Site Visit

by Doug Irwin, CPBE AMD DRB

Back in the "good old days," we would rely on jocks or board ops to let us know the radio station that was our common employer was off the air or otherwise had some sort of problem.

That was then—this is 2015. Today, it's likely there are many hours of the day, and days of the week, that there is "no one home" at the studio locale of the station you for which you work. Even if a listener were to call, there's no one there to answer the phone, right?

Clearly, you need your own way of knowing that your stations are on the air, or not. Having a device that calls you on the phone is nothing new; it's just that today, there are more and better ways of being made aware that something is wrong.

ROUND 1: TRANSMITTER SITE CALL-OUT

Having the remote control call-out from the transmitter site was a great feature because, inevitably, it was nearly always faster than a jock or board op. Of course, if you wanted to have alarm calls for something other than transmitter or power readings, you had to add your own outboard devices, like silence sensors.

There are two problems with relying on this methodology by itself.

First, by trusting a single telephone line that doesn't get used often, you risk this happening: The station went off the air, and you never received a call because, for some reason, the phone line was dead.

A second common problem is this: You lost power at the transmitter site, and for whatever reason, the generator didn't start. You had the remote control on a UPS, but the UPS died. The equipment racks were then dark. No calls out—you didn't know what happened until much later. That makes for a bad day.

ROUND 2: BACKUP REMOTE CONTROL AT THE STUDIO SITE

One fairly easy way to get around the problems associated with a single phone line remote control was to simply install an additional remote control as the studio location, with its own phone line. On this remote control, you would "meter" items like program silence, off-air silence, loss-of-carrier and probably other studio parameters, such as rack room temperature, door alarms and whatnot. If one or the other remote control was dead for some reason, you still received notifications from the other.

This is a pretty reliable method, considering you can add multiple phone lines to a remote control's call-out list. But, there can be problems associated with this method too.

For example, what if your transmitter remote control indicates that your carrier power is normal, but your studio remote calls you, wakes you up, and tells you there's no carrier? That's an annoyance, of course, that just adds stress to your life.

There are ways to mitigate such problems.

ROUND 3: ADDITION OF EMAILS

When you begin using more sophisticated remote controls, and add network access to a transmitter site, as well as a studio site, you can implement methods for filtering messages, and making sure that only the most important get your attention "at all costs"(which for me means a telephone call at any hour of the day).

Today, there are more and better ways of being made aware that something is wrong.

You will need a remote control that can be configured in such a way that some alarm conditions will prompt an email only, while others will prompt an email and a telephone call.

Let me give you some examples:

- **Silence on the backup air-chain.** I do want to know about this, but not by way of a wake-up call. This should send an email only.
- **Program silence at studio, but not at transmitter site.** This would seem to indicate a sensor problem. I do want to know about it, but not with a phone call in the middle of the night. Use PPM monitor to corroborate data to make sure what is going over the air is correct; if PPM alarm indicates the incorrect program, then call-out immediately.
- **Power reads zero on transmitter site remote control, and studio remote indicates no carrier.** Clearly the corroboration of data between two isolated systems means that it's very likely not a false alarm. This should prompt an immediate call-out. A remote control that can be scripted, using "AND" logic, would be needed.

One can go on and on with examples because every radio station situation is different and likely unique.

By applying technology that is readily available today, you can make your job a little less stressful, hopefully lowering the chances that your work life will interfere with your regular life.

Irwin is RF engineer/project manager for iHeartMedia Los Angeles. Contact him at doug@dougirwin.net.

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These Projects Are Perfect for Summer

by Doug Irwin, CPBE AMD

Fig. 1: This is how all AM tower bases should look—free of weeds.

Summer has come to all of North America now—even though it arrived long ago out west.

Along with vacation, another great thing about summer is the more relaxed nature of transmitter site visits. No snow and ice to contend with in June or July (I hope).

What are the types of transmitter site projects best suited for summertime?

We'll take a look at them this time around.

GROUNDS MAINTENANCE

If you have an AM site, spring and summer introduce a whole new set of "weeds" and other bushes growing in the field(s) around your tower or towers. I recommend finding a landscape maintenance service to take care of them.

There are a few things to keep in mind, however:

- Don't expect the weeds at the base of the towers to be removed by contractors. There are too many RFR hazards to contend with. You'll have to deal with the ground inside the locked tower fences yourself.
- Make sure you know the methodology used by whomever you hire for weed abatement and overall mowing of the property. Just double check that they aren't doing anything that could damage your ground system, like using shovels or pickaxes.

As the years go by, you'll find having a set of contractors for projects like this is ideal. If the crew you used last year did a good job, by all means, have them back the following year and the year after. Consistency is very important when it comes to the routine projects.

Do you own the road to any of your transmitter sites? Undoubtedly they've developed potholes, ruts and other impediments over the winter. Summer is a good time to get those repaired because the types of companies that do that sort of work are busier in the wintertime—ultimately meaning their rates are more expensive, of course. If you want to economize on projects such as these, common sense says that you should get them carried out while there isn't as much work, overall, in your area.

ROOF MAINTENANCE

This would mainly apply to you, of course, if you own the building that houses the transmitter site. As I said, if you want to economize on contractors, you need to engage them when

they're not busy, or, at least, when they're at their least busy time of the year. From where I sit in California, it makes sense to work on roofs when it isn't raining out. Although weather could certainly be different in other parts of the country.

Many engineers are probably not familiar in the ways of dealing with contractors. When it comes to working with roofers (or contractors in general), you should always strive for multiple bids on jobs.

Here are my recommended steps:

- Define exactly what it is you want to do. Have it written down, if necessary.
- Always try to obtain at least three bids. Part of the reason you want to define exactly what you need is so that you can be consistent from contractor to contractor in explaining it. If you tell two or three different contactors two or three different things, then comparing bids is a waste of time.

Fig. 2: Keep condensate pans free of debris. This will keep drains clear.

- Throw out very high or very low bids. Getting multiple bids shows you how realistic they are. Quite often, you'll get a very high one, or a very low one; likely you can throw those out. When the bids come back fairly close to one another in price, then you can start having some confidence in them. Make sure you compare them for what is included, and what is not included, as well.

AIR CONDITIONING MAINTENANCE

Early summer is usually a good time for air conditioning service because it hasn't gotten really hot yet, right? I know that varies across the country. I also know that in many regions, air conditioners are in constant use, no matter the season.

Often, air conditioning problems aren't dealt with until something is "broken" and the transmitter space is 100 degrees Fahrenheit (or more). I hope this is not your methodology; there are plenty of routine maintenance items for air conditioners. (I'm referring to ones that use air for the heat exchange, by the way—not chilled water.)

Fig. 3: This photo shows a truck-mounted fuel polishing system.

These include:

- Filter replacement. Hopefully you aren't just doing this annually.
- Coil cleaning. Most air conditioning guys seem to call it the "coil," but to my mind it's more like a radiator. Air gets blown across it as part of the heat exchange mechanism. With all the air, comes dirt; and when it gets dirty, its ability to exchange heat with the air diminishes. Get this coil cleaned once per year (summertime would work fine for that).
- Condensate drain plugs. If you have condensate pans, make sure that the drains are clear.
- Gas pressure. Slow leaks can occur over the course of a year. Hopefully when your A/C service people come by, they bring and use the pressure gauges to make sure the gas pressure is within tolerance.
- Bad bearings. You can get a fairly good idea about the shape that the bearings in blowers and motors are in by simply listening to them, and feeling for vibrations. Replacing bearings is usually quite expensive, so again, if you can figure out when the A/C repair guys are not quite as busy, it makes sense to do the work then.
- Test emergency service. Occasionally, you should call your A/C service company after-hours to make sure that the number you have is correct and to see how responsive they are. Don't wait until there is a real problem, on a Friday night before a holiday weekend, to discover that you have the wrong number for them, or that they never call you back.

Eliminate potential sources of stress—plan ahead to have the all the sites in order before those holiday weekends or vacations.

GENERATOR MAINTENANCE

In that window of time between wintertime power outages and summertime power outages, you might find that your generator service company has time for some routine maintenance at your site. It's very much like air conditioning maintenance; see to it that they take care of the routine maintenance procedures specified by the (engine) manufacturer. Again, I recommend calling them after-hours at some point, making sure you have the right number, and ensuring they actually respond.

Load bank tests are usually done once per year, at most. Letting the generator get up to full temperature, for several hours, at its rated

load, will instill confidence.

Fuel polishing is another item to consider for your summertime maintenance. It's the removal of non-combustible particulate matter, microbial contamination, sediments and water. The difference between fuel polishing and fuel filtration is that polishers break down combustible solids so that the fuel stays within industry specs; fuel filters simply pull all the solids out. Some of those solids actually add lubricity to the fuel and make up part of the BTU value; continual filtering can remove them completely, which is not the real goal, according to *dieselfueldoctor.com*. The polishing process is somewhat elaborate—see Fig. 3. We had this process done recently at one of our transmitter sites—Fig. 4 shows the bucket of "stuff" that was removed from just 300 gallons of diesel.

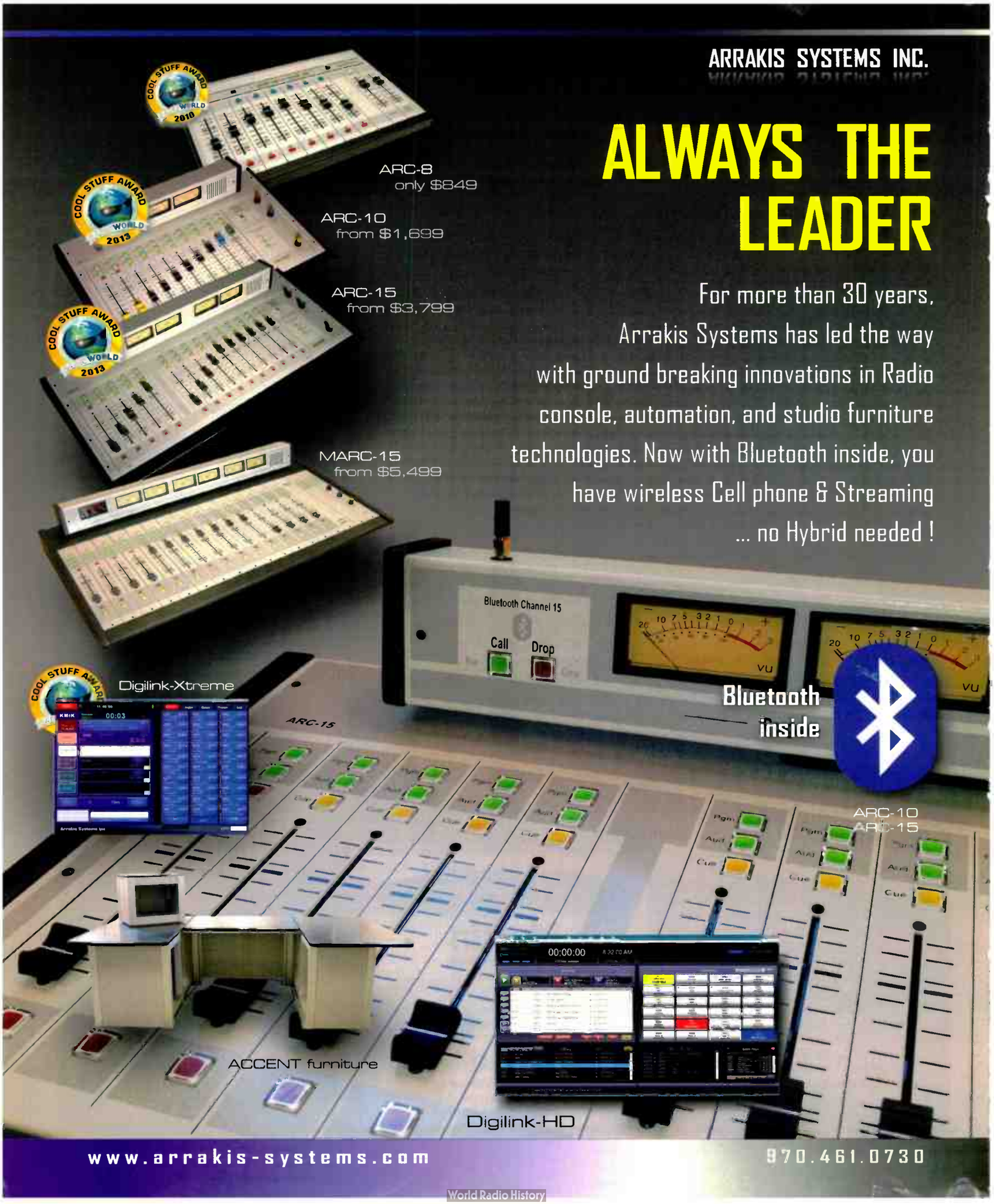
Fig. 4: This particulate matter was removed from 300-gallon diesel tank.

INFRARED TESTING

If you have a generator, then you have an automatic transfer switch. It's a good idea, once yearly, to do infrared testing on all the electrical panels inside of the transmitter site. Running the generator, switched over to the load, is wise at this point because you can also carry out the IR testing on connections and wires that are not typically used—namely, the "emergency" wires and contacts inside of the ATS.

So there you have it: An entire list of things to take care of during that wonderful period of the year. Sure, you can do any of these things at any time of the year, really—but why put it off until the weather is bad? If you want to make your work life a little easier, then apply some common sense and hard-won experience.

Eliminate potential sources of stress—plan ahead to have the all the sites in order before those holiday weekends or vacations. It's a good way to keep that phone from ringing.



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Use Automated Testing Technology to Monitor Remote Sites

by Dennis L. Sloatman

Flashback to 1975 in Cedar Rapids, Iowa: I had just accepted my first job as a chief engineer for an AM/FM combo operation. Times were simpler then, with turntables, cart machines and reel-to-reel decks. Most importantly, my AM and FM transmitters were at the same site, with no alternate transmitters.

Despite the simplicity of those times, I was always busy with remotes (a lot of local sports games with a temperamental old tube-type RPU), transmitter failures, monitor points, DA problems, tower lights not coming on at sundown—and yes, I did an air shift.

I frequently drove to the transmitter to fill out the maintenance log, calibrate the remote readings, inspect the grounds, and check the AM parameters prior to taking monitor points. Iowa thunderstorms and monstrous winter weather triggered problems with equalized telephone lines, power outages, blown fuses and an iced-up FM antenna.

Today, many of us are responsible for four or more call signs (I have 10). We have more work, more stations and decreasing staff. Most engineers make site trips to test generators, A/C systems and—when time allows—backup systems. Often our many responsibilities leave little time for these routine weekly inspections.

To me, there is nothing more frustrating than learning of a problem with a backup transmitter, generator, audio processor or cooling system because it failed to work when needed; and, it is equally frustrating to know that the problem could have been discovered early and the outage avoided had there been more time for routine inspections.

Looking forward, demands on our time are

likely to increase, so problems like this aren't going away.

Regardless of your market ranking, an off-air situation is gut-wrenching. The purpose of this article is to teach you how to avoid those moments by minimizing station downtime and maximizing station reliability and efficiency by the use of automated testing. When you lack the time to make frequent and regular site inspections, automated equipment testing can provide the solution by alerting you to a system problem before that problem escalates into an actual off-air emergency.

I understand that many broadcasters are conservative about adopting new techniques and feel reluctant about going "off the reservation" for different (and often better) solutions. However, experience has shown that a remote equipment monitoring system with automated testing can help you by effectively allowing you to be "in more than one place at a time," thus increasing your productivity and simply allowing you to get more things done during the week.

VIGILANCE IN TESTING

In order to minimize the chances that an undiscovered equipment failure will catch us off-guard, my facility now employs a remote monitoring solution, which consists of two parts:

1. Automatic, scheduled testing of backup systems
2. Continuous testing and monitoring of critical/important systems (we'll explore this in greater detail in future articles).

At our stations, we use sensors and out-of-range email alerts to monitor many parameters: transmitter room temperature, radio STL signal level, generator running and online status, transmission line pressurization, three-phase line voltage, nitrogen tank pressure (if used), de-icer current (if used) and audio chain silence alarms. I program the software to send us daily equipment "I'm here and online" emails, as well as "I have been monitoring the generator block heater for three hours and it has cycled on at least once" notifications. If I don't receive these daily emails, it's time to investigate.

I use this continuous automatic testing approach to alert my staff and me to various out-of-tolerance conditions. My application of continuous automatic testing to broadcasting equipment has evolved over many years of trial and error.

AUTOMATIC SCHEDULED TESTING

Let's examine a sample automatic scheduled testing routine for an auxiliary (backup) transmitter. There is no single procedure that will address all needs, so for discussion purposes, I've created a generalized flow chart for a weekly auxiliary transmitter "qualification" to serve as an example. My hope is that you will use it as a guide to spark some ingenious monitoring ideas of your own!

Please refer to the flowchart (page 22) while reading the discussion.

We begin with the initial software setup: Select a day and time for the program to run the automatic test. I recommend Tuesday/Wednesday at 10 a.m. for these tests. Mid-morning tests provide sufficient time for you to travel to the site if a problem is uncovered, without interfering with your early morning routine duties. Further, it's early enough in the week to address any issues without being sidetracked with the usual Monday deluge. In any case, choose what makes the most sense for your requirements.

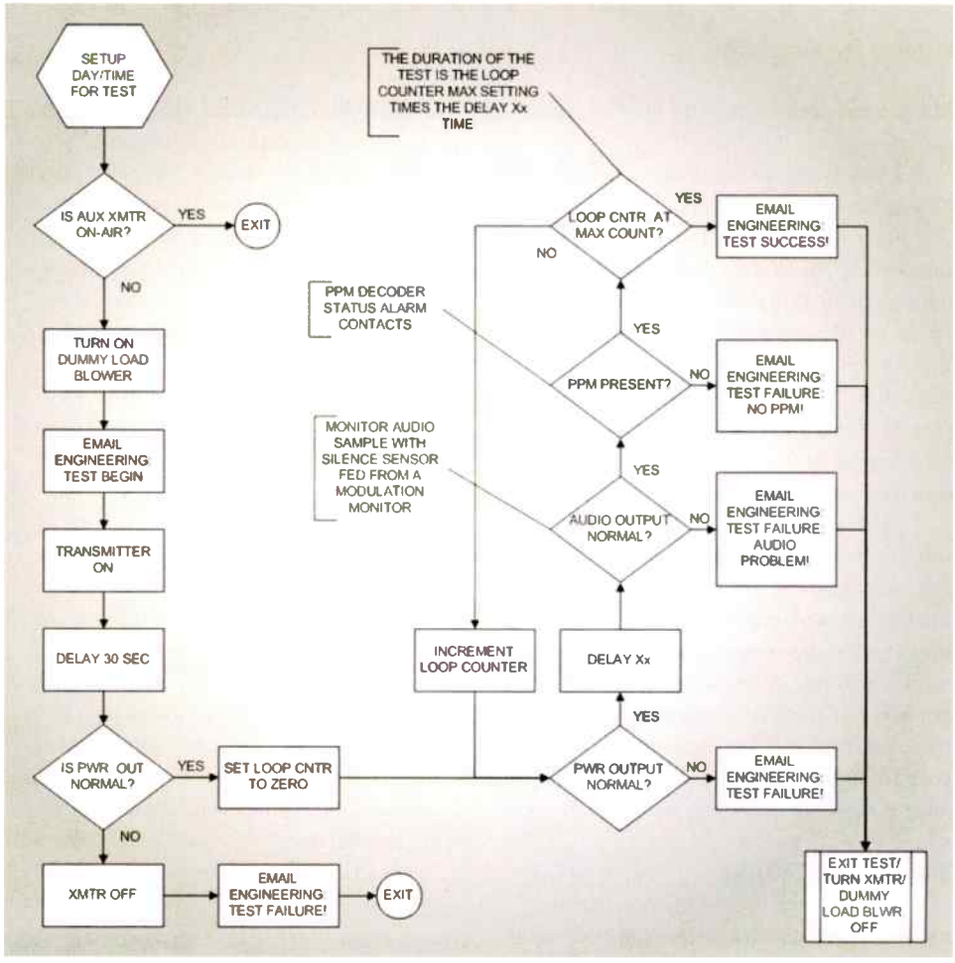
Now let's follow the steps as the automated test routine begins at the selected date and time.

The first detail the program checks (using status or metering signals) is that the aux transmitter is not the active transmitter. If it is, the routine exits without further action.

If the aux transmitter is not on-air, the program then turns on the dummy load blower (if applicable). It follows this by sending an alert email to the technical staff informing them that the weekly test has begun.

Next, the program turns on the transmitter. This process varies depending upon if the transmitter is a tube-type or "solid-state" transmitter. For example, if the transmitter is tube-type, the program can turn on the filaments for 30 seconds, and then turn the HV on.

After the transmitter is turned on, the program waits 30 seconds and then checks if the power output is normal. "Normal" is defined by what the engineer considers to be the acceptable operating range for the particular transmitter being tested. If the transmitter power output is excessively low, the program gives the command for an instant shutdown and sends an alert email to the technical staff informing them of a test failure.



This is an example of a transmitter test routine.

If the transmitter power output is within acceptable limits, it is time to check the rest of the parameters. The program continues by setting a loop counter to zero (the reason for this is addressed below).

The program enters the main test loop. Here, it can inspect as many parameters as an engineer chooses, and he/she can add, alter or delete a parameter by simply editing the software. In this example, the loop will examine power output, audio level "modulation" and PPM decode OK/fail. I monitor these particular parameters because I believe their combined results provide a good qualification of the system as a whole.

The program now cycles through the loop. During each iteration, the program checks one parameter and then increments the loop counter by one. The first loop iteration checks the power output level; the second iteration checks the audio level; the third checks PPM status again; and so on. If a parameter failure is detected at any point during the loop, the program exits the test routine, sends an alert email and performs a shutdown procedure (transmitter off, delay, dummy load blower off, etc.).

The settings for the delay timer and the loop counter are important. My system's delay timer is set for a relatively short delay time (10–15 seconds), while the loop counter maximum is set so that the product of the loop counter maximum setting and the delay timer equals 15 minutes. I chose this time limit because I believe that 15 minutes is long enough to run a stable test without stressing air conditioning and significantly raising utility bills. Keeping delay timer settings of short duration allows the routine to more or less continuously monitor parameters during the test and more quickly react to failures

during the test process.

Once you initiate a remote monitoring process at one site, it can become quite addictive. Your first testing routine will likely inspire other ideas and improvements. You can "tune" your routine by editing the software. Find what works best for your operation—that's half the fun of automated testing!

I should mention at this point that at minimum, three remote control vendors (Burk, Davicom and WorldCast Systems) offer scripting software that will permit you to implement a flow chart such as the one presented here as well as even more intricate routines to fit your specific requirements.

REAL WORLD IMPLEMENTATION

Let me provide two recent personal experiences to demonstrate how remote monitoring saved the day at my facility.

Recently, we received an email alert that the standby transmitter at our site in Beverly Hills failed the weekly automatic test. After driving through L.A. traffic to the site, we discovered the transmitter had multiple issues, including an open filament variable voltage control transformer, an inoperative SSR (which controlled the bias on/off), a failed bias circuit breaker and a control relay that had fused contacts. Obviously, something nasty had happened up there, but what's really important is this: Without the alert from our automatic monitoring system, the failure might have gone undetected until the standby transmitter was needed.

In another instance, the weekly test for an auxiliary transmitter at one of our AM stations (the flagship for the Los Angeles Dodgers) alerted us that, although the transmitter was operating normally and at full power, its audio chain was silent! The radio STL link selected as the audio source for this transmitter had no audio output (we have three audio sources and select a different source for each of the three transmitters). This is a four-hop link (yes that's right—four-hops) and in this case, the source of the trouble was at one of the intermediate points in the path. We selected an alternate audio source until the root cause with the radio link was resolved. The automatic test alert had again saved us from a "surprise" outage. We have a saying here in L.A.: "Got to keep Vin Scully on the air!"

CLOSING COMMENTS

I spend a good deal of time in my job working on spreadsheets and budgets, reading long emails and attending meetings and conference calls. While busy with these office duties, it's always reassuring when an email pops up with the message, "KXXX auxiliary transmitter test results normal."

I hope the approach I've outlined in this article can benefit you and your facility. Let's put this technology to work for us!

Sloatman is the director of engineering and IT for iHeartMedia Los Angeles.

Old Westbury Web Radio Educates Online, in the Studio

by Joe Manfredi

The beautiful 604-acre campus of the SUNY College at Old Westbury, N.Y., is home to the college Internet radio station Old Westbury Web Radio. Located in the Student Union's top floor, this 24/7 Internet radio station has grown significantly, not only in size, but in the quality of its technologies and programming.

OWWR is an interdisciplinary learning environment for students of all academic disciplines, and programming opportunities are available to them, as well as faculty and staff, alumni and community volunteers. The mission of OWWR is to act in the interest, convenience and the necessity of the public in conjunction with the college mission, while educating and entertaining a global audience. OWWR is a variety station that features news, talk, music programming and sports, as the official radio station for the SUNY College at Old Westbury Panthers.

When OWWR began 10 years ago this November, it consisted of three analog studios: one on-air and two production suites, with a small post-production workstation. The station began with a donation including equipment from Bloomberg Radio News and received additional support from the college. Today, OWWR (*www.owwrny.org*) has four studios and can be heard worldwide online and via Tunein Radio (keyword: "OWWR").

EXPANSION PLANS

After many years of use, the original (donated) Audioarts R16 console started to run out of steam. The decision was made to upgrade and expand. I reached out to a trusted colleague and friend, our Chief Engineer Bob Anderson, with the result that OWWR's main "Studio A" was upgraded to a digital console in the fall of 2014. The analog wiring and

some equipment were removed; the studio's wires were retraced, labeled and tested; new equipment was installed for expansion; and the programing and installation of the Wheatstone IP-12 was executed. It is here where all the live programming originates.

The other three studios are currently analog, for academic and production purposes, although "Studio C" is wired for backup purposes to ensure continuation of programming.

OWWR has always relied on Adobe Audition for recording, and BSI's WaveCart for audio playback of breaks and station identifiers.

During the academic semesters, OWWR students produce and anchor news coverage, Monday through Friday at 6 p.m. They also record on-campus press conferences and programs featuring special guest lectures and execute a variety of interviews for air. The OWWR sports department covers numerous campus basketball and baseball games, including sideline reporting, along with pre- and post-game coverage. News and sports programming both feature a wide variety of politicians, authors, athletes, coaches, business leaders and other industry professionals.


Studio D

OWWR, like all college radio stations, is also a haven for all musicians from multiple genres, both independent and signed. Over the years, hundreds have strut their stuff with live performances for both wired and acoustic sets. Other guests include comics, poets, actors, directors and you never know which DJ might pop in to rock the Technics SL-1200MK2 turntables and Gemini mixer.

When the OWWR News and Sports divisions are in the field, they use a variety of equipment including the Marantz PMD-660 and 661 flash recorders; the Olympus 320 digital camera and

the Olympus 321 digital recorder; the Mackie 1402-VLZ portable mixer; JK Audio's ComPack telephone interface; the Shure PGX24 (with SM58) wireless mic system; Behringer XENYX 2442 and UBB1002 portable mixers; and the Digigram UAX220 USB audio interface.

As you might expect, all specialty news, sports and entertainment coverage is made available for download or podcast on the news website, *www.catalystradionews.org*. You can also find OWWR on all major social networking sites.

PROVING THEIR SKILLS

In 2009, I decided that OWWR was ready to show concertgoers at Downtown Sounds (*www.downtownsoundslive.org*) in Glen Cove, N.Y., just what it is capable of.

The staffers of OWWR started to execute live analog phone cut-ins via a JK Audio RemoteMix 4, Shure SM2 headsets mics and Electro-Voice RE-50B handhelds. I'm the original concert host, and have been for 18 years, and I decided to up the ante: OWWR now webcasts both audio and video with four switchable cameras (Sony PD-150s and Canon Vixias) through an Edirol switcher, live on *ustream.com* (keyword: "OWWRNY").

Soon, we're planning to deploy a new Tieline Bridge-IT for digital webcasts.

OWWR is also host to the Diabetes Research Institute and St. Baldrick's Fundraisers, providing on-location public address support, as well as live audio and video webcasting.

Now under construction is an additional analog production suite consisting of an Arrakis ARC-10, Behringer MS16 monitors, Electro-Voice RE-20s, a Behringer HA-8000 headphone amplifier, an American Audio Genie II phono-to-USB interface, and additional analog and digital playback connectivity. The new studio will be ready for use for the OWWR staff by the start of the fall semester.

Old Westbury Web Radio is also home to interns and work-study students, and participates in the SUNY College at Old Westbury Community Action, Learning and Leadership (CALL) program, that, for six consecutive years, has earned a place on the President's Higher Education Community Service Honor Roll.

OWWR live online via the Internet and fiber optic from transmitter room.

Radio can play a major role in the development of the student at any stage of his or her academic career. OWWR engages students and provides an environment that encourages them to find their own voice, to strengthen confidence in their convictions, their thought processes, and their self-perception, while they assume ownership of their education and future at Old Westbury.

It is truly the students, faculty, alumni and community volunteers that make OWWR special. Old Westbury has the most diverse student population in the SUNY system, and to bring that diversity to the global marketplace while simultaneously playing a role in shaping the minds of students is amazing and gratifying.

Station Manager Joe Manfredi has nearly 20 years of broadcast and college radio experience and is an instructor in the American Studies/Media & Communications department, teaching a variety of radio and television courses at SUNY/Old Westbury.

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Longley-Rice Considers The Entire Environment

by Jeremy Ruck, PE

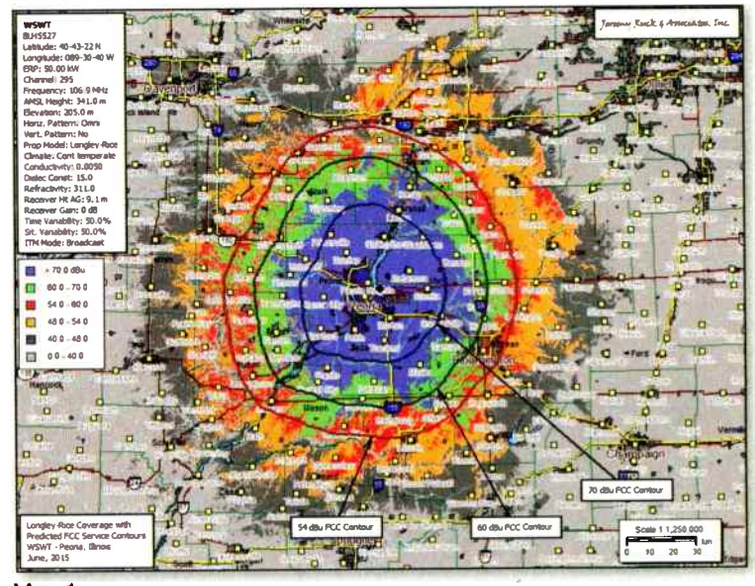
In the golden age of our industry, when AM was king, and FM was the new twerp on the block, the realization came about that the original method of determining propagation of these new signals required some refinement.

The original propagation curves were developed in the late 1940s, based on studies performed at that time. Nearly 20 years later, in the mid- to latter-1960s, the new curves were released. These are a refinement of the original models and were developed through additional studies.

Since the effects of terrain on the propagated signal had been empirically observed, a terrain roughness factor was introduced into the model. This factor was intended to correct for additional deviations that would tend to occur in mountainous regions, but its use has more or less been on the fringes of engineering for the last half-century or so. The curves were intended to be representative of average terrain, which was pegged with a delta-h value of 50 m. Delta-h is defined in a distance range of 10 to 50 km (6-31) miles from the transmitter, and is the difference between 10 percent below the highest elevation and 90 percent below the highest elevation in this slice.

While the standard contour method has worked reasonably well for the last 50 years, the more a particular case diverges from the standard assumptions, the greater the observable spread is in observed behavior versus predicted behavior. Simply put, the contour model works fairly well in the Midwest, but the further you get from fly-over country, the more problematic it becomes.

One of the major shortcomings of the contour model is the fact that it bases its distance to particular field strength on the average terrain in a limited slice along an azimuth. For FM, that slice exists in a zone from 3 to 16 km (2 to 10 miles) from the transmitter site. All other locations are ignored. Thus, for example, if I had a Class A station with an ERP of 6 kW and an average terrain in the 3-16 kilometer slice from the transmitter along a given azimuth of 100 m, the standard contour model would predict a distance to the 60 dBu contour of 28.3 km along this azimuth. Then suppose I constructed an infinitely tall granite wall at 17 km from the site. The contour model would continue to show 60 dBu at a distance of 28.3 from the site, even though we all intuitively know the wall would stop the signal. Similarly, what happens with the terrain closer to the site than 3 km is also ignored.



Map 1

Enter the terrain dependent models, the most famous of which is Longley-Rice.

LONGLEY-RICE

Around the time that the current curves were under development, the Longley-Rice or Irregular Terrain Model was also being developed. The genesis of the model creation was due largely to the needs of television frequency planning. Since significant computing horsepower is required to make predictions with this model, its use for many years was restricted, for economic reasons, to those with very deep pockets. The proliferation of huge desktop computing power has allowed the model to become more widespread in its use. Indeed, there is hardly a day that goes by that I do not run several such maps from the comfort of my office, and I wager the same is true for many of you.

The relevancy of the Longley-Rice model is due to the fact that it does not look at just a sample of the terrain, but looks at all of the terrain along a given path length. Additionally, other factors, such as atmospheric properties, free-space, localized ground cover and receive antenna characteristics, are considered. The result is a fairly accurate representation of how a propagated signal behaves in a given environment. Recently, in an attempt to verify observed problems in coverage with a particular facility, I performed field strength measurements against Longley-Rice modeled coverage. In nearly all cases, the measured deviation was less than approximately 1 dB between measured and modeled. That's pretty darn close.

In determining field strength values, the model uses free-space attenuation, and then applies statistical estimates to adjust the value accordingly. The variables utilized are a situational variability, time variability and location variability. The received signal level is therefore the signal attenuated by free-space losses

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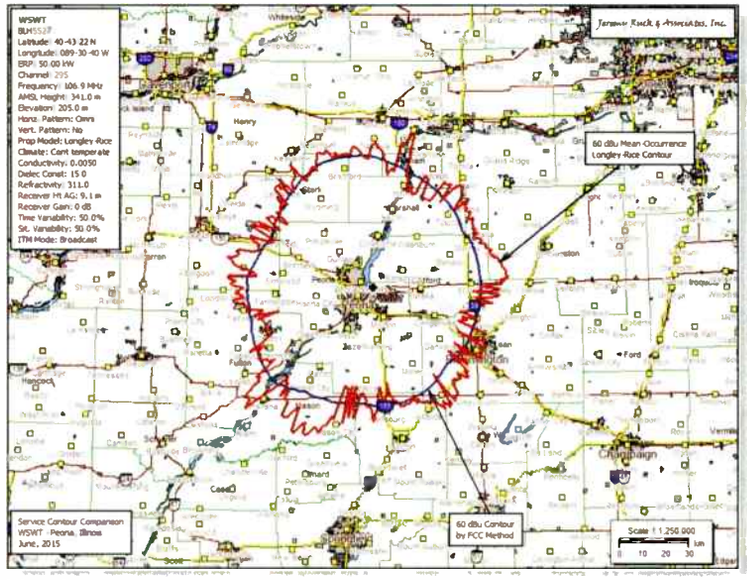
further attenuated by the sum of these attenuation variables. Because of the number of variables available, some of which can be tweaked by the person performing the study, there can be swings in predicted field strengths.

For example, calculating predicted field strength in a continental temperate climate zone would yield different results than if the same path were calculated in a desert or tropical environment. Similarly, due to scattering, urban areas will result in a greater attenuation of the signal than over open land. Ground conductivity also plays a role in the model, with its effects more pronounced at lower frequencies.

To get results that are more accurate with Longley-Rice, the sample sizes can be changed. For instance, one commercially available software package allows cell size to vary from 0.1 to 4 km. For terrain samples, this package also allows terrain to be sampled at several defined intervals from 30m to 1 km. The result is that very fine or coarse resolution maps may be created. Of course, the finer the resolution, the longer the time the calculations take to complete.

Since Longley-Rice provides output on a cell or pixel basis, contours are not native to the model. The Federal Communications Commission tends to prefer contours, and so many of the available packages will allow you to derive a contour from the results. Typically, a contour may be derived for a first, mean or last occurrence of a particular field strength. If the terrain is irregular in a particular region, this can sometimes have strange effects. Wild variations in the terrain up or down along a given path can result in the contour location on a given azimuth being at a significantly different location than an adjacent radial. This can pose problems for city of license coverage studies, as the derived contour may fall short of serving the community, while inspection of the individual cells shows there is more than adequate signal.



Map 2

Although the commission accepts Longley-Rice for both coverage and interference studies for television facilities, its use by FM stations is typically limited to city of license coverage and main studio location studies.

SKYTOWER

Until a decision in 2010 colloquially known as Skytower, the commission typically limited the use of Longley-Rice to cases where the delta-h value along paths in question was less than 20 m or greater than 100 m, and required at least a 10 percent variance in the coverage predictions between the curves and Longley-Rice. The delta-h provision has been removed, and now anytime there is a variance of at least 10 percent between the models, Longley-Rice may be used.

It is important to note, however, that Skytower does not authorize a blanket use of Longley-Rice in all instances. Its applicability is limited to cases where the 70 dBu ("city grade") field strength is of interest, such as demonstrating city of license coverage at the application stage for "commercial" channels, or in showing that a particular main studio location is rule compliant. All other uses such as allocation exhibits, contour overlap, interference studies and city of license coverage for "non-commercial" channels still must rely on the applicable contour derived from the standard FCC contour.

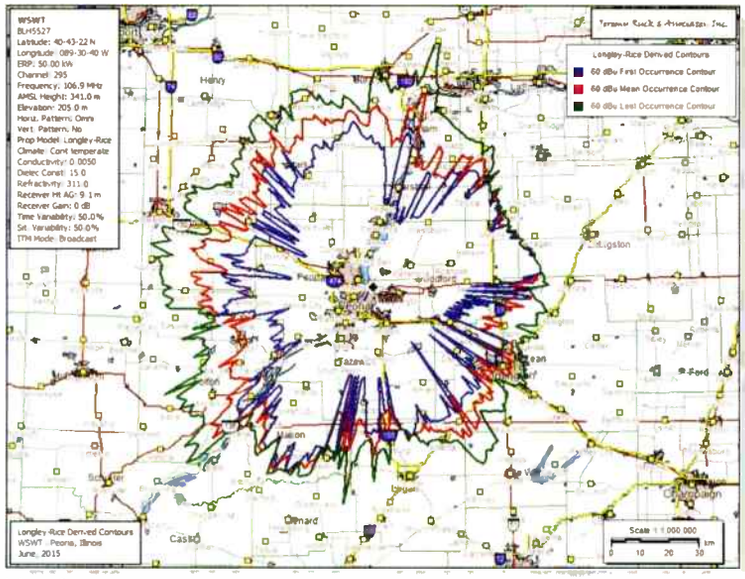
Finally, Longley-Rice allows the receive antenna height and gain to be factored into the signal calculations, whereas the FCC contours are based on a dipole antenna with a receive height 30 feet above ground. Adjusting the gain and height of a receive antenna with Longley-Rice can allow more illustrative examples of coverage, especially in urban areas when combined with localized groundcover effects. While such illustrations are beneficial for understanding the coverage of a particular facility, submissions to the commission using Longley-Rice will still need to be based on a dipole at the standard height.

MODEL EXAMPLES

To wrap up this month, an illustration of the result Longley-Rice provides is informative. The first map (page 28) illustrates the predicted

coverage of one of the stations in my area by this model. The prediction assumes the impact of local ground conditions, and a dipole antenna at the reference height. On the first map, the Longley-Rice coverage is overlaid with three FCC contours. The variations in terrain caused by the River tend to increase the coverage in certain directions, especially to the north.

In the second map (at left), a comparison is drawn between the 60 dBu contour by the FCC standard method, and the mean occurrence 60 dBu contour derived from Longley-Rice. On average, the FCC contour and the Longley-Rice contour are actually similar to each other. The delta-h in this region is reasonably close to 50 m, on which the FCC contours are derived. As a result, a correlation between the two models should be expected.



Map 3

Last, but not least, the third map (above) compares the first occurrence, mean occurrence and last occurrence 60 dBu contours for the facility as derived from Longley-Rice. Even with the relatively flat terrain in the region, there is a wide spread between the locations of the first and last time on each radial where the 60 dBu field strength is calculated.

In the end, Longley-Rice is a huge step forward in predicting facility coverage. Consideration of the entire environment in which a station operates allows for a more accurate picture of what is transpiring. Armed with that information, both management and engineering are better equipped to make necessary decisions.

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

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The Analytics of Things Means Taking a Calculated Risk

by The Wandering Engineer

When you think about it, the term "routine" maintenance doesn't really make that much sense; we fix things routinely because we never really know ahead of time when something will break. Most things don't routinely need replacement, and sometimes, replacing parts routinely just wears out their associated systems faster. In the ideal world, things would get replaced just before they wear out.

Routine maintenance schedules are a pretty dull tool.

With the proliferation of solid-state transmitters, routine maintenance has become even less so. Transmitters in particular have become members of the Internet of Things faster than a lot of other devices. Some "call home" to the manufacturer when their fans start to slow, their filters clog, their keep-alive batteries lag or something is about to burn up.

The really special ones let you sign up for a level of service that initiates a chain of events at the manufacturer in the event that parts are needed. You get the parts delivered at an appropriate speed and up-to-date installation instructions attached to the email that you can forward to that IT person who wants to get into RF. I'm going to refer to this feature as the "Analytics of Things." AoT is all about the use of information technology to complete as much as possible of a process that can be automated.

It's a win-win. Manufacturers get to sell parts, to keep things updated and to gather performance metrics that can turn into product improvements. You get the parts and instructions without having to go to the site and do diagnostics, and they don't have to do a lot of customer service (i.e., hours of hand-holding and consoling). If you like it, then maybe they sell even more new AoT devices. Everyone is happy.

It seems like just yesterday most of us were isolating our equipment on closed IP networks for security purposes. Now we invite entities in to help us maintain the ever-more-complex and foreign equipment. Security didn't get less important, friends, nor have the bad guys dropped their game. We are willing to take a calculated risk, balancing the threat of hacking versus the benefits of AoT. Is there really any other way forward, though?

21ST CENTURY BUSINESS MODEL

According to some sources, 20 percent of the population free-lances (doing occasional gigs) and 15 percent of us moonlight (meaning regular work). In the last century, companies were all about large workforces and capital-intensive businesses. Now, in this century, the largest retailer has no inventory or stores; the largest media giant doesn't own a newspaper or broadcast station; and let's not forget Uber, the quasi-cab company where individuals can make something of a living driving their own car, using their own insurance as "contractors."

I'm going to suggest that the next step in transmitter maintenance is AoT that calls upon Uber-type engineers—broadcast engineers who work with RF—to do the actual, hands-on work. Full-time or after hours, broadcast engineers who work on transmitters will likely get a call from some Uber-engineering service, and bid on doing work at a transmitter site they might never have seen. If available, you make a bid and take the gig, download the directions you'll need, and off you go to meet a drone with the replacement parts at the transmitter site. The door lock opens when you get to it with your tracking cell phone. A camera records you working. The station manager or PD (sorry—"brand manager") rates you *x*-number of stars for the quality of the work you just did.

Transmitter work has, in most cases, devolved into the replacement of modules, or the occasional switch or fan. Yet, there seem to be fewer and fewer people able to even do that.

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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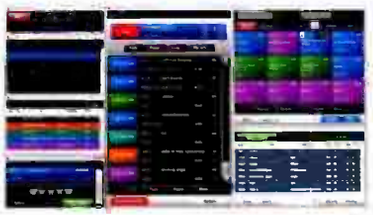

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