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Radio

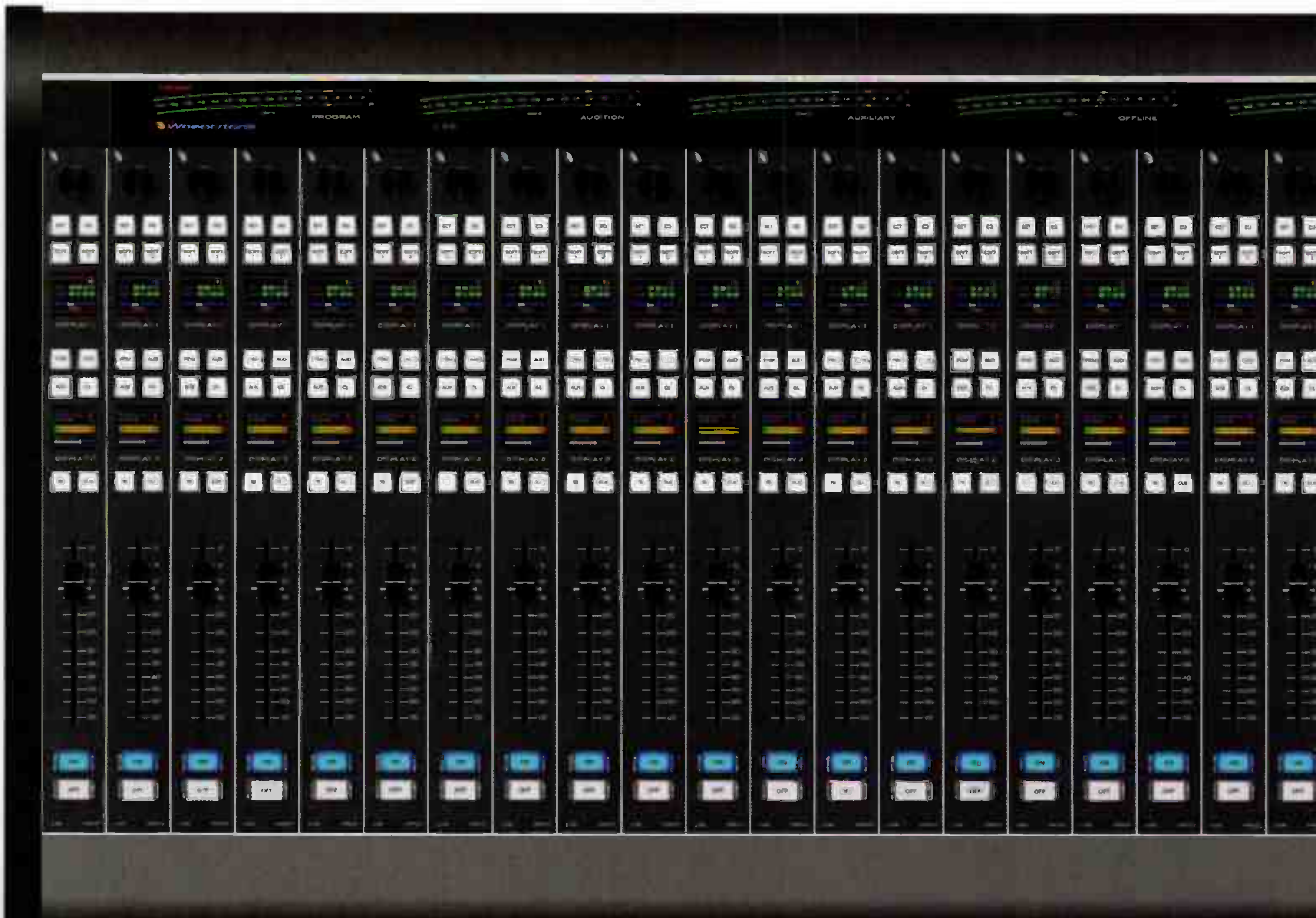
THE RADIO TECHNOLOGY LEADER

EMF's Collaborative Redesign

These facility renovation plans considered aesthetics and ergonomics

AUGUST 2016 | RADIOMAGONLINE.COM
NewBay

LXEvolved



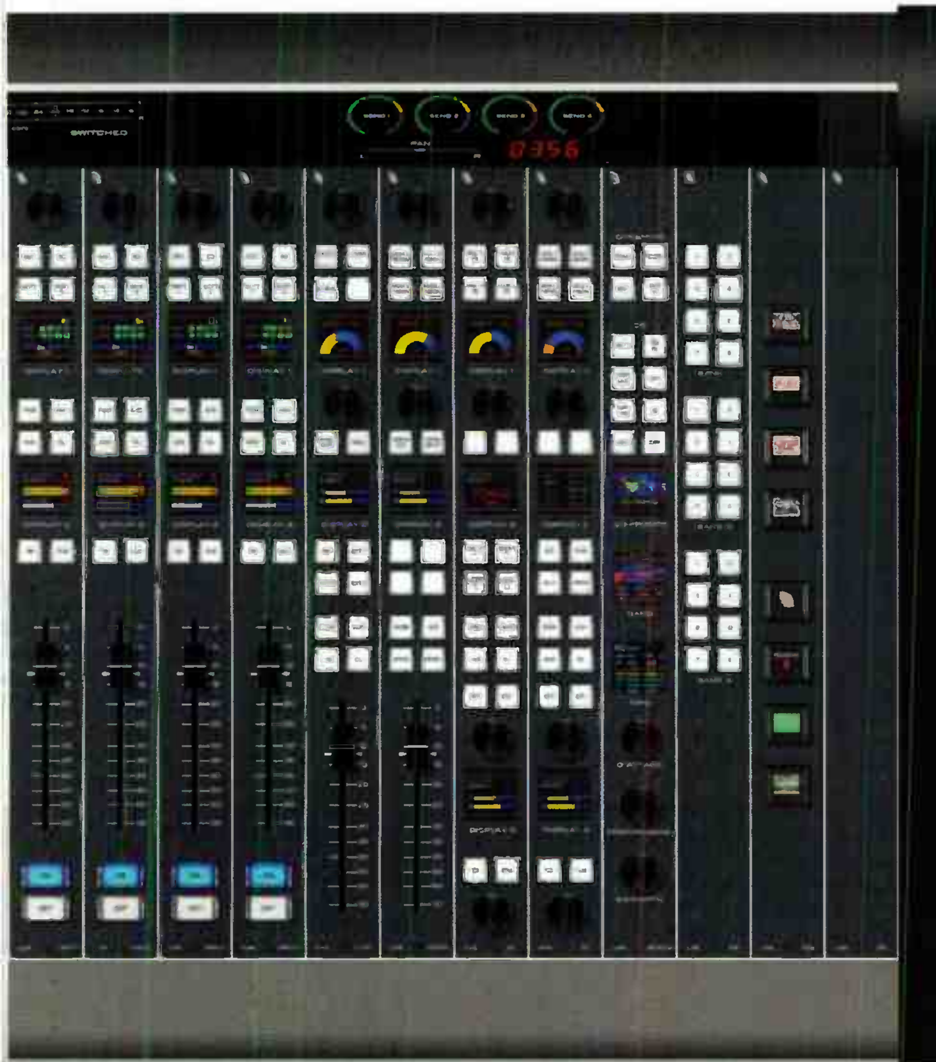
The Evolution of LX Radio Control Console

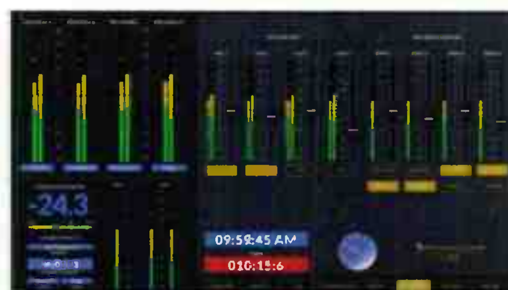
Wheatstone's new LXE console brings control surface configuration to a new level. Going far beyond the usual "any source to any fader" network concept, the LXE is a fully flexible control interface, where every switch and rotary control is programmable to perform any desired function. This means console 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 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.

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On the cover: The newly built studio at the EMF facility in Rocklin, Calif., features an Axia fusion console.

COLUMNS

DEPARTMENTS

FIND THE MIC AND WIN!

Tell us where you think the mic icon is placed on this issue's cover and you could win a **Hosa UXA-110 Tracklink USB interface.** Send your entry to radio@RadioMagOnline.com by **Sept. 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.*

Introducing

Whirlwind's THS Family of headphone boxes,

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VIEWPOINT

Consistent Lifelong Learning

I hope you've noticed over the last year (and more) that Radio magazine includes not only a variety of topics and authors, but articles aimed at engineers in different stages of their careers and with different degrees of interest. Whether you're new to the job and want to learn the basics, or if retirement is just around the corner and you want to dig deeper, we have an article for you every month.

Our regular contributors are always here, discussing topics known to all of us but which are constantly evolving.

Lee Petro follows up his June 2015 FCC Update on foreign ownership of U.S. radio stations. It seems an Australian couple wants to increase their stake in a small radio group here in the U.S. — to 100 percent. A new precedent could be set, and soon. Does this sound like the natural evolution of media ownership?

Jeremy Ruck's RF Engineering column is back this month. If you are tasked with maintaining an AM radio station, read Jeremy's advice and take it to heart. There aren't too many AM mentors out there, and I'm happy to give you an opportunity to learn from Jeremy.

From our final page: Sign Off. As usual, the Wandering Engineer has something to say about radio and the state of our industry. Streaming media in the car has come a long way — it wasn't that long ago that an EVDO card and a jumper from the headphone out of a laptop provided "streaming" for your car. Has the digital dash gone forward or backwards since that time?

We also always showcase a facility because engineers are interested in seeing how the other guy did it.

Not long ago I was at one of our transmitter sites in the high desert of southern California, studying a newly built facility of a new neighbor, Educational Media Foundation. Rather than a collection of gear jammed into a rack and wired without planing or clear purpose, the EMF installation was designed and engineered in a fashion that is impressive and made me want to learn more about it. This month we're telling you all about what is on the other end of that far-flung system.

And of course, lifelong learners can read up on other subjects that aren't necessarily in the typical radio engineer's wheelhouse. We offer several articles that will hopefully inspire you to think out-of-the-box and to learn something new.

First, I present ideas on how to build a short-hop communications system to carry remote control data and/or serial data when the site is just out of reach of wire and conduits.

Second, we have an article on VPN: What it is, what it does, and how to implement it.

And third, where you will be farthest outside of the broadcast box, Dennis Sloatman is back with the second in a series on learning to use programmable logic controllers. Colleagues, put down the Raspberry Pi and Arduino for broadcast applications. PLCs are the way to go and are meant to be installed in the kind of environments many of us call "home."

One final thing: Next time you're online, please take 10 minutes to fill out our annual, anonymous Salary Survey, located here (*https://www.surveymonkey.com/r/23ZBM3J*). The results always enlighten us about the state of our industry — and the more you tell us about your experiences, the better information we'll be able to share. ◘

Doug Irwin, CPBE AMD DRB | Technical Editor

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Radio
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August 2016 | Vol. 22 No. 8

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A NewBay Media Publication

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SUBSCRIPTIONS: Free and controlled circulation to qualified subscribers. Customer Service can be reached at: newbay@computerfulfillment.com or by calling 888-266-5828 (USA only) or 978-667-0352 (Outside US) or write us at Radio Magazine, P.O. Box 1884, Lowell, MA 01853, USA. Back issues are available by calling Customer Service.

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Radio, Volume 22, Number 8, (ISSN 1542-0620) is published monthly by NewBay Media LLC, 28 East 28th Street, 12th floor, New York, NY 10016. Periodical postage paid at New York, NY and additional mailing offices. Postmaster: Send address changes to Radio, PO Box 1884, Lowell, MA 01853.


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Making a Wireless Extension Cord

by Doug Irwin, CPBE DRB AMD

Normally a transmitter site or studio facility is a little island in which all the wiring and cabling remains. But what about the occasions in which you have wiring that needs to extend outside of that boundary, but just barely?

For example: you have a generator outside of your studio. You want to measure battery voltage and block heater current; but 50 yards of asphalt and concrete separate the generator from the building. No one is going to pretend that you'll dig up the lot to put in a conduit for that (and no one had the foresight to do it during installation), and you can't pull the signaling cable through existing conduits. What now?

Here's another example: You have an ATU located 200 yards from your AM transmitter building, and you want relay status to come back in to the building. Unfortunately, the original cabling did not include enough conductors; some of the status comes back, just not all of it. Again, no one is going to install a conduit, least of all through a ground system, just for those extra status signals.

B&B Electronics features a line of radio modems, supporting analog and/or serial data, using ISM bands.

One final example: you have a diesel fuel tank at the transmitter site. When the power goes out, after few hours, you find yourself wondering: how much fuel is really left?

WHAT DO YOU DO?

There are ways, of course, to "send" status signals and analog signals across short distances.

One possibility comes from the industrial world —thinking outside the "broadcasting box!"

A good example of that is B&B Electonics. Their Zlinx Xtreme Wireless I/O is a radio modem (900 MHz or 2.4 GHz ISM band) that is intended for outdoor use (rated IP67). In its peer-to-peer mode, you can pass two analog signals, two status signals, and two relay outputs between two of the devices. Range is listed as being as high as 1.5 miles with the antennas provided — so a couple of hundred yards should be easy enough.

"What about security?" you say. Well, they use spread-spectrum and come with either 128 or 256-bit AES encryption. (AES in this context means Advanced Encryption Standard.)

Another version of the same radio (the Industrial Radio Modem) is designed to pass RS-232, 422 or 485 across similar distances at data rates up to 230.4 kbps.

In this application, you could use (as one example) an SRC-16 Plus from Broadcast Tools. This device provides 16 optically-isolated inputs and 16 SPDT, 1-amp relays; two devices will "talk" to one another over a serial data link, such as that provided by the Industrial Radio Modem mentioned earlier.

Broadcast Tools describes it as a "relay extension cord" and thus it fits the theme of this article. The SRC-16 Plus has LED indicators to display input and relay status and three front-panel LEDs that display power, serial transmit and receive data. Connections are made via plug-in euroblock screw terminals. The SRC-16 Plus is supplied with LED indicators to display input and relay status. Three front panel LEDs display power, serial transmit and receive data. Plug-in euroblock screw terminals are provided for ease of wire installation/removal.

I'll admit that the remote generator fuel tank monitoring scheme is a bit more tough, but here's the idea: Use an ultrasonic depth gauge

BinMaster's ultrasonic fuel detectors can be used to directly measure fuel depth in a tank.

that indicates depth via an analog signal. Then, send that data over a radio modem like the Wireless I/O (mentioned above).

As one example: BinMaster makes the SmartSonic line of ultrasonic, narrow beam technology distance sensors. "SmartSonic's sensor probes are designed to adapt to the internal tank conditions, automatically adjusting power and receiver sensitivity to any distance and reflecting surface. This technology ensures the same echo is maintained over the entire operating range which enhances measurement accuracy," according to their brochure (the URL of which is seen below). The sensor is programmed to send out a 4-20 mA analog signal (which is compatible with the wireless I/O modem mentioned earlier), or it can send out its data via RS232 or 485, to a computer running the company's calibration/data logging software.

In this application, you'd use the Industrial Radio Modem. ■

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

RESOURCES

B&B Electronics | www.bb-elec.com/Products/Wireless-Cellular/Zlinx-Wireless-Modems-and-I-O/Zlinx-Industrial-Grade-Wireless-Radio-Modems.aspx

BinMaster | www.binmaster.com/products/info/60-ultrasonic/2921-ultrasonic-transmitter

EMF Innovates in Creation of National Network

by Jason Ornellas, CBRE CRO

Educational Media Foundation is based in Rocklin, Calif., and owns and operates the radio networks of Air1 and K-LOVE.

EMF began operating its first station in 1982 and moved to Sacramento, Calif., in 1993, after a single station grew to 14 (seven stations and seven translators). In 2002, EMF moved to its current location, which includes a group of 77 engineering personnel in various roles, such as field engineers, technicians, NOC operators, site development, software and engineering operations. The Rocklin-based department focuses on network distribution and RF for 800+ signals across the country.

EMF's philosophy has been to maintain a very cost-effective infrastructure, but early on, the organization made the decision to use only the best equipment appropriate for a station's budget, without neglecting on-air sound and reliability.

In the early 2000s, EMF started to build turnkey facilities — using the same equipment and layout at every site, to the extent possible. This decision made it easier to have repair and replacement gear on hand, as well as ensuring that the depth of knowledge at their home-base was sufficient to remotely talk contract engineers through any problem.

THE SECRET STUDIO

EMF's current facility in Rocklin began with 23 studios made up of nine production rooms, six voice-tracking rooms, four news studios, four on-air studios (two main and two redundant backups) and a secret voice-tracking studio inside the president's office!

The facility was wired around a three-tier TDM router that utilized fiber, AES-3 (110 ohm cable) and 75-ohm cable. The copper infrastructure made for a perfect marriage with the PR&E Hybrid Consoles that they have been running to date.

THE NEW DESIGN

The studio facility is being redesigned in a collaborative effort between the PD, studio ops, engineering, in-house API developers and other partners, such as the Telos Alliance, RCS, Pico Digital and GatesAir.

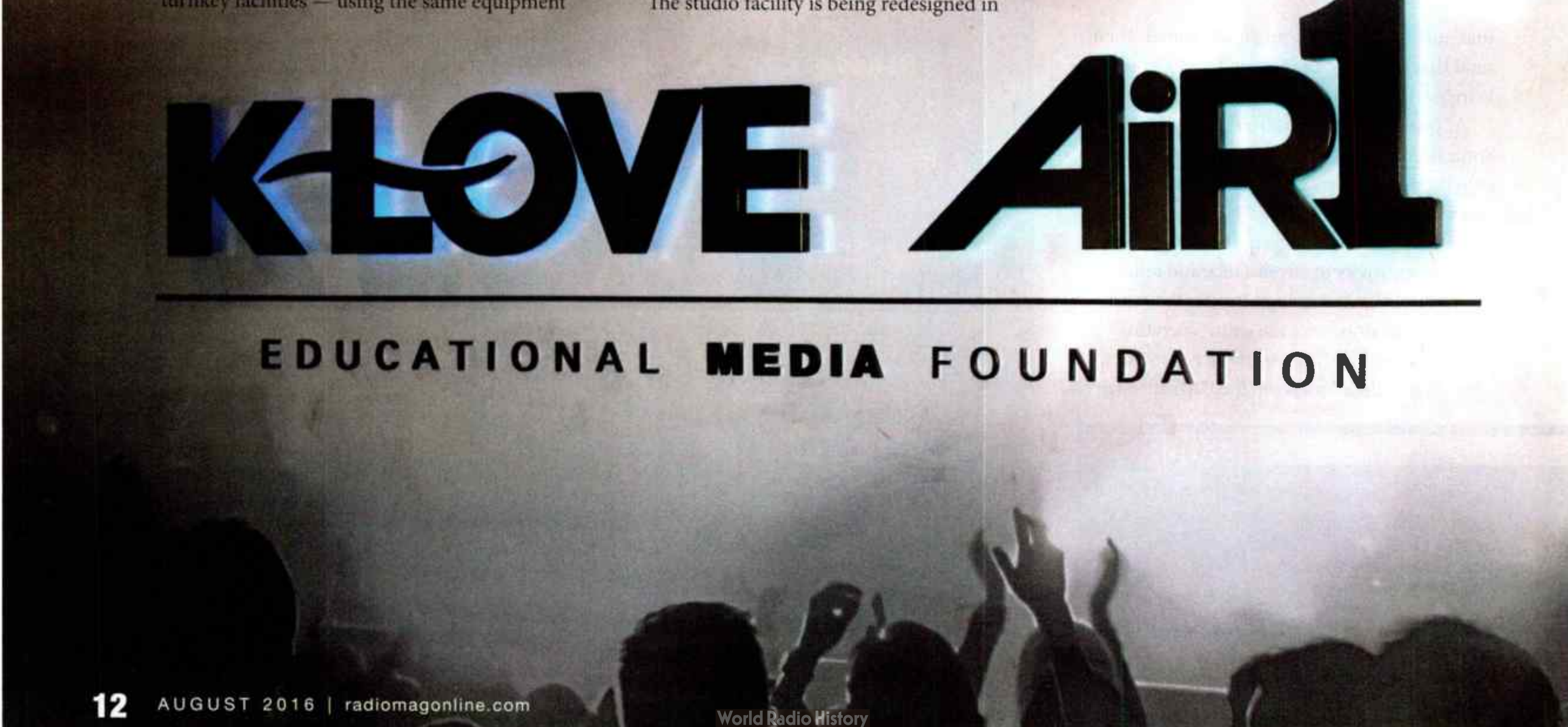
The goal was to open up the studios and to create a visual radio concept ready for HD video, while at the same time becoming more conductive for talk.

EMF continued with its tradition of standup furniture, but also added a kitchen-height solid surface, counter top allowing the co-host the option to sit. The studio furniture also includes an ADA-compliant wheelchair position. The transition from 39-inch to kitchen height to wheelchair position creates a tri-level aesthetic that transitions to sitting position in a less dramatic form.

Each design was carefully considered with respect to color, aesthetics and ergonomics. EMF has an in-house tech who is also a craftsman that made life-size 1:1 cardboard models of all the furniture in the CAD Drawings to ensure everything felt right in the room before the sign- off of the blueprints.

UPCOMING TRANSITION

EMF has recently brought up their new Axia System, comprising Axia Fusion and Element consoles with a la carte modules based on the



The EMF Network operations center is located in Rocklin, Calif.

needs of each studio. Every source and destination gets a unique ID that is managed by Axia's Pathfinder software. The heart of this system is the Excel spreadsheet that keeps all those unique IDs organized.

EMF prefers being a "centralized network," not only in the distribution of programming, but in the use of equipment at all of their stations. Engineering is inclined to modify equipment as necessary to fit the organization's unique needs.

In 2009, both the Air1 and K-LOVE Morning Shows moved to Eastern Time with the acquisition of a three-studio facility in Indianapolis. That facility utilizes a Harris Vistamax Router with Harris control surfaces with built-in nodes. There are many custom-built hardware pieces to control the switch between the two facilities, including those that route relay commands and RDS. This process is handled by the board operators in Rocklin.

Choosing to build an infrastructure that is not too proprietary, but that remains customizable for their needs is the challenge EMF engineering is facing. The building of the parallel infrastructure and maintenance the existing on-air system is not an easy set of tasks.

EMF is also building a Cisco infrastructure with passive redundant back-planes and extra switches in an arrangement configured to be self-healing. Allowing the Axia Pathfinder software to act as the router and control management will facilitate the plan to allow any of the 23 studios to become an on-air room as long as local RCS Zetta machine has Axia drivers and unique IDs configured.

NETWORK DISTRIBUTION FEATURES

Two of the newsrooms in Rocklin were customized to give access to two uplink channels

The EMF transmitter lab accommodates repair and refurbishment services for older transmitters.

that were routable by the staff using an EMF-developed application they call SUI — satellite user interface. The backup redundant studios became break-out rooms and were assigned additional uplink channels that (via SUI) can go live and break the network feed in any of EMF's markets. The key pieces of this function were the SUI in combination with the Wheatstone bridge.

EMF uses a customized store-and-forward system to automate the file transfers to players in the field for localized content. This system was built by Wegener in collaboration with EMF. The automation system sends pulses (scheduled in the log) to all the sites and the players all play the stored content. This feature also allows EMF to send a local event to a specific destination without being distributed across the whole network.

Over the course of the next couple years this will be replaced with a new system, based instead on AoIP combined with the RCS automation system.

EMF plans to virtualize everything to have the flexibility that comes with modern networking within the context of broadcast. Whereas now EMF uses Wegener iPump satellite receivers with a hard drive to play local content when a relay is triggered, the new system will feature "relays" that are ingested as pad data in to a centralized mux that marries data with Livewire, subsequently virtualized, and then sent to the remote sites via UDP. This system will be a custom design from the EMF Engineering team in collaboration with Pico Digital.

Indianapolis will connect assets via MPLS and RCS's Site Replication, which was originally developed for Sirius XM. Distribution of the audio feed will be handled by EMF's satellite team using the infrastructure of that site.

From its headquarters in Rocklin, audio will be routed to remote sites via multiple solutions including AoIP over private networks, satellite and even ISDN, depending on location and function.

RF FACILITY / TX REBUILDS

EMF built much of its network on older, high-quality transmitters, and they learned early on that there could be significant cost advantages if they purchased used transmitters. The investment a few thousand dollars' worth of repair parts and the appropriate number of man-hours for cleaning could provide a transmitter that is just about as good and reliable as new.

Unfortunately, the economic decline of 2008-2009 meant that many broadcasters stopped replacing their transmitters, and so the used transmitter market dried up to a small trickle.

Today, EMF is mostly buying new transmitters and the "Transmitter Lab" focuses on low-power (exciter, translator) repairs and re-builds. The organization hopes to start up the rebuilding full-size transmitters sometime in the not-too-distant future.

From their means of distribution, to their emphasis on consistency in their transmission facilities, the engineering department of EMF has developed an efficient, innovative network—one worthy of note, and emulation.

VP of Engineering Sam Wallington, Director of Engineering David Shantz and Manager of Studio Operations Jonathan Obien contributed to this article.

Server racks at EMF headquarters

Programmable Logic Controllers: Applications in Broadcasting

by Dennis L. Sloatman

In part one of the series, I discussed the essentials of PLCs, took a brief look at the internal structure of the PLC, considered programming methods — the most common of which is "Ladder Logic," and hinted at the software to program the PLC. In this part, we'll set out to get an inexpensive PLC up and running.

AUTOMATION DIRECT

There are many vendors and sources of PLCs: Automation Direct, FactoryMation, B&B Electronics, and yes, even eBay, among others. I will use the Click PLC available from Automation Direct as an example in this article.

The specific CPU I'll discuss here is their model C0-00DR-D, which features eight digital inputs and six relay outputs with 1-amp rated contacts. Also featured in this PLC are two RS232 Serial ports.

Click PLC programming cable

There are other versions, which are slightly more expensive and include RS-485 and/or an Ethernet port. This DIN-Rail mounted CPU is powered by a 24 VDC power supply. You can use either their matching DIN-rail mounted C0-00AC 24V/0.5A unit or your own favorite regulated supply. The CPU sells for $69, while the power supply sells for $29.

One note about PLCs: The total of the inputs and outputs of the PLC is referred to as "points." For the Click PLC mentioned here, the combination of eight inputs and six outputs makes this a 14-point PLC.

PROGRAMMING SOFTWARE AND GETTING CONNECTED

The free software can be downloaded at *http://support.automationdirect.com/products/clickplcs.html.*

There is also a collection of Click startup videos, which can be found here (*http://www.automationdirect.com/videos/listall*).

I suggest you download the free software, install it and explore its features a bit. Much as with any programming software, PLC software takes a bit of practice in order for users to truly become proficient.

This particular PLC has 2 RS-232 ports. Port 1 is used to interface to the PC running the programming software while Port 2 may be used to communicate with other PLCs (via ModBus commands) or to communicate with an HMI display or a PC running SCADA (Supervisory Control and Data Acquisition) software. I suggest you purchase the $14 factory-made data cable which uses an RJ-11 connector on one end for the Click serial connection and the familiar DB-25F connector for the PC. As serial ports on PCs have become less common, you may also need an inexpensive USB-Serial adapter (it's always good for a broadcast engineer to have USB-Serial cable on-hand in any case).

The documentation which is available in PDF form as well as the instructional videos I mentioned earlier will guide you through the initial connection process. The PC should negotiate the serial parameters as defined in the Click — I've thus far have not needed to go into the hardware settings in Windows to make any changes.

INITIAL PROGRAM WITH THE PLC

We'll start with a simple test program which will use the PLC as a latching relay and add more features as we go. Let's examine the code in the screenshot (shown on page 20 at bottom).

The Click PLC identifies physical inputs (that is, the actual electrical inputs on the terminals of the PLC) with "X" and physical outputs as "Y."

The model PLC we're evaluating here has eight inputs designated as X001 through X008 and the outputs numbered Y001 through Y006. I need to point out that, in order to make the ladder program more readable and easier for you to understand, these "X" and "Y" I/O points can be given nicknames such as: "Transmitter 1 On" and "Blower Motor Control."

In addition to these physical I/O points, there are (get ready to be amazed): 2,000 control relays; 1,000 system control relays; 500 timers; and 250 counters — all of which are in fact, simply bits in memory addresses (a fact I mentioned in earlier articles and which is a key point to remember in order to avoid confusion). In addition, common programming constructs such as subroutines, for-next loops, interrupt handling, math operations and sequencers* are available.

SAMPLE PROGRAM DISCUSSION

OK, let's see what we made here.

Starting with ladder line one, and going from left to right, we have external digital input X001 connected to C1. When input X001 is asserted, C1, which is used here as a set coil, turns on. On line three of the ladder diagram, C1 is instantiated as a normally-open contact and when closed, turns on output coil Y001. This output coil can conduct up to 1-amp and can be used to turn an external device on. When input X002 is asserted, we reset C1, the contact opens and Y001 switches to off.

In an earlier paragraph, I mentioned there are 2,000 control relays, all of which are just bits in the PLC memory. C1 is one of these. Control

CONTINUED ON PAGE 20

FOOTNOTE: * *Sequencers are also known as "Drum Sequencers." Think of the timer in your laundry washing machine as it sequences through the various cycles based upon time and/or external input. The PLC Sequencer is a function block which emulates this action digitally with precise control which may be event-driven or time-driven (or a combination thereof!).*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list price **$1,099**

*USB sound card supports USB HID compatible PCs

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CONTINUED FROM PAGE 17

relays can be configured with many different attributes. For example, they can be set to be retentive, which maintain their state even during a power loss to the PLC; or they can be used as "edge contacts," which will react to either a rising-edge pulse or a falling-edge pulse when instantiated as a contact.

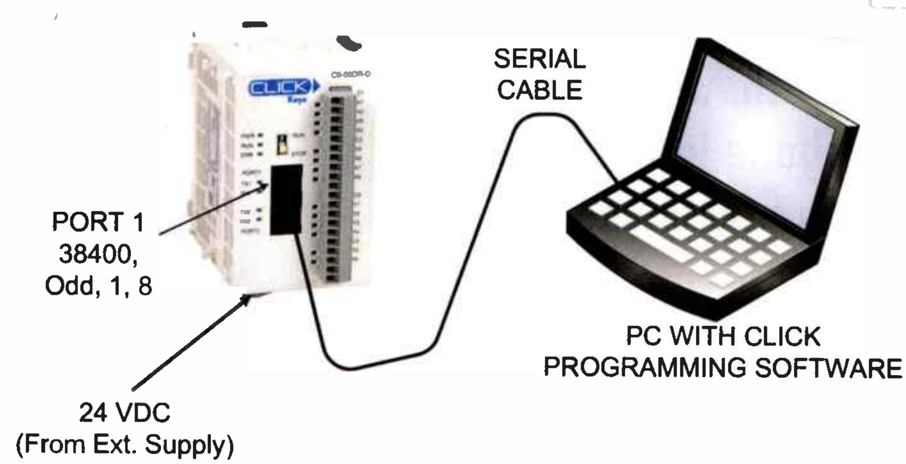
One word I will use throughout this series is "instantiate." This is a verb that means to turn something abstract into something real. When I instantiate C1 as a coil, it means that I'm taking a memory location and assigning it to an object that will be placed on the ladder.

When instantiated as a "coil," C1 can be used as an on/off device, or, as used in the sample program, a set/reset latching device. (That's just one more attribute that can be assigned to that control relay C1.)

It may help to think of this control relay C1 as the coil of the relay when used as an output on the right-side of the ladder diagram, and as one of the associated contacts of that coil when used on the input, or left-side of the ladder diagram. And here's a vital point about the power of this program: C1 can be used a coil with hundreds of normally-closed or normally-open contacts when instantiated anywhere on the left-side of the ladder diagram.

What this also means is that you can "rewire" your system with mouse clicks — rather than with a soldering iron and wire cutters.

With a couple of clicks I can change C1 from having two output contacts (for example) to one having say, five output contacts. I can make them all normally open, or all normally closed, or I can mix them anyway I want. You could also think of this as a logic device (an AND gate) which has multiple inputs, and also, if I want, multiple outputs.



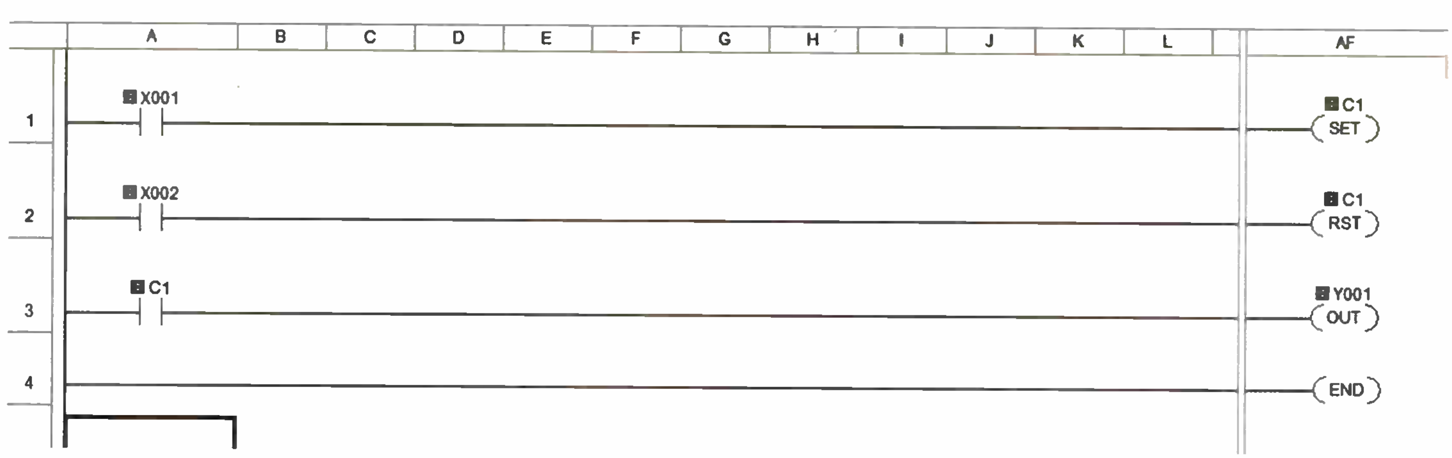
PC Connection to the PLC serial port

FURTHER DISCUSSION

To be sure, the sample program is trivial and meant solely as quick demo of the PLC. If you examine the brief overview of the click specifications I outlined above, it is clear there is a great-deal of capability available. You can declare the inputs to the PLC to be standard on/off inputs, or "pulse-catch" which allows the designer to actuate a de-bounce filter or to declare the input to be an interrupt initiator. (Interrupts are useful if you need a priority handling routine in your program to immediately divert the PLCs attention to a critical process — think of a big red Emergency Stop button). Should you need to add inhibit action in a line of ladder code, you can add a normally-closed contact from one of the inputs in series with the X001 contact which, if actuated, will prevent the external device from being turned on (think of an interlock or a limit switch).

INTERNAL AND SYSTEM CONTROL RELAYS

A very useful set of built-in control relays (again, not physical relays — memory registers) are available for you to use with the



Latching Relay Program

What this also means is that you can "rewire" your system with mouse clicks — not with a soldering iron and wire cutters.

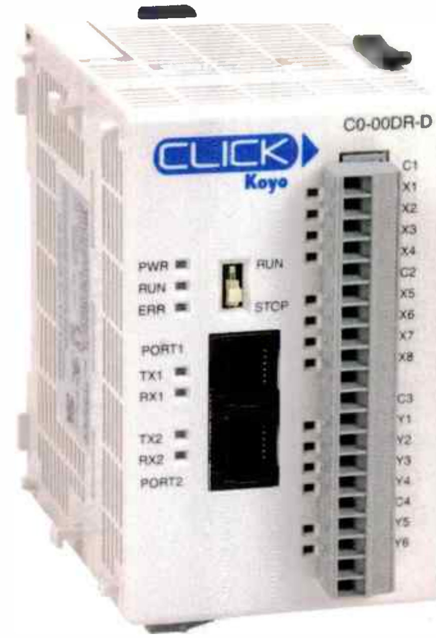
Click (and most other PLCs). These save you lot of time and thought by not attempting to create your own.

Some examples are: Real-Time Clock, 10ms, 100ms, 500ms, 1-sec, 1-min, 1-hour pulses, watchdog timer, battery status, various PLC error flags, data port status flags and PLC status flags.

One of my projects was a directional antenna controller with an automatic pattern change feature which made use of the PLC's RTC and its internal comparators to match real time with entries in an internal data array table in order to perform the automatic day/night pattern change.

So far, we have covered some internal architecture and operating system of the PLC; we've suggested where to purchase your first PLC, discussed where to get the software, and finally how to get connected to the PLC. In this article (second in the series), we've designed a simple program to test the PLC and discussed the powerful instruction set which you have available to you.

Next month, we'll go into more depth discussing various programming methods, some tips for a more stable running program and something called "tags." As the programs become more complex with hundreds of lines of code, some good practices should be followed in order to avoid unexpected results and I'll discuss them.



The Click 14-point PLC, right out of the box

by Jeremy Ruck, PE

Listen to the Stories Your Meters Tell

One of the major lamentations of the small- to mid-size market engineer is the dearth of test equipment available for their use. While this problem may not always affect a contract engineer with a robust portfolio, or a group chief, it tends to be especially acute for our brothers and sisters functioning as employees. This month we look at some of the test gear used on the RF side of AM antenna systems.

I have always thought of monitoring a directional antenna system as something akin to a three-legged stool: When all three legs are there, and in good condition, you can plant your keister with confidence.

The three simplest pieces of test gear for a directional AM antenna system are the current meter, the field strength meter and the phase monitor; and although no longer required under commission rules, well-engineered stations will maintain and rely on their base current meters. Regular measurements with these items will ensure the health of the array and help you to spot problems.

Let's take a look at each of these items.

Changes in current meter values, with no corresponding power change, are indicative of an impedance change. If noted at the common point, the impedance change could be something simple in the trim circuit, which matches the actual common point to the transmitter impedance; or it could be a more complex issue elsewhere in the array.

From the base currents, inferences to the ground system and seasonal shifts can sometimes be made from the absolute values, while the current ratios are indications of pattern shape.

Baseline impedance values measured at the phasor output and ATU inputs can also serve to aid in quickly identifying the location of a problem should it develop. In other words, when the array is all tuned up and working nicely, make reference impedance measurements at those locations, and note them in the log. They could be very useful down the road.

Phase monitor inputs can occasionally be affected by lightning. An easy check on phase monitor health is to take the reference input and parallel it to the other inputs with tee adapters and short lengths of coax. A healthy monitor will indicate very similar magnitude readings across all inputs, with some minor variations in phase. Several degrees of change in phase are to be expected with multiple adapters and short cable lengths.

The AIM 120 is a fits-in-your-briefcase VNA that works in conjunction with a laptop or PC.

Monitor point values at variance from typical norms, or in excess of licensed values, should be investigated. In some cases, the array may be experiencing seasonal variations. In others, environmental factors may have changed in the vicinity rendering the current limit invalid.

The use of the impedance bridge further quantifies the condition of the system. Bridges come in two different flavors, which can be referred to as "cold" and "hot" or "operating" versions. The two most well known cold bridges are the General Radio models 1606-A and 916-AL. Both of these bridges require the use of an external driver and detector, and are to be used only by the very low power levels provided by generator/detector combos. The two most common models of that are the Delta Electronics RG-4B and Potomac Instruments SD-31, which provide both in one box. Alternately, an RF signal generator may be utilized as a driver, with a field strength meter being used as a detector.

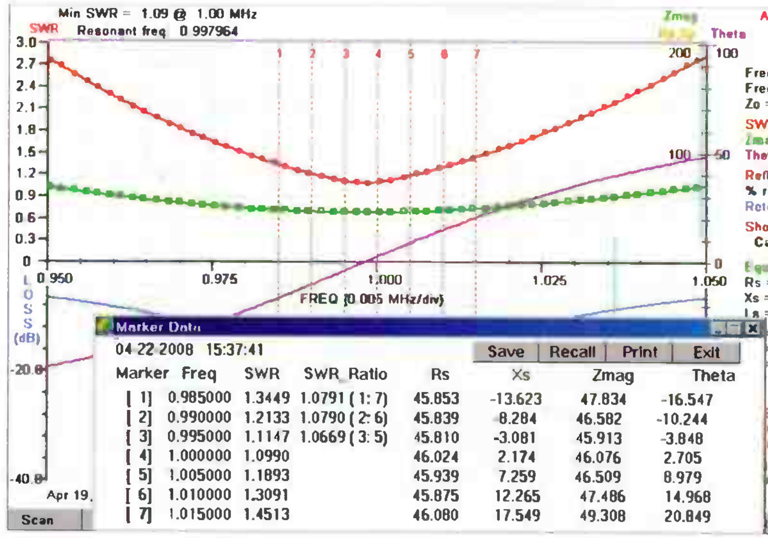
In order to measure impedance values under operating conditions, a "hot," or operating impedance bridge is utilized. Several varieties of these are manufactured by Delta Electronics including the Common Point Bridge and OIB families. The CPB family has three different power levels (5, 50 and 100 kW) available, intended for permanent installation at the common point of the phasor. These models have a measured resistance range of 30 to 100 ohms and a reactance range of plus/minus 50 ohms at 1000 kHz.

On the portable side is the OIB family. The initial model is the OIB-1, which covers resistance values of up to 400 ohms, and reactance values of up to 300 ohms at 1000 kHz. The newer version is the OIB-3, which expands the resistance range to 1000 ohms either side of a short, and the reactance range to +/- 900 ohms at 1000 kHz. Both of these models will handle up to 5 kW of modulated power, or up to 10 kW dead carrier, and also function as a cold bridge with a RF driver/detector combo.


Courtesy of Jim Hatfield

Jim Hatfield Sr., taking field measurements for KIRO, about 1941.

Since the GR and OIB bridges follow slightly different designs, they present reading values differently. The OIB requires no user balancing, and provides direct readouts based on the dials and a combination of extender switches. The indicated dial value for reactance must be multiplied by the frequency in MHz, while no conversion is necessary for resistance. Similarly, the GR bridges require no conversion for resistance,



The AIM 120 not only collects the data but also facilitates the generation of graphs — helping the user through its analysis.

but the reactance conversion is one where the dial reading is divided by the frequency in MHz.

Additionally, the GR bridges require balancing at the frequencies of operation, and the reactance reading is relative to the balance point. A typical balance of the bridge occurs by setting the resistance to zero ohms, and the reactance dial to some value that will cover the expected measurement range. For example, assuming a station at 1000 kHz and a measured reactance range of +/- 300 ohms, we would set the dial for 300 ohms, and then with the bridge grounded, adjust the initial balance knobs for a null. This means that an impedance of 0+j0 ohms is indicated by the bridge as 0+j300 ohms. Put another way, 300 must be subtracted from the measured reactance value to obtain the actual reactance. Since we are testing at 1000 kHz, no additional conversion of the reactance is required.

As they become more cost effective, the vector network analyzer is finding more and more use in the AM station of today. Perhaps the most cost effective VNA for AM use is the Array Solutions family. In particular, the Power AIM-120 is specifically designed for use for broadcast measurements. The analyzer itself, which runs almost forever on a gel cell battery, is slightly larger than two packs of smokes laid side-by-side, and is controlled by a PC platform computer such as a laptop or tablet. The unit can also function as an impedance bridge using tones, has distance to fault, and generates Smith Charts. Due to the single port configuration and software design, this unit is generally limited to a cold bridge type of measurement.

The balancing of the GR bridges discussed functions like calibration. While the OIB bridges do not require user calibration techniques, the network analyzers do. Calibration of the analyzer establishes the reference plane, and eliminates effects of connectors and cabling up to that point. Typically, calibration standards come with a fixed connector, such as the "N" type. Thus, when calibrating for AM use, which more often than not utilizes alligator type clips, attaching the clips to the standard directly with care is care is a good practice. Although some stray inductive and capacitive effects remain due to clip placement, their impact will tend to be much smaller than connecting the standards directly to the analyzer port, and ignoring the cable entirely. This can become very critical in situations where high reactance values are present, such as on skirted towers, or those with multiple isocouplers.

From the simplest current meter all the way to the most complicated network analyzer setup, a story is told.

Network analyzers are verbose and provide much detail, but like a complexly woven tale, details can be overlooked or misinterpreted. A current meter, like a haiku, lacks details, but conveys a powerful message. Even if the library is incomplete, much can still be learned from what is available.

Ruck is the principal engineer of Jeremy Ruck and Associates, Canton, Ill.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VPN Adds Safety Factor When Using Public Internet

by Doug Irwin, CPBE DRB AMD

Like it or not, broadcast engineers must pay close attention to network security. After all, we've seen what can happen to a station when the proper amount of diligence isn't applied. In this article, we're going to cover the use of the public internet for business, and specifically, making use of virtual private networks.

A LITTLE HISTORY

Twenty-five years ago, most computers around a radio station were used for traffic, billing and accounting purposes. In the mid-1990s, stations started adding direct internet connections. Though there were many obvious things a station could do, there were also, not surprisingly, unintended consequences from the connection.

Once you open a window to the rest of the world, it should come as no surprise that someone on the outside would try to sneak in through it. Such is the public internet.

Fig. 1: Typical remote user with VPN client on local machine.

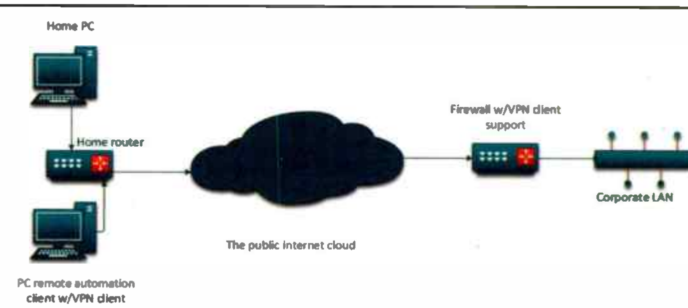

Fig. 2: VPN client running on instance of remote automation machine.

BASIC FEATURES OF VPN

VPNs are very secure and a great way to keep the bad guys out of your network, while allowing legitimate users the remote access they need. Before discussing applications of VPN, let's talk a little about just what it does. Use of VPN facilitates the following security features:

Authentication. Verification is provided to make sure the packets are coming from a legitimate source, and not someone else in the middle (that is, somewhere else out in the world). The packets are encrypted and can only be decrypted by the receiving computer or VPN endpoint. Authentication ensures that only the people that are supposed to see the packets actually do.

Integrity. Packets are verified so that the receiver knows they weren't modified along the way.

Antireplay. This is a feature that prevents someone in the middle from copying the packets and resending them later. The bad guys can copy a stream of data on the internet, modify it ever so slightly, and then play it out to the receiving device, which in turn "thinks" the data came from a legitimate source and allows it into the network. This is just one way your network can be compromised.

Privacy. No one in the middle can read the data transported by the packets because they are encrypted and only the receiving end can decrypt them. The data looks like scrambled garbage to everyone except the user that can authenticate it.

These features are accomplished by the establishment of a VPN tunnel between two "edge" devices (that is, two devices that have an interface connected to the public internet). In this context, "tunneling" means that the packets are encapsulated by inserting them within another packet. A VPN tunnel means that the encapsulated packet has been encrypted — making it indecipherable to anyone that happens to pick it out as it transits a network.

The VPN devices also add extra headers to the encapsulated packet, with fields that allow for the security features described. When packets are received by way of the tunnel, they're stripped of the extra header, de-encrypted, and then sent out on to the local network that is behind the VPN device. The sending device and receiving device usually are not aware that the packets sent and received have

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Registration sponsored by: Marketron | facebook.com/radioshowweb | @radioshowweb | #radioshow2016 ever been through a tunnel. When implanted between routers, VPN tunnels are transparent to all devices on the network. Only the edge routers "see" the VPN packets and can decrypt them.

COMMON USES OF VPN

Network security issues notwithstanding, it's clear that there's no going back; the public internet is ubiquitous and cheap, and its problems are far outweighed by its usefulness. One must learn to live with its inherent dangers, and one way to do that is by using VPN.

(A note on the scope of this article: We're not going to cover the details of system configuration for VPN — meaning neither command line nor web-based methods. We'll discuss action items towards the end so that you can still get such systems implemented.)

Some of the most common uses of VPN are as follows:

Remote VPN client. (See Fig. 1) If you work for a larger broadcaster that has a corporate IT department it's likely you already work within corporate policy that includes use of VPN. On the other hand, if you work for a smaller organization, you may not have gotten quite this far yet. When working from a remote location (such as home) the remote computer will make use of a client that, when opened, establishes a secured connection to your LAN. Your remote computer, for all intents and purposes, is on the remote LAN. This naturally comes in very handy if you want to work from home or some other remote place. All the other hosts on the LAN can be accessed as though you were plugged in to the same layer-2 switch.

Remote talent with automation. (See Fig. 2) I have worked with at least one circumstance of a remote talent who required our automation system at home and needed to do WAN-casting from there. That person was working from home, just like anyone else could — but clearly the situation was slightly more complicated. In reality, this talent could, by way of the VPN connection, place carts in to any station's automation, anywhere in the company, all across the country. A simple cable-modem provided the physical layer connection to the internet.

Remote office. (See Fig. 3) Working from home usually means opening the VPN client and closing it when finished. However, you may have a situation with a remote office — for example, a sales office in another town — that needs a permanent, secure connection to your headquarters. In this situation, both ends would have a VPN router, and the two would make a secure connection that would remain in place all of the time. In this way, two geographically separate networks can appear to all users to be one single LAN. A variation on this idea is for the VPN connection to be used over the public internet in the event that a regular, point-to-point connection provided by the local Telco goes down.

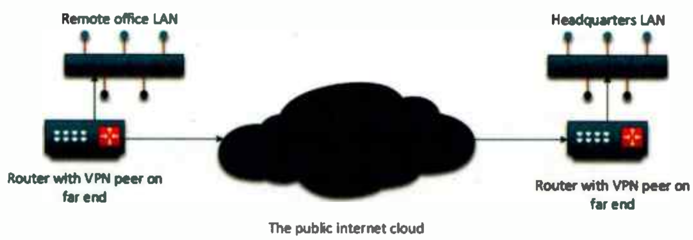


Fig. 3: Main office and remote office connected via the public internet but using VPN peers.

Fig. 4: Transmitter site configured as LAN extension using VPN peers.

Remote transmitter site. (See Fig. 4.) Clearly a remote transmitter site can be considered as a remote office. Having it as part of the same LAN can be very handy while you are in the office during the week — since connections to remote hosts are going to be easy to make — in fact, just as easy as any other connection around the station. In some instances the same kind of functionality can be achieved through the use of port-forwarding through a firewall located at the remote site. The advantage to the remote user is that no VPN client is necessary; the disadvantage is that your firewall could be hacked.

IMPLEMENTATION

As I wrote earlier, VPN configuration is beyond the scope of this article, but I will suggest means by which you can still see that it is used to provide security for your use of the public internet.

If you happen to have the IT chops to configure VPN yourself, then take a look at the scenarios presented above and if appropriate, put them to use.

If your station has a separate IT department familiar with VPN configurations, then discuss the ideas presented earlier and see if any are appropriate for your station or facility.

It is possible that engineering and IT simply have not previously discussed network security as it relates to a transmitter site (as one example). We all know that there are many IT day-to-day issues that are "fires," and infrastructure issues sometimes slip through the cracks.

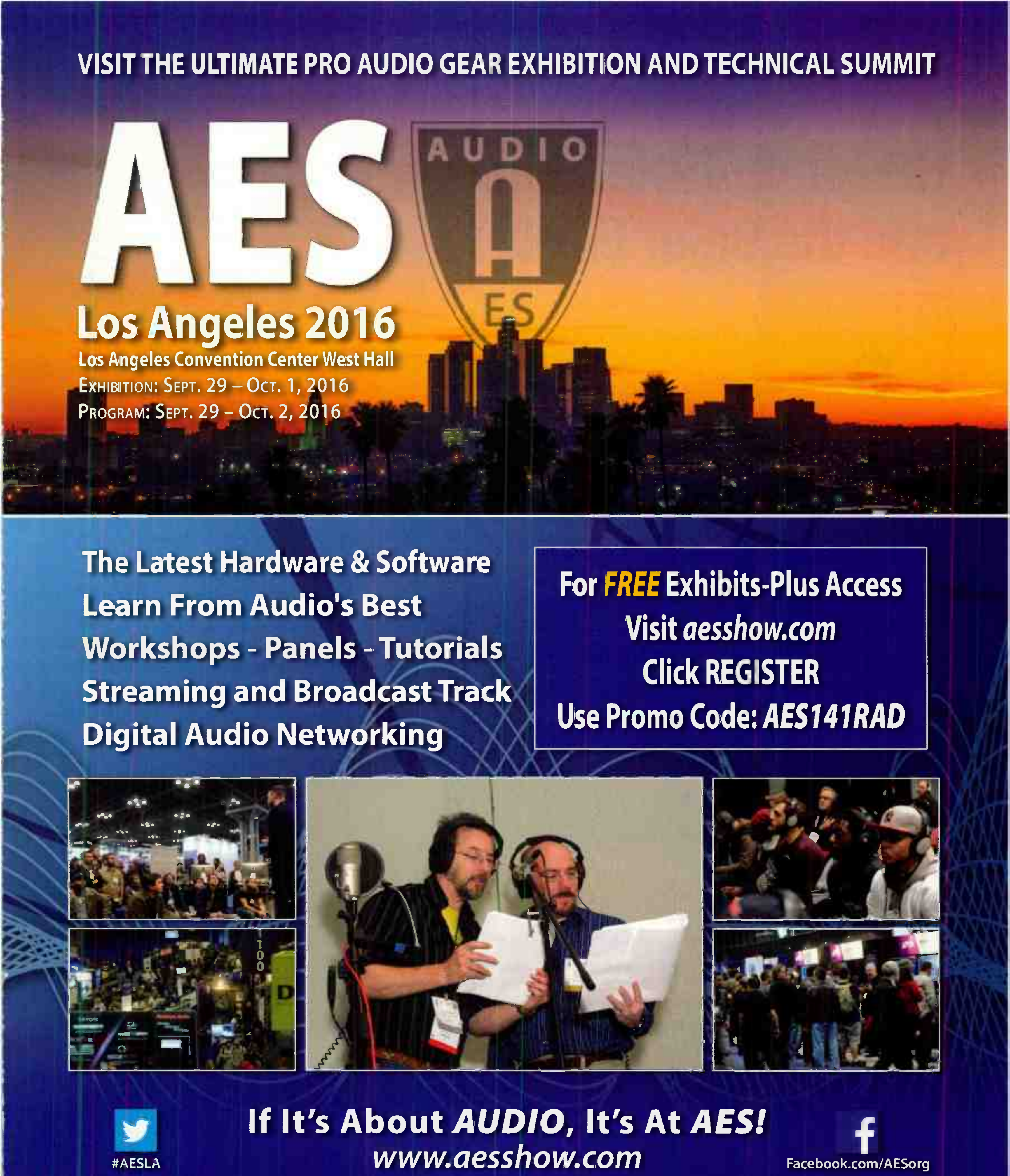
If you are by yourself without the time to learn how to set up VPN connections then consider hiring a local IT consultant to help you through the implementation. Sure — it will cost, but it's cheap compared to the expense involved in fixing the consequences of poor network security.

AOIP CONNECTIONS THROUGH THE VPN TUNNEL

One of the most common uses of the public internet is the transmission of audio over IP and you may be doing that already for 'nailed up' connections like an STL. The addition of VPN between the two ends will not adversely affect AoIP connections according to the manufacturers with whom I communicated for this article, which include Comrex, Telos, Tieline and Worldcast Systems.

Though it represents one extra step in configuration, and one extra on-going function to maintain, the use of VPN is a great way to secure your internal networks, hosts and all the features for which they are used.

My thanks to Chris Cottingham for his help in the preparation of this article.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HD Radio Time Alignment and the Belar FMHD1

by Ed Allen III, CPBE

Cox Media Group was an early adopter of HD Radio; we first went on the air with HD in 2005. At the beginning HD Radio installation was fairly simple, regardless of your transmission system, hi, mid, low or space combining — you had an HD exciter feeding a transmitter and time alignment was fairly simple.

As things became more complicated with multiple HD channels and the addition of importers and exporters, installation methods began to vary. With varying types of connections between importer, exporter and the Exciter Exgine things became more complicated and timing started to drift. Listener complaints forced the industry to take action. Some local radio dealers actually stopped selling HD Radios because buyers returned "broken" radios due to time alignment issues.

From the earliest days when you listened to FM with one ear and HD with the other, to newer equipment that measured the difference between the two, the time adjustment was always manual. With six HD stations, keeping things aligned can take a good chunk of time out of your day.

Several years ago, we purchased a Belar FMHD1 and installed it at the studio with an outdoor antenna. This allowed us to monitor all six of our HD stations. The FMHD1 has real-time measurement of over-the-air analog versus HD Radio time alignment. This provides a tremendous improvement from earlier equipment that required you to measure, then align, then measure again, etc.

Using IP we are able to connect to the web GUI from the transmitter. This allowed precise adjustment of time delay at the transmitter, or using VPN anywhere else. But still the adjustment was manual.

When Belar announced new firmware for the FMHD1 that would automatically measure and adjust time alignment, we jumped at the chance to check it out.

Since we already owned an FMHD1 it was a simple matter of updating the firmware on the unit. It will now automatically measure and adjust up to six stations.

We use the time delay in our audio processors to delay the FM signal. All processing is done at the transmitter; we use a combination of Orban 8500HD, 8600HD and Omnia.11 processors. We have had no problems interfacing with any of these processors. The FMHD1 will also interface from most current processors from most major manufacturers and most exporters, if you do your time alignment there.

CONFIGURATION

Setup is fairly simple. All processors or exporters you wish to automatically adjust must be available via IP and you will need to know the amount of delay dialed in to each processor.

Then, using either the front panel or the web GUI on the FMHD1 (I have found the web GUI to be easier), you enter the frequency of each station you want to check and how long you want it to monitor that station before moving on to the next. I have found that five minutes per station works well — less time than that often does not give the FMHD1 enough time to analyze and adjust the station.

Next, go to the "configure" tab for each frequency, where you will enter the IP address of the processor or exporter for that station, user name and password for that processor and how often you want to update the processor delay. I found one minute works well. Enter the amount of delay currently in the processor. This

The FMHD1 front panel display

sets the center of the alignment window. Then go to scan and enter "enable."

The FMHD1 will start at the first station, measure time alignment, connect to the processor via IP, then send a correction value to the processor at the interval you entered. In my case it spends five minutes on each station and sends a correction value to the processor every one minute. At the end of the five minutes, it moves on to the next station and repeats the process. We leave our unit on, and it continually corrects 24/7.

You can monitor the status of auto correction either on the front panel display or via the web GUI. On that display you will have the bar graph showing audio level difference and time difference for both "average" and "fast" measurements. Time difference is shown in both the number of samples and in milliseconds. After connecting to the appropriate processor it will also show the current amount of delay within the processor and the new value that will be entered at the next correction interval. You will also find the time remaining to the next correction and the time remaining before it switches to the next station. If you are only correcting one station, it will remain on that station and continually correct audio delay.

Some things the FMHD1 will not do — for example, it will not adjust audio levels. It will tell you the difference in audio levels, but that's all. The display will show you audio difference of up to 20db, but does not specify which is louder, FM or HD. By trial and error I determined that the level shown is for the HD, so adjusting audio to the minus side will reduce the audio on the HD. I have also found that if you adjust audio to 0db difference, the HD audio will be louder than the FM. We have found that setting audio to -2 to -3db gives the smoothest blend between FM and HD.

It will also not adjust phase; it will tell you if your HD and FM are in phase, but you have to make the adjustment in your equipment yourself.

One minor inconvenience in the display is that it only tells you the average delay error. The web GUI shows both fast and average delay error and it would be nice if that were available on the front panel as well.

Aside from the minor glitches I described, it's a great unit. It's been keeping our six FMs in time alignment for several months now. It's nice not to have to check the time alignment every day and know that it's correct. ■

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A Solid Wall of RF

by The Wandering Engineer

When I find something that works, I buy a lifetime supply. One of those rare things was a small FM transmitter with digital readout.

You might remember these little transmitters. Before streaming was cool, one could take a laptop with a wireless network card (EVDO in those pre-LTE days), tune in Wisconsin Public Radio and transmit it on an open FM frequency to the car radio as one drove down "the 101" (that's California-speak, where all highways begin with "the").

Not a bad trick…listening to a pseudo-radio playing the cheesehead informational hits while cursing the LA traffic.

You really needed to pull over to "tune" it, but I do know that it would not disconnect from San Diego to Santa Barbara — a run of about 200 miles, give or take.

One of the neat things was that there were only a few open "slots" on the FM dial, so when I shut the little transmitter off, I could hear an endless string of cars on the highway dip in and dip out with whatever tape or iPod-type device they were listening to.

Within a few years, the open slots weren't so open, especially when a Franken FM took that magic 87.7-87.9 slot.

My listening habits were saved, at least temporarily, when one manufacturer produced a high-quality (read: more than Part 15 power level) device that would kind of blow a hole open on the dial. One could hear these a block away, so of course, some broadcaster called foul, and magically, the imports stopped. I thought I had bought a lifetime supply, but alas, poor construction and design limited the device's lifetime.

In the end, it made more sense to buy cars with USB slots, two outlets — one always on, one not — a mini-plug and Bluetooth. Today, I really don't want to drive a car that doesn't have those.

When it comes to rental cars, half the time they don't have all of that stuff, and the other half of the time they block the Bluetooth; that means I have to consume radio like a "normal" person.

And that is easier said than done.

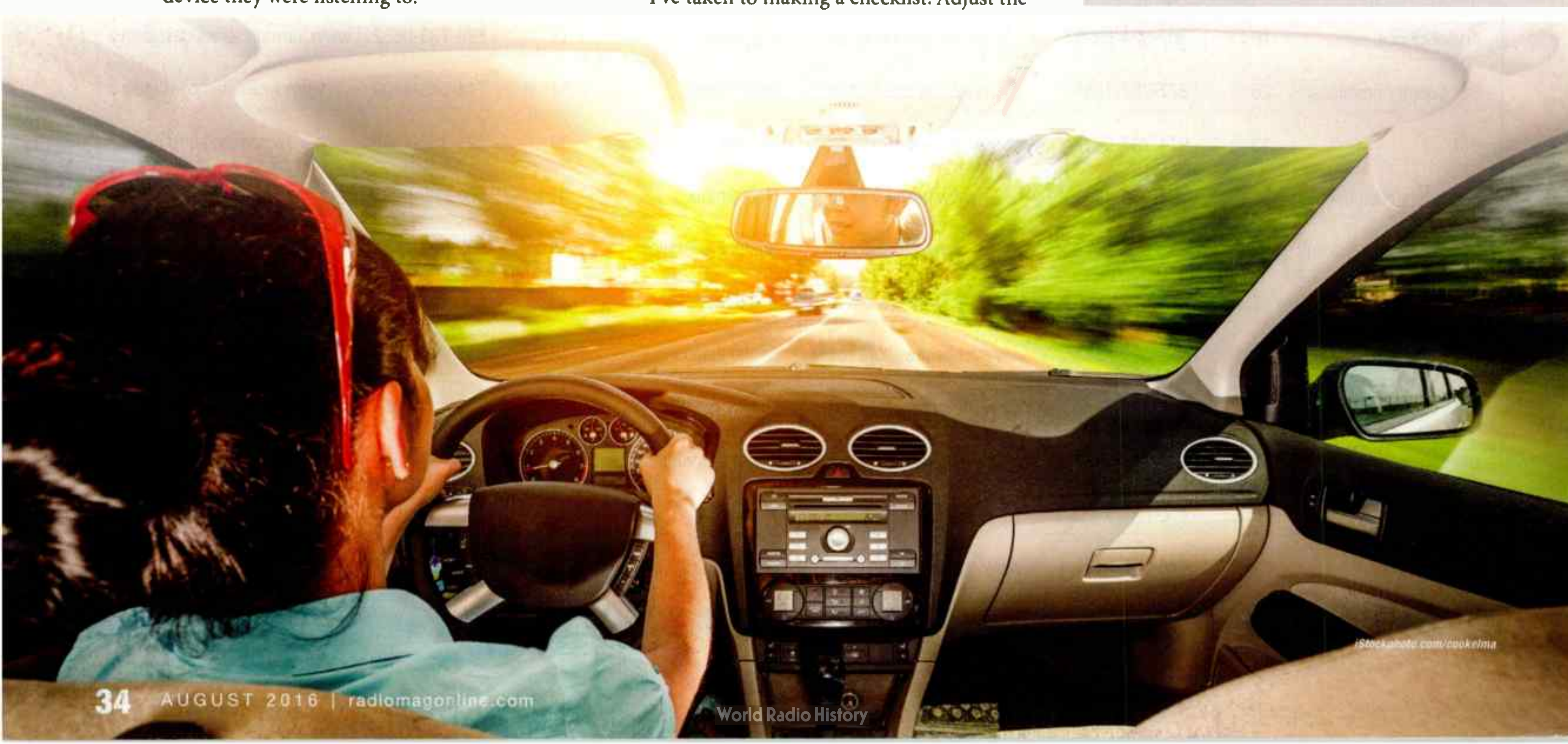
I've taken to making a checklist: Adjust the mirrors, check for damage, make sure there is gas in it —and then set up the radio and familiarize myself with its quirks.

Some of these radios really did have me reading the manual and googling "how-to-dos." The last time I rented a car, I chose the same model as the car I own, just so I didn't have to learn how to use the radio — but even that didn't work! The model year change incorporated a completely different user interface.

I can't believe I just said "radio" and "user interface" in the same sentence.

Two knobs and a dial do a pretty good job. Nested menus and mixing tactile and touch screen controls give you access to lots of features, but all I want to hear is a traffic report and maybe scan to see if there is something interesting, like a reggae station. Listening to the radio should never be this hard.

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.



10 INCREDIBLY AWESOME THINGS YOU CAN DO WITH A BLADE BEFORE YOU EVEN NETWORK IT

REPLACE YOUR SOUNDCARD

When you install the WheatNet-IP driver, you can get rid of your soundcard, its breakout box, switcher, serial interface, and your isolation. Stream up to 24 stereo channels of audio to a WheatNet-IP system (8 per BLADE).

INTERFACE & CONTROL ALL YOUR STUFF

12 logic universal GPI/O ports along with 128 software logic ports for you to control whatever you have plugged in. When you finally get to a network, control everything on it without breaking a sweat.

CREATE & MANAGE COMPLEX SIGNAL PATHS

Say you need a mix-minus for a live show or remote broadcast. With our ASSOCIATED CONNECTIONS, you can create a predetermined back haul, IFB feed or mix-minus for each device based on its location in the system or on a fader. When a base connection is made, up to ten additional connections can be made.

PROCESS STEREO AUDIO

Each BLADE-3 has a stereo multiband processor with:
4-band parametric equalizer,
3-way crossovers, 3 compressors,
3 limiters, and a final lookahead limiter - all can be used across a network.

PLAY NICELY WITH OTHERS

You've got some other gear you want to use. No problem. Your BLADE is fully AES67 compatible to allow exactly that. We've been to PLUGFEST with our BLADES and we know they work perfectly with anyone else's stuff that's up to snuff.

SPIN SOME REALLY COOL AUDIO CLIPS

There is an optional built-in audio clip player that you can use to put emergency audio on the air. Add files, organize the playlist, and fire playback with a logic port, triggered by silence, logic or manually.

DIAL IN A MIX OR TWO

There are TWO 8 x 2 mixers built into the BLADE. Why? So you can combine multiple inputs and deliver lovely mixed stereo audio. Of course, you can configure those mixers any way you like.

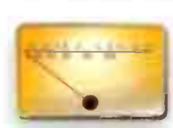
USE YOUR FAVE AUDIO FORMATS

There are a bunch of audio formats out there and we've got them covered. HD/SDI, AES, MADI, AOIP, ANALOG, TDM.

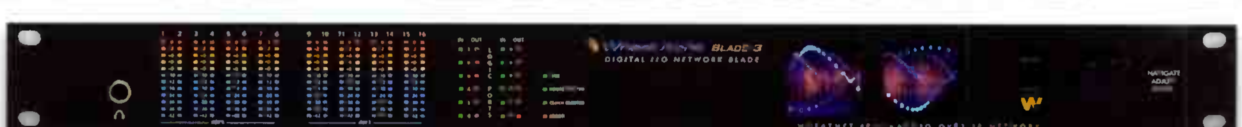
MAKE FOUR VOICES SOUND AMAZING

With the M4-IP USB mic processing BLADE, you get all this cool BLADE stuff, AND you get FOUR built-in voice processors based on our famous M-1/2.

DETECT SILENCE AND DO SOMETHING ABOUT IT



The BLADE is constantly monitoring stuff. Silence, for instance. When it finds it, it can do just about anything you want, INCLUDING having it play clips that it optionally stores.



And as cool as all this is, it's just the start. Wait until you network it with our intelligent control surfaces, talent stations, panels and other BLADEs. It'll blow your mind. Learn a lot more at: blades.wheatstone.com

BLADE-3 AN ENTIRE BROADCAST PRODUCTION STUDIO IN A SINGLE RACK SPACE

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