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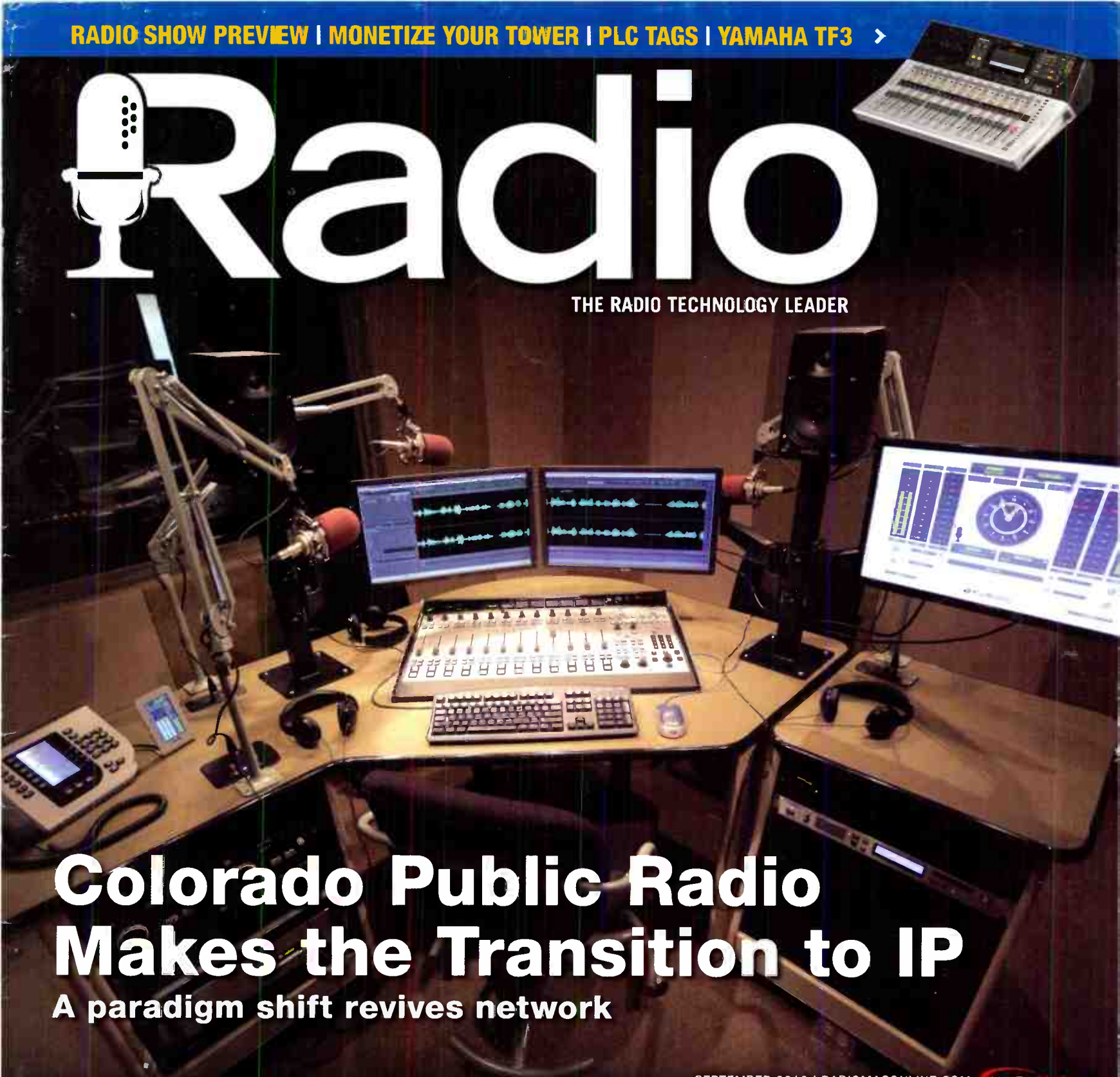
Radio

THE RADIO TECHNOLOGY LEADER



Colorado Public Radio Makes the Transition to IP

A paradigm shift revives network

SEPTEMBER 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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Ryan Warner of CPR News busily reacying a story.

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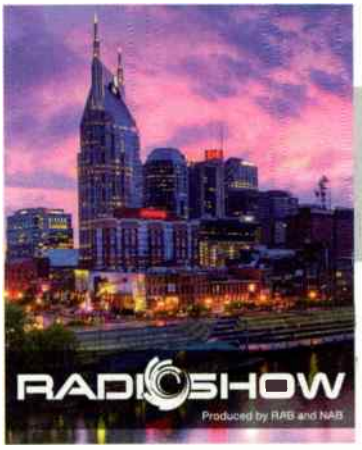

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On the cover: One of CPR's eight on-air studios, featuring an Axia Fusion console, Telos VX and furniture by Graham Studios.
Photo credit: Ervin Coffee

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 IBT-300 Drive Bluetooth Audio Reciever**. Send your entry to *radio@RadioMagOnline.com* by **October 5**. 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

Fall in Love With Remote Season

Out here on the West Coast, where I'm based, September represents the end of summer, and it's still hot on most days. However, I know leaves are already turning in many parts of the country, and high school sports are playing their usual fall role. Consequently, we're following a bit of a joint theme this month: sports coverage and AM radio.

But first, Lee Petro will bring you up to speed on the nationwide EAS test that is scheduled for the 28th of this month. And were you aware of the prohibitions relating to the advertisements of e-cigarettes? If not, you should read FCC Update right away. Ignorance is no excuse, as far as the commission is concerned — of course, if you read the magazine regularly, you're probably well aware of that.

Chris Wygal is back in this issue with a review of the Yamaha TF3 mixer. While its role is mainly for front-of-house applications, you might want to try it for remotes. It certainly has the capacity to do that, and more. Check it out in Field Report.

I know thousands and thousands of sports remotes have been done over the years in the same tried-and-true method: two mics, single-bus mixer and a Marti. I'm going to suggest, though, that it's time to add some sizzle to your remotes. If you follow professional or college level sports, you quickly come to appreciate all the technology used in producing them. This month's Trends in Technology column is meant to give you some easy-to-implement ideas for improving the quality of your local sports remotes.

Jeremy Ruck is our resident expert in AM radio engineering, and this month he's back with some ideas about how to increase revenue using your AM towers. And along those same lines, the Wandering Engineer waxes poetic about tall towers in Sign Off. I know many engineers who feel the same way he/she does.

Each month, we endeavor to teach you something new. For September, Colorado Public Radio is featured as our facility showcase. They've built a great new facility, all based on audio over IP. How soon will you apply this same technology to your facility, if you haven't already?

Dennis Sloatman returns with his series on programmable logic controllers. This month, he goes into the inner workings of the device, describing the tag database. If this topic is new to you, please read the first two articles, found in our July and August editions if you want more background. (If you've misplaced your copies, remember that you can find links to the digital edition archive at *radiomagonline.com/currentissuearchive*.)

We've talked about SNMP extensively. However, what if the networked function you need is associated with an older piece of gear that doesn't support SNMP? Is there still a way to use it? The answer is "yes" in many cases — check out Tech Tips this month for some ideas on how to make it work for you.

I'm attending the fall Radio Show in Nashville at the end of the month, and I hope to meet you. If you haven't given any thought to the show, check out our Radio Show 2016 preview. It might not be too late to make some travel plans!

Doug Irwin, CPBE AMD DRB | Technical Editor

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THE RADIO TECHNOLOGY LEADER

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Of Emergency Alerts and E-Cigarettes

by Lee Petro

The Federal Communications Commission announced that there will be a nationwide test of the Emergency Alert System on Sept. 28 at 2:20 p.m. (Eastern Daylight Time). All EAS participants are required to participate during the national EAS test.

Prior to the national EAS test, EAS participants should review the information they submitted in the EAS Test Reporting System to ensure that no changes are necessary. If changes are required, they must be made in ETRS by Sept. 26.

The FCC will require all EAS Participants to submit an initial report regarding their experience during the National EAS test by 11:59 p.m (EDT) on Sept. 28 — i.e., the same day that the national EAS Test is conducted. The initial report (Form Two) requests that the EAS participant confirm that it received the EAS signal from its assigned monitoring source, and that it responded in accordance with the FCC rules.

Subsequently, the FCC will require that all EAS participants submit a second post-test report (Form Three) no later than Nov. 14. Form Three requests additional information from EAS participants regarding their performance during the national EAS test. In particular, Form Three seeks information on the specific timing of the respondent's receipt of the EAS signal from its monitoring source, and whether there were any complications associated with its receipt.

Form Three also requests information regarding the performance of the EAS participant, i.e., whether there was any equipment performance or user problems associated with the signal's retransmission. If there are any issues or complications that arose during the national EAS test, then the EAS participant is requested to provide an explanation.

Finally, two reminders: First, the FCC considers the following licensees and service provides as EAS participants: (i) radio and television broadcasters; (ii) operators of cable and wireless cable systems; (iii) Direct Broadcast Satellite licensees; (iv) Satellite Digital Audio Radio Service licensees, and (v) wireline video system operators. Second, if you are unclear about your responsibilities during the National EAS Test or what equipment is required, you should review 47 C.F.R. 11.11.

GUIDENLINES ON E-CIGARETTE ADS

In the May 2014 FCC Update, I discussed proposed rules released by the Federal Drug Administration to regulate electronic cigarettes as a tobacco product. In May 2016, the FDA adopted new rules that affect e-cigarettes and other electronic nicotine delivery systems (e-hookah, e-cigars, vape pens, advanced refillable personal vaporizers, and electronic pipes) by classifying these products as tobacco products.

By expanding the definition of "tobacco products," the FDA set forth guidelines regarding the advertising of these products. The stated purposes of these new rules is to protect youth and young adults from tobacco-related death and disease.

In particular, the new guidelines prohibit the targeting of advertisements of these newly-covered tobacco products to minors (i.e., under the age of 18) and also prohibit advertisements that contain statements that would mislead the public with respect to the health benefits of e-cigarettes or other newly-covered products. These new guidelines not only affect the content of radio and television advertisements broadcasted over the air, but also advertisements on websites, social media sites, billboards, email and texts.

Therefore, broadcasters should immediately update their screening process for new advertisements throughout their organization to ensure that they do not accept advertisements that could be seen as targeting minors or promoting the health benefits of these products. Moreover, careful scrutiny should be given to broadcasters' sponsorship of live events to ensure that any advertisements or promotional materials relating to these newly-covered products comply with the new FDA rules.

DATELINE

Oct. 1, 2016 — Stations with five or more full-time employees in Alaska, Florida, Hawaii, Iowa, Missouri, Oregon, Washington, American Samoa, Guam, the Mariana Islands, Puerto Rico, Saipan, and the Virgin Islands must place their Annual EEO Public File Reports in the station's public inspection file.

Oct. 3, 2016 — Stations with 11 or more full time employees in Iowa and Missouri file their Mid-Term EEO Report (FCC Form 397) with the FCC.

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

The CPR Bridges Broadcast Center is located at the Denver Tech Center in Centennial, Colo.

CPR's Prognosis Is Good With Axia [In]Fusion

by Judy Bandstra, Broadcast Engineer, Colorado Public Radio

In the world of electronics, 12 years can be a lifetime. Systems fail, technology changes, and the "state-of-the-art" system you commissioned is at its end-of-life.

Last summer, it became clear that the audio routing system at the heart of the Colorado Public Radio statewide network was failing. Multiple attempts to revive it proved fruitless. The equipment was dying. This spring, CPR breathed new life into its air waves.

Colorado Public Radio was born 46 years ago in a broken-down old house on the campus of the University of Denver. It was run by students back then and called KCFR. It was a tiny, news-only, 10-watt station, the first non-commercial public radio station in the city.

In 2004, KCFR moved to our current location, south of the Denver Tech Center in Centennial, Colo. By then, we had acquired KVOD, a classical format and re-branded to become Colorado Public Radio. Today, the Colorado Public Radio family includes three separate services: CPR News, CPR Classical and CPR's Open Air, a new and independent music format.

Our network reaches more than 470,000 listeners each week over a statewide web of 13 stations and 17 translators. The source audio for our network originates from our Tech Center home base, which houses eight on-air studios, one live performance studio, five voice-tracking sound booths and the hub of our satellite and STL operations. One additional on-air studio is located on the western side of the Continental Divide in Grand Junction, Colo.

MORE THAN UPGRADES

Now, with the integrity of our network at stake, the audio router, and by extension, the entire audio chain, had to be rebuilt. However, changes in technology over the lifecycle of the existing system required more than an equipment upgrade. It required a paradigm shift from the old world of TDM routing to the new world of audio over IP.

The heart of the new system would no longer be a traditional audio router, but an IP-based data switch. This created concerns about the compatibility of the new system with existing audio chain equipment and with current and future automation systems. There were also concerns about latency in switching and the operational impact that might create.

To address these concerns, Vice President of Engineering Dean Phannenstiel chose Axia.

"We had existing Livewire options with our PRSS equipment, Nautel transmitters and Program Delay Manager boxes," Phannenstiel said.

The Livewire protocol also integrated well with the current RCS NexGen automation

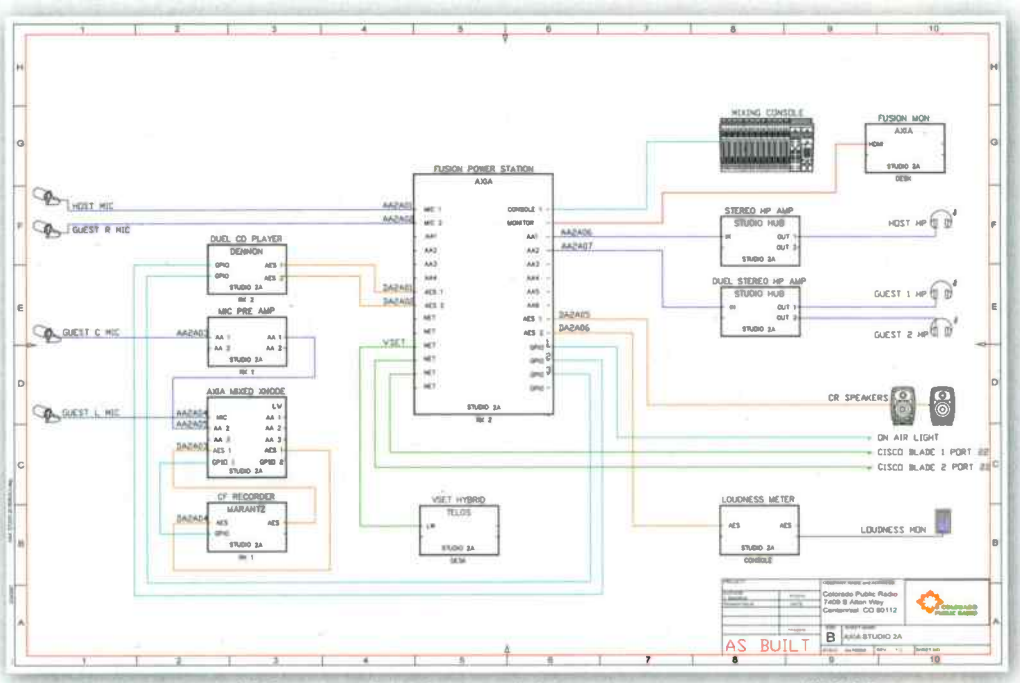
system and with the new Zetta system, which will replace it later this year. Phannenstiel worked with Greg Dahl of Second Opinion Communications to determine which Axia consoles best suited our studio needs. He also looked for advice on Axia user forums and Pubtech and spoke with engineers at other stations currently using Axia. There were definite advantages to Axia that appealed to him.

In the end, Phannenstiel's decision relied as much on gut feeling as it did tech specs. "I liked the look and feel of the Fusion," he said.

After extensive consultation with Dahl, and the CPR Production and Engineering teams, Phannenstiel decided on one Power Station, paired with a 16-fader Fusion console, per studio. Each console is configured with 12 faders and a monitor module. In place of the old Telos hybrids, there is a Telos VX engine, which integrates with our existing Shoretel VOIP system, and a two-line Telos V-Set phone in each studio. One of the operational advantages to this system is that it automatically routes the mix-minus to the appropriate destinations.

Each studio is tied to the rest of the Livewire network through the new nexus of the system, the IP switch. Phannenstiel knew that because it could become a single point of failure, the switch had to be robust: "We had to build it to be nearly bulletproof."

He selected the Cisco 4510 with fully redundant processor boards, switch blades, power supplies and its own UPS. All studios tie back to the switch through redundant Cat 6 lines.



Every station can benefit from complete documentation. Here we see an as-built CAD of CPR Studio 2A, done by Judy Bandstra

The new Fusion consoles were considerably larger than the old boards, so the existing studio furniture needed to be replaced or modified. Rod Graham, owner of Graham Studios, built the original cabinets in 2004. We contacted him and asked if he could modify the furniture to accommodate the new boards. He agreed. His team prebuilt some new desktops at their shop and then made several trips to our studios to install them. They modified the other desks on site.

GETTING IT DONE

We completed the project in three phases.

First, I documented the existing system using Autocad. Every wire and every piece of equipment in our system was catalogued and illustrated in signal flow, location and elevation drawings. That process took several months, but it created a roadmap to guide us in building the hybrid system we would need to bridge the gap between the old time-division multiplexing router and the new Livewire system.

Then, we added Axia xNodes at strategic points within the audio chain. That enabled

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us to seamlessly remove portions of the old system when the new Axia system was brought on line. It also provided an emergency bypass audio path for all sources to the program DA in case of a TDM router failure. We integrated a total of 16 analog, digital and GPI Axia nodes into the audio chain, tying the old and new systems together.

Next, we focused on the studios. Before we decommissioned the old ones, Phannenstiel and broadcast engineer John Van Milligan preconfigured the new engines.

"The Powerstations were configured in both a control room/studio configuration as well as a standalone studio configuration based on what profile was selected. We added additional profiles based on each of our format's needs in addition to some general purpose voice tracking and interview profiles. We created stacking events using Axia Pathfinder to map a specific button on the board to arm the board for 'Live' for any format based on the profile selected. We also created 'next event' buttons for playback control for the automation audio servers," Phannenstiel said.

Our eight studios are paired into four sets, according to station format. To cause the least amount of disruption to operations, we spread the buildout over four weeks, taking one pair off line per week.

Our engineering team worked together to decommission and rebuild each studio. I finished up the final wiring and documentation, and Dahl returned to help with the final configuration. Over the course of the project, there were some studios running on the old TDM router, and others on the new AoIP system. Because of our phase-one hybrid build, the transition was seamless. At the end, when all of the studios were fully converted to the Axia system, we decommissioned the old TDM router.

Once the new system was online, we addressed the initial concerns about switching latency. Because of the nature of the system, some delay was unavoidable, but Van Milligan found a work around for most issues.

Photo Credit: Erwin Coffee

One of many racks in the CPR facility holds DEVA 8008 silence sensor/backup audio players, Broadcast Tools ADMS 44.22 analog/digital matrix switchers and Axia xNodes.

"I knew it was not going to be a show-stopper," Phannenstiel said.

Studio guests can't listen to the final program audio feed to air because it contains too much latency. However, studio headphones and microphones, set to live mode, show no perceivable delay. The biggest concern in moving to the new system was how well end users would adjust to the change. That has not been an issue so far.

"We've really had nothing but positive feedback," he said.

In the technical operations center, we installed an Axia SoftSurface virtual control panel and an Axia 17-button smart panel to assist with confidence monitoring and control. The panel "was configured using Pathfinder to have hot buttons to quickly route predefined sources to air for any of the three services, as well as displaying which studio is armed for live and button color changes for active routes and live studios. To prevent accidental button pushes on the panel, we created a special 'unlock' button that needs to be pushed before a hot button can be activated," Phannenstiel explained.

In the engineering shop, we added a Telos

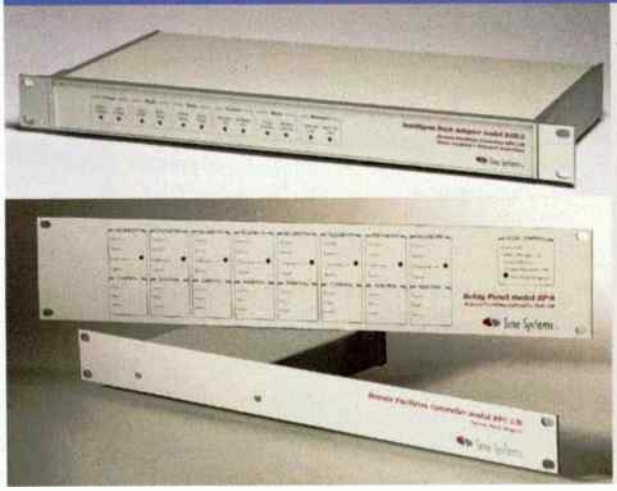

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Photo credit: Erinn Coffee

Judy Bandstra contemplating the finishing touches to one of the 14 studios of CPR.

XSelector routing panel and a QC station to allow us to monitor any audio signal in the system. We also installed Pathfinder Pro software on redundant servers to give us virtual routing control of the entire system.

The current and final phase of the project is upgrading the voice tracking booths. These are heavily used to produce on-air content, but they are currently equipped with old analog mixers with no interconnectivity to the main system. The booths are paired; two for music, two for news. A fifth standalone music booth piggybacks the live performance studio. It will have a QOR.16 and an iQ eight-fader console. For the paired booths, we are installing an Axia QOR.32 engine with one Telos Desq six fader console in each booth. The QOR engine automatically partitions its I/O to accommodate the two consoles. The news booths will also have a one-line V-Set hybrid phone. All of the voice booths will now tie into the new Livewire network through the Cisco switch.

When the final phase is complete, we will once again have a fully "state-of-the-art" audio chain, from microphone to microwave.

The gradual integration of this new technology into our core of operations has helped CPR operators and engineers build confidence in the AoIP concept of system architecture. There is no guarantee of longevity in the life of any system, but with the infusion of new technology, there is hope. CPR now has a system more robust, more flexible, and more user friendly than the one that came before it. After 12 months of major surgery, the prognosis is very good.

Judy Bandstra has been a broadcast engineer for nearly 20 years, having spent the last year and a half with Colorado Public Radio. Prior to that she spent seven years in the U.S. Navy as an RF technician.

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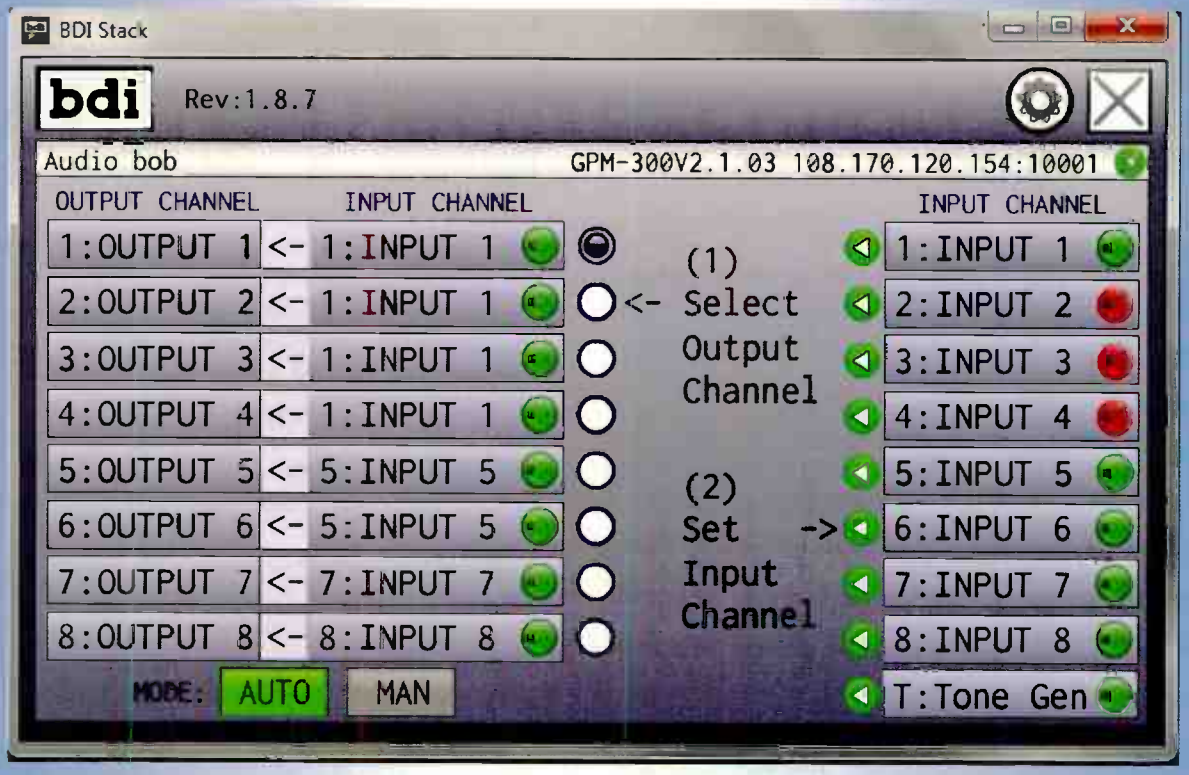

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Play to Radio's Strengths With Remote Sports Broadcasts

by Doug Irwin CPBE DRB AMD

The talent table allows for three WVRC talent positions each with Clear-Com announcer boxes. Custom furniture by Omnirax.

It's mid-September and the high school and college football seasons have already gotten off the ground. Basketball is not far behind, either. The summer Olympics may have also inspired you.

Therefore, we're going to consider how to bump up the professionality and cool factor of your remote broadcasts, and we're going to show you a great example of what can be done to maximize their impact.

If you have any interest in sports at all, then you know the typical features of a TV sports broadcast. Amateur sports are pervasive on TV, and even though production values aren't quite as high as professional sports, many of those elements are common.

It isn't hard to add sideline reporters and sideline microphones to your radio broadcast. You should also consider higher-quality audio, full-duplex links back to the station. This allows interactivity between the station and the remote venue — perfect for pre- and post-game shows.

Historically, a typical remote setup is a couple of inexpensive mics, stands and a single channel mixer, feeding an RPU transmitter that sends audio back to the station. This will get the job done — just like it has for the last 50 years — but it doesn't leave any room for other remote features. You'd have to take your "cues" off the air, of course, which means you can't use a delay; you need relatively good air monitor at the venue; and it certainly limits what you can do for away games.

HEADSETS AND MIXERS

Today, nearly all announcers use headsets that include a boom microphone.

There are a myriad of such headset combos available, but to get you started, look at the Audio-Technica BPHS1 (low price), the beyerdynamic DT-290 MK II (medium price) and the Sennheiser HMD-26 (higher price).

Mixers are another item of which there are dozens from which to choose.

When adding communications links back to the station (or even another venue), having multiple busses becomes an absolute necessity. Not only will you need the program bus — sending audio back to the station — but you'll need a bus that handles headphone communications as well.

The Behringer Xenyx 1202FX comes with four mic preamps (on XLR connectors); one post-fader

The beyerdynamic DT290—a medium-price option

The remote revolution is here

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The Codec Company

The view from the WVRC producer's position at the WVSSAC tournament.

aux send per channel (which you could use to develop your headphone mix); and a three-band EQ per channel input. In addition, it has four stereo inputs (via 1/4-inch TRS) connectors. Main, FX and monitor outs are done via 1/4-inch TRS connectors.

You could also consider the Denon DN-408X. It's an eight-channel, two-bus mixer with five mic preamps (on XLR connectors). It also has two built-in compressors to better handle screaming announcers; built-in EQ; and balanced outputs (on XLR) with a USB port for getting audio in and out of a computer, which is great way to integrate pre-recorded interviews and game highlights.

The Henry Engineering SixMix has 10 inputs (two of which are mic level on XLR connectors) including an integral A/D + D/A digital audio USB computer interface. On the output side, it has a stereo Program mixing bus, a Mix-Minus output, a Cue bus with internal Cue speaker, headphone outputs for the operator and a guest as well as monitor outs.

The Mackie ProFX8V2 comes with four mic preamps (on XLR connectors) with optional phantom voltage; three additional stereo inputs (on 3/4-inch TRS connectors); and balanced outputs via XLR and 1/4-inch TRS connectors. In addition to its stereo bus (which has a ganged gain control), it has a stereo effects bus, a monitor bus and USB connections for getting audio in and out of a computer.

The IFB R1a hooks on to your belt, gives you a headphone out, and allows for great mobility around a sports venue.

The Lectrosonics IFB T4 features 250 mW of output power. Mounting the antenna as high as possible ensures good coverage of any venue.

SIDELINES AND COURTSIDE

Sideline (or courtside) interviews are commonplace now. In order to accomplish these, you need both a wireless mic and wireless talkback, which necessitates mixers with multiple busses.

You will need to develop a headphone mix that all the talent can hear when using a roving reporter. In this way, the rover can hear the other talent and they can talk to one another in a bus that is "off-line."

Choices in wireless mics are numerous and come in a wide range of prices. Among the many manufacturers to consider are Lectrosonics, Shure, Sennheiser, Audio-Technica and Sony.

Stay away from receivers that have fixed or integrated antennas; always go with a receiver with antenna connectors. That way you can connect a real antenna and locate it in such a manner that it has the best line-of-sight to

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where you expect your remote talent to be standing.

For example, if you are at a football venue, you will likely have line of sight to the entire field from the broadcast booth. Use a directional antenna in this application and attach your antenna to the window sill and make sure no bodies will end up in front of it.

For basketball, the situation can be more difficult, since you will find yourself at courtside. One option (though you must make sure it is secure and can't tilt over) is use of a tripod-type speaker stand with a short PVC extension. Place the antenna at the top of that, getting it up and over everyone's head. Proximity to courtside would also dictate an omnidirectional antenna.

Wireless talkback may be new to you and there aren't as many choices on the market. But again, look for talkback transmitters that have an antenna output via a connector; avoid any with an integrated antenna.

One such system is the Sennheiser ew 300 IEM G3. Among its salient features are its 1680 frequency choices in total (you specify the band when ordering); automatic scan for available channels; Ethernet access for the transmitter allows control via IP; operation in stereo mode; receiver battery indicator; and an auto-lock feature prevents accidental changes in settings.

Another choice for wireless talkback is Lectrosonics. The IFB T4 is a frequency-agile transmitter with 256 UHF channels available (using 100 kHz steps) and 250 mW of output power. Its complementary receiver is the IFB R1a, which will operate up to eight hours on an alkaline battery. The transmitter features an XLR input and a mic preamp; the receiver is meant to drive headphones or an earpiece for the remote talent. The IFB T4 is meant to use an external antenna; mount the transmit antenna up as high as you can to optimize coverage to all remote talkback receivers.

THE BIG EARS

Another common feature for courtside or sidelines are parabolic "ears" used for gathering live sound. (While this can add excitement to the live broadcast, make sure you are running the remote broadcast through a delay unit!)

Wildtronics makes a 22-inch clear polycarbonate parabolic reflector with an integral mic mount; you supply the mic. There's an XLR output on the rear of the dish and a short cable is used to connect your mic to that output. You can hold the reflector and point it by hand, or you can use to attach the handle to a tripod by way of a 1/4-20 threaded socket. It's quite likely you'll be getting this mic audio back to the remote mixer by way of a wireless mic, and likewise, the person operating it will need his or her own talkback receiver.

The Henry Engineering SixMix was designed by broadcasters and thus has a more familiar layout for radio personnel.

COMMUNICATIONS BACK TO THE STATION

We all know about the popularity of amateur sports and how that translates in to sales potential. Still, money is always an issue when it comes to provisioning remote broadcasts. If you were to emphasize the purchase of new headsets, wireless mics and talkback, and perhaps even the "big ear," you could easily find yourself over budget.

However, there are some relatively inexpensive means by which you can use the public internet to get your programming back to the station, to complete the system.

Use of Skype for inexpensive communications has been done for as long as AoIP has existed.

Its ability to pick up sound from sidelines or courtside will give your broadcast a very live feel. Make sure you use a delay unit as well — you never know what words will be uttered by players and coaches.

A relative newcomer to this space is ipDTL, which requires nothing but two computers (connected via the internet) running the Chrome browser and USB audio interfaces. A different service, also using Chrome, is Source-Connect Now. (Both require a modest subscription fee.)

Naturally, using the open, public internet for remote broadcasts presents potential problems. You get what you pay for, right?

The major issues typically are:

- **Availability.** Sure, internet access is nearly ubiquitous. Still, if you don't visit a venue ahead of time, you won't know for sure whether or not it's reliable — or even exists.
- **Traffic flow.** Even if you know of a "solid" internet connection at a remote venue, you can never be sure how it will work for you when the venue fills up with fans and other users. A network connection provided by the venue could easily fail or slow to a crawl during an event. While this would be OK for live reads done by remote talent (which seem to be the emphasis of both ipDTL and Source-Connect Now), since they can always do multiple takes, it would clearly be unacceptable for a live sports broadcast.
- **User training.** In my experience, many people doing remotes have enough problems making simple gear work for a remote. If you send them out with a computer that needs to be configured in any way, be ready for tons of panicked phone calls.

The engineering issues inherent with use of the public internet are effectively addressed in the designs of professional AoIP codecs, many of which have been previously discussed at length in Radio.

PUT IT ALL TOGETHER

At this point, you may be thinking that no radio station puts this kind of emphasis on amateur sports, but I'm glad to disagree. Yes, they do! Let's consider one example.

West Virginia Radio Corp. owns and operates 30 radio stations throughout West Virginia and Cumberland, Md., in addition to operating the MetroNews Radio Network, with more than 60 West Virginia affiliate stations.

This will get the job done — just like it has for the last 50 years — but it doesn't leave any room for other remote features.

MetroNews has held exclusive broadcast rights to the West Virginia Secondary School Activities Commission State Basketball Championships for more than three decades. MetroNews also has a newly formed partnership with the Mountain East Conference (NCAA Division II) to produce and distribute radio and television for its conference championship tournament annually.

Each year, the WVSSAC and Mountain East basketball tournaments are held in Charleston, W.Va., at the Charleston Civic Center over the course of a three-week period; and during that run, WVRC produces and distributes all 56 live basketball games on the radio, in addition to which they broadcaster 20 on television.

The Denon DN-408x has an intuitive layout that can be learned quickly.

WVRC's typical arrangement for a radio crew includes three courtside talent positions: Play-by-Play, Analyst and a "spare" spot used for a coach's postgame interview. Each is equipped with a headset and ClearCom announce box.

The producer/engineer is responsible for mixing the broadcast, as well as directing the talent and running all production elements, commercial breaks and pre-recorded interviews. The producer also edits interviews for upcoming games during the current game.

For many years, WVRC utilized venue-provided courtside conference-style tables for its talent and workspace. However, after recently entering into a long-term agreement with the SSAC for continued production of the events, WVRC decided it was time to build custom furniture, turning to David Holland of Omirax to get the ball rolling.

"We really put a lot of emphasis on the technical quality of our broadcasts," said Chris Moran of WVRC. "The content and formatics of the show have always been top-notch, and are still to this day produced on-site for the entire tournaments by our President and CEO Dale Miller. But he also believes strongly in being world-class when it comes to the technical execution of everything we do.

The Sennheiser HMDC 26—slightly more money.

"So our mobile production rig is no exception. We're using a Mackie 1604 VLX4 console that we built the furniture around. For media playback, we utilize a 360 Systems Instant Replay, as well as a VoxPro system for editing and playing back interviews. We use all Lectrosonics wireless mic and IFB gear for our sideline reporter. For transmission, we are sending our program back to Morgantown for uplink on two redundant paths — one using ISDN with Telos Zephyr Xtream units and the other over IP using Telos Z/IP Ones. Both paths carry full 20 kHz stereo audio, as well as automation closures which we also originate from courtside."

As one can easily see, if a high-quality, professional result is desired, the people producing the show need to know what they want and they must be willing to commit the resources needed (both human and financial) as well. West Virginia Radio Corporations commitment to the WVSSAC is a great example of that.

One of the key phrases teams reiterate is that "there's always next year." Your season is likely well underway, and if it's too late to implement now, it's not to start planning ahead for next year. Remote sports broadcasts are a strength of radio, and you should always play to your strengths.

The Yamaha TF3

by Chris Wygal

Radio stations are comprised of every make and model of staff member. Some are creatively minded and some are wired for practicality.

Engineers fit into this radio dynamic in a unique way. They are generally forced to play both roles.

Planning and designing a new AoIP system is practical. Keeping track of EAS logs? Practical. But then Friday night rolls around, and the station is hosting a jazz combo performance downtown. That's when the engineer starts thinking creatively, and he needs good tools to produce a memorable product.

The designers at Yamaha gave this some thought when they developed the TF3 digital mixing console. It was built primarily for FOH mixing, and it can be operated efficiently by nearly anyone with cursory mixing experience. It's stuffed full of popular features that a broadcast engineer can access quickly and efficiently.

FIRST THINGS FIRST

I've used several different makes and models of consoles for live sound jobs and recording gigs over the years and have yet to find a manufacturer that builds better head amps than Yamaha.

The TF3 uses the same preamp technology that is built into all of the Steinberg products. This effectively means the TF3 is loaded with discreet class-A preamps that provide ultra-low distortion, plenty of gain and a low noise floor. A Shure SM58 or a Neumann U87 will always sound excellent on this console.

The TF3 has 24 motorized faders that each include select, cue and on buttons. Instead of sticking a "scribble strip" tape above the fader

CONTINUED ON PAGE 28

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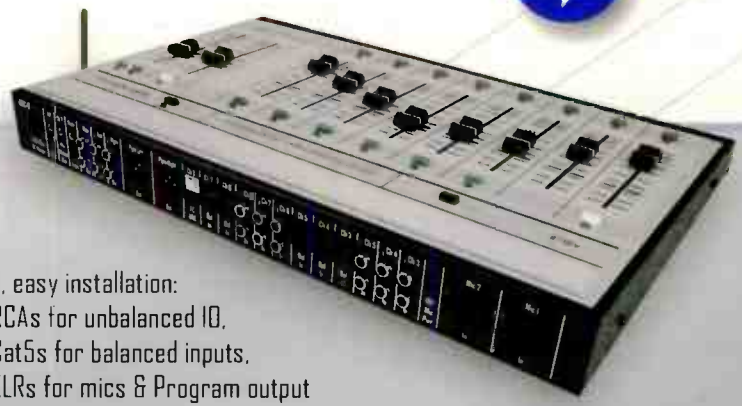

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CONTINUED FROM PAGE 24

bank, The TF3 boasts easy-to-read, high-resolution LCD screens and multi-colored LED indicators above each fader. The LCD screens display input number, input name and other pertinent settings relative to each fader. The LEDs are for color-coding the faders using any of eight colors.

The back of the TF3 is simple and intuitive. Twenty-four Neutrik Combo Series jacks facilitate three-pin XLR or 1/4-inch TRS (and TS) input connections. Outputs are assigned to any of the 16 "omni" outputs housed on male Neutrik XLR jacks.

The "omni" design is a Yamaha feature allows the user to assign any output function to any physical output. There is not a dedicated bank of "AUX" outputs, for example. This is especially handy because most professional audio snakes use female XLR plugs for stage returns. Or for permanent studio installations, a combination of XLR and 1/4-inch wiring isn't necessary. All the outputs are one XLR format.

The TF3 has 24 physical inputs; channels 25–40 are allocated for DAW playback or return channels and are made available when using the Tio 1608-D I/O.

The back of the TF3 also has two RCA inputs for "Stereo 1" and "Stereo 2." This is useful for playing music from a laptop, iPad or any unbalanced source. A 1/4-inch footswitch jack allows for activating any of several TF3 functions with a pedal. As an example, functions such as cueing a specific channel or recalling a scene stored in the console can be done hands free. The back panel has a USB jack for connection to a Mac or PC and an RJ-45 network connection for computer configuration and AoIP.

TAKE THE LEAP

Historically, the jump from analog mixing to digital mixing was quite a leap. Digital consoles were designed with two caveats. Much of the design was virtual in nature. The traditional channel strip disappeared and was replaced by a common display or channel strip in the middle of the console.

Anyone new to digital consoles needed to have considerable experience behind analog desks. This was generally due to understanding signal flow. Once the concept of signal flow was established, digital mixing consoles weren't so hard to learn.

When I unboxed the TF3, I saw what I expected: Lots of faders, a few buttons and a display in the middle. Knowing nothing about the TF3, I was excited to see what happened when it powered up.

My original goal was to set up the TF3 for a network sports broadcast. The setup I had in mind included eight on-air members, a producer, two playout devices and twelve stadium effects mics and feeds. This also included separate headset mixes and IFB mixes.

In less than one hour I had the TF3 ready to go on the air without ever having opened the user's manual. This was a key factor. Yamaha boasts the simplicity and intuition built in to the TF3, and I wanted to see it for myself.

FORM AND FUNCTION?

Ease-of-use was a design priority with novice engineers in mind. However, the TF3 still houses large-format console features. Function wasn't sacrificed for the sake of making it easy to use.

Keep in mind that the TF3 is free of typical individual channel strips. Head amp gain, EQ, aux sends, pan and other familiar functions are all handled via the touch screen display on the TF3 bridge. The touch screen is highly functional and is the window into each working part inside the TF3. If the user has a cursory understanding of typical mixing necessities, the touch screen is easy to navigate.

For example, consider "one-knob vocal mode." Upon selecting a channel and navigating to the EQ settings, the user finds a 20 Hz to 20 kHz parametric equalizer. A novice user may have trouble with the concept of parametric EQ. Plus dragging icons on the touchscreen to adjust frequencies and Qs may be overwhelming.

One knob vocal mode, however, allows the user to use the physical "touch and turn" knob on the TF3 bridge. As the knob is turned, the parametric EQ applies a 100 Hz high pass filter. Turn the knob some more and 300 Hz is rolled off. As the knob is turned further still, high frequencies and then mid highs are bumped up. See the pattern?

These are typical EQ adjustments made to vocal mics. The same feature applies to the compression settings as well. While the user can use the touch screen to craft any and every compression scenario, "one-knob vocal mode" simultaneously adjusts threshold, ratio, attack, release and knee settings for basic, comprehensive adjustments.

The TF3 allows users to label each input fader based on the characteristics of the source. Eight categories ranging anywhere from

headsets, wireless vocal mics, horns, strings and DI boxes are available for selecting icons for labeling channels. Plus, each input can be given a name up to eight characters. This information appears on the scribble strip LCD displays and the touchscreen.

If the TF3 is being sent out with a novice engineer, all of the parameters can be preset for him.

FADE TO...

The 24 faders on the TF3 are multifunctional. Depending on the fader bank settings, the faders are used to control inputs, AUX levels and DCA levels.

As opposed to traditional "sub mix" levels found on small to medium-format consoles, DCAs, or "digital control amplifiers" are employed on the TF3, and for good reason.

Harkening back to the analog consoles, voltage control amplifiers controlled the voltage levels on input faders. Instead of routing input signals through a sub mix, VCAs remotely controlled the voltage level on the faders. This reduced noise in the signal path when attempting to group inputs. DCAs operate exactly the same way and give the TF3 the same functionality found on its large format cousins.

When installed on a local IP network, the TF3 can be used in conjunction with TF Editor and StageMix for more advanced setup and configuration and monitoring control. TF Editor puts TF3 programming and control on a Mac or PC. StageMix is an iPad app that talent on stage can use to create individual monitor mixes. Any DAW or recording software can be used with the downloadable ASIO driver via USB connection to the computer for multitracking. TF3 ships with Steinberg Nuendo Live.

TF Editor puts TF3 programming and control on a Mac or PC.

The TF3 has 24 physical inputs and channels 25–40 are allocated for DAW playback or return channels from the available Tio 1608-D I/O rack slot setup. The Tio 1608 is a 16-in, 8-out 2RU AoIP interface that is Dante compatible. In Dante environments, all the TF3 inputs and outputs are usable throughout the entire audio plant via AoIP. The TF3 is well-suited for an in-house production installation.

In addition to the rear USB port, a port for an iPad and a USB stick (thumb drive) is situated on the meter bridge. This facilitates audio playback and recording as well. Files stored on the USB stick can be played through the TF3 and the mains or aux busses can be routed to the USB device for basic recording. A final thought: The headphone jack is on the meter bridge, which means you won't hit the plug-in with your leg!

The TF3 is a feature-rich tool that would require a lengthy and exhaustive review in order to cover all of its available resources. The primary take-away that applies to radio engineers concerns the simplicity and complexity that is wrapped up in one mixer. A novice sound technician can use the TF3 and he has economical tools needed to complete the task. On the other hand, a well-seasoned engineer can use the full complement of TF3 functions and enjoy the benefits of large-format console features.

Wygal is the operations manager for The Journey Radio Network in Virginia.

Radio Takes Center Stage in Music City

So you didn't get a chance to go to the spring NAB Show in 2016; various circumstances just didn't allow for it.

Of course, you should make every attempt to go next year, but in the meantime, have you considered the fall Radio Show?

It's happening Sept. 20–23, in Nashville, Tenn, at the Omni Nashville Hotel.

Nashville is a great location for an event such as the Radio Show because it's quite conventiently located within in the United States. If you were to draw a 1,000-mile radius circle around Nashville, most major cities in the U.S. fall within it: To the northeast, Boston; to the west, Denver; to the southeast, Miami. In short, it's not a long plane ride, and it's a do-able drive for many.

EXHIBITORS

Many of the companies you missed in Vegas will be at the fall Radio Show, and some new names are also popping up on the list.

We've given you an exhibitor map in this issue, so you can make a beeline for your

CONTINUED ON PAGE 34

RADIOSHOW EXHIBITOR LISTINGS

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The fall Radio Show exhibitors shown below were aggregated from the convention website at the end of August. A complete list will be available onsite at the convention.

You can visit these booths during the show hours, which are:

- ***Wednesday**, Sept. 21 from 9 a.m. to 6:30 p.m.*
- ***Thursday**, Sept. 22. from 9 a.m. to 4:30 p.m.*

COMPANY	BOOTH
AdMall by SalesFuel	17
BD Sales Training	119
Benztown	18
BizTalkRadio	308
Bonneville Distribution	209
Broadcast Electronics	**28**
Broadcast Software International	116
Broadcast Supply Worldwide	503
Broadcasters General Store	**202**
Burli Software Inc.	305
Comrex	103
de Wolfe Music	29
Dielectric	11
DJB Software/Digital Jukebox	**206**
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Netia	**216**
NewBay Media/Radio magazine	512
NextRadio	409
OMT Technologies	16
OwnLocal	406
Powergold Music Scheduling	508
PromoSuite	402
PURE Jingles	31
Radio Advertising Bureau	507
RadioTraffic.com	9
Radio magazine	**512**
RCS	111
ReachLocal	312
Regional Reps	303
RF Specialties Group	7
Second Street	3
Shively Labs	1
Sierra Automated Systems	213
SoCast	314
SocialNewsDesk	22
Specialty Data Systems	317
Sun & Fun Media	12
Test All Media	218
Today's Homeowner With Danny Lipford	104
vCreative	20
Veritone	403
V-Soft Communications LLC	215
Wheatstone Corp.	**106**
WideOrbit	203
WorldCast Systems	5
Worldwide Communications Consultants Inc.	220
Zipwhip	15

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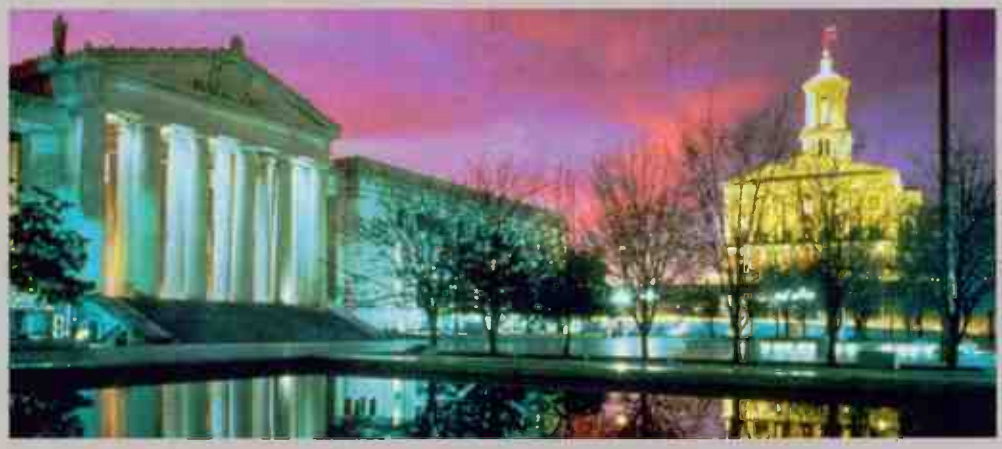
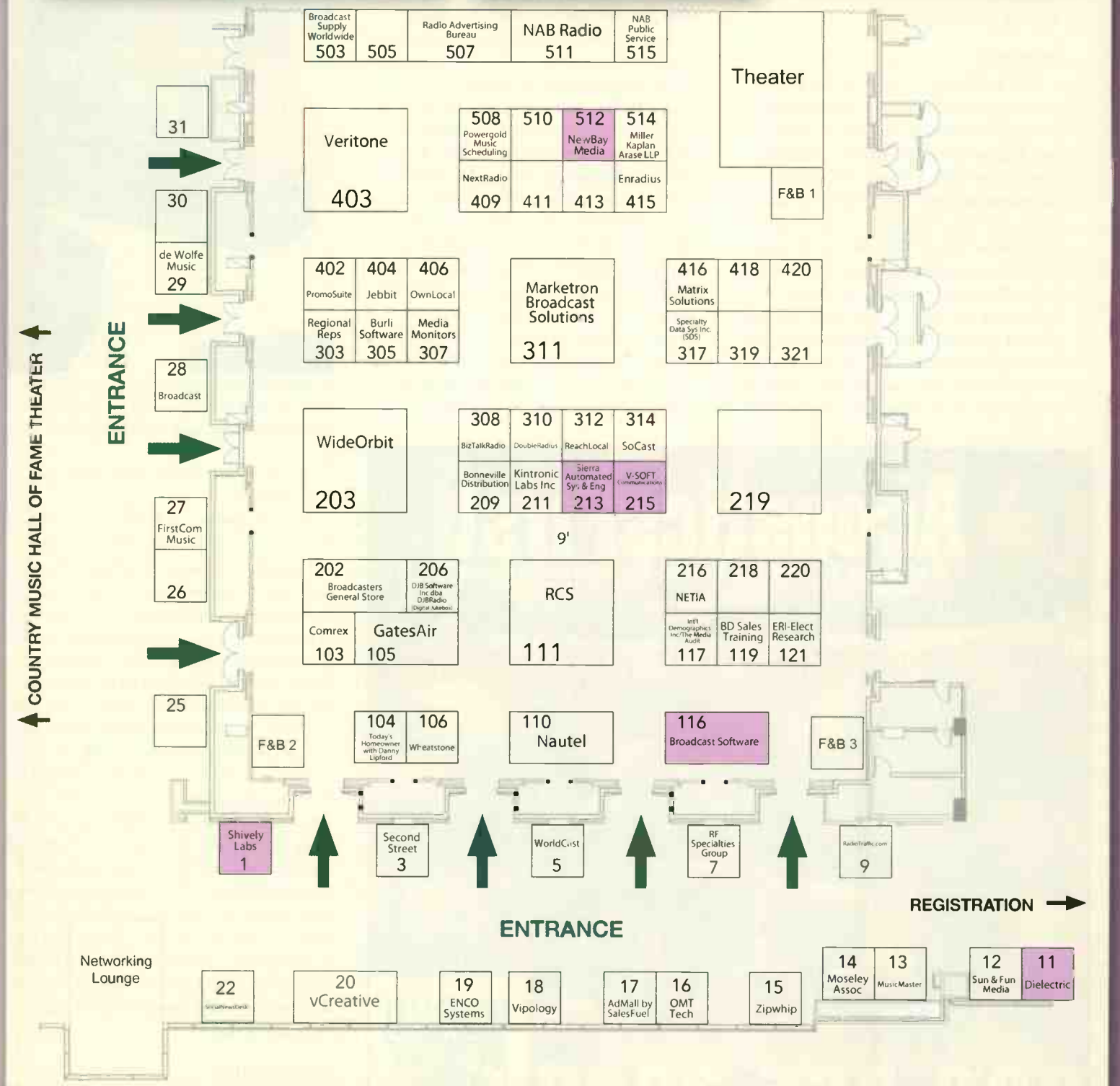


Nashville's legislative plaza features the Parthenon and the State Capitol building.

RADIOSHOW EXHBITOR FLOOR MAP



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priorities. Find it on page 32-33.

If you want to see gear up close and first hand prior to making 2017 cap-ex decisions, this is a good opportunity.

SESSIONS

The Technology session track will be of particular interest to broadcast engineers.

"When It Hits the Fan: Prepare, Respond and Recover from Cyberattacks and other Operational Catastrophes" will be presented on **Wednesday, Sept. 21 at 10:45 a.m.** Howard Price, director of business continuity planning for the Disney/ABC Television Group, will share several case studies. According to the Radio Show website, he will take attendees on "an edge-of-your seat tour of the present and future threats facing radio operators large and small — and the risks you can minimize now with planning that will protect your people, your plant, your programming and perhaps even your job." Attendees will explore the emerging threats to cybersecurity, facilities, your brand and most importantly, your personnel. You also will learn steps you can take to prevent or mitigate threats, enhance operational effectiveness and efficiency.

On **Thursday, Sept. 22 at 9:30 a.m.**, "The Digital Dash — Improving the Consumer Experience" will be presented. The moderater, National Association of Broadcasters EVP and Chief Technology Officer Sam Matheny, will host panelists Jacobs Media President Fred Jacobs and Commonwealth Broadcasting Corporation President and CEO Steve Newberry. "Radio broadcasters need to know what automakers are planning for the future of the center console. With all the media options available for drivers and passengers, broadcasters need to make sure that listeners can find their favorite stations on the radio. This panel will discuss why broadcasters need to keep lines of communication open with "Detroit."

Photo Credit: Nashville Convention & Visitors Corp.

Music City's night life provides plenty of options, from honky tonks to jazz clubs, toney restaurants and barbecue joints.

Later on **Thursday, at 3:30 p.m.**, Ray Sokola, Vice President, Technology Solutions, DTS will present "Enhancing the Listener Experience: New Developments in Audio." New technologies and applications that promise to improve the way consumers connect with audio programs are on the way: Whether at home, in the car or jogging on the beach, in the very near future we can expect to become ever more immersed in the sound field. This session will offer a glimpse of things to come.

Here are a few other sessions that should be worth checking out: "Get Ticked Off! An Essential Checklist for Digital Success in 2017" **(Sept. 21, 1:30 p.m.)**, "10 … 9… 8… 7 Days Until the Next National EAS Test! Are You Ready?" **(Sept. 21, 2:30 p.m.)**, "Embracing Podcasts: How to Maximize the Effectiveness of Your Content" **(Sept. 21, 3 p.m.)**, "The FCC's New Online Public File System — What's Going on and What's Next" **(Sept. 22, 10 a.m.)** and "Keeping Up with the Changing Radio Regulatory Landscape" **(Sept. 22, 2:15 p.m.)**.

SOCIALIZATION

Never forget that conventions are great places to network with colleagues — past,

present and maybe even future.

And consider some of the other events scheduled for the show that are intended to help you do just that.

For example, DTS, Inc. Chairman and CEO Jon Kirchner will appear in conversation with NAB President and CEO Gordon Smith at the Radio Luncheon on **Wednesday, Sept. 21 at 11:45 a.m.** The National Radio Award will also be presented to Don Benson, former president and CEO of Lincoln Financial Media Company, at this event.

This year's NAB Marconi Radio Awards Dinner and Show will be hosted by well-known on-air personality Scott Shannon. The event will take place **Sept. 22** at the Radio Show. Tickets are required in order to attend, so plan ahead and reserve yours.

And if you're arriving in town early or heading out Friday afternoon, be sure to attend the Kick-Off Party (**Sept. 20 at 8 p.m.** in the Omni Nashville Hotel Legends Ballroom) and Music and Mimosas, which is scheduled for **Sept. 23 at 9 a.m.** and will also be held in the Omni Nashville Hotel Legends Ballroom.

WHILE YOUR'RE THERE...

The Omni Nashville Hotel is connected to the Country Music Hall of Fame and Museum, with easy access to the city's best entertainment.

Nashville's Downtown Circulator offers attendees a free and convenient way to get around downtown or to The Gulch (which is another hot spot for dining and live music, from bluegrass to jazz). The Green Circuit takes you between The Gulch and Riverfront Station; the Blue Circuit runs south to north serving key destinations between the Schermerhorn Symphony Center and Bicentennial Mall. The Purple Circuit runs primarily south of Broadway along Hermitage and Second Avenues and serves key destinations between Riverfront Station and the Richard H. Fulton Complex.

Nashville is also home to Andrew Jackson's Hermitage, the Cheekwood Botanical Gardens and is a foodie's delight.

Music City will never disappoint an audio-centric tourist. In addition to the Country Music Hall of Fame, you can also visit Music Row, the Grand Ole Opry and the Honky Tonk Highway.

The Radio Show may not be as big as the spring NAB Show, as you likely know, but still affords you many chances to get your hands on equipment to help with budgeting decisions for next year. If you want to talk to a dealer or manufacturer, this show provides a great opportunity for in-depth conversations.

Of course, the fact that the show is in Nashville this year is a plus, since the town alone has more than enough reasons to visit, convention or no convention. We hope to see you there!

SNMP: Not Just for New Gear

by Doug Irwin CPBE DRB AMD

The Broadcast Tools I/O Sentinel, seen at left, allows the remote keying of the Marti TX by way of a GUI on the rack room remote control.

In this column, we often talk about remote control applications with newer pieces of gear that support SNMP. However, I also know that there is a lot of gear out there too old for that. This time around we're going to see how to apply newer remote control features to older gear.

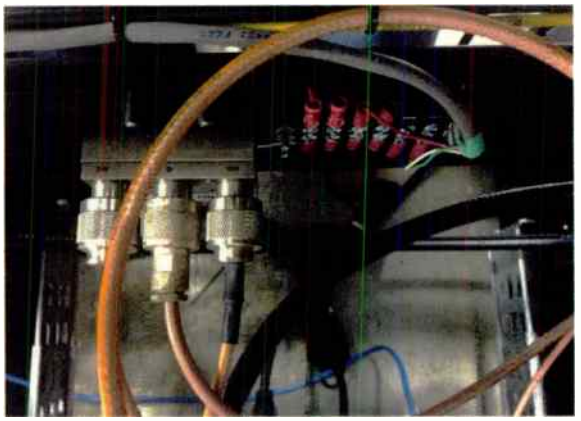
Before we go on, you may be asking: "What is the advantage here? Why bother with SNMP?" Well, there are two primary reasons to do so:

- **Remote control wiring can be greatly simplified.** At some point, this is going to make your job easier.
- **Gain the ability to add ancillary devices to your graphic user interface.** As long as there is IP connectivity between the two points (one being your primary remote control and the other being an ancillary device), the ancillary device can show up on the GUI.

The basic remote control features are ON and OFF, of course, and the status that indicates when the device is actually ON or OFF. It's pretty easy to achieve this with a very basic SNMP setup. Analog readings are a bit harder to come by; not as many devices will read analog voltages.

There are at least three familiar remote control manufacturers that support SNMP signaling: with Burk, you could use the ARC Plus Touch and auto pilot; another choice is Audemat CONTROL and scripteasy; and finally, Davicom, using DV-mini, among others. If you use one of these three devices as your primary remote control, you'll be able to add on SNMP control to ancillary devices.

From my own experience, I can tell you about two devices that are particularly friendly to SNMP signaling: the Broadcast Tools I/O Sentinel 4 and the Site Sentinel 4. Both devices provide relay outputs that can be controlled via SNMP (think remote push button) and status inputs that can be read by SNMP.



The script on the rack room remote control energizes the T-R relay, and keys the TX; when through, it unkeys the TX and then releases the T-R relay.

REAL LIFE APPLICATIONS

Consider this example. I have a remote two-way base station transmitter that normally gets keyed up by editors in our news department. However, when in the field, testing a receiver at one of our receive sites, I don't want to bother them to key this two-way. By way of an SNMP-capable remote control, I can access our network (via VPN) and using the GUI, key it myself. This is an instance of when SNMP can make your job easier.

Let me give you another example of the kind of ancillary control done via SNMP.

What I wanted to do was to build a very basic, backup remote control that operates via a satellite connection (actually a VSAT terminal) that has limited IP bandwidth. Here's the thing to remember: This backup control actually lives in our rack room, but its remote control outputs and inputs on are the other end of the vsat connection. In this case, I configured the remote control and the Site Sentinel 4 to "talk" to one another via the vsat connection, providing remote pushbuttons and remote status; therefore, I was able to not only back up the "normal" remote control at the site, but the connectivity as well.

With reductions in staff and increases in the number of sites many of us have to maintain, having remote controls that access other devices via the same GUI can be very, very helpful. You can be in two places at once.

Irwin is the Director of Engineering for iHeartMedia Los Angeles. Contact him at doug@dougirwin.net

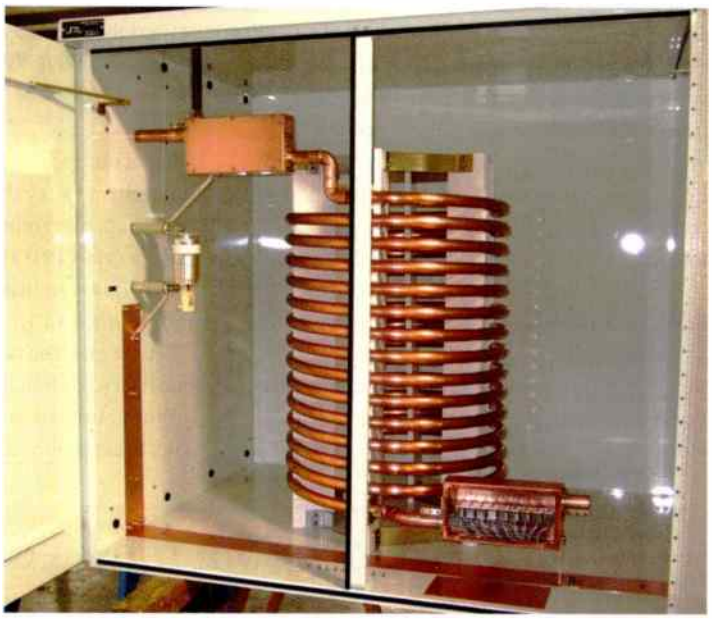
How to Use AM Towers for Other Stuff

by Jeremy Ruck, PE

It has always seemed a little odd to me that residents and governmental types are staunchly opposed to a single tower, a couple at most, that will enhance their communications. Yet, these very same people love acres and acres of windmills that scar the landscape for miles.

To be sure, this inconsistency can probably be chalked up to an exchange of compensation, not to mention the exercise of vogue politics. Despite this fact, the potential for opportunities for co-location of facilities can still abound, even with a hot AM tower.

No doubt, you just cringed at the thought of adding something to your stick or array, especially if your system is fractious and cantankerous. Those on the flip side will insist that a hot tower cannot be used under any circumstances.



Need Ethernet on your series-fed tower? Consider this Category 5 isolation inductor, by Kintronics Labs.

As is usually the case, the truth is found betwixt the extremes, and so this month we look at the use of AM towers for other stuff.

The addition of this "other stuff" to an AM tower will affect the tower, or the stuff, to varying degrees, depending on the isolation scheme being utilized. Therefore, some schemes will work better than others will with certain topologies and AM antenna conditions.

ISCOCOUPLERS IN ACTION

Perhaps the most common way to add an antenna and transmission line to a base insulated AM tower is through the use of an isocoupler. Conceptually, this device couples the transmission line conductors at the significantly higher operating frequency of the system added to the tower, but keeps them decoupled at the AM operating frequency. This typically is accomplished by providing a high shunt impedance at the AM frequency, which in the case of a single isocoupler, tends to impact the tower impedance minimally.

As an example, consider a single tower antenna for 1000 at the heights of 150, 90 and 60 degrees. One of the popular modeling programs yields impedance values of 782-j13, 44+j18 and 11-j113 ohms, respectively, for these three towers. Assuming the isocoupler has a capacitance of about 100 pF, the resulting shunt impedance at 1000 kHz is –1600 ohms. This impedance is added in parallel to the impedance of the tower, and

therefore the addition of a single isocoupler would shift the impedance to 623-j315, 45+j17 and 10-j105, respectively, for the three heights.

Note that the taller tower has a greater shift, which is the result of the parallel combination of two high impedances. Thus, an isocoupler may not be the best choice for a tall tower.

But, what happens if our tower is intended to be utilized for a wireless phone company desiring the installation of say 12 antennas and lines? Since an isocoupler would be necessary for each line, we are now looking at the parallel combination of the tower impedance and 12 isocouplers. Now our resulting tower impedances change to 21-j129, 51+j1 and 3-j6 ohms.

Obviously, a complete redesign of the ATU for the taller tower is necessary, while the quarter wave tower moves only a few ohms and could probably be handled by the existing ATU, if enough range is available. Most disturbing, however, is the short tower, which winds up with an impedance pretty darn close to a short at 1000 kHz. This impedance is close enough to zero that such a solution will probably not work. Unfortunately, some engineers have discovered this problem only after the installation was completed or well underway.

Some schemes will work better than others will with certain topologies and AM antenna conditions.

SKIRT THE PROBLEM

One solution to this problem is to ground out the tower by crossing the base insulator and installing a skirt or folded unipole.

With the tower itself now at ground potential at ground level, the transmission lines for the added stuff can be bonded directly to the tower itself. The skirt, of course, is connected back into the tower at some elevation, the height of which will vary the impedance at the AM frequency.

If changing over to this type of feed from a series feed, it is important to note that the impedance of the antenna at the AM frequency will likely have a much larger reactive component. As a result, a physical change in the components in the ATU will likely be required.

The use of isolation coils also provides a way to cross the base insulator. In this scheme, coax is wound into a cylindrical shape. This design also provides a high impedance across the insulator, but control over the impedance can be accomplished through parallel resonance with a variable capacitor, or by the inclusion of taps.

Understanding PLC Programming Methods and the Tag Database System

by Dennis L Sloatman

In part one of this series, we looked at the PLC's internal architecture, briefly discussed ladder logic programming, Human-Machine Interfaces, advantages of the PLC's ability to react consistently with the outside world and some possible applications. In part two of this series, we looked at some specifics such as where to buy a PLC, getting started with programming, a small sample program using ladder logic, some ladder logic functions and provided some links to instructional "how-to" videos. In this article, we move on to discuss some advanced topics, including tag database vs. fixed memory.

PLCS VS. LEGACY CONTROL SYSTEMS

In order to underscore and to drive home the impact of the PLC, let's consider the legacy method of creating a system controller. Not so long ago the engineer would construct a device employing dozens of relays, diodes, relay sockets, possibly resistors and capacitors for timing circuits along with power supplies, wiring, some sort of wiring termination (i.e., barrier strips) and an enclosure. Should any changes to such a controller need be made or any enhancement added, wiring harnesses would have to be undone, moved, parts added or removed — all of which gets messy and is quite time consuming.

Obvious negatives to such a system controller are maintenance and serviceability, aside from the difficulty in making changes.

PLCs could greatly reduce the footprint of the relay racks in the NYC subway and are more than adequate to handle "and logic," as well as control issues at a transmitter site.

And let's face it: The moment you leave the station, those custom controllers are scary to your successors at best, and at worst, removed and tossed out as soon as possible.

Consider the control system shown here. It was part of the New York City subway system.

Also consider the conditions at many broadcast transmitter sites: Dirt and dust, temperature extremes, humidity and EMI/RFI are common.

In part one of this series, I pointed out that devices such as the Arduino and Raspberry Pi aren't good choices in these sorts of environments. Their lack of capacity to drive or sink the current necessary to work with industrial loads means that they need to be supplemented with custom enclosures, relays, power supplies for the relays and connectors — thus putting them right back in the legacy category I previously mentioned, largely negating their benefits.

PROGRAMMING METHODS

In previous articles, I have discussed ladder logic, which is very much a sort of electronic schematic symbolization of the control system you are designing. This makes programming the PLC accessible to the broadcast engineer who has a solid electrical/electronic background.

In the next illustration, you see an example of ladder logic drawn from an AM station antenna controller I designed some years ago. "Contacts" are at the left on the ladder with "Coils" on the right (recall that these are internal memory locations, except when using true electrical outputs like relay contacts or open-collectors). Logically, the flow of the system is from left to right (input to output) and then down to the next rung of the ladder.

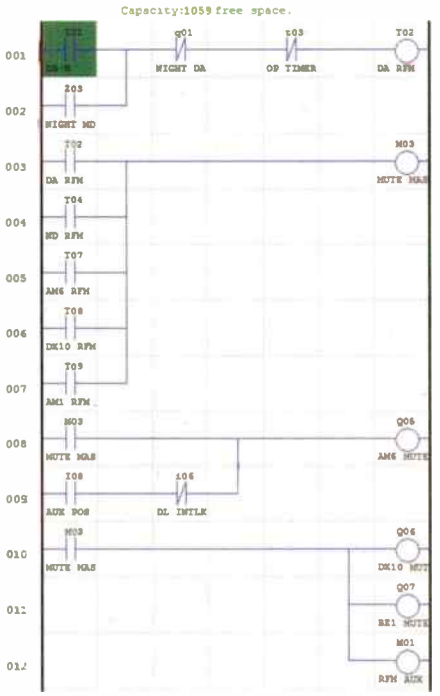


Fig. 1: Ladder logic (portion of directional antenna system controller)

While I believe ladder logic is the optimal programming language for the PLC, there are at least two other methods of which the reader should be aware: Functional Block Diagram and Structured Text (which is somewhat similar to Pascal and will not be discussed here).

FBD is an interesting programming method which you should consider as it presents a sort of block diagram look and feel. FBD may bring forth memories of a digital logic class you may have had in college.

My advice is to try both of these methods, as you may find that your design is easier to

visualize using FBD instead of ladder logic.

Not all PLC programming software provided by vendors supports FBD, but all (of which I'm aware) support ladder logic.

In some cases, the vendor-provided programming software features a simulation mode that permits the designer to debug a program without connection to a PLC. This is a powerful feature for testing various designs without purchasing several controllers (CPUs).

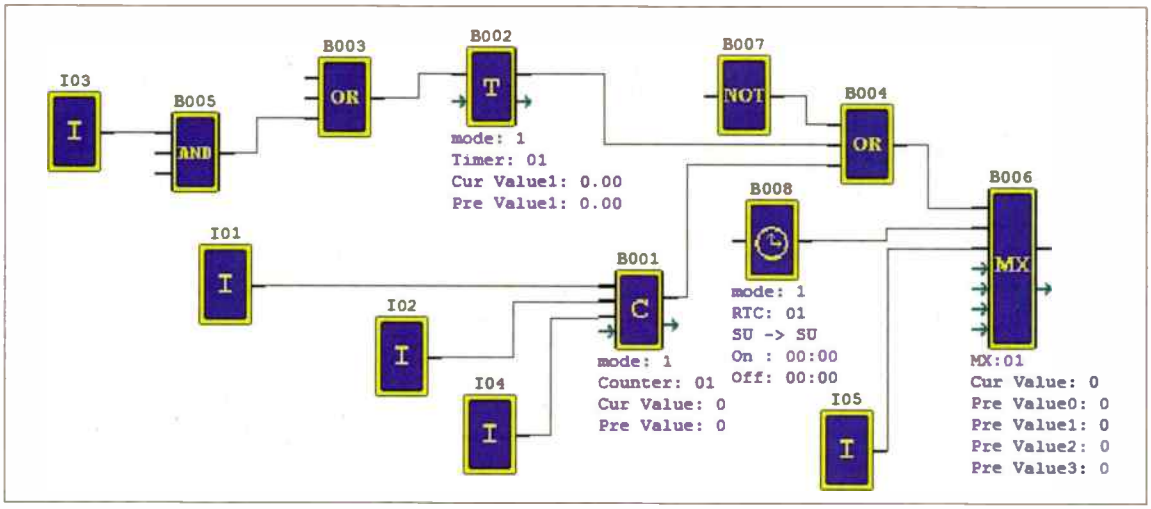


Fig. 2: Functional block diagram method of programming

SOME DEEP TECH NOTES

I once more wish to drive home the point with respect to contacts and coils.

When I teach PLC design to engineers who are newcomers to the topic, I often find that there is a common misconception (and understandably so) with respect to the ladder logic objects.

The PLC is programmed with so-called "coils" (outputs) and "contacts" (inputs) and even complex function blocks, such as mathematic operators, analog comparators or timers/counters are referred to as "coils." Anything that is an output or has an output, is referred to as a coil.

Any object on the left of the ladder diagram (see Fig. 1 on page 13) is a "contact" — whether or not it's an actual physical contact. Similarly, anything on the right side of the ladder is "coil' whether or not it's an actual physical contact.

To those readers who have had programming courses in college (such as C, C++, Assembler, etc.) or otherwise have programming experience in such languages, it helps to consider most of these objects (except for the actual hardware coils and contacts) as operating system variables stored in the CPU memory. This, in fact, is precisely what these objects are.

All of this information (ladder program, variables and comments) is stored within the PLC, so it's rather self-documenting.

In some PLC architectures, the programmer is allowed to freely use an object, or in programming terms, to instantiate the coil or contact and set the attributes of that object to whatever is required. You can declare whether the object is a binary (on/off, digital I/O), 16-bit integer, 32-bit integer, 32-bit floating point, signed or unsigned and ASCII "on the fly." This type of programming approach is similar to unstructured programming languages.

PLC TAGS AND THE TAG DATABASE

In more advanced PLC designs, a more structured programming approach is taken with the use of "tags" which are stored within the PLC's memory in a tag database.

With a Tag Database, all function blocks, including contacts, coils,

program variables (e.g., as a timer value called "Transmitter_ RF_ Mute_ Timer"), as well all other objects, are stored as variables with attributes such as initial value, float, string, integer, Boolean (on/off), ASCII text, discreet inputs and discreet outputs. While this may seem confusing at first-glance, it's a superior approach for more complex designs but does require (as in structured programming languages) the designer to declare these variables — tags — as well as the data type in advance of their use in the program.

One salient features of this design is that all of this information (ladder program, variables and comments) is stored within the PLC, so it's rather self-documenting — that is to say, anyone making modifications can download the entire PLC program into the programming software, even if they do not have access to the original programmer's file. (As you might expect, PLCs can be password-protected.)

	Basic CPU
Control Method	Stored Program/Cyclic execution method
I/O Numbering System	Fixed in Decimal
Ladder Memory (steps)	8000
Total Data Memory (words)	8000
Contact Execution (boolean)	< 0.6us
Typical Scan (1k boolean)	1-2 ms
RLL Ladder Style Programming	Yes
Run Time Edits	No
Scan	Variable / fixed
CLICK Programming Software for Windows	Yes
Built-in Communication Ports	Yes (two RS-232 ports)
FLASH Memory	Standard on CPU
Built-in Discrete I/O points	8 inputs, 6 outputs
Built-in Analog I/O Channels	No
Number of Instructions Available	21
Control Relays	2000
System Control Relays	1000
Timers	500

Fig. 3: Click PLC specifications

Much as in programming languages, you can also assign an initial value to the variable or tag. Data arrays may also be defined in the tag database and in fact, this is how I chose to construct a table of pattern change times for an AM station directional controller with the months as the row data and the pattern change times as the column data.

In summary, Tags are names that you assign to variables of any type stored in the PLC memory. Some examples of tag names might be: Ant_Sw_Delay, RF_Loss_Delay, Overtemp_Alarm_Delay, etc.

A LOOK AT SOME SAMPLE PLC SPECIFICATIONS

PLCs vary in design. In some, you will see in the device spec sheet a tabulation of how many timers, counters, comparators, registers, real time clock functions, internal contacts and

other function blocks, such as Proportional, Integral, Differential (PID) you have available for use.

Generally, the number of these provided will be well in excess of your needs, but these are limitations, nonetheless.

In more advanced PLC designs, the PLC has a given amount of memory for you to use however your design requires. For example, if your design needs 134 timers but only 60 counters, 188 internal "contacts" but only 20 comparators, you have that flexibility to use the available system memory as dictated by your design.

Recall that I said that all of these ladder objects are essentially variables stored in memory? This is at the very core of the concept for flexibility of resource allocation.

Let's look at a representative "fixed-resource" PLC specification sheet (Fig. 3).

Just a quick examination of the Click PLC data sheet will show the quantity of available resources. This $69 PLC has quite a number of objects available and for most designs, is more than enough to suffice. Look at the number of timers: 500! There are 1000 System Control Relays (which are internal CPU-defined memory flags such as real time clock functions and internal timers and system flags), 250 counters — each of which can be user-defined as up/down, up or down with presets. Common programming constructs such as for/next loops, interrupt-handling and subroutines are also available.

As I mentioned, more advanced designs using tags allow you to allocate the available resources as your needs require, but you would be hard-pressed to use all the control objects which are available in the representative specification sheet above.

In part one of this series, I touched upon deterministic operating systems, and I stated that Windows does not lend itself well to applications which require real-time control.

PLCs can scan the entire ladder logic program in milliseconds (see specification for "Typical Scan" in the data sheet). The PLC is as close to "real-time" as you'll likely ever get and with repeatable results. This feature of the PLC can be further enhanced through program segmentation through the use of subroutines and interrupt-handling; that is, initialization of a program can be handled upon startup only (say in a power-up "set to defaults" routine) with timing-critical control handled by interrupt routines (which work in the PLC much as they do in computer CPU's with stacks, "push" and "pop" action).

Now that we've covered the essentials of the PLC, such as programming methods, "underneath the hood" topics and have discussed some of the specifications, next time, we move to building a broadcast-related application of an easily available and inexpensive PLC.

This advertiser index is a service to readers. Every effort is made to ensure accuracy, but Radio magazine cannot assume responsibility for errors or omissions.

The Allure of Tall Things

by The Wandering Engineer

I like towers. Eiffel tower, CN Tower, Sutro, Freedom Tower, Devil's Tower, Tower of London, broadcast towers, or the ham tower that protects the house from lightning. Even the Bible speaks of the Tower of Siloam and the Tower Babel — I'll admit those two didn't work out so well.

I think everyone should have one. It's not the most discriminated-against personal trait out there, but it's close. I believe we were born this way, though some have suggested that with therapy or training, I might one day be normal.

I frequently bicycle by a 5/8th wave, series-fed radiator for one of those fire-breathing clear channel stations that once covered the nation.

I know this to be true, as I listened while wasting time in a hot tub in San Diego for news of a large winter storm to pass so I could adjust my travel plans. I listened on an overnight watch to that serene voice, sailing in heavier seas than expected, headed to the Dry Tortugas in the Gulf. I listened alone sitting on the steps of Thomas Jefferson's Memorial late one night as I thought through a meeting the next day. I listened on the shores of Lake Mono, Lake Superior and Lake Tahoe. And I think I heard her way off in the distance in Hawaii on a rental car radio with a broken antenna.

Way before John Malone's (then the head of TCI cable, absorbed by ATT and now Comcast) 1992 controversial prediction of a "500-channel universe," late night radio offered a 50-channel universe. The Grand Ole Opry, Mormon Tabernacle Choir, The Detroit Tigers, Barn Dance and a hundred shows long forgotten were available from their individual tall towers to the continent. One could surf up and down the dial, looking for, and finding, something we didn't know we wanted to hear.

From down the path, I look to the tower to gauge my distance to it. Mentally, I add on 3/8ths more and compensate for the velocity factor of the tower to see in my mind what a wavelength looks like. It's big. I look at a cloud top that I know from the radio is a storm hoverng over a community 50 miles away. It's a bit of math, but the top of the tower lines up with the top of the storm, and I come up with 60,000 feet. There is going to be hail and damaging winds in that one, and the radio confirms this within the hour.

I can't ride and do trigonometry at the same time — besides this is a visual construct to savor. A helpful hiker pops his earbuds to ask if I've counted the stripes. I'm a broadcast engineer, I don't have to; it will be seven for any relatively short tower. He says you can tell how tall the tower is by multiplying the stripes by 100-feet. Oddly enough, he's not that far off. The lady with him asks if I can move clouds with my thoughts too… I say no, but I can measure them in wavelengths.

When I go home to visit mom, the cluster of towers triggers the first waves of nostalgia half-an-hour before I see the house.

To every tower lover who has suffered at the hands of anti-tower extremists, you are not alone. I say pray for them, and stack, baby, stack.

Townsquare Media's WYOS in Binghamton, N.Y., started life as WKOP, when its engineer was Charlie Hallinan, a founding member of the SBE.

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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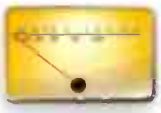

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