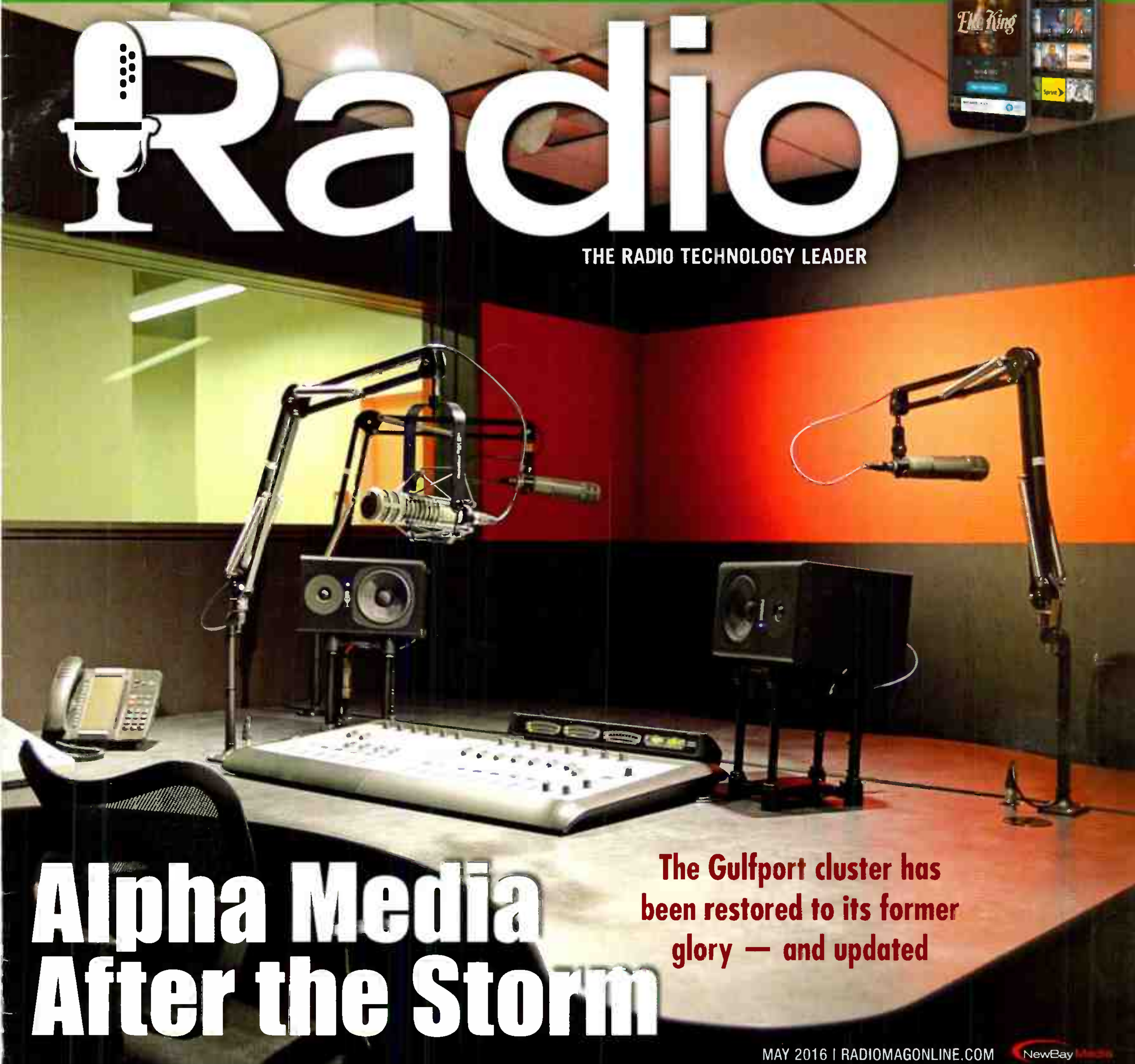
STLs and ICRs | Cybersecurity Tools | Main Studio Rules | ATSC 3.0 ›

Radio

THE RADIO TECHNOLOGY LEADER



Alpha Media After the Storm

The Gulfport cluster has been restored to its former glory — and updated

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LXEvolved

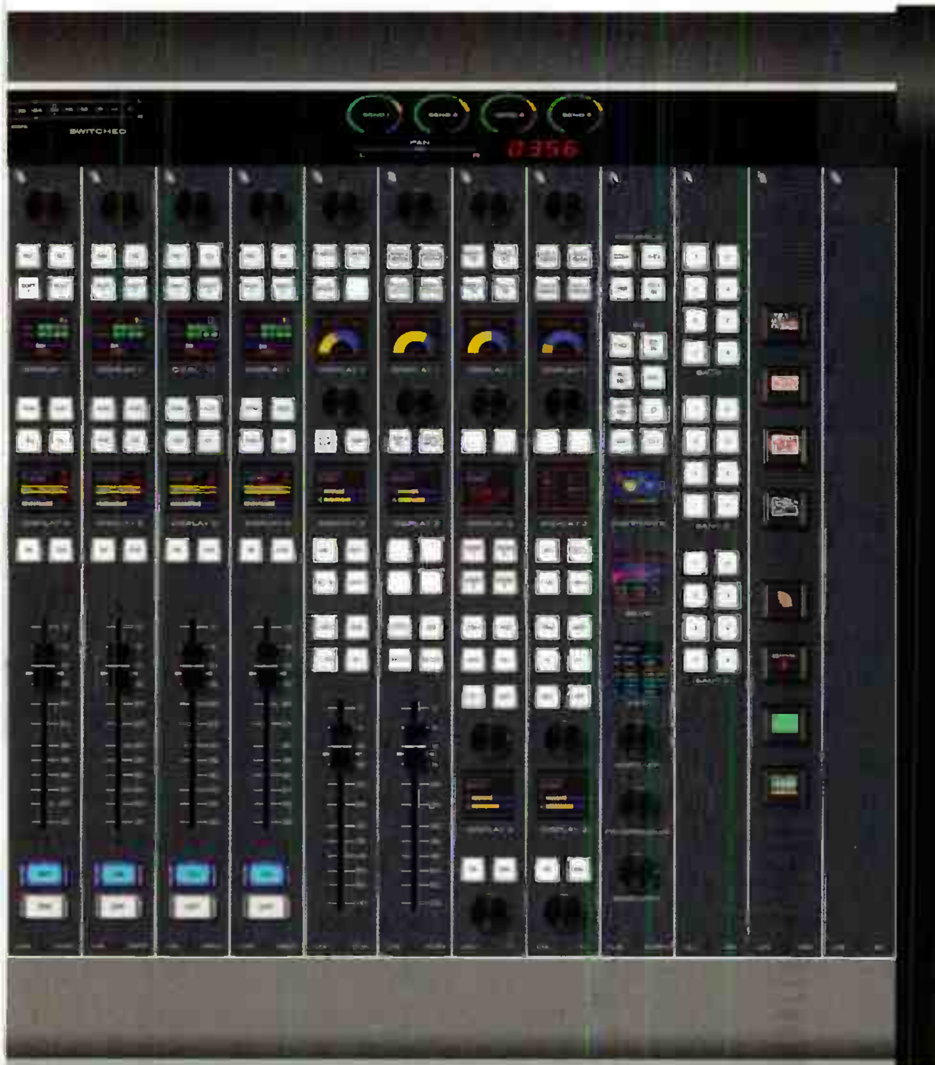
The Evolution of LX Radio Control Console

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

Any Way You Want It

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

THE INTELLIGENT NETWORK



The World At Your (Motorized) Fingertips

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

All New Graphical User Interface

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

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A production studio sports the Alpha Media logo, which features CEO Larry Wilson's rescue dog, Bear.

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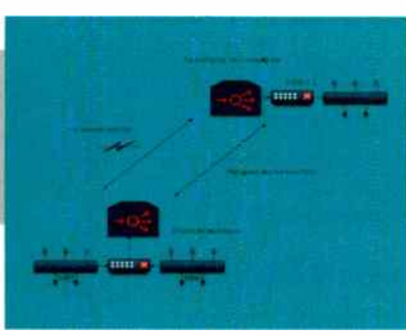

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DEPARTMENTS

On the cover: Clean lines in the on-air studio for 96.7—The Bull.


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Try This — It Just Might Make Your Job Easier

I hope you've noticed that we use up many of Radio's pages in talking about new technologies and how they're pertinent to our industry.

It's not about "the way we used to do it" (because in many cases the way we used to do things is nothing but ancient history now). Not long ago, I thought my ability to fix high-voltage power supplies was an important one. Gone are the days when I needed to know how to fix tape machines. My ability to align a cartridge/headshell combination with its RIAA preamp is anachronistic now.

In place of those old skills are new ones, such as dealing with IP connectivity. Desktop support is also something many of us do, in addition to the more traditional aspects of taking care of a radio station. (I'll admit that desktop support is not a strength of mine.)

One thing I have found, though, is that one must take the time to learn about the new technologies and then how to put them into place. At first it can be tough, especially when there's no immediate payoff. On the other hand, the first time I apply a skill I've newly learned to solve a problem, it feels particularly satisfying. It makes for a great day. I hope that you take some of the ideas we're showing in Radio and make use of them in order to make your job a little easier.

Let me give you a couple of examples.

In this issue, Chris Cottingham is giving you some ideas about inexpensive ways to keep track of network security at your station. With the recent radio station hacking incident in mind, gaining that know-how makes you that much more valuable around the station.

Jeremy Ruck is back this month with an article that discusses not only our legacy STL models, but use of Part 101 radio systems as well. With all the needs for IP connectivity at a remote site, this topic is an important one.

Our Trends in Technology article in this issue is all about how to build a self-healing system of interconnectivity with private networks.

Our features are also all in place this month: Lee Petro discusses some recent enforcement actions that the commission has taken; our Tech Tips entry is the wrap-up of a series we've published about the rehabilitation of old transmitters that have been taking up valuable space at your transmitter site. And our Facility Showcase features a very nice build-out for the Alpha Media group of six stations in Gulfport, Miss. Don't let the market size fool you — it looks fantastic.

Normally, all of our NAB Show coverage is in our June edition, because it takes some time to put it all together. Somehow, the Wandering Engineer managed to sneak in a set of observations about this year's show a bit early, and we're bringing it to you this month instead. While his topic appears to be about TV, in reality it's all about the truly disruptive nature of the Internet and its effect on broadcasting. I'm sure you'll enjoy it.

Thanks for picking up this issue of Radio!

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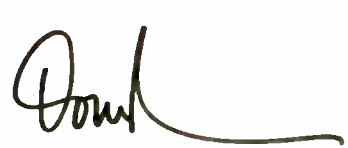

Doug Irwin | Technical Editor

Radio THE RADIO TECHNOLOGY LEADER

May 2016 | Vol. 22 No. 5

EDITORIAL
Technical Editor: Doug Irwin, CPBE DRB AMD
Managing Editor: Emily Reigart
Web Editor: Michael Balderston
Editorial Assistant: Cameron Vigliano

CONTRIBUTORS
Fred Baumgartner, Chris Cottingham, Lee Petro, Jeremy Ruck, The Wandering Engineer, Fardau van Neerden, Chris Wygal

CORPORATE
President and CEO: Steve Palm
Chief Financial Officer: Paul Mastronardi
Controller: Rick Ng
Vice President of Web Development: Robert Ames

VIDEO/BROADCAST GROUP
Executive Vice President: Carmel King
Vice President of Sales/Group Publisher: Eric Trabb

ADMINISTRATION AND PRODUCTION
Editorial Director: Paul J. McLane
Production Manager: Lisa McIntosh
Advertising Coordinator: Caroline Freeland

AUDIENCE DEVELOPMENT
Corporate Director Audience Development: Meg Estevez
Circulation Manager: Kwentin Keenan
Circulation Coordinator: Michele Fonville

ADVERTISING SALES REPRESENTATIVES
Publisher, U.S. Sales: Steven Bell
sbell@radiomagonline.com | 212-378-0400 x519

International Sales Manager: Rafaella Calabrese
rcalabrese@broadcast.it | +39 320 8911938

Japan: Eiji Yoshikawa
callems@world.odn.ne.jp | +81 3 3327 5759

Asia-Pacific: Wengong Wang
wwg@imaschina.com | +86 755 83862930/40/50

Member: American Business Media

A NewBay Media Publication

NewBay Media, LLC
28 East 28th Street, 12th floor
New York, NY 10016

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.

LIST RENTAL: 914-925-2449
danny.grubert@lakegroupmedia.com

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Radio, Volume 22, Number 5, (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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Broadcasters: Comply With Main Studio Rules

by Lee Petro

Growing up in the 1970s, many of us imagined the main studio of a broadcast station was similar to what we saw in "WRKP in Cincinnati." While stories of broadcasters' hijinks at their studios are legendary, the reality of life at the studio is often more mundane, especially when it comes to compliance with the Federal Communications Commission's rules. So, while the FCC is moving slowly to implement a Web-based public inspection file for radio stations, other main studio rules recently became the fodder for enforcement actions.

First, the FCC imposed a $10,000 forfeiture on a noncommercial broadcaster that failed to place 13 quarterly issues/programs lists in the station's public inspection file. As disclosed in its renewal of license application, the broadcaster acquired the station in the middle of the station's license term and did not implement procedures to comply with the FCC's requirement that broadcasters create and place into their public file a summary of the programs aired by the station to address community issues during the prior three months.

Before the last renewal cycle, the FCC added a certification to the renewal application to require applicants to confirm that these lists were placed in the public file in conformance with the FCC's rules, and the broadcaster was required to disclose that it had failed to comply with this FCC requirement in its renewal application.

Seeking a reduction of the $10,000 forfeiture, the broadcaster claimed that it was under financial strain, but did not respond to repeated requests by the FCC to substantiate its claim of financial hardship. Since the broadcaster did not provide this information, the FCC stood pat with the $10,000 forfeiture.

DON'T DO THIS

The second FCC decision illustrates a textbook case of what a broadcaster and its staff should not do when the FCC comes knocking.

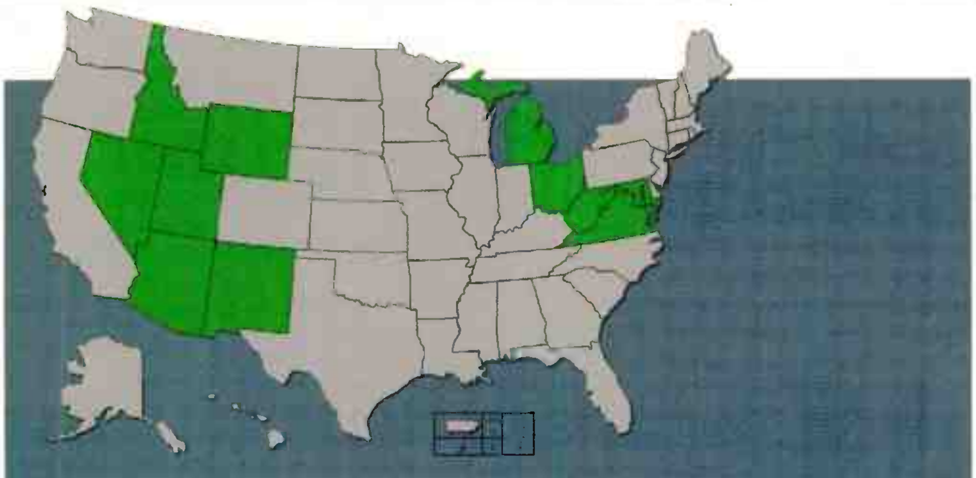
According to the forfeiture order, FCC agents arrived at the main studio location for a Class A television station seeking to conduct an inspection of the station. Rather than walking through the front door, though, the agents were held at bay due to a locked gate outside the main studio.

Apparently, the FCC then contacted the station and spoke with the station's general manager, who said he'd be right out. Ten minutes later, he emerged, but said he could not permit the inspection at that time, as he had a doctor's appointment and there was no one else at the station to facilitate the inspection. The FCC agents returned a month later and again sought to conduct an inspection, and the station manager came out to the gate, spoke with the agents, and said he'd be right back, but he never returned, and the FCC could not inspect the station. In both cases, the FCC agents reportedly attempted to contact the station's owner, but did not receive a response.

As a result, the FCC issued a forfeiture of $89,200 for failing to permit an FCC inspection and for failing to maintain adequate staffing at the main studio. The FCC noted that its rules require immediate access to conduct on-the-spot inspections of all broadcast stations, and the station manager's refusal to unlock the gate prevented the inspection from occurring.

The FCC also noted that access to the main studio should not have been blocked during regular business hours, and the station manager's statement regarding the lack of other staff at the main studio indicated that the station did not have a meaningful staff presence at the main studio during regular business hours.

Finally, as with the other case, the FCC also rejected the request to reduce the forfeiture due to financial hardship. While the broadcaster apparently



DEADLINES

June 1, 2016 — Stations with five or more full time employees in Arizona, Idaho, Maryland, Michigan, Nevada, New Mexico, Ohio, Utah, Virginia, West Virginia, Wyoming and the District of Columbia must place their Annual EEO Public File Reports in the station's public inspection file.

June 1, 2016 — Noncommercial radio stations in Michigan and Ohio file Biennial Ownership Report (FCC 323-E); new form and filing deadlines not yet effective.

June 1, 2016 — Stations with 11 or more full time employees in Michigan and Ohio file their Mid-Term EEO Report (FCC 397) with the FCC.

provided some financial information, it did not provide all of the information requested by the FCC. The FCC also took notice of a pending sale of the same station for $6.4 million in deciding not to reduce the forfeiture.

So, some quick takeaways for broadcasters from these two cases are: (i) establish and follow procedures to ensure that materials are prepared and placed in public inspection files on a timely basis; (ii) ensure that a station's main studio is staffed properly and is accessible to the public and the FCC during regular business hours; and (iii) respond on a timely basis to the FCC when it requests additional support for requests to reduce a proposed forfeiture.

The FCC will favorably consider such requests when it is presented with supporting information, but not responding to the FCC's request for additional information will likely lead to a denial of the reduction request.

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

Alpha Media Recreates Gulfport Cluster

by Mark Greenhouse

Portland, Ore.-based Alpha Broadcasting was formed in 2009 with an initial acquisition of six stations. Merging with L&L Broadcasting in 2014, rebranding as Alpha Media and acquiring Digity LLC in February 2016, it has become the third-largest broadcast company in terms of number of markets and fourth-largest regarding station count.

Digity's Gulfport, Miss., cluster was a staple of the Biloxi broadcast region when Alpha Media assumed ownership in 2014. Consisting of six stations — WXYK(FM), WCPR(FM), WGBL(FM), WQBB(FM), WXBD(AM) and WTNI(AM) — it occupied an elderly building that had been heavily damaged in 2005 by Hurricane Katrina. Although insurance had restored the facility, it did so only enough to make it operational; no improvements or upgrades were performed.

The cluster's "Grip and Grin" front foyer is stylish and modern.


All eight studios feature Axia Radius consoles, with six-fader expansion frames and user keys.

Alpha Media's Directors of Engineering Mike Everhart and Trent Muldrow recruited St. Louis, Mo., architectural firm V Three Studios to evaluate the original building. Together with V Three's engineers Kurt Kerns and Gabe McKee, they likened the structure to that of a used car that knew it was being driven to the dealership to be traded in. An air conditioning unit caved in through a bathroom ceiling revealing the sky; remaining AC units were failing to keep the studios cool, other tenants in the building had departed — the old facility began to self-destruct as if it knew it was to be abandoned.

CREATING A NEW HOME

A new location for the stations was chosen in a strip mall at 9471 Three Rivers Road in Gulfport, Miss., V Three approached the project by meeting with the local market, assessing Alpha Media's needs, scope, budget and expected growth agenda. Equally important was creating a facility that reflected Alpha's "L&L

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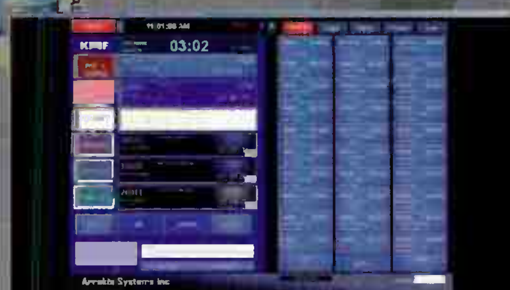
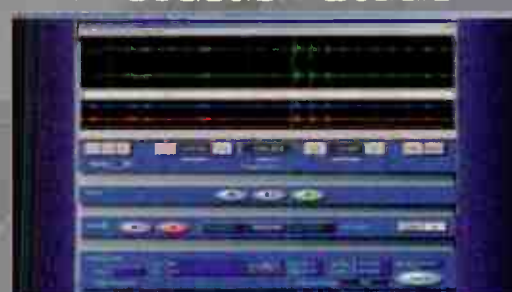


Management

Production Studio



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Centerpiece of the cluster — the central nervous system on display.

— Live and Local" personality; the location was also intended to be available to the public for promotions, live performances, charity drives and contests.

While Everhart, Muldrow, Kerns and McKee collectively contributed to the architectural plan, Trent expressed his appreciation for V Three Studios, describing how early on they created hand drawings of the proposed new facility and these sketches proved to be the basic blueprint for the new facility and not much changed from that. "They really got it right the first time out," he said. The team decided to perform a "gut rehab." Design began in January 2014, demolition began in December 2014 by stripping out everything but the external walls, an electrical room and a vehicle bay; then came reconstruction and the new cluster was broadcasting by early June 2015.

Based on V Three's observation of how well the layout of the original cluster worked, the new floor plan mirrors the arrangement of the studios and corridors in the original building. After the first "test fit" draft was approved by Kerns, it was taken to Alpha Media's local Gulfport Operations Manager Kenny Best and General Manager Ricky Mitchell for evaluation and input. All parties agreed it was an excellent plan and work began, ending up with the wiring, assembly, and integration which was led by Alpha's Contract Chief Engineer Danny Miller.

RECONSTRUCTION, RECREATION

As with many reconstruction projects, there were unanticipated complications. The mall owner did not have "as built" drawings in his possession, causing many trips by many teams to "recreate the structure." Additionally, the gut portion of the project revealed not only structural damage from Hurricane Katrina but also termite and water damage so extensive it led to the near-complete demolition of the leased building. Later, during excavation to erect an STL tower, an unmarked drainpipe and rogue fiber lines were unearthed, creating the need for several trips to City Hall to identify them. Existing HVAC systems, initially considered acceptable, are now under consideration for replacement.

A serious complication arose after the blueprints were completed and construction had begun. The new broadcast facility is located directly in the flight pattern of Gulfport-Biloxi International Airport (GPT), which services both commercial and military aircraft. V Three Studios determined that the airplanes took off *away* from the building, measured that audio volume and incorporated appropriate acoustical isolation materials into the construction plans to regulate it.

However, soon after the project began the airport created a new flight plan so that aircraft were directed to take off directly *over* the new site. V Three reevaluated the noise levels and developed new acoustic assemblies and envelopes to perform the criteria of keeping the roar out.

The general contracting company Dan Hensarling, Inc. of Gulfport, Miss., received praise from all four principals for their keen interest in these new designs and their cooperation in rebuilding the plant. Kerns reports "the studios sound great!"

Demolition and reconstruction completed, the new location is now home to the six on-air studios and two production facilities.

INSIDE VIEW

The architects decided on unusual shapes to make the building a delightful working environment. For colors and finishes, Kerns said, "We pulled from the established logos of the stations as well as corporate branding and integrated those graphics into the whole facility, creating collaborative areas for local visitors as well as spaces that could be used for video or performance that simultaneously pushed Alpha's message out to the public."

McKee added, "We located the rack room centrally with an all-glass wall to show off the technology within the facility." Looking to the future, V Three designed the electrical infrastructure, cable trays and conduits from the technical operations center to the studios to support the expectation of three heavy technical upgrades over the coming years before a new facility might be required.

Telos Axia Radius consoles were installed in all eight rooms, and six-fader expansion frames with user keys were added in the studios. Muldrow commented that Alpha was already using Axia in their Portland, Ore. facilities, so Everhart was already familiar with them. All audio is 48k uncompressed .wav over IP and lives within the Axia network. Utilizing Axia xNodes (AES/EBU, analog and GPIO), V Three designed the racks to group associated equipment in close proximity to minimize the length of signal paths.

StudioHub's array of adaptors were chosen to provide connectivity from all hardware devices to Cat-5 and Cat-6 cables. Cisco routers handle the data transfer and KVM switches were employed to bring keyboard, video and mouse controls into the studios. Muldrow noted, "The only punchblocks in the whole facility are for telephone lines."

Studio furniture is one of the most important decisions in outfitting a facility. In many studios it is one of the main capital expenses. Much more than providing a surface to hold up a console and some microphones, it supports the financial, strategic and personal goals of station ownership and management. It can affect sound quality, installation and maintenance costs and, ultimately, company

V Three architects chose bold colors to brighten the common area between the technical operations center and the two main on-air studios.

morale. Omnirax of Sausalito, Calif., provided the furniture for this install, with lead designer David Holland shepherding the fabrication, delivery and installation for the plant while ensuring the production schedule stayed on-time and on-budget.

Holland told me that V Three designed the Gulfport studios with Omnirax's Phoenix line of furniture in mind as the template for right-sizing the studios while still accommodating Alpha Media's particular needs. The two production rooms had unique shapes and custom designs were required.

The "break" room was designed to double as a performance space, and the infrastructure was initially considered to permit an engineer to occupy the space as well. Ultimately, however, Kerns realized "using the Axia system made this unnecessary because all we really needed to get audio back and forth was a network connection and hooking up an Axia xNode there. Plugging in all the audio sources allowed us to feed any of the six studios."

In addition to this room, the two larger "showcase" on-air studios were constructed to accommodate bigger groups, so these are considered performance spaces as well.

Alpha Media's Everhart and Muldrow kept existing equipment for analog STL links. A short (to accommodate the flight paths of GPT) 40-foot self-supporting tower is still under construction; in the meantime they are able to make some of the shots directly from the rooftop of the new cluster. Everhart said they are also implementing a multi-hop redistribution system to a centralized tower site near the building, which makes it easier to get significantly more height and relay those signals out to Alpha's other existing sites.

We ended our conversation with a "tip" from V Three Studios — carefully check out local codes when you build! In the course of this project, some unanticipated regulations were discovered — for example, in Harrison County where the stations were relocated there *must* be a water fountain somewhere in the facility — one had to be added to the cluster after it was completed. Additionally, as part of building requirements, first responder emergency personnel's communication devices must be able to transmit and receive indoors. County technicians perform signal measurement tests and if their radios don't communicate, it's incumbent on the building owner to create a repeater system that will permit the equipment to work within the facility.

Luckily for Alpha Media, it passed the inspection without further ado.

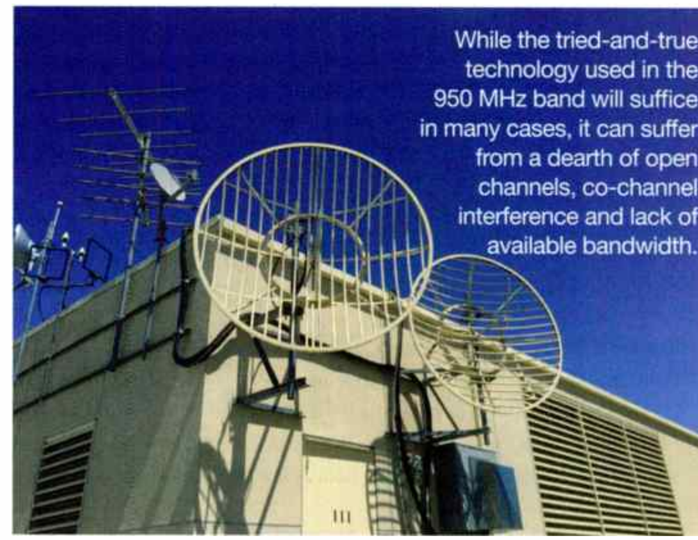
Be the Master of Your (Network's) Destiny

by Jeremy Ruck, PE

One of the workhorses of any broadcast facility is the link between the studio and another location, such as the transmitter. For those where the studio and transmitter address are one and the same, this link can be as simple as a few wires or a couple of coax runs, but in cases where the facilities are separate, a different approach is typically required. With their quasi-ubiquitous nature and robust reliability, the use of public networks has become more much more attractive in recent years.

Although essentially plug-and-play, such networks can be problematic for one simple fact: You are not the master of your destiny. Murphy's Law would then say that the public network would be unavailable when you need it most. This of course could be due to some sort of disaster situation, or maybe even a Washington-controlled kill-switch. The solution is therefore to construct and maintain your own network.

Perhaps the most common type of delivery is the studio-transmitter link or the inter-city relay (ICR) utilizing the 950 MHz band. Authorizations in this band are generally filed as broadcast auxiliaries under Part 74 of the commission's rules. However, applications in that band, as well as in other bands, can be filed under Part 101 of the rules. In this case, the link facility is authorized under the Private Operational Fixed Point-to-Point Microwave Service, or "OFS" for short. The OFS bands cover a significant amount of real estate from just under one gig, all the way up to 95 GHz.



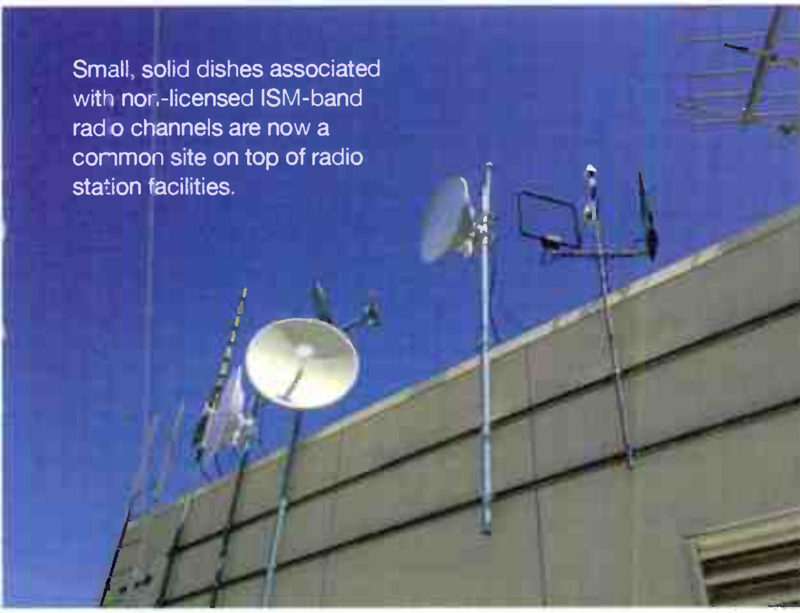
While the tried-and-true technology used in the 950 MHz band will suffice in many cases, it can suffer from a dearth of open channels, co-channel interference and lack of available bandwidth.

The first step in adding a radio STL is to do a rough estimation of the general technical requirements and frequency availability. If you are considering a multiple-mile hop in the middle of the great plains with a couple of audio channels, the traditional 950 MHz band is probably the way to go. On the other hand, that band may not be available in a spectrally congested region. Similarly, bandwidth requirements in excess of 500 kHz will also preclude its use. In such cases, the higher frequencies under the OFS rules may be the way to go. Remain cognizant, however, that the upper frequency bands have greater free-space attenuation, and may require a truncation of the path length. Additionally, higher frequencies become more susceptible to issues like rain fade and are more likely to be impacted by temperature inversions and paths over water and other anomalous terrain types. The use of diversity, briefly touched on later, can alleviate these problems.

Before delving into the process for engineering a link, we will take a look at some of the functional differences between the venerable 950 MHz band, and the 11 GHz band (as an OFS authorization). As we will see, the free-space loss along a path increases with the transmission frequency. Thus, a greater ERP may be required to maintain communications on higher bands. Additionally, at 11 GHz and higher frequencies, rain fade rears its ugly head.

The tradeoff, however, is that the microwave bands allow for a much greater throughput of data. On the 950 band, the maximum permissible transmitted bandwidth is 500 kHz. Even with a robust digital architecture, this bandwidth operationally limits things to say four audio channels and a couple of data channels. If analog architecture is utilized, you are typically looking at the audio for one station. By contrast, the 11 GHz band permits bandwidth of up to 80 MHz. One manufacturer has a system that will provide 350 Mbps data transfer rates utilizing a 56 MHz bandwidth. At that kind of data rates, you can have audio, telemetry, and even a pretty good internet connection.

After establishing a concept based on your data needs, the next course of action is to look at the path between transmit and receive ends of the link. The terrain along the proposed path and the distance between the ends of the link are the important pieces of information here. In the past, the way to create a path profile was to draw the path on USGS topographic maps, and then pick the elevation values off the maps at short and regular intervals. These values were then transferred to 4/3 Earth Radius graph paper and the dots connected. With digitized



Small, solid dishes associated with non-licensed ISM-band radio channels are now a common site on top of radio station facilities.

terrain databases of substantial accuracy now available, software methods of creating terrain profiles have supplanted this methodology. Still, however, ground truth is important to weed out the potential anomalous obstruction. Satellite image applications are invaluable here.

Although the line-of-sight path may be free of obstructions, losses can still come into play if there are obstructions in the Fresnel Zone. Generally sixty percent of the Fresnel zone must be keep clear of obstructions for maximum link performance. The Fresnel zone is an oval-shaped region, with its long axis along the link path, and the radius on the shorter axis a function of frequency and path distance as defined by the following:

$$r_{meters} = 17.32 \times \sqrt{\frac{path\ length\ (meters)}{4 \times frequency\ (GHz)}}$$

Note that since the frequency term is in the denominator of the radical, a higher frequency will necessarily imply a narrower Fresnel zone. The converse is true, and for a five-mile path at 945 MHz, the Fresnel zone at its widest point will be 83 feet in radius. Therefore, in practice it would be preferable to avoid obstructions within about 50 feet of the line-of-sight path.

If the path looks to be viable, then the total loss along the path can be determined. The start of this calculation is to determine the free-space loss. For path lengths in kilometers and frequencies in GHz, this loss is as follows:

$$FSL = 92.45 + [20 \times log(f_{GHz})] + [20 \times log(d_{km})]$$

This value is then adjusted by the gains and losses on both sides of the system relative to an isotropic source. Since the desired quantity is the total path loss, components in the system such as amplifiers or antennas should have their numerical values subtracted, while components with a loss such as filters and transmission lines should have their numerical values added. Antenna gains are sometimes specified relative to a half-wave dipole. These values should be increased by 2.15 dB to arrive at the equivalent isotropic value.

The total path loss is then subtracted from the transmitter power to arrive at the received carrier level, which will be a negative number. If transmitter power is provided in terms of watts, then it must be converted to dBm or decibels above one milliwatt by the following:

$$dBm = 10\times\log(1000\times P_{Watts})$$

The fade margin is then the difference between the received carrier level and the receiver sensitivity. A negative number implies a non-functioning path, since the sensitivity of the receiver is greater than the signal level. A positive number indicates a functioning path, but is it reliable?

As it turns out, we can actually estimate the reliability based on the fade margin. In addition to the path length (D), fade margin (F), and frequency in GHz, two additional quantities of the terrain factor (a) and climate factor (b) are defined. The suggested terrain factor values range from 0.25 for mountainous or rough areas to 4 for very smooth areas, including paths over water. Recommended climate factor values are 0.5 for coastal areas, 0.25 for temperate areas, and 0.125 for mountainous or dry areas. The outage probability becomes:

$$P = a\times b\times(2.5\times10^{-6})\times f_{GHz}\times {D_{miles}}^{3}\times10^{\frac{-F}{10}}$$

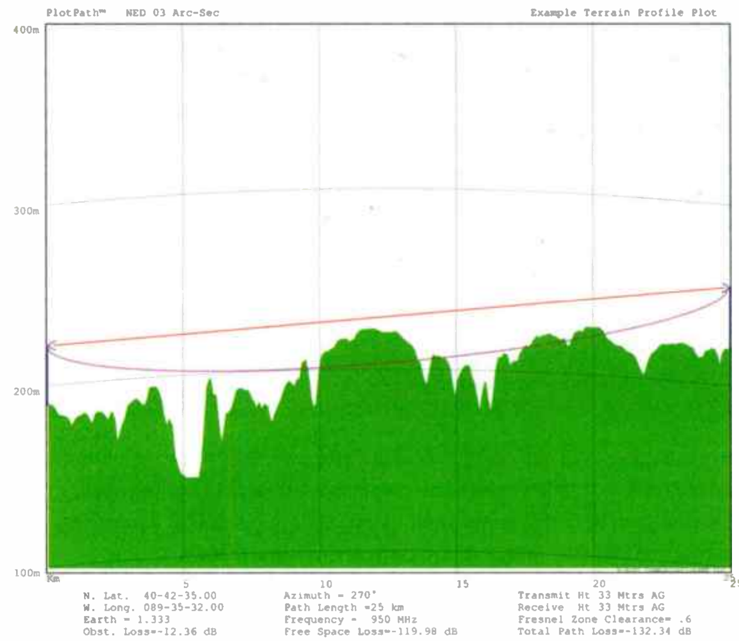
This number returns a reliability percentage by the following:

$$\%R = 100\times(1-P)$$

From the reliability percentage, the annual outage time may be determined. Keep in mind, however, that the estimated outage time does not all occur in one shot. Rather it is the estimate cumulative time for a given calendar year. If the reliability is left as a percentage, it is illustrative to take it out to several places past the decimal. Reliabilities of at least 99.999 percent relate to the Ma Bell standard of "five nines."

To put these numbers in perspective, at 950 MHz, a reliability of five nines for a ten-mile Midwestern path equates to a fade margin of around 18 dB, and an outage time of about 5 minutes per year. The same path and fade margin at 7 GHz drops the reliability to 99.993 percent, and increases the outage time to around 37 minutes per year. To get five nines back on the 7 GHz path, the fade margin would have to be increased to around 27 dB.

The final step before construction and operation of the path is the coordination (officially known as Prior Coordination Notice, or PCN) and the subsequent application process. Since no approved list of coordinators is maintained by the commission, the coordination process can be performed by anyone. Part 101.103 of the commission's rules spells out the process, but in general a notification by the proponent and response by potentially affected entities else is required. The notification provides the technical parameters to potentially affected entities for their review. (For more information on the PCN process, see the Trends in Technology article on page 25.)



An example of a terrain profile illustrating line-of-sight, but obstruction of the 60 percent of Fresnel zone.

The response can be either active or passive. In the active case, a potentially affected entity specifically communicates in writing with the proponent to either approve or object to the proposed facility. In the passive case, the proponent waits at least 30 days and assumes no objection exists if no response is received. Expedited coordination may be requested, however, it should be noted that the rules imply that a response is required in that case, whereas a 30-day period requires no response for valid coordination.

If objections are raised, the proponent will need to attempt changes to the system to alleviate the concerns. Any changes to the system that cumulatively exceed the major change criteria will then require their own separate notice. Such notices remain valid for six months from their initial date. If an application is not filed in that time, the proponent must resend notices to potentially affected entities. Once coordination is completed, the application can be filed with the commission, the facility constructed and operation commenced.

Occasionally the techniques of diversity are utilized to alleviate issues resulting from interference and fading. A system employing spatial diversity utilizes multiple transmit and/or receive antennas, which create slightly different paths. Anomalous effects along one path typically will not affect a similar path simultaneously, thereby reducing the potential outage time. Since additional equipment is required, this scheme tends to be more expensive.

In the end, a licensed link avoids the pitfalls of unlicensed links and can prevent transmission issues such as light loss on fibers and network performance problems for a myriad of other issues. They allow the station more control over their destiny, but even that comes with a certain price.

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

Cacti, Squid and Snort Your Way to Secure Networks

by Chris Cottingham

I have found that most engineers have more monitoring on their transmission facilities than they do on their local network. Nonetheless, the engineering network has become critically important with the advent and implementation of audio over IP and the need to access the Internet for virus updates, Windows updates and show audio downloads.

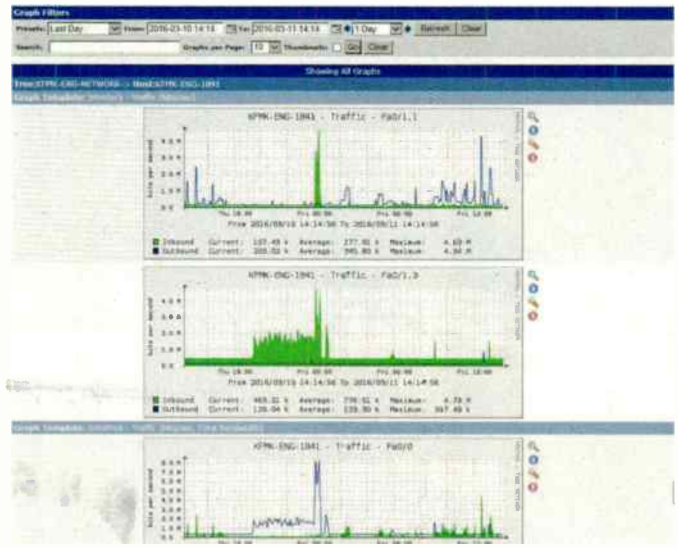
Engineers need to keep an eye on their networks. We cannot take the word of outside support that our critical infrastructure is working, nor can we just sit back and assume we are operating normally. Engineers need to control access to ensure that the engineering network is virus and malware free.

This article is not a comprehensive list of everything that you need to do to secure a network or enable monitoring; rather, its goal is to give an engineer an idea of where to start. Monitoring and controlling the local network is just as important as monitoring the modulation on your FM signal or your pattern on an AM station.

I have stated in previous articles that whatever is connected to the Internet can be hacked; all you can do as an engineer is manage the risk to which you are exposing your network when you enable Internet access.

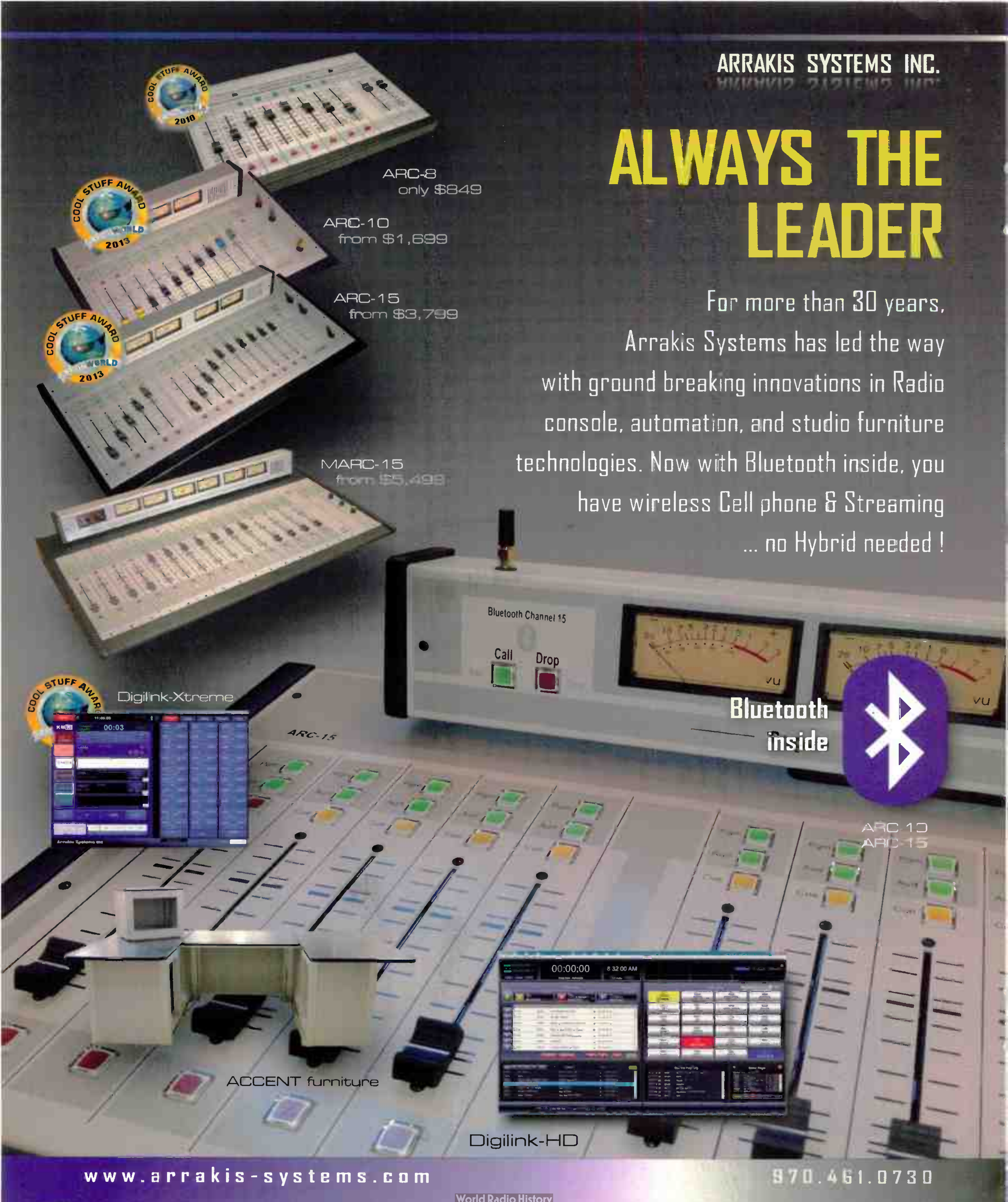
Some engineers manage this risk by *not* enabling access to the Internet on any of their machines. Other engineers manage this risk by enabling firewall technologies, network monitoring and restricting access.

I tend to be a little more paranoid than most when implementing network access to the Internet; to counter that fear, I utilize free technologies that require a bit of elbow grease to get running. The technologies that are commonly used are Squid proxy servers, Snort IDS servers, Cacti SNMP monitoring servers and firewall access rule restrictions.



The Cacti user interface shows inbound and outbound bandwidth generated by the LAN.

These technologies help manage the risk of having Internet access on the engineering network. Most of these are Linux-based and as such are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available free of charge. These services can all be installed together and run from a single Linux-based server computer.

KEEP AN EYE ON SECURITY

Monitoring the network is one of the first security tasks an engineer needs to accomplish.

Cacti is an open-source network monitoring tool that can monitor almost anything on the network that uses SNMP. I utilize Cacti exclusively to monitor my switched Ethernet network and Cisco-based routers; it provides status on bandwidth utilization, port error count and CPU utilization.

In its most basic form, Cacti does a fantastic job of letting an engineer know how much bandwidth is in use and which computers are using it. If the bandwidth in use changes drastically, this can be an indication of a network-related issue. Knowing how much bandwidth is in use allows an engineer to adequately plan for network capacity and to see if network hardware is failing or over-subscribed.

Cacti can be used to monitor Windows or Linux-based computers on the network for general health status as well. It is a great tool for keeping an eye on the basic health of the network, creating baseline network utilization logs and monitoring the health of network hosts. Cacti can be loaded on Windows or Linux; the Cacti website has a wealth of information and downloads for multiple platforms.

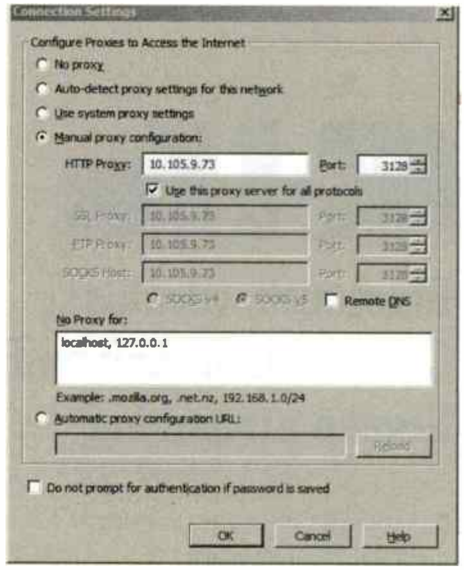
Its website is *www.cacti.net*.

CONTROL ACCESS

Another aspect of maintaining the network is controlling the data access. I do this by using a product called Squid. It is mainly used as a Web cache proxy server, but it can be configured to proxy FTP traffic. When properly configured, it will intercept, scan and control all the Web and FTP data going in and out of the network.

Since it intercepts the data, Squid can control how that data is handled. Squid can be configured to scan the data for malware or viruses and it can also be configured to block access to certain Web or FTP sites. If Squid detects a problem with the scanned data, it will drop the data and inform the engineer that it has detected an issue. Squid has the capability to log all web traffic and generate reports.

All of the clients on the network need to be configured to send data through the Squid proxy



Configuring Firefox proxy

server. The configuration is easy and can usually be done within a couple of minutes per machine. Once this configuration is done, none of the client machines will be able to communicate directly with websites or FTP servers; and because none of the clients can communicate directly with Web or FTP servers, it is a great time to block all FTP and Web access at the firewall. The only device that should be allowed to access Web or FTP services on the Internet is the Squid proxy server.

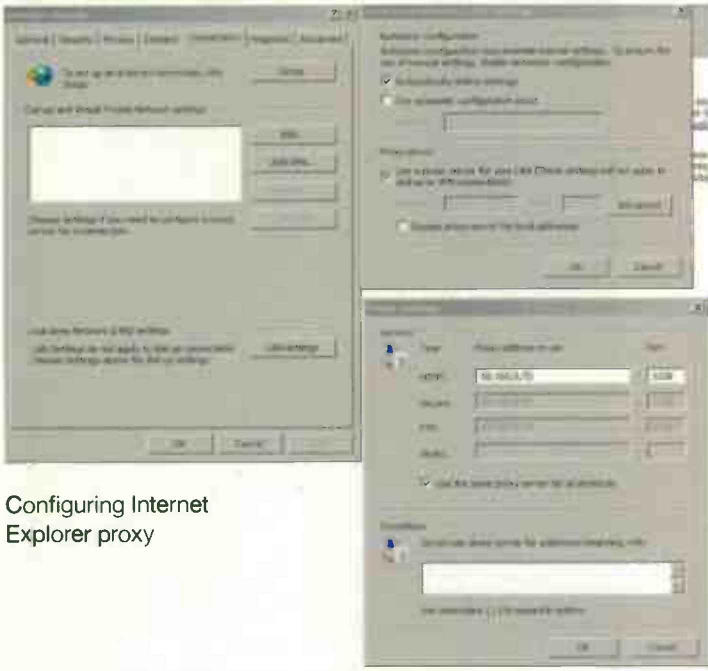
The real drawback of Squid is that there is no real GUI interface for it; it is completely configured and administered from the command line. (If you are in need of a GUI, Webmin is a loadable package for most Linux systems that has Squid configuration support.)

Squid can be loaded on Windows or Linux and is free of charge. More information about Squid and software downloads are found at *www.squid-cache.org*.

INTRUDER ALERT

The final piece of monitoring for the network is use of a Snort server. This is considered an Intrusion Detection System. An IDS scans the network for various malware and virus signatures. Once a signature is detected, the IDS alerts the engineer. An IDS does not take any action on the network to stop the virus or malware: It is up to the engineer to take action and correct the issue.

In order to use Snort, one port on the switch is set to mirror or receive all of the switch traffic, and Snort server is then plugged into this port. (Because switches are designed to direct network traffic only to destinations that are specified, we need to mirror a switch port. The actual



Configuring Internet Explorer proxy

Tools ready to use for Squid webmin

terminology and command set in Cisco IOS is SPAN, for Switched Port Analyzer.)

Snort needs to see all of the traffic on the network to work properly. What I do is mirror the port on the switch that the Internet router is plugged into; in this way I can use Snort to monitor all of the incoming and outgoing Internet traffic. This is very useful since the Squid server will only see the Web or FTP traffic on the network. Snort will see all of the traffic coming in from or going out to the Internet. Information about Snort and downloads are located at *www.snort.org*.

There are also commercial products that will encompass all of the individual technologies listed above. These products are usually a "one size fits all" solutions that have significant price tags. Go ahead and install one of these if you have the budget. If you don't have the budget, the three technologies I covered briefly will do a nice job of giving an engineer visibility and control of his or her local network.

Cottingham is a Cisco, Microsoft and CompTIA instructor with 25 years experience in IT and radio engineering. He's the chief engineer of KFMK in Austin, Texas.

TECHTIPS

Time to Check Your Work

by Doug Irwin
CPBE AMD DRB

We've reached the last step in our transmitter rehabilitation project. In our penultimate installment (April 2016 issue), I discussed physical issues with the RF output stage. For the purposes of this article I'm assuming you've completed *all* the steps mentioned previously in the series.

As I've said in the previous five installments: Working with transmitters that use any kind of high voltage (whether AC or DC) is inherently dangerous. *Never work on transmitters when alone or tired.* Take every precaution, and then take every precaution again.

The half-wave cavity lacks the HV blocking capacitor wrapped around the tube anode. However, the high voltage still needs to be kept isolated. Keep all surfaces that isolate DC clean.

THE MOST COMMON PROBLEM WITH ANY TUBE AMPLIFIER

You can waste a lot of time analyzing problems that are actually caused by a bad tube. It's imperative before going on that you know the tube you have for the transmitter is serviceable.

The best way to tell is to install it in another transmitter. If it works normally, it's ready to go back to the transmitter being fixed.

If it doesn't, stop the project until you can get another tube. (You probably know this, but for those who don't — a good source of large rebuilt vacuum tubes is Woodland, Calif.-based Econco, and they'll take the "dud" off of your hands as well.) The tube you use for testing can have low filament emission — that's fine for testing.

THE SECOND MOST COMMON PROBLEM

The vacuum-tube amplifier operates at a very high voltage, and low current (the ratio of which is, of course, the plate resistance). The output network is used to match this high impedance to the low impedance of the load. By necessity, the plate is connected to the high-voltage DC, but a quarter-wave matching network presents a short for DC. Obviously a capacitor is needed, then, to block the DC and pass RF. This capacitor couples the RF by being physically wrapped around the anode of the tube, and the entire plate supply appears across it.

A common problem is a failure of this capacitor. Before you even energize the plate supply in this transmitter, inspect this capacitor for obvious problems. Actually, if a "new" capacitor is available, it wouldn't be a waste of time to simply replace the old one.

Inspect all high-voltage standoff insulators before energizing the plate supply. One-half-wave cavities lack the blocking capacitor, but the network is still energized by the plate supply. Clean any part of the output circuit that is used to isolate DC.

LOAD AND DIRECTIONAL COUPLER NEEDED FOR TESTING

I hope you aren't planning on using an antenna as the load for testing purposes. You'd have to do testing in the middle of the night then, correct? That would violate the cardinal rule of transmitter work: Avoid it when you are tired.

If you don't have a dummy load, stop the project until you can obtain one; and when you

A Bird "drop" slug is an ideal way to sample RF after the low-pass filter. Use caution when connecting to your spectrum analyzer — typically 20 to 30 dB of attenuation is called for.

do, make sure it's reasonably close to 50 ohms. Sometimes the load resistors can be cracked (and open) causing the load presented to be higher than 50 — which could complicate your amplifier testing.

When making a temporary connection from the output of the transmitter to the dummy load, it's best to insert a directional coupler in-line. It's not absolutely necessary, especially if you have one going to your main antenna (because at some point you'll be connecting this transmitter to it).

However, you may not know how well the meters on the transmitter are working at this point in the test. If the plate current meter, or the output meter are giving you bad information, then again, you might be wasting time analyzing a problem with the amp that doesn't really exist.

TIME TO TEST YOUR WORK

We've discussed many steps in this series, and now we're about to put everything together. The tube is in its socket and ready to be energized; the amplifier output is seeing a good load. You have an exciter that provides enough RF to drive the IPA so that it drives the grid of the final.

WE WANT YOUR TIPS

Tech tips may be suitable to earn SBE recertification credits. Send your tips to radio@RadioMagOnline.com.

At this point I always have the power control turned down, but I caution you: If you turn it down too far, sometimes you'll think that nothing is happening at all. Some power controllers virtually turn the amplification *off* and beyond. You can energize the plate circuit, though, just to make sure it comes up and stays on.

So here we go:

- **DOUBLE CHECK** that the final amplifier compartment is closed, and that all interlocks are closed.
- **PLATE ON:** The power supply should come up, and high-voltage should be indicated. At this point you may not have much plate current, or any output at all.
- **GRID DRIVE.** Check the grid current. Are you getting the appropriate amount? Check the input tuning and increase the drive if necessary.
- **POWER CONTROL.** Turn the power controller up some. You should see some plate current and screen current (if using a tetrode) indicated.
- **POWER OUT.** Hopefully your directional coupler is indicating some power. Use plate tuning (dip plate current) and then the loading control to find the peak in output power. At this point, the goal is ***maximum smoke*** (maximize the power output).
- **RAISE POWER.** As you turn up the power controller, tuning steps need to be done again. This is an iterative process. Continue until reaching your output power goal.

If you've reached this point, and the transmitter is humming along — well, congratulate yourself, because you've succeeded.

SPURIOUS AND HARMONIC CONTENT AND NEUTRALIZATION

Ideally, for this test you'll have access to a spectrum analyzer because this is the quickest way to look for "junk" in the output of the amplifier.

If you have inserted a directional coupler in the line, hopefully you can insert a "drop" sample slug in it to give you a direct sample of the RF after the low-pass filter. (Use caution driving the S.A. input, though; you'll still have a substantial signal coming out of this drop sample.)

Neutralization is the process by which the amount of coupling from output to input of the amplifier is minimized. If there is too much coupling from output to input, the amplifier may become unstable. Common symptoms would be oscillation (in other words, there is still output, even without exciter drive) or perhaps the presence of spurious signals (varying in frequency and level) as seen in the output of the amplifier. Consult the transmitter manual for the specific neutralization procedure.

The author is engineer/project manager for iHeartMedia Los Angeles and tech editor of Radio magazine. Contact him at doug@dougirwin.net

System, Heal Thyself

by Doug Irwin, CPBE AMD DRB

Sometimes you will find yourself tasked with a technical chore that, on the surface, sounds very easy, but turns out to be quite complicated.

Let's say circumstances warrant a transmitter site's move to a new location. You find, though, that there are *no* 950 MHz-band channels available. They're already all used in your market. To make matters worse, your engineering buddies from across town tell you that the telco facilities that do exist at the new site are unreliable; they fail when it rains or snows (or when the sun is out), and repairs sometimes take days or longer.

"Not acceptable!" you think, envisioning yourself spending Friday night at the site, waiting for a call-back from telco. "There has to be a better way!" And there is.

In this article, we'll look at other radio link options — such as 11 GHz as prescribed in Part 101; the 952–960 MHz band, as prescribed in Part 101; and, of course, non-licensed, ISM band options as well.

A MORE SOPHISTICATED APPROACH

Many STL systems provide only that, communications in one direction only. Now that IP connectivity is commonplace and expected, it's time to do the engineering on a fully-duplex system. The 950 MHz legacy systems still have their place — and we use them regularly. By necessity, though, we've moved way beyond their native capability. Having high-speed IP connectivity provides many benefits that will be appreciated once it's up and running.

There's an important point about IP connectivity that I want to make clear, though, because it represents something of a paradigm shift from what we're all used to, when it comes to using the legacy gear. The nature of Ethernet, and IP, is that it is easily made to be *self-healing*. This not only provides an obvious advantage in keeping your station on-the-air, but it also frees you from having to be the one that does the "healing." Systems can be designed and then configured to do much of your work for you, and then letting you know after the fact, by way of an email (or

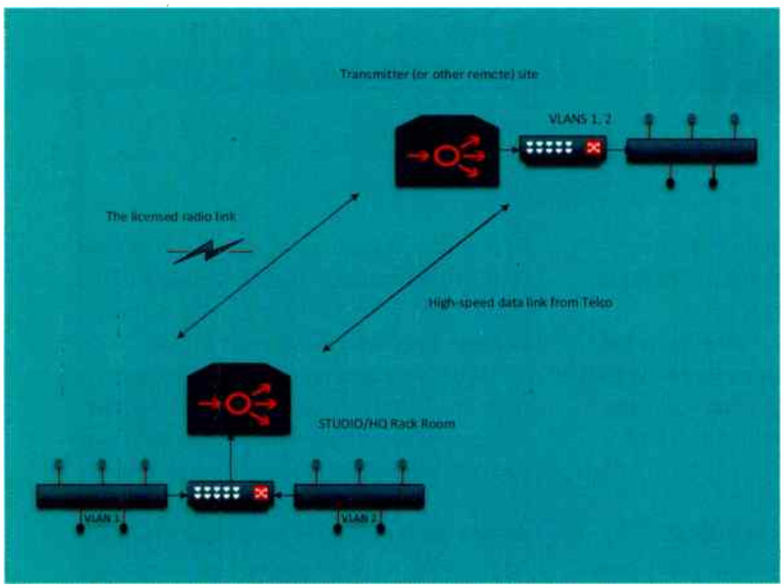


Fig. 1: Interconnectivity between the studio and transmitter site, provided by dual IP links, in a self-healing configuration. One link is via radio, and one via wireline.

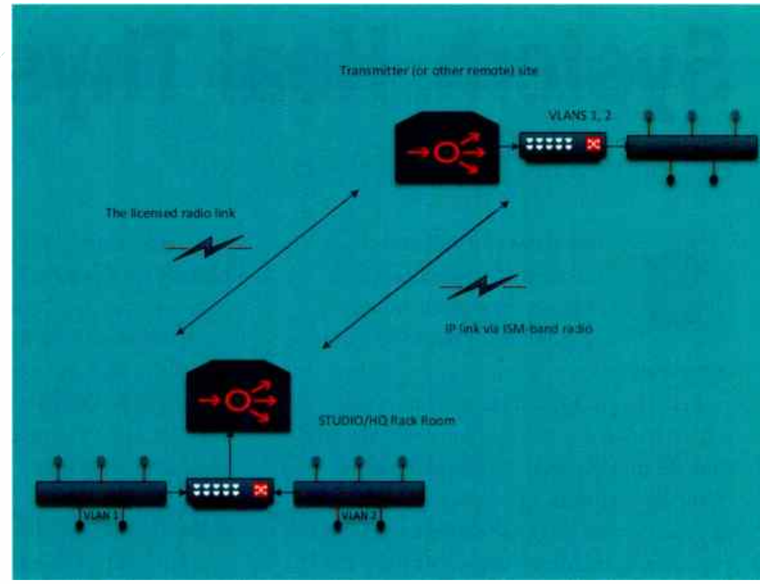


Fig. 2: Interconnectivity between the studio and transmitter site, provided by dual IP links, in a self-healing configuration. Both links are based on radio.

other remote control functionality).

While what follows may seem like more of an IT topic, it's important to discuss it (at least conceptually) so that you can really understand what I mean by self-healing.

For the system to work as I'm about to describe, two links need to be established; and, after establishing both links, you will have a choice as to how to configure the self-healing aspect:

- **Load-balancing at layer-2.** Both ends of *both* links will terminate in a layer-2 switch. The load-balancing function means that you configure the layer-2 switch to share both links for the passing back and forth of the Ethernet frames. In the event one fails, the layer-2 switch will start passing *all* of the traffic over the *remaining* link. You need to be careful not to "over-subscribe" the path, meaning that the normal amount of traffic passing over either link is less than 50 percent of its ultimate capability.

- **Using a router to switch routes at layer-3.** In this case, both ends of the link will terminate in a router (operating at layer-3). Normally, the router will pass all traffic over one of the two links. You will configure the router to move all the traffic to the backup link in the event that the primary link fails. When the primary link comes back, the traffic will start routing over the primary once again. The primary link would be on one network segment, and the secondary link would be on another.

- **Two separate networks, isolated from one another.** This is a bit of a turn away from the self-healing aspect; however, since many AoIP codecs have two network ports, and can be configured to switch automatically themselves, you could consider this method. At the far end, some hosts would be on one network, and some on another. If one link were to fail, some hosts (those with only one NIC) would become unavailable to the far end, while others would remain available.

In each of the three cases, your AoIP traffic will continue to flow (with perhaps a very brief gap) after one of the links fails. Using a remote control with SNMP will allow you to learn of the failure; another option would be a use of PRTG, which can be easily configured to let you know of network ports going up and down. So — unlike the old days — instead of being woken up in the middle of the night by a silence detector or panicky jock, now you let your network devices fix the problem for you. During normal business hours, you can see what happened.

IDEAS

The first of the self-healing system configuration ideas we'll look at will make use of a licensed IP radio and a telco backup. (See Fig. 1.)

One link providing IP connectivity in this case will be provided by a licensed IP radio operating in the 11 GHz band. (See this issue's RF Engineering column on page 14 for more details on how to license that type of radio link.)

Earlier I alluded to "unreliable" telco connectivity; however, for purposes of this discussion, let's assume that you can get high-speed connectivity to your new site from your studio facility.

If your telco provider is AT&T, ask them about ASE (ATT Switched Ethernet); if your provider is Verizon, ask them about Ethernet Virtual Private LAN Service; for Frontier, ask about Ethernet Local Area Network; and for CenturyLink, ask for plain old metro Ethernet.

Deciding which of the two links becomes the "primary" and which is the "secondary" may take some doing. In an ideal world, both will be very reliable; but in reality, you will likely find one is better than the other. Clearly, the better one should be your primary.

The second of the self-healing configurations is seen in Fig. 2. This is a variation of the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first method; the second link is now provided by an unlicensed radio link, operating in one of the Industrial, Scientific, Medicine bands. Why would you want to pay telco for the second link when you use an unlicensed radio? Or, for that matter, why would you even go for a licensed radio?

There are a couple of aspects you need consider. First: Not to cast aspersions on the quality of the ISM radios, but you will find that many of them are very inexpensive and meant to be throw-aways. They are simply not as rugged as some of the radio brands I'll mention at the end of this article.

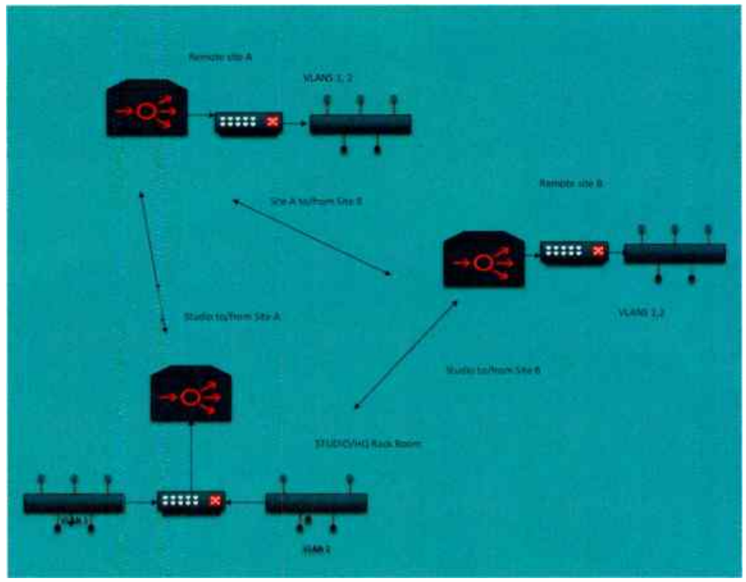

Fig. 3: Interconnectivity between the studio and two remote sites. Both sites have redundant paths to and from the studio location.

That being said, my experience with this type of radio has been very good. We have not had a radio failure, nor an instance of unexplained interference to any of the radio links we use here in Los Angeles. Your mileage may vary, however. Call me conservative, but I would be hesitant to rely 100 percent on this type of radio for mission-critical applications; for a backup, though, I'm comfortable.

The third self-healing configuration (Fig. 3) is simple variation on the first two; however, in this case, we have three sites, instead of two. An example of this in practice would be one studio location, a main transmitter site (location A) and an auxiliary transmitter site at location B. The studio to A link would be your normal route; in the event that failed, traffic would flow from the studio, to site B, thence to site A. In any case, both sites have a redundant path.

Many manufacturers are now making microwave radios because there is a large market for "backhaul" from cell sites. (Just think about all that data flowing over LTE networks!) That's an advantage for us because as more brands fight for market share, pricing gets better.

Here are some of the features you'll need when specifying a radio system:

Layer-2 (Ethernet) Interface. You're going to treat this radio link as if it were a simple Ethernet cable. This goes for the metro Ethernet connections I discussed earlier as well. In addition to their Ethernet interfaces, some radios still have "auxiliary" TDM interfaces which can carry one or more T1s; so if you need some time to transition between TDM and IP, and you still want to use an older T1 shelf, this is something to consider.

VLAN Priority Support. It's quite likely that you'll be using the radio link or the metro Ethernet as a VLAN trunk because it's a good idea to separate your AoIP traffic from *all* other traffic to and from the other end. It's typical that a link such as this will support nearly 100 mbps throughput (or more), so I doubt that anyone downloading a manual (as an example) on the far end is going to interrupt or even slow down AoIP traffic; however, at the very least, consider it to be future-proofing.

The 802.1Q standard defines a system of VLAN tagging for Ethernet frames and also contains a provision for a quality of service prioritization scheme known as 802.1P, which indicates the priority level of the frame. The 802.1Q standard adds this information to the Ethernet header. The priority level values range from zero (best effort) to seven (highest). You can configure these values to prioritize different classes of traffic such as AoIP versus "everything else" you might use to and from the transmitter (or other) remote site.

One more thing to keep in mind when you build a system such as this: Frames for the native VLAN are not tagged, and thus can't be prioritized. Don't send your AoIP traffic in the native VLAN.

Adaptive Modulation and Coding. This is a feature of many radio systems, whereby the modulation, coding and other signal and protocol parameters are adjusted to match the conditions on the radio link. For example, if the link fades, the modulation rate is adjusted to lower the throughput of the system. The idea is that higher-priority traffic will still pass through, even in adverse conditions.

Remote Access. Radio links such as the ones we've been talking about are designed to operate in a networked IT environment, and this remote access is a given. You'll have full HTTP access to all configurations and parameters. SNMP support is a standard feature of this type of system.

From my own experience I recommend having an additional backup network at the remote end, for two reasons: First, if the radio link fails, and that's all you have for connectivity, then you'll be completely blind as to what is going on at the far end. Second, even if the radio link is simply being aimed by a rigging crew, it's really tough to rely on it to tell you its own signal strength at the remote end.

With that backup network in place, you can log into the remote receiver and see what is going on. Nothing fancy is needed — perhaps the old DSL line you've been using up until this point. The scenarios depicted in Figs. 1 and 2 will also allow you to have backup access, of course.

Indoor Unity/Outdoor Unit. Many of the older microwave systems use a very expensive waveguide between the radio and the antenna up on the roof or tower. Today it's more likely that your system will consist of an indoor unit and an outdoor unit.

The indoor unit can live in your rack room; the outdoor unit usually mounts right on the back of the antenna. The two devices communicate through intermediate RF frequencies that can be accommodated through a much more readily available coax, such as LMR-400.

The outdoor unit is also powered over the same cable. It's typical of ISM radios to be mounted directly on their dishes as well, and to be connected directly via a Cat-5 or Cat-6 cable, which also carries the power. This greatly simplifies installation. Use direct-burial category cable for this type of connection.

Brands to look at for the IP radio systems are many: Ceragon, Aviat, Dragonwave, Exalt, Racom and Proxim are obvious ones. For ISM radios, one must at least look at Ubiqity and Adtran.

With the licensed radio links you must of course go through the prior coordination notice process with all the local users, since the frequencies are shared. If the PCN process shows that your frequency choice and path design will not cause interference to other users, you can begin the application process.

The process sounds more difficult than it really is, and there are lots of firms that will do that work for you, such as Comsearch, Micronet, V-Soft, RFEngineers.com, Terrestrial RF Licensing Corp. and Jeremy Ruck and Associates.

INNER-CITY RELAYS

Let's completely shift gears now and go back to our 950 MHz topic — except we're going to consider a band that is *just above* the one with which we're accustomed. Part 101.101 describes the spectrum between 952 and 960 MHz as usable for Private Operational Fixed Point-to-Point

In many cases, carrier-grade microwave systems are made up of an indoor unit connected to the outdoor unit mounted directly on the back of the antenna, as shown. Interconnecting cable is something like inexpensive LMR-400.

Microwave Service (OFS for short). I have seen this band used for at least two applications (both of which were inner-city relays):

- **Double-hop STL.** There was an application of this band at a station I inherited years ago. Two transmitter sites simulcast the same program; and since they were some 50 miles apart, and out of view from one another, a two-hop STL was needed. Again, spectrum was an issue; so the first link was put on the OFS band I referred to earlier. The second hop went the "final mile" to the transmitter site, and was in the 945-952 MHz band we normally use.

- **RPU pickup.** I know of two instances where inner-city relay was used to return a very remote RPU receiver audio output back to a physical location from which it was more accessible by conventional means.

If you were to decide to use a system such as this, it would still be necessary to go through the normal PCN process. The good news is that the gear we are accustomed to using — and perhaps you have some of it on the shelf — is usable for this application. Sure, it's a bit old-fashioned, especially with the availability of the inexpensive ISM-band radios. Still, keep it mind as an option.

One advantage of the current crop of ISM radio systems is their diminutive size, which can be accommodated by a simple non-penetrating roof mount, as shown.

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PROBLEMSOLVED

BW Broadcast Provides High-Power, One-Box Translator Solution

A common way to build a translator has been using an FM receiver and off-air pick-up of the station to be translated; then using the demodulated audio to feed the input to a small transmitter, operating on the new frequency.

Many smaller organizations have used this method and others over the years. A more efficient (read: more economical) way to accomplish the off-air translator is to use a *single-box* solution — meaning receiver and transmitter, all-in-one.

The Family Life Radio Network, based in Bath, N.Y., airs contemporary Christian music, biblical teaching, kids programs and news on nearly 70 radio outlets in New York and Pennsylvania.

Chief Engineer John Coulter recently found himself needing a equipment for some of Family Life's translator facilities. He turned to a new product from BW Broadcast: the TR series. The TR300 V2 and TR600 V2, are "one-box" solutions that include BW's RBRX1 Re-broadcast Receiver and V2 transmitter.

The TR series includes:

- Adjustable audio and RF bandwidth
- Silence detection that automatically switches between the MPX, analog or AES/EBU inputs as needed
- RDS PI code checking, to prevent the translator from being hijacked or jammed
- Hot-swappable, slide-in power Supplies
- Remote control by Ethernet with email alerts, SNMP, silence detection, and built-in logger
- Built-in audio processing and stereo generator
- Morse code FSK ID keyer as standard
- The TR300 V2 is rated at 300 watts; the TR600 V2, 600 watts

"We currently have six BW Broadcast TR units in service throughout the Family Life Network," said Coulter. "They are easy to set up and can go from box to broadcasting in ten minutes. The remote functionality works well also whether you're using a computer or a handheld device over the internet. The built-in receiver in the translator unit rivals a competitors unit but is two-thirds the cost. The adjustable bandwidth is very useful at RF-congested tower sites."

MORE INFO
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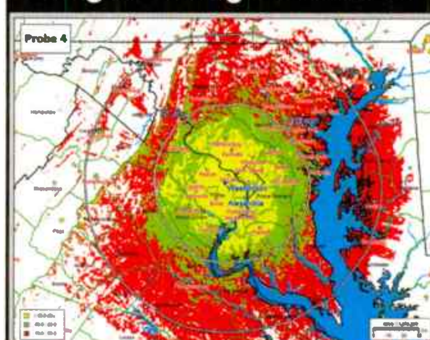

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Broadcasting Killed the Internet Star

by The Wandering Engineer

Something very weird just happened in Las Vegas. Since the invention of the Internet, broadcasters have been afraid of what was going to become of them, just as movie theatres were afraid of TV, and newspapers were intimidated by radio. Just as we were calculating the scrap value of our towers, broadcasting figured out how to beat the Internet at its own game.

For some time, broadcasters have been limited by the return channel. In the old days, listeners called in, sent contest entry cards, visited events, and even hung out in front of storefront broadcaster's windows. Then we gave them URLs to call up and click through. Today, the Internet just kills broadcasting when it comes to interactivity, the ability to target advertising (since that's more profitable) and finally to provide many more choices as to who or what you can listen to.

NO LONGER ANTI-INTERNET?

What if broadcasting wasn't the anti-Internet, but an IP-based system with *all* of its attributes and some really big unique advantages?

NextRadio (amongst a number of schemes) combines IP and radio, as does RadioDNS.

During the spring NAB Show, it became clear TV's ATSC 3.0 accomplishes this goal just beyond the imagination. One thing: It's not TV anymore. ATSC 3.0 is as much radio as it is anything else given its multimedia nature. I've made that case before in this column — that radio and TV are not so different now that the technical limitations are long gone. Cellphones come with cameras and video displays, and radio now serves up art and visual content. When you Skype, you can turn the picture on or off as you wish … your devices don't discriminate between video and audio only services any longer.

What ATSC 3.0 does is create an IP path not only to mobile devices (something that ATSC 1.0 didn't do so well) but to home networks as well. The part to remember about ATSC 3.0 is that, ideally, the off-the-air antenna connects to the home gateway router, *not* the living room TV. Of course, it can still reach a plain old TV (with something like a dongle with an F-connector on one end and a DVI or HDMI connector on the other) but that's the equivalent of granny's flipfone in this world.

What if NextRadio — shown here on a Samsung Galaxy S7 — is just the beginning of radio's expansion?

Broadcasting is now in the IP delivery business, but unlike with the Mobile Network Operators and Internet Service Providers, there is no monthly fee or data cap, no congestion, no walled gardens, no privacy issues, no quality of service tiers, no edge servers or content distribution networks with their streaming fees … and broadcasters control it and compete for your attention.

Qualcomm has put cameras and FM receivers into its mobile phone chip sets for years, probably sticking the MNOs with something they did not at first want. The cameras eventually produced revenue as Snapchat introduced a world of video sharing to burn up revenue producing bits, but MNOs make lots of money from users that never hit their data caps.

Broadcasting via the 3GPP network would certainly reduce the unused bits, and there is no guarantee that customers will pay for more. The MNOs would rather they have their own "broadcast" platform, which may look a lot like eMBMS, the LTE version of Multimedia Broadcast Multicast Service.

Up until now, the owners of the Internet have operated as a bit of a cartel, controlling what can show up in a home's or mobile device's IP stream. One can expect that reluctance to activate the FM chip is a tempest in a teapot compared to what happens when broadcasting leaves its technologically imposed island and becomes IP pipes right into the devices in people's homes, hands and cars.

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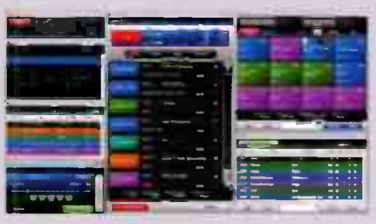

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