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An utimate DIY project

How we ended up designing and building our own diplexer

Cris Alexander
CPBE, AMD, DRB
Technical Editor

AM is dead! We should stop wasting time on it and focus on FM.

I've heard that sentiment in various forms for years, probably going back to the late 1980s. Is it true? In some cases, yes. Is it universally true? Absolutely not!

Just take a look at the list of top stations in the big markets and you'll likely find at least one AM in each.

Without trying to start or extend a debate, it's all about content. Give people what they want and they will listen. Or they would if they had receivers that could pick up those AM stations clearly ... but that's another topic for another day.

My point is, while I recognize that many AM stations are living on borrowed time, many others are alive and well and serving their markets.

We are blessed to have a second home in the mountains a few hours west of Denver, on the other side of the Divide. Denver broadcast signals don't penetrate that 12,000+ foot wall of granite, which means that local radio stations in the mountain communities must fill the void.

In the town a dozen miles or so from our mountain home, a 5 kW mid-band daytimer does that very well, providing the only wide-area radio service in the region. That station has an FM translator, but because of that whole line-of-sight thing and the aforementioned walls of granite, that coverage is local to the town. But the AM goes over the hills and into the valleys and serves the whole area.

That same kind of scenario plays out in small communities all across this land. AM stations with or without translators provide service that would otherwise be unavailable. People listen because it's the only place to get local news and weather.

They may listen to SiriusXM, Spotify or some other service a good bit of the time, but you won't get local news, weather and information there. You need a local broadcast station for that.

What about in the big cities? Oh sure, you've got KFI in Los Angeles, WINS, WOR and WCBS in New York, WGN and WLS in Chicago plus a host of others. In my hometown of

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20 Cameras solve the problem

Denver, KOA has been a longtime leader. But what about others in those markets? Are those stations viable? Should they be shut off and bid a fond adieu?

Based on my own experience, primarily with my employer, I can tell you with confidence that many of what some would consider "also-ran" AM stations in the large and medium markets are doing just fine.

Sure, some have FM translators, but many don't, or their FM signals have limited coverage because of interference and spacing restrictions. So my conclusion is that some — a lot of — AM stations are not only worth keeping but are worthy of investment.

At some point, all-digital may become a factor in that. I have mixed feelings about digital AM, whether hybrid or all-digital, and we're going to have to wait a good while before the jury comes back in on that transmission medium. But if we just consider the core, the analog signal and coverage that is universally receivable on any radio that features the AM band, I'd say that a bunch of AMs are worth saving, keeping and even improving.

That said, there are economic considerations that we just can't get around.

Existential question

Over the past couple of years, I have been working to save one of our Denver AM stations that was losing its site. Long story, but it's one you've heard time and again: The site owner wants to sell the tower site for development. It's apparently worth much more with a different use than as the tower site for a couple of AM stations.

When we got a notice of lease non-renewal from the site owner a couple of years ago, we began looking for siting options. And in the discussions, the question persisted: Is this station worth saving?

I won't go into more detail on those discussions but suffice it to say that we determined that the station has value, and with that in mind, we started looking at options, including moving it to one of our existing owned sites.

Because of those economic considerations I mentioned, it turned out that really wasn't an option. But we did find another home for the station just a couple of miles from the existing site. All it would take would be a diplexer to make it work with the 5 kW station that already called the site home.

Diplex equipment isn't cheap. It requires vacuum capacitors, large coils and multiple cabinets. It didn't take me long to figure out that a "store-bought" diplexer would not fit the budget for this station. Which left us with just one option: designing, building and installing our own diplexer, sort of the ultimate do-it-yourself project.

We love presenting DIY projects in these pages, and in this one we hand you a doozie that we'll tell in two parts.

I'll warn you, this kind of project is not for the faint of heart, and it requires specialized skills and experience to pull it off. Thankfully we were blessed with both.

Above
The author works on the 3D puzzle of component placement.

> **Even if you don't have all the needed skills, materials and tools, you can get by with a little help from your friends.**

The point of all this is to show that even big, complex, difficult DIY projects can be done with the right skills, tools and materials. And even if you don't have that trio of required ingredients, if you have or can get two of the three, you can enlist some help for the other and still get it done.

Keep that in mind when facing technical challenges going forward. RW

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CBRE

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CPBE, AMD, DRB

Crawford rolls its own in an AM move

By building its own diplexer, Crawford kept a cap on relocation costs

In 1999, our company purchased another AM station in Denver to add to the three other stations it already had in the market. This particular station operated on 1220 kHz with 660 watts, diplexed with a 1 kW 1340 station into a tower on Denver's iconic Ruby Hill.

We operated the station from that site for more than two decades while the site and the 1340 station changed hands several times.

Several years ago, we received a notice from the site owner that our lease would not be renewed at its expiration at the end of 2022. Apparently the site's real estate value was such that its continued use as an AM broadcast site could not be sustained. At that point, we began looking for alternate sites.

Our initial plan was to move the station to the KLZ site, which was already shared with 810 kHz KLVZ for its nighttime facility. We would have to add one more tower to create a 500-watt two-tower array (sharing one of the 810 towers) and produce a shallow null to the north to protect a first-adjacent channel station in Laramie. All the engineering was done and we filed for and received an FCC construction permit for that move.

Below
The authors at the build site.

Some might wonder why we would even bother. After all, the values of "senior band" radio stations have decreased significantly in recent years, and we wouldn't be the first to send in a license for an underperforming AM station for cancellation. But for us, the station had value and potential, so it was worth saving.

However, when the cost estimates came in for the filters and detuning apparatus that would have to be added to the four 810 and two 560 towers plus the phasing and coupling system for the new 1220 operation, it was clear that the cost to relocate the station to the KLZ site would far exceed the value of KLDC. We needed another plan.

Plan "B"

At that point, just a little over a year from the lease expiration at the Ruby Hill site, we began looking around for possible sites.

One that came to mind was a unique site a couple of miles south of Ruby in Englewood. It was a site we had looked at decades earlier for our then-800 kHz station. There had been two towers at the site, which was collocated with a building materials warehouse complex and commercial nursery.

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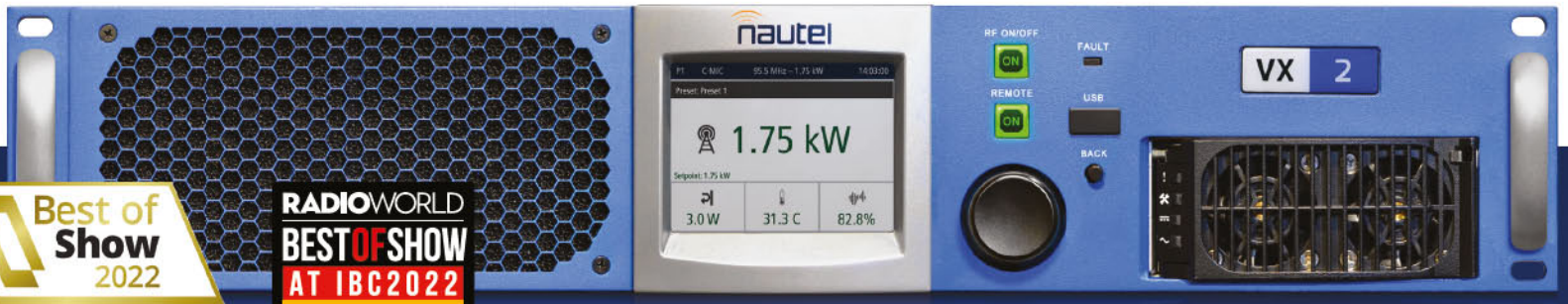

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Driving around the area, we could not find the 400-foot tower that had been on the north side of that site, but the 200-foot tower on the south end was still there. We found that the site was home to a 5 kW 1390 kHz station, KGNU.

At that point, we contacted the good people at KGNU and began negotiating a lease agreement with them. At the same time, we started on the allocation study, running a number of radials to determine the ground conductivity in several directions. The results showed that we could increase power to a full kilowatt, which would essentially replicate the full-market Denver coverage we had enjoyed for many years from the much taller tower at Ruby Hill.

Once we had an agreement with KGNU, we filed the construction permit application, modifying the CP we already had for the KLZ site. We got a grant in short order.

“Certainly KLDC with its full-market Denver coverage had value to us, and the station had income, but certain economic realities were still in place. Spending $60,000 or more to move the station was out of the question.”

Certainly KLDC with its full-market Denver coverage had value to us, and the station had income, but certain economic realities were still in place. Spending $60,000 or more to move the station was out of the question. We had to do it for $20,000 or less. That was a tall order!

Back in 1999 at the old site, we had built a “budget” diplexer using a pair of surplus weatherproof cabinets from Kintronic Laboratories and a bunch of coils and vacuum capacitors left over from various projects around the company. Diplexing a pair of stations operating with 1 kW or less and with 120 kHz of separation was not a tall order, and that diplex equipment served us well for 23 years. It was those cabinets that we had our eye on for a new “home-brew” diplexer.

Cris started the design work for the diplexer in the spring of 2022, beginning with a set of impedance sweeps of the KGNU tower on 1220 and 1390 kHz. He worked the design using a list of surplus components that we had on hand as a pool to choose from in the design. All those components were manufactured by Kintronics and had been salvaged during upgrades and divestitures.

Go big

A diplexer that would handle 5 kW from one station and 1 kW from another would take some more doing than our old Ruby Hill low-power diplexer, and we would need some big coils to make it work.

With the design details all worked out and making maximum use of parts on hand, we still had a good list of new components we would need, including a pair of 92 uH 30-amp coils and a 42 uH 30-amp coil.

Cris worked through our list with Dr. Bobby Cox at Kintronics to work up a list of needed parts, including a new bowl insulator for the 1390-pass/1290-reject module, several fixed and variable vacuum capacitors and mounting hardware, silver-plated tubing, silver-plated strap, hardware, coil clips, 4-inch copper strap and insulators of various sizes along with fiber washers and studs.

In addition, we would need stands on which to mount the existing cabinets, including a prematch cabinet (another surplus Kintronics cabinet that had started its life housing the ATU for a 1530 station in Colorado Springs decades earlier) and the existing KGNU ATU cabinet (which was tab-mounted on Unistrut). It was quite a list and quite a pile.

One other item we would need for the project was a dual Cat-6 isolation choke that would allow us to couple a pair of Cat-6 cables across the base insulator for a tower-mounted all-ODU microwave link to the studio. That isolation coil was something totally new to us and we were eager to give it a try.

In due time, a liftgate truck came to the loading dock at our office and dropped off a large crate loaded with all the above parts and the isolation coil. We uncrated the contents and hauled it all out to the KLZ transmitter site, where the three-bay garage would serve as a temporary manufacturing facility for the new diplexer.

A plan was drafted for the move that would have minimum impact on all the stations except KLDC. A mid-September date was chosen that would likely provide for good weather (September weather along the Colorado Front Range is usually the best of the year) and would allow for completion well in advance of KGNU’s fundraiser in October.

Prep work

In anticipation of the Sept. 12 “D-Day,” we did as much of the preparatory work as we could. A new equipment rack was purchased and installed in the cellular-type Thermo-Bond prefabricated transmitter building at the KGNU site.

Power was run to the new rack, a whole-rack UPS was installed and wired in.

With just room for one rack, the positioning of all the equipment in the rack, including the Nautel J1000 main transmitter, was carefully planned. Likewise, the placement of the prematch, diplex and ATU cabinets was mapped out with care. Appropriately sized HVAC-type prefabricated mounting pads were purchased and placed at the site.

The middle of August, we brought in a tower crew to install the microwave link on the KGNU tower. They hung the Kintronics dual Cat-6 isolation choke on the tower, and we bonded the bottom to the ground strap at the tower base and the top to the tower. We had to work through some equipment issues with the microwave link, but it did communicate with the choke. A new set of impedance sweeps was made to determine the effect of the choke, and the results were as expected, lowering the impedance by a few ohms.

In late August, we disconnected the Nautel ND-1 auxiliary transmitter at Ruby Hill and transported it to the new site, connecting its surge suppressor and power. We also bypassed and removed the main/aux/dummy antenna switch from Ruby Hill and hauled it and the dummy load to the new site and installed them.

Since both transmitters' RF outputs were type-N, I opted to use N-female connectors on the antenna switch, so I ordered some panel-mount Amphenol N-female connectors and made some adaptor plates to allow me to mount them in the three-hole 7/8-inch EIA openings in the antenna switch. We used Commscope 1/2-inch "superflex" coaxial cable for all the KLDC high-level RF transmission at the new site.

With power, antenna switch and dummy load in place, we shortly had the aux transmitter making a kilowatt into the load. With other needed materials such as 3/4-inch rigid copper tubing and fittings, 3/4-inch PVC conduit and fittings, 3/4-inch liquid-tight conduit and fittings, wire, cable and all sorts of other things stockpiled at the site, we were as close to ready as we could be.

The final component of the plan was bringing longtime CBC-Birmingham Chief Engineer Stephen Poole to Denver

Below
After all components were removed, a good cleaning was the first step in the remanufacturing process.

to assist. Stephen is a very experienced broadcast engineer who has had charge of two of our AM stations for many years. His participation would be invaluable.

In our carefully crafted plan, we would take the Ruby Hill stations down on a Monday morning, remove both the diplex cabinets and the prematch cabinet, and haul them to the KLZ site. The contract engineer for the 1340 station was Eric Scace, who was also the contract engineer for KGNU. Cris had made a quick design for a simple tee-network ATU for the 1340 station, and Eric built that up in yet another surplus weatherproof cabinet. Once the existing diplex and prematch cabinets were out of the way, Eric would mount the new 1340 ATU in place of the prematch cabinet, connect and adjust it.

Above
Clean, empty cabinets provided a blank canvas. We'll show you the results next issue.

> **With power, antenna switch and dummy load in place, we shortly had the aux transmitter making a kilowatt into the load. ... We were as close to ready as we could be.**

We would then haul the three Ruby Hill cabinets to the KLZ site, remove all the components and power wash them. After that, the "manufacturing" process would begin, with solving the three-dimensional puzzle of component placement the first order of business. Manufacturing and pre-tuning would wrap up on Tuesday, and we would haul everything to the KGNU site on Wednesday, taking KGNU down and installing the filter cabinets. The plan was to have both stations back on the air by the end of the day on Wednesday.

In the concluding part of this article in February, we'll get down to nuts and bolts, drilling, mounting, plumbing, brazing and adjusting. RW

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NRSC publishes guidelines for EAS implementation

It centers on the delivery of emergency alerting and information via FM

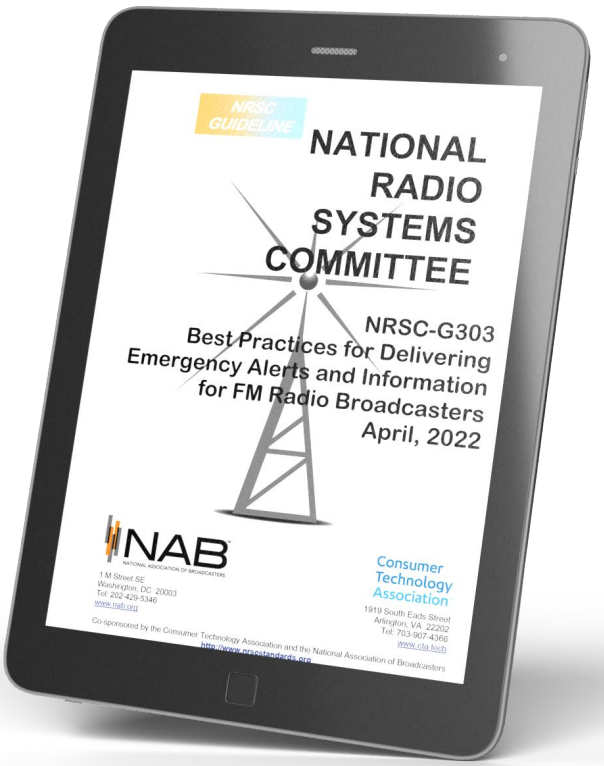
Writer

James E. O'Neal
Longtime Radio World contributor and former technology editor of TV Tech.

While many projects and initiatives may have been sidetracked by the global pandemic, a major initiative of the National Radio Systems Committee wasn't among them. The group's latest effort, released last spring, centers on the delivery of emergency alerting and information via FM.

The document, with appendices and annexes, spans slightly more than 100 pages and is officially known as "NRSC-G303, Best Practices for Delivering Emergency Alerts and Information for FM Radio Broadcasters, April, 2022."

While the publication does not replace the FCC's "AM & FM Alert System Procedures" or any other instructions, rules or regulations issued by the commission governing Emergency Alert System procedures, it is a useful (and state-of-the-art) compendium of what FM station owners and operators need to know about EAS and the dissemination of emergency information in today's world of ancillary data transmission, digital broadcasting and the internet.



Two-year project

The NRSC's treatise places a great deal of information about EAS in one place, and builds on it with a systematic treatment of new modalities and methodologies for getting the emergency word out in the 21st century.

Its editor David Layer, who is vice president, advanced engineering in the NAB's technology department, said, "The recognition was that there was no NRSC document like this." While resources about alerting technologies and their implementation were available, they were spread out.

"We wanted to put it all in one place and significantly expand upon it. This is exactly the kind of thing that the NRSC wants to do: provide information to broadcasters of topics of interest."

Below
David Layer

Layer said NRSC-G303 took two years to complete. "There were about half a dozen people involved," he said, primarily broadcasters, equipment manufacturers and emergency alerting experts. Not surprisingly, the pandemic was a factor in the development schedule as well.

Larry Wilkins, a broadcast inspector with the Alabama Broadcasters Association and chair of that state's EAS committee, was a major contributor, as was Matt Straeb, executive vice president and chief technology officer of Global Security Systems, and Xperi, which developed an HD Radio Emergency Alerts service that is described in the document.

In addition to serving as a useful compilation of basic EAS information, NRSC-G303 provides guidance for broadcasters wishing to implement some of the relatively new methodologies for delivering enhanced emergency alert information.

In particular, the document may be helpful to those wishing to learn about how the text and graphics display capabilities incorporated in contemporary radio receivers may be used for delivering emergency information.

It's not light reading, as it provides at least some information on just about everything germane to current EAS practices and technologies. However, information is presented in a number of easy-to-digest "bites" and does not necessarily have to be read in a linear fashion. Also included are real-world examples and case studies from Mississippi, Louisiana and California that are particularly interesting.

If you have questions about EAS and its implementation, they likely are answered in this publication. As its title

implies, however, NRSC-G303 is focused on FM radio signals. While AM remains very important in the nation's overall EAS infrastructure, this work zeroes in on the higher number of listeners and data transmission capabilities of FM that aren't available with standard AM broadcasts.

EAS in various contexts

Although the term "metadata" was coined only a few decades ago, it has become entrenched in just about everything that goes on technology-wise in the 21st century. Broadcasting, and especially the transmission of emergency information, is now greatly assisted by this notion of "data on top of data."

A focus of NRSC-G303 is in providing information about tapping metadata to enhance the aural presentation of emergency alert information and to provide useful non-verbal information in the form of maps and other graphics.

NRSC-G303 zeroes in on exploiting Radio Data System and HD Radio technology for delivery of metadata containing emergency information.

RDS is available in more receivers than is HD Radio at present, so information about tapping this delivery modality is presented first.

Layer said a large percentage of the nation's 13,000 or so FM stations use RDS to deliver textual data such as call sign, programming format, song titles and the like to receivers that are able to decode and display this information, which is most automotive receivers.

"Broadcasters need to be structuring what they send out based on the latest receiver technology. These new auto infotainment platforms support many other audio services besides radio. A lot of cars have bigger and better displays; the market penetration is growing, but there are a lot of older receivers that have limited display capability," he said.

"Broadcasters have been scrolling Program Service RDS messages to get their messages out. The PS field is typically displayed all the time — their call sign or maybe a slogan of up to eight characters," he continued.

Early on, "Broadcasters realized that additional information could be presented even on a small eight-character display by scrolling or 'chunking.' It's been a common practice for a long time. There are receivers that will not display a scrolling message, but I would not discourage broadcasters from using scrolling PS. It all depends on what market they're in and what kinds of receivers people are using in the market. The goal is to try and hit as many receivers as possible."

NRSC-G303 describes ways for utilizing the limited RDS graphical display capability in emergency situations and makes note of its advantages.

The document also provides technical information on RDS delivery technology and potential difficulties in its implementation for handling emergency traffic (such as a legacy STL that can't handle the 57 kHz RDS subcarrier) and potential solutions.

Illustration from NRSC-G303 document

Illustration from NRSC-G303 document

An emerging technology, RDS2, supports transmission of additional data and larger images than legacy RDS and could enhance an FM station's capability for emergency information delivery; it is mentioned briefly.

More technologies

HD Radio, the guidelines note, is better suited for dissemination of emergency information thanks to its digital nature and capability for handling metadata.

In addition to transmission of maps showing the paths of storms, evacuation routes, road closures due to manmade and natural disasters and the like, the document notes more attributes and capabilities that don't exist in other forms of radio broadcasting, including:

- Support of message strings as long as 374 characters
- Multilingual audio and text transmission
- Signaling that can automatically "wake up" compatible receivers from a standby mode to delivery emergency messages
- If enabled by the user, the forced tuning of an HD Radio receiver to a station transmitting EAS messages even if

Top
Typical RDS Emergency alerting display. Example is from KGOU(FM), Norman, Okla.

Above
Typical HD Radio display of emergency information. From KWGS(FM), Tulsa, Okla.

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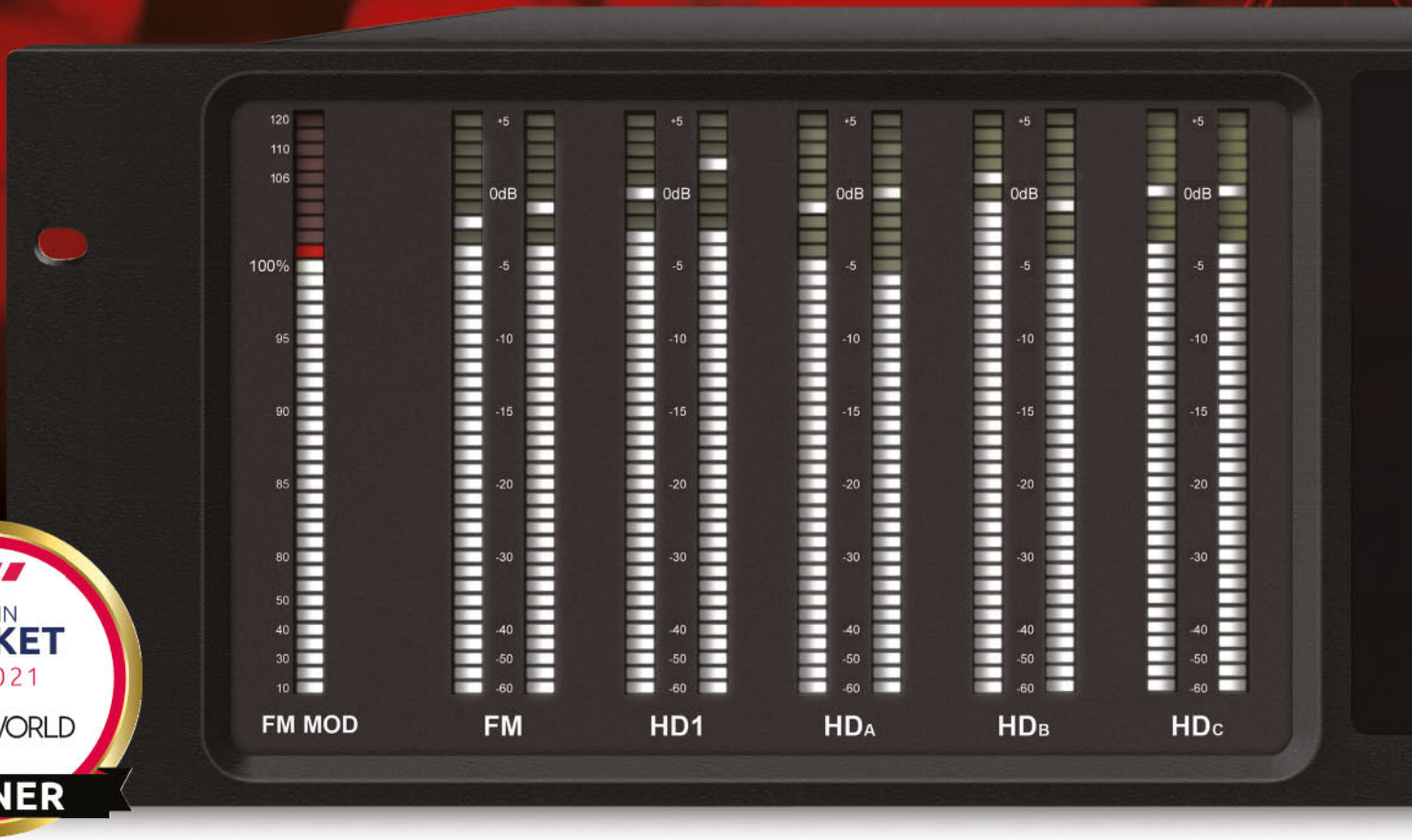

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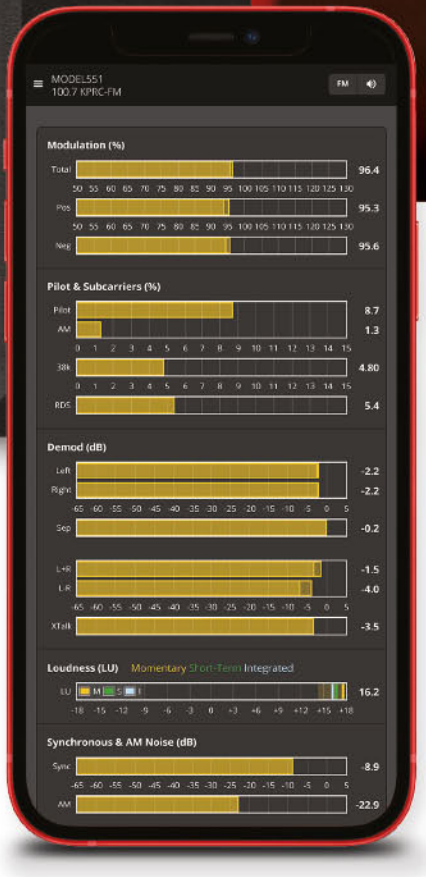

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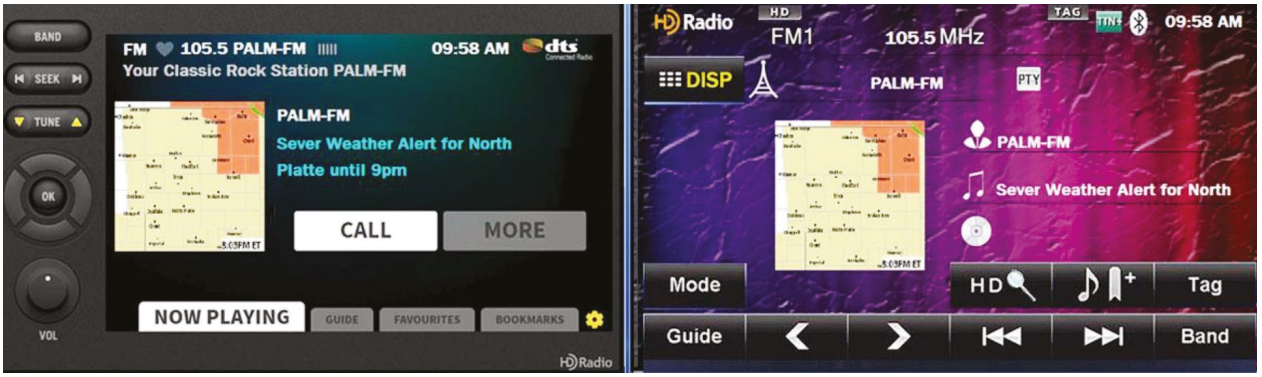


Right
"Mockup" receiver displays of EAS metadata. The display on the left shows what a hybrid "connected" receiver might display, while the one on the right illustrates the information that might be available via an HD Radio supporting HD Radio emergency alerts.

Below
A hybrid HD Radio OTA/internet alerting scenario for "connected" receivers. The OTA components are shown in red and the broadband connectivity is shown in blue.

the user was listening to a station not transmitting such information

- Targeted messaging to specific receivers for delivery of secure information to first responders

NRSC-G303 also goes beyond what's available with RDS and HD Radio, discussing the EAS possibilities of newer or less-familiar technologies such as MetaPub, Alert FM and DTS AutoStage.

"MetaPub is a fantastic metadata system developed by NPR," Layer said. "The document includes examples on how alerting is done with this technology — how metadata can be used in a non-music program [such as to enhance] stories broadcast on NPR affiliates. It offers the potential for emergency alerting using existing channels."

Alert FM is a private network from Global Security Systems that uses RDS to reach special receivers. The users are typically colleges or municipalities that want to have another method for alerting populations.

DTS AutoStage is a new, hybrid radio service from Xperi. Car receivers are connected with both over-the-air tuners and mobile broadband. "What you can do with a platform

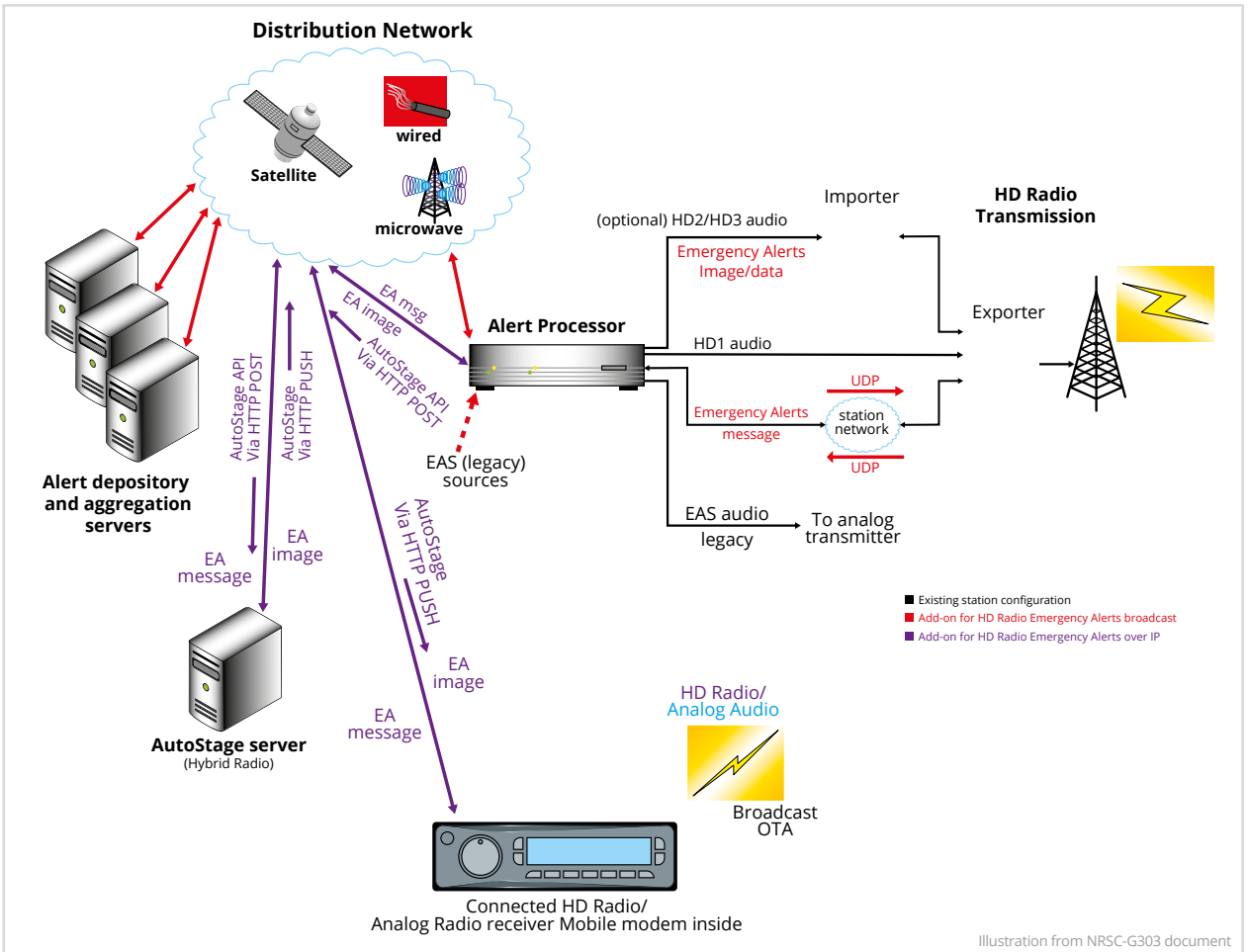


Illustration from NRSC-G303 document

About the NRSC
The National Radio Systems Committee is sponsored jointly by the National Association of Broadcasters and the Consumer Technology Association. It is dedicated to evaluating new and changing technologies and applying the knowledge gained towards recommendations for technical standards and guidelines related to broadcasting and consumer receiver design and manufacturing.

like AutoStage is really limitless," Layer said. "Broadcasters are just starting to explore this."

Hybrid radio is an emerging technology that can greatly enhance delivery of emergency alerting information, and the "best practices" publication devotes several pages to the topic.

It does, however, recognize that hybrid radio is a nascent technology, and issues this caution: "The broadcast industry should ensure a deep understanding of (audio and consumer electronics) requirements to ensure successful support of hybrid radio services and the user experience."

Eye on the cloud

Another emerging broadcasting modality is described: the transitioning of basic radio transmission operations to the cloud or to a centralized hub or other off-site operational service. At the present time, there are no provisions for moving EAS functionality into the cloud, and the NRSC-G303 document notes that the FCC still requires physical EAS equipment to maintain local service area monitoring. This includes the two required legacy monitor sources.

Tried and true

Despite the many ways emergency information can now get to the public, it's refreshing that NRSC-G303 recognizes the resilience of broadcasting compared to other alerting modalities such as cellphone networks.

This is underscored in a case study about massive fires in California: "During both the 2018 Camp Fire and the 2020 North Complex fires, multiple cell towers failed in the areas under evacuation and alerts from the cellular-based CodeRED and IPAWS mass notifications were not delivered, and notices from the Sheriff's Office social media pages didn't reach everyone," the document states.

"What we've learned is you have to have redundancy within the system because no one single platform can be 100 percent successful. No one single platform can be counted upon in every situation or disaster. And the Camp Fire certainly showed us that."

Get your copy

Asked for a key "takeaway" from publication of the NRSC guideline, Layer responded: "The purpose of this document is to inform broadcast engineers as to what emergency alerting using FM radio is all about and how it's implemented."

He encouraged all FM radio broadcast engineers to review this information, as they may not be familiar with at least some aspects of it.

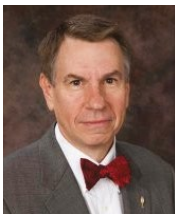
"In times when getting emergency information out to the public in times of crisis, it can all come down to a broadcast engineer."

It is available free at *https://www.nrscstandards.org* under the Standards/Guidelines tab.

Cameras solve the problem

Security cameras can be used for many purposes at a remote transmitter site

Writer



Frank McCoy

The author is freshly retired from his role as chief engineer for the Salem Media properties in Chicago, legendary directional AM stations WIND and WYLL. He also has worked for ABC, Gannett, Skywave Inc., Capstar Broadcasting Partners and American Media Services.

For a decade or more, the larger broadcast ownership entities have been moving towards a consolidated, regional approach to managing their IT systems. Concerns for security, cost and staffing have driven this evolution.

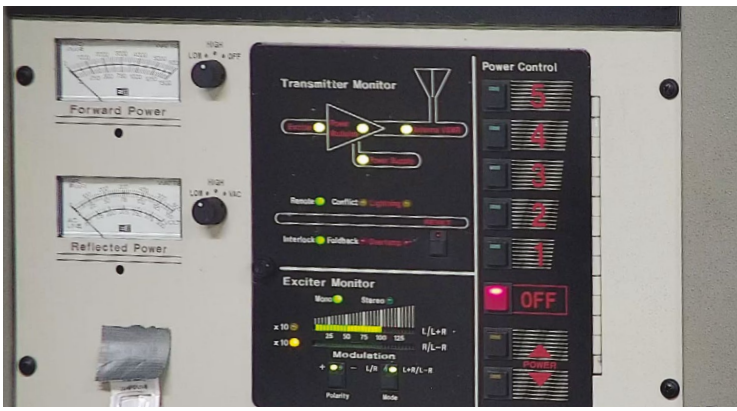
The results have been mixed, in part because there is little uniformity from market unit to market unit in broadcasting, especially radio. Metaphors like "herding cats" come to mind when describing the problem.

Standardization works best for enterprises that can equip their front-line units identically because the business model is largely the same everywhere. Still, consolidated IT has contributed to keeping order across far-flung IP networks and bring-your-own-device employee environments.

Unfortunately, this model couldn't be further from reality on the content development and delivery side. Radio's configuration varies by day and daypart. While some dayparts are under IP automation control allowing for standardization, most markets of size air some live content.

This requires studios, microphones, consoles and the like — typically bespoke. The delivery of content to consumers relies on high-powered transmitters and complex antenna systems generally far from the studio and usually no-two-alike.

Add to this the "STL" content delivery mechanism, managing compliance with an array of laws, safety, the care and feeding of often very geriatric systems and other taken-for-granted challenges.



Above
A camera permanently pointed at the entry gate and drive will document people and vehicles entering and leaving the property.

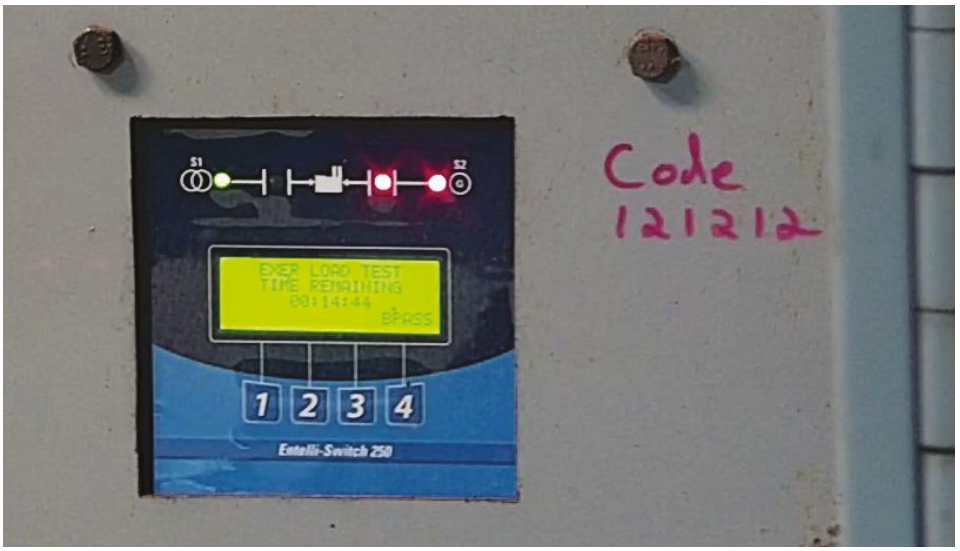
Right
A security camera pointed at the front of a transmitter or other piece of equipment can provide indications not otherwise easily accessible for troubleshooting.

Right below
Here a camera is used to monitor the fuel level in the generator tank, something that is often difficult to do with a typical remote control system.

These days, finding technical staff with sufficient expertise in analog and information technology, as well as willing to adopt the 24x7 availability required to keep the revenue stream alive, has proven difficult. The generation of engineers who grew up in this environment is retiring. That light broadcast managers see down the tunnel is the headlight of a locomotive.

This makes the NOC model a significant challenge for radio's front-line operations. No-two-alike environments and centralized management are mutually exclusive concepts. Trying to suss out the state of affairs at some mostly unfamiliar transmitter site hundreds of miles away based on the simple telemetry provided by even the best broadcast remote controls is a fool's errand. Often the only additional knowledge is a frightened local employee dispatched to the transmitter as "eyes." And dispatch requires precious time.

I think I may have stumbled onto the solution.



Above
Watching the generator transfer panel during a weekly unmanned test can show up issues with the system.

Outside the box

For several years I have been installing cheap, power-over-ethernet (PoE) IP cameras all over the place. Via assorted data paths, I can access these cameras from anywhere and put eyes on the systems I maintain almost as though I was standing there.

The architecture is simple. Usually I repurpose a retired PC from the office environment and load it with camera management software. Then I buy a power-over-ethernet switch on eBay or grab one my IT department has retired.

I configure the combination and add remote console access software like Logmein or Dualmon. The corporate IT department prefers that these facilities be air-gapped from their networks, so in most cases they live on an isolated cellular 4G hotspot network segment. Maybe Starlink if it's available.

Just mount your remote eyes where they can see what's important and wire them. I even have cameras in and outside tower doghouses, connected using short data links with hardware from outfits like Ubiquity.

This facility allows me to remotely view nearly every device in the plant. I have saved presets for pan, tilt, zoom and focus for every panel and every indicator that might be useful in addressing a problem. As I interpret the telemetry from the remote control, I can confirm actions I take with real-time video of the result.

Parameters that might be overlooked because of limitations on the number of remote control channels now become accessible. Sometimes parameters don't lend themselves easy remote measurement. Fuel levels

> **For several years I have been installing cheap, power-over-ethernet (PoE) IP cameras all over the place.**

come to mind, where designing an electrical interface with flammable liquids or gasses might be iffy. And there are countless legacy devices designed presuming the user would be on site. Modulation monitors are an example. Finally, pulling back for a wide shot of a familiar rack can help quickly determine the location of an interruption.

The solution

More importantly, this can be done from pretty much anywhere on earth.

This is how I believe the staffing dilemma that radio now faces can be solved or at least can be mitigated to a degree. The solution might take several forms.

Perhaps the most obvious is a centralized corporate NOC. Each radio station or other entity under remote management would document the program delivery flowchart in a few binder pages with photos showing the key components. Then the staff at the NOC could be taken on a video tour of the facility for familiarization, all without leaving their desks. This might be repeated on some pre-determined interval, so NOC personnel remain fresh on plant details including concerns and weaknesses.

Groups might create engineer teams, perhaps by time zone, where each local engineer on the team has familiarity with every plant in the region. There are any number of variations on this coverage theme. But underlying this strategy is familiarity with most common broadcast devices. Even devices that aren't familiar are usually easier to understand if you can see them. No longer dependent upon someone else's eyes or an opaque remote control for understanding, the chances for success are greater.

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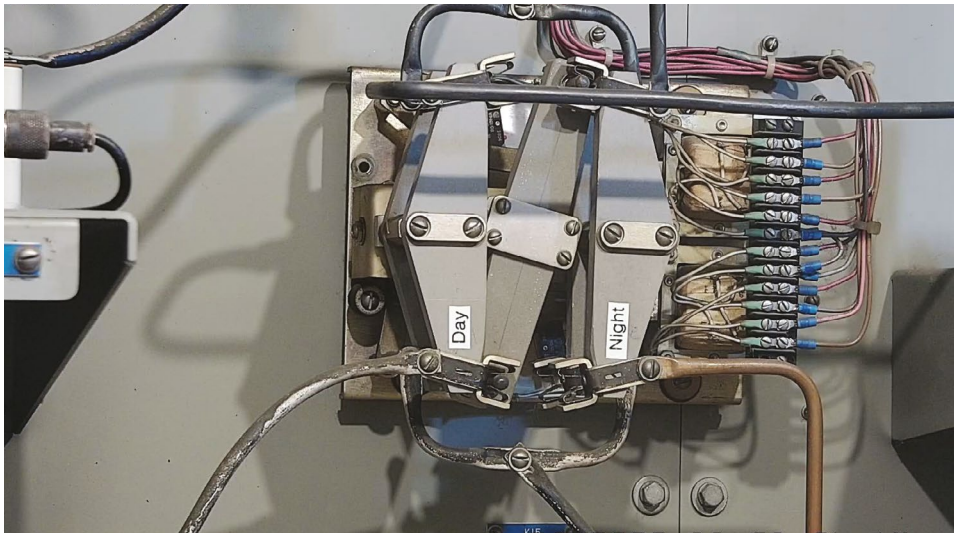

Top
Pattern switching problems can be difficult to troubleshoot. A camera can reveal whether contactors are moving freely and fully seating or hanging up.

Above
Retired PCs can be repurposed with camera management software to provide control and access.

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