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Show time
A sampler of regional U.S. trade shows in the second half of the year.

A little DIY
William Harrison creates his own USB hub in a Decora panel.

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Runnin' up that hill

Your latest free ebook is available

Paul McLane
Editor in Chief

The headline to this column is a gratuitous reference to a haunting Kate Bush song originally released four decades ago. But since Kate's song recently found its way to 1 billion streams on Spotify — thanks to the tune's "rediscovery" in a Netflix series — I can't resist using it to promote your latest free ebook, conveniently titled "Getting Data Up the Hill."

With so many options for sending your radio station's audio and metadata to the transmitter site, we wanted to return to update you on one of the most important decisions that radio engineers must make in designing their air chains.

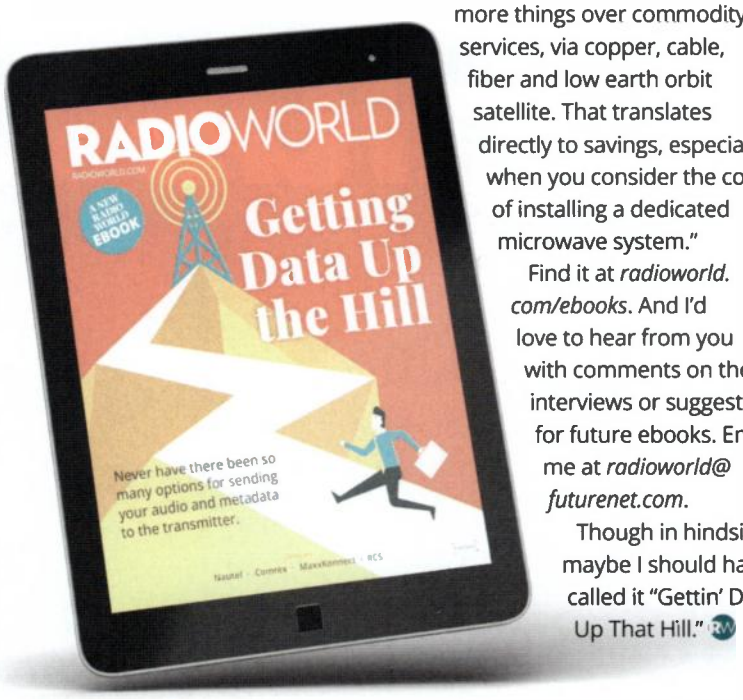
The questions we explore include licensing and unlicensed options, internet connectivity, the state of wireless IP links, various bands including 950 MHz, MicroMPX, last-mile challenges, the use of systems like Starlink, redundancy and how to stay connected in natural disasters.

Sharing their expertise with me were Josh Bohn of MaxxKonnect, Paul Cintolo of Comrex, Jacob Daniluck of Tieline, William Harrison of WETA(FM), Cindy Hutter Cavell of the Spectrum Group at Capitol Airspace, Tommy McElmeel of Family Radio, Ted Nahil of 2wcom and Jeff Welton of Nautel.

William Harrison told me that the most important trend over time is how broadcasters have embraced internet protocol, specifically via public internet.

"It has become the default delivery mechanism, as opposed to the exception," he said.

"In the past, we relied on specialized systems to allow multiplexing of audio, control and even extending a POTS line via dedicated circuits like ISDN, T1, microwave or even fiber. These days it seems we're sending even more things over commodity services, via copper, cable, fiber and low earth orbit satellite. That translates directly to savings, especially when you consider the cost of installing a dedicated microwave system."



Find it at *radioworld.com/ebooks*. And I'd love to hear from you with comments on the interviews or suggestions for future ebooks. Email me at *radioworld@futurenet.com*.

Though in hindsight maybe I should have called it "Gettin' Data Up That Hill."

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On the cover
Sjef Verhoeven, Marek Farkaš and Ester Vlčková. See page 20.

Foreign Sponsorship

Radio World legal columnist Gregg Skall has posted a column explaining the FCC's revised sponsorship identification requirements for foreign government-provided programming. Here's a summary of his post, which you can read in full online.

The federal Office of Management and Budget recently approved these rule modifications but deferred compliance until Dec. 8. Only new agreements or renewals on or after that date must comply.

Radio and TV broadcasters will now have a "duty of inquiry" to obtain the information needed to determine whether programming is sponsored, paid for or furnished by a foreign governmental entity. In such cases the station must make a public disclosure at the time of broadcast, identifying the source.


Cimmerian/Getty Images

Stations have two ways to meet the verification requirement. The first is a written certification agreement signed by the "lessee," i.e. the programmer, and by the broadcast licensee. They can write their own or use a template provided by the FCC; Skall's post lists the details.

The second option is for the programmer to provide screenshots of search results for their name from two federal government databases specified by the FCC. If the search does not provide results in either database, no further search is needed.

The verification requirement can't be avoided through informal, short-term or week-to-week type arrangements. And the rules apply to all programming, regardless of length, including short-form advertising as well as issue ads, paid PSAs, religious programming and locally-produced or distributed programming.

There are some exemptions, as Skall explains; and the rules do not apply to NCE stations, since the FCC already prohibits them from receiving compensation in exchange for broadcasting programs.

"The primary change accomplished by the rule revision is to remove the burden on broadcasters to themselves reach out beyond the FCC's data to other government sources to confirm the identity of their advertisers and programmers," Skall wrote. In its place, the commission imposed the two options described.

Skall noted that the NAB continues to oppose this rule as placing an unlawful burden on already burdened broadcasters.

To read his column "What's Up With the FCC's New Foreign Sponsorship Rules," visit *radioworld.com* and put "foreign sponsorship" in the search field.

Writer

Randy J. Stine

The author wrote last month about the debate over EAS in software.

Regional trade show season kicks off

Here's a sampler of events that may be closer to home

Expense budgets being what they are, a state or regional conference may provide a radio manager or engineer a more affordable option for some networking and education. Exhibitors meanwhile are able to meet with customers much more economically.

"Unlike massive international expos, where smaller voices get drowned out, smaller regional conferences offer a focused platform where ideas really resonate," said Tessa Potter, president of the Western Association of Broadcast Engineers (WABE), which is marking the 75th year of its own event.

The second half of 2025 offers a number of opportunities to see why state and regional trade shows are still valuable. Popular topics at these events include artificial intelligence, virtualization, advanced analytics, the fast-changing FCC regulatory landscape, possible changes in EAS rules and ways for sales teams to compete in today's media marketplace.

Here's a sampler:

Above
The Kalahari in Round Rock hosts the TAB show.

TAB Show

When: Aug. 6–7

Where: Kalahari Resorts & Conventions, Round Rock, Texas

Info: *https://tabshow.org*

Highlights: The Texas Association of Broadcasters event is the largest state broadcast association show in the country; it draws around 1,200 people and typically features 125 booths. Tech sessions include talks such as "Drone-based Trouble Shooting at Tower Sites" by Paul Shulins of Over the Air RF Consultants; "Transmission Site Security Virtualization" with Matt Leland of Burk Technology and Pat Moore of Broadcast Construction Solutions; and "SNMP for Remote Control / Transmission Line Imaging" with Tony Peterle of Lawo.

Alabama Association of Broadcasters Annual Conference

When: Aug. 7–8

Where: Ross Bridge Resort, Brimingham

Info: *https://al-ba.com/wp2/*

Highlights: Among sessions on Aug. 7 is an all-day engineering workshop featuring a talk by Greg Martin of Rohde & Schwarz with a look at advancements in radio and TV transmitters. There will also be a talk on sizing and installing diesel generators, and Larry Wilkins of the ABA discussing the importance of good audio quality. The broader event also features sessions on AI, public media, federal broadcast policy and other topics.


John Mailhot of Imagine spoke last year.


The Pinnacle Awards event is a popular part of the convention.

Nebraska Broadcasters Association Convention

When: Aug. 12–13

Where: Embassy Suite, La Vista

Info: *www.ne-ba.org*

Highlights: The conference features a series of talks covering management, technical, programming, sales and newsroom issues. SBE Chapter 74 is helping put together the presentations for engineers; those speakers will include Davina Sashkin of Wilkinson Barker Knauer LLP, Dan Hyatt from DNAV, Jacob Daniluck of Tieline and Jing Zhou from Harmonic Inc.

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Manny Centeno, director of IPAWS at FEMA, third from left, is shown last year with leaders and show attendees from the WBA and MBA.

Midwest Regional Broadcasters Clinic

MIDWEST REGIONAL BROADCASTERS CLINIC

When: Sept. 15–17

Where: Madison Marriott West in Middleton, Wis.

Info: *https://broadcastersclinic.com/*

Highlights: The Wisconsin Broadcasters Association, the Minnesota Broadcasters Association and two chapters of the Society of Broadcast Engineers team up to produce the clinic, which dates to 1956. The NAB's Sam Matheny will discuss technology transitions and how broadcasters are adjusting, talking about "tectonic trends impacting broadcasters, including metadata and connectivity," according to the session description. Other engineering topics include advances in FM antenna technology with Nicole Starrett of Dielectric, transmitter site tips from Nautel's Jeff Welton, project planning with Paul Stewart of Summit Technology Group, and Workbench tips from John Bisset of Telos Alliance.

Midwest Broadcast & Multimedia Technology Conference

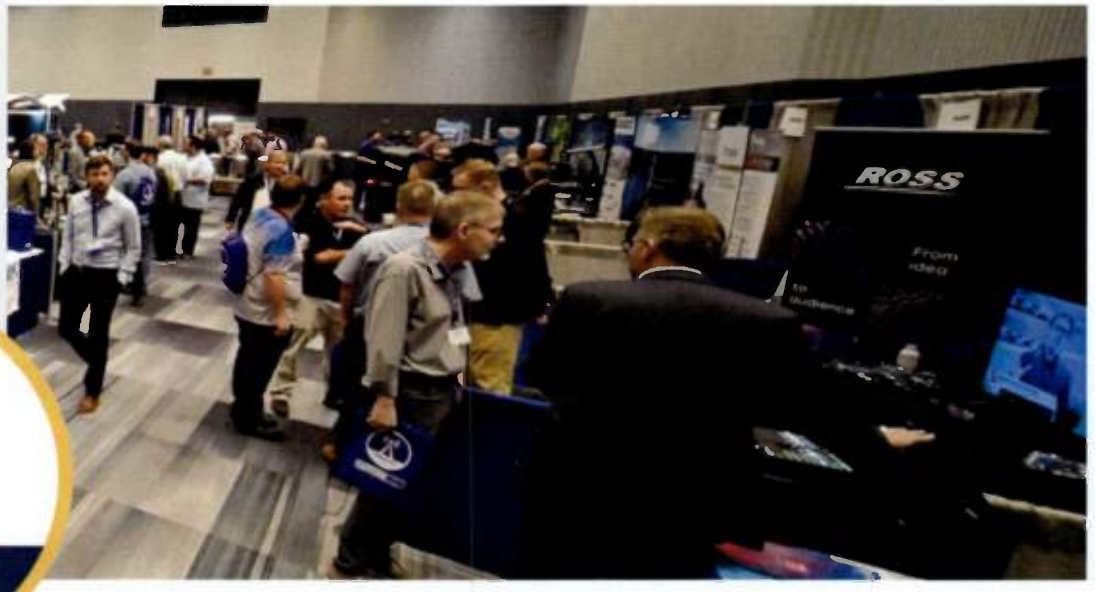
When: Sept. 24–25

Where: Columbus, Ohio

Info: *https://mbmtc.oab.org/*

Highlights: It's two days of sessions and technology for broadcast engineers and multimedia professionals, produced jointly by five state broadcast associations. The agenda was pending as of late June. The Society of Broadcast Engineers will hold its national meeting in conjunction with this event.

MBMTC 2025



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WABE Media & Entertainment Technology Conference

When: Sept. 29–Oct. 1
Where: Telus Convention Centre, Calgary
Registration: *https://wabe.ca/home/conference/attend/*
Highlights: The conference from Canada's Western Association of Broadcast Engineers offers a blend of education, networking and celebration. This year

WABE celebrates 75 years. The event moves around; last year's in Edmonton drew about 400 people. Organizers say broadcast and entertainment technology professionals are welcome to share ideas, explore solutions and shape the future of the industry. Tech sessions offer an opportunity to gain insights and do a dive deeper into the topics shaping the broadcast industry. Free exhibits-only passes are available.

Shure products on display at WABE.

Kirk Nesbit, representing the Canadian Association of Broadcasters, at a past event.

CCBE/OAB Conferences

When: Oct. 27–28
Where: Delta Hotels Toronto Airport & Conference Centre
Info: *https://ccbe.ca/2025-ccbe-conference/* and *https://oab.ca/conference/*
Highlights: The Association of Central Canada Broadcast Engineers moves its annual event to Toronto this year, and to a later date than in the past. And for the first time it will be held jointly with a conference of the Ontario Association of Broadcasters. CCBE organizers say a list of broadcast engineering sessions and papers for 2025 will be published soon.

LOCAL RADIO CONNECTION 2025

A Few More Shows

Here are a few more upcoming events that may be of interest. In some cases, agendas and details were not yet posted as we finalized this issue of Radio World:

- The Tennessee Association of Broadcasters Conference and Excellence in Broadcasting Awards takes place on Aug. 18 at the Country Music Hall of Fame in Nashville.
- The Georgia Association of Broadcasters' GABCON is set for Sept. 19–20 at Truist park in Atlanta.

GABCON
September 19-20, 2025
TRUIST PARK

- The Kansas Association of Broadcasters Convention will take place on Oct. 6 in Manhattan, Kan.
- Meanwhile on the national convention scene, NAB Show New York returns to the Javits Center on Oct. 21–23; we'll preview it in an upcoming issue.
- And the annual AES Show heads to California's Long Beach Convention and Entertainment Center Oct. 22–25.

Writer
Randy J. Stine

Sage looks to the future of EAS

Price says now is the time for software-based alerts

When Sage Alerting Systems announced it would no longer produce an Emergency Alert System hardware encoder, the NAB and other alerting stakeholders took notice.

As we have reported, NAB's petition urging the FCC to allow software-based EAS mentioned Sage's prominence, and several commenters called it a reason to expedite a decision.

"NAB highlights the risks broadcasters face, now that only one EAS device vendor that produces the required ENDEC device remains," wrote Cox Media Group. Another commenter called the decision a red flag. "Apparently it is no longer profitable for small manufacturers to build and support a very unique system with a small customer base."

According to Sage, the decision stemmed from difficulty in acquiring parts to build new units. It continues to offer hardware repair, user support and software updates.

President Harold Price said Sage is working towards a more sustainable future that includes simplifying hardware requirements and potentially eliminating them entirely. "The goal is to more fully integrate EAS into the broadcast environment, not relegating it to the periphery, as had been common since Sage's first EAS product in 1996," he said.

He answered questions via email this spring:

What do existing users need to know about Sage support?

Harold Price: We continue to offer support via phone and email. We will continue to provide software updates as needed, for example, our free update for the new Missing and Endangered Persons event code and some other improvements will be out [shortly]. We also provide hardware repair for the model 3644 ENDEC.

Below
Harold Price is shown speaking at a 2023 FCC event in a video from C-SPAN.

How long do you expect to be able to provide parts and support for the 3644?

Price: We have parts on hand for end-of-life components for several years, based on past repair rates. Not all repairs involve these parts, of course. We intend to continue to support software in the 3644 as long as it is needed.

Sage supports NAB's petition. Describe this shifting landscape from hardware to software solutions.

Price: The reality is that the broadcast industry will continue to require its technical staff to accomplish more with fewer resources. This trend is driving a need to reduce integration complexities, including wiring, the overall number of hardware boxes, analog/digital format conversions and protocol compatibility.

Software-based Portable People Meters are often mentioned as a recent success in removing the need for a standalone hardware device. PPM algorithms are integrated into existing audio manipulation devices. An EAS encoder/decoder is more complex. It includes handling data from legacy EAS FSK data, FEMA CAP servers, local alert origination and selection filtering and FCC requirements, but the overall concept is the same.

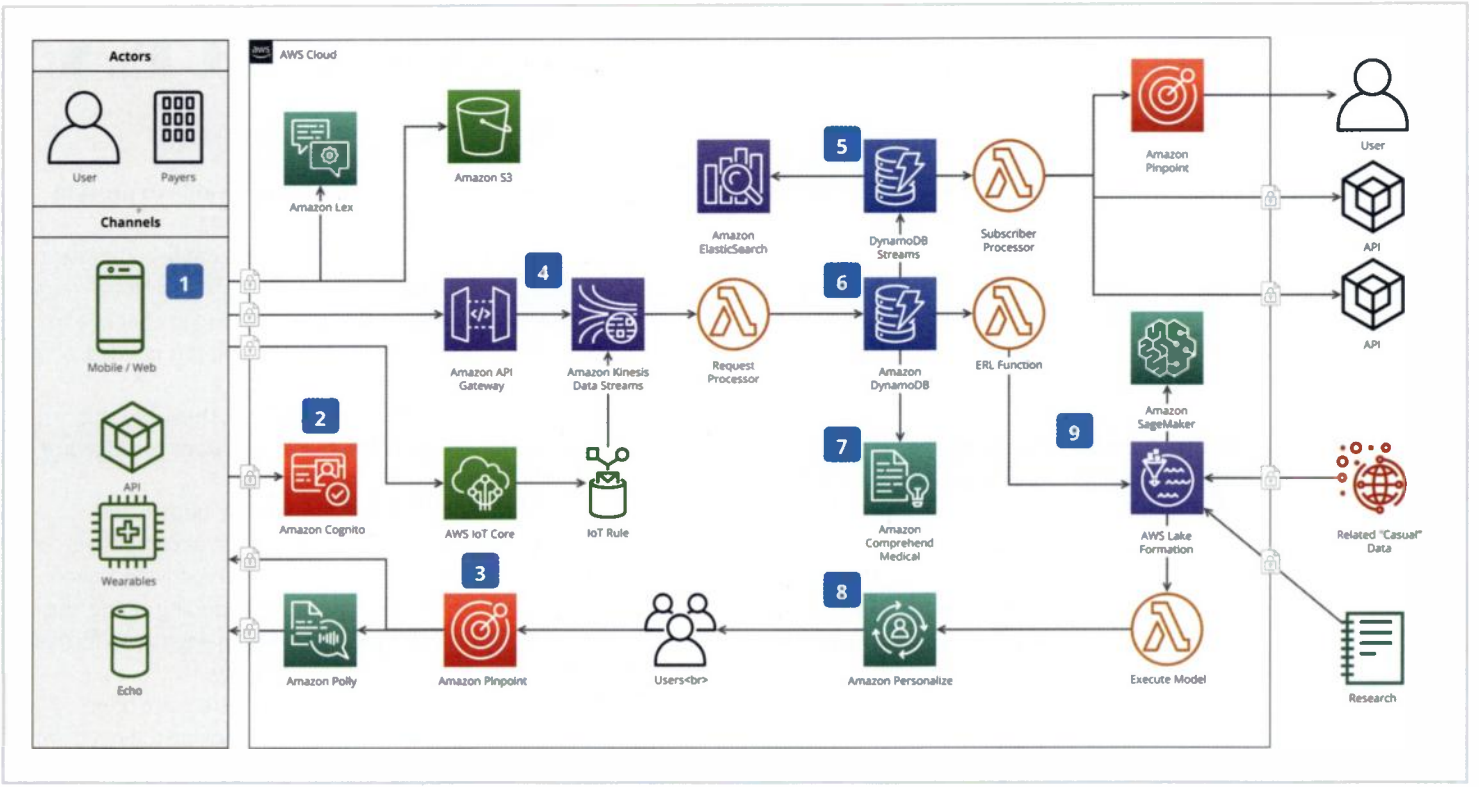
The industry has been asking for an option for EAS virtualization for several years. The recent NAB petition is a reflection of the increased pressure to modernize the Part 11 rules to permit virtualization and to allow for co-hosting EAS with other broadcast elements within devices like audio processors, playout systems and transmitters. EAS might run in a hardware card; a virtual machine or container in a server; or in a small standalone unit. There are other considerations, such as cybersecurity and compliance with the various EAS protocols. This is not something that requires years of study, the issues are known.

It is time to expand the options beyond the current regulations.

You told the FCC that Sage would bring software EAS products to market if the commission makes changes to the rules.

Price: Yes, if the FCC changes the rules to permit EAS virtualization, we would bring a product to market quickly. Several use cases would require collaboration with non-EAS equipment manufacturers — we expect they would allocate development resources once rules changes are in progress.

We also realize that some stations prefer the existing standalone approach. It is possible that Sage would develop simplified hardware to meet those needs.



John Bisset
CPBE
The author is in his 34th year of writing Workbench. He handles western U.S. radio sales for the Telos Alliance and is a past recipient of the SBE's Educator of the Year Award.

Above
Fig. 1: Free tools from draw.io can be used to create useful diagrams. This is a non-broadcast example. Let your imagination run with it.

Check out what draw.io can do for you

Also, why did Harold engrave the back of a panel?

I was part of a conversation recently with Workbench contributor Paul Sagi and equipment inventor and manufacturer Harold Hallikainen.

Paul shared a free download for diagramming available at *www.drawio.com*. This tool works with Google Drive and Google Workplace. According to its website, "draw.io is a technology stack for building diagramming applications, and the world's most widely used browser-based end-user diagramming software." Harold has used it to create useful block diagrams.

Have you used this tool, or something similar? Share your experiences. Drop me an email to *johnpbisset@gmail.com*.

Intermittent operation

Archie Simpson's tale about using "impact engineering" to fix an intermittent in an audio console brought a lot of chuckles.

Fred Baumgartner reminds us that when someone drops a handheld radio from a tower, we might say the radio has been "returned to kit form."

Meanwhile contributor Frank Hertel offered an anecdote about intermittent operation. In the late 1960s, he worked for a TV station that had an RCA quad tape machine with a problematic module. The module used Blue Ribbon Connectors — big, heavy-duty plastic connectors with gold spring fingers. The contacts were rated for high current flow.

Years later, Harold Bass of relay manufacturer Potter & Brumfield told Frank: "If you have too large a contact, and do not flow enough current through the contact, it will likely eventually fail to provide a good connection. This is also true of relay contacts."

Frank experienced a similar phenomenon while maintaining a Harris SX-1 AM transmitter. At sign-on, the transmitter would perform the first "step" of its step-start procedure but would not step to the full power setting. Frank thought it needed a new controller board.

Harris support folks suspected a dirty contact on the large contactor in the bottom of the main breaker panel. The tech further explained that one set of the contacts on that main contactor was used to send a verification

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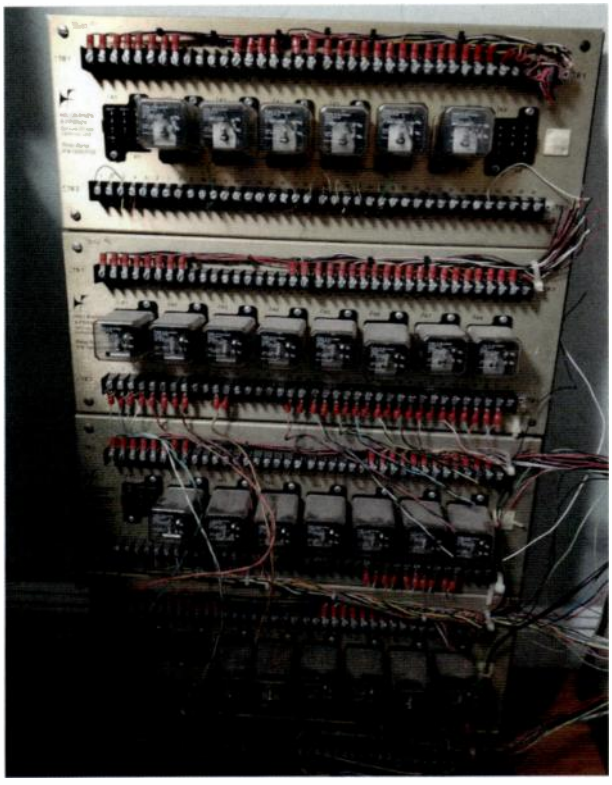


Near right
Fig. 2: A transmitter control interface designed by Harold Hallikainen.

Far right
Fig. 3: The relay panels.

Below
Fig. 4: Only an engineer with years of troubleshooting experience would think to engrave the rear of panels, to help identify components.

signal to the controller board. At the time, engineers didn't know that they were not drawing enough current through those spare main breaker contacts to keep them "clean," so to speak.

Frank cleaned the contacts that the small wires were connected to, and the problem was resolved.

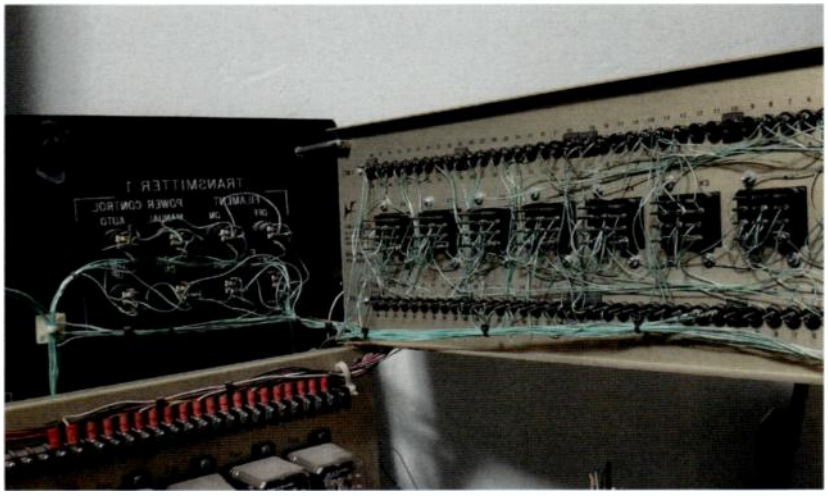
Touchy feely

In a recent column I recommended that when you're inspecting a transmitter site, open the breaker panels to check whether any breakers have tripped.

Scott Cason, based in Louisville, Ky., has been a broadcast engineer for 35 years and a contract engineer for 21. He's also an ABIP inspector in Kentucky and Indiana and the director of engineering for the Kentucky Broadcasters Association.

He recommends that you feel the front of each breaker with your hand to see if any are warmer than normal. If you do this regularly, you'll know which ones run a little warm. Any breakers that seem warmer than they usually do could be sending a red flag. (And you know a failure would happen on a weekend or over a holiday.)

Also, if you have the budget, Scott suggests going a step further by investing in an infrared thermometer.



Clever!

I mentioned Harold Hallikainen above, and you may recall me telling you in a previous column about his use of engraved panels.

Harold sends along images of an interface panel used between a remote control system and the transmitters at an FM station. The panel is shown in Fig. 2. It was all wire-wrapped relays, as seen in Fig. 3.

The relays are socket-mounted on panels held by spacers on the back of the panel. The spacers on one side are hinged so the back panels can be "folded" to the side for access, shown in Fig. 4.

Notice that the back of the engraved panel is engraved with the reverse image of the front. This made it easier to determine which front-panel part you're working on. (Speaking of Harold, if you are a ham, you will enjoy this site: *https://w6iwi.org*.)

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If it doesn't exist, make it!

I needed a USB hub to mount in a Decora panel

Writer

William Harrison

Chief Engineer, WETA(FM), Washington, D.C.

From time to time, you may find yourself in a situation where something you want or need just can't be found.

There are various ways to deal with the problem. You can do without. You can use something similar. You can come up with a different way to accomplish the task.

But sometimes, in the right circumstances, you can build what you need and get the precise solution you desired.

Here's an example that arose during recent studio renovations at WETA. In an effort to modernize and streamline, we elected to install some StudioHub panels: a headphone amp (P/N SH-HPB), a two-button panel to switch between the "Live" and "Auto" modes of our automation system (P/N SH-2BUTRJ), and a three-button panel to control our EAS device (P/N SH-3BUTRJ).

StudioHub panels adhere to the Decora standard, and to that end they also sell a 19-inch rack panel (P/N SH-RACK4) that allows the user to mount up to four devices. Similar mounts are available from other manufacturers such as Middle Atlantic, RDL, Lowell, Strong and others, and in various configurations such as one to four devices horizontally in a single RU, or up to nine devices vertically in three rack units, so there are plenty of options.

We also needed a small USB hub in the room so that peripherals could be more easily connected removed from a computer, which was located out of the way and not convenient for physical access to the ports.

Normally this would be a separate device on the counter, or mounted to a rack shelf; but with that one unused space in the aforementioned rack mount, I set about looking for a USB hub that mounts in a Decora opening. After all, Decora

The Award-Winning RMT 416

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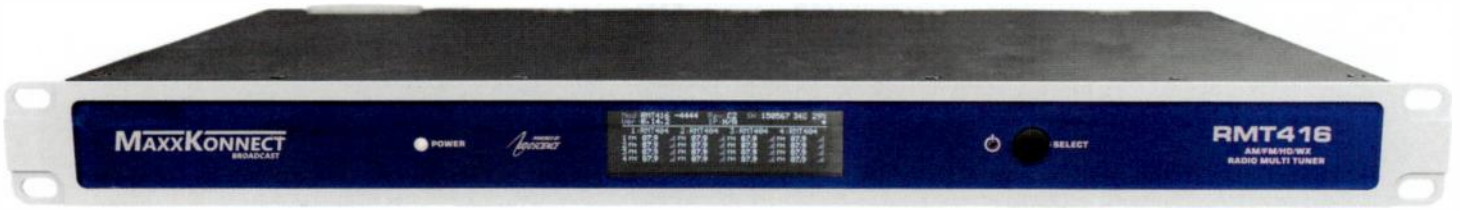

Companies everywhere are increasingly occupying smaller physical spaces while also needing to rely more on automated monitoring and alerting. Many publicly traded companies also must navigate compliance issues of proving performance of their radio operations. In an effort to meet those needs MaxxKonnect has partnered with AudioScience® to bring you the RMT416 Streaming Radio Multi Tuner.

The RMT416 is a single rack unit housing its power supply and network connection. There are 4 slots to house the user option tuner cards. Each tuner card features 4 tuners with analog audio for each tuner on a RJ45 connector. When fully populated with 4 tuner cards the RMT416 can host 16 individual tuners in one rack space!

Available tuner cards are:

RMT403 – AM and FM/WB | RMT404 – AM/AM-HD and FM/FM-HD

Web Based Control

Configuration of the RMT416 is all done from its intuative internal web page. The user is free to select which band and frequency for each tuner. The HD tuners allow the user to "lock" the tuner to any available HD channel permitting discrete monitoring of not only HD1 channels but all sub-channels.

Built-in email silence alerting, including activation thresholds and timing, may be set for each individual tuner or not used at all.

Listen Anywhere Using Icecast

The RMT416 can be configured to send audio from any or all of its tuners to a user supplied and configured Icecast Server. In addition to providing live listening for multiple people, there are several readily available programs that can record Icecast. This creates options for off-site logging and listening of air feeds which increasingly is an audit requirement for publicly traded companies.

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- Audio Performance: Audio Level, Silence Detection, Silence Detection Settings
- Icecast Settings: Icecast Enabled, Mountpoint Settings

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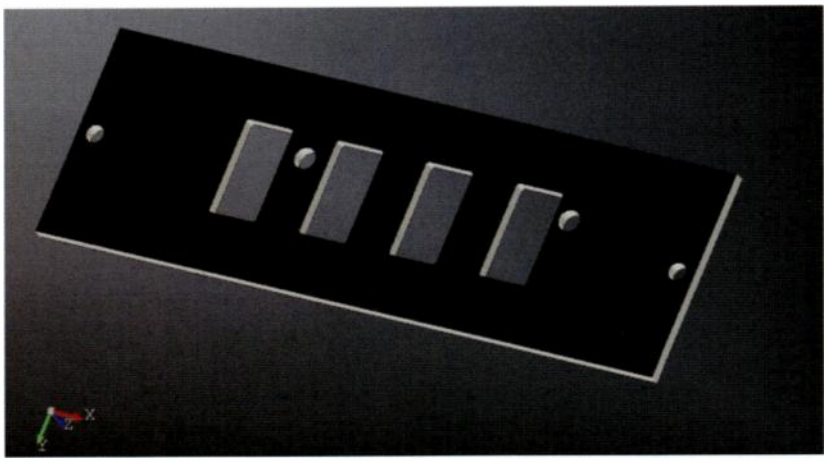
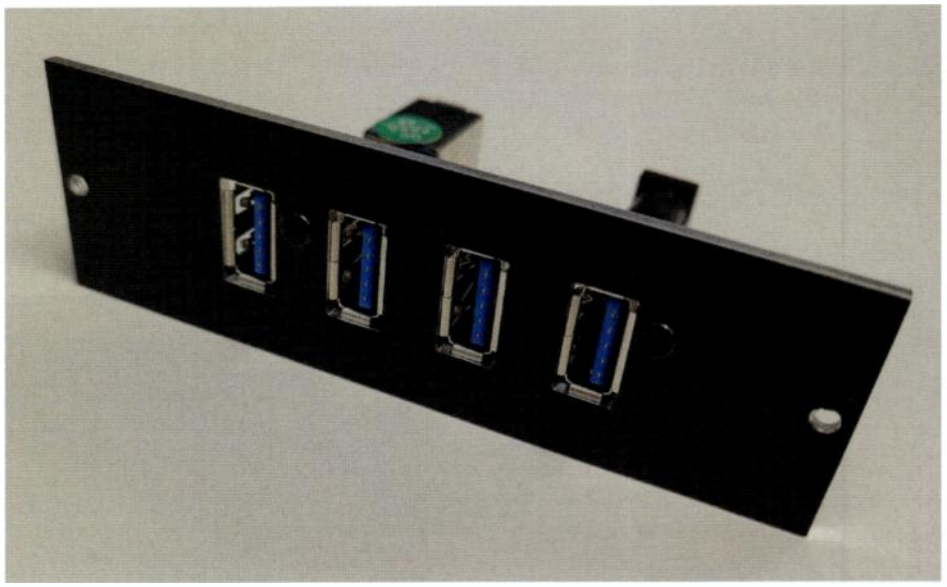


Above
A mockup of the panel.

Above right
The CoolGear 3510 USB Hub Board.

Right
Assembled prototype.



is a common standard in conference rooms and home theatre systems, so it must exist, right?

Well, maybe. If it does, I haven't found it. I spent way too much time looking. And while I found numerous small USB hubs that could have worked if mounted elsewhere, this didn't provide the elegant solution I envisioned.

So I set about making my own. In truth, I did not design and manufacture a USB hub from scratch. While I'm certain I could do so, the quicker and far simpler thing would be to adapt an existing hub into the Decora form factor.

The "standard" size of a Decora device is 2.62 by 1.3 inches, at least according to Google, so the ports on the hub had to fit within that rectangle. While there were a few that met this requirement, I ended up choosing the CoolGear Model No. CG-3510S4-Board, a four-port USB 3.1 hub module.

I chose it for three reasons: 1) It did not have an enclosure, which I wasn't likely to use anyway. 2) Since it is a module, you could clearly see there were mounting holes in the circuit board that I could take advantage of. 3) CoolGear offers a technical drawing on its website that allowed me to confirm it would fit in the space I had available.

Once I received the board, I set about making a few measurements and sketches as to how to mount it in the Decora opening.

> **"With one unused space in the rack mount, I set about looking for a USB hub that mounts in a Decora opening."**

Realistically the technical drawing could have allowed me to start prior to receiving the hub, but I find it best to work with a part in my hand to prevent unforeseen issues from cropping up.

Since I wasn't concerned about matching the depth of the cutout, I chose to use a simple flat rectangular plate with two holes to allow it to mount to the rack panel, and four rectangular cutouts for the USB ports.

This left only the task of how to mount the hub to it. Since the mounting holes in the hub were horizontal and the

panel I wanted to mount it to was vertical, I settled on using two small nylon 90-degree mounting blocks (Essentra PCB-MB-01) along with some No. 4 stainless machine screws and locknuts.

For the panel itself, I turned to a company called Front Panel Express, which I've dealt with previously. They offer free design software to allow you to create custom panels of any kind, from rack panels to AV outlet covers to complete enclosures, milled parts, signs, etc. Drawing the panel in their software took little time, as their software is intuitive and simple to use.

While I could have made the panel myself with a piece of aluminum, a drill and some files, I knew I was going to need more than one, and I wanted them all to look good and be interchangeable.

Had I chosen, I also could have had them engraved or printed with text, the station's logo, etc.

The price quoted for my panel, in black anodized aluminum of 2 mm thickness, was just under $30, which seemed reasonable. Price per panel goes down with quantity, so bear that in mind if you decide to use their services.

Once everything was in hand, assembly was a matter of a few minutes. All the parts fit together as intended, and indeed the finished product was quite sturdy and up to the task of folks plugging and unplugging repeatedly.

All in all, a success. And now others who might need to find a USB hub to mount in a Decora panel can also accomplish the task, should they choose to do so.

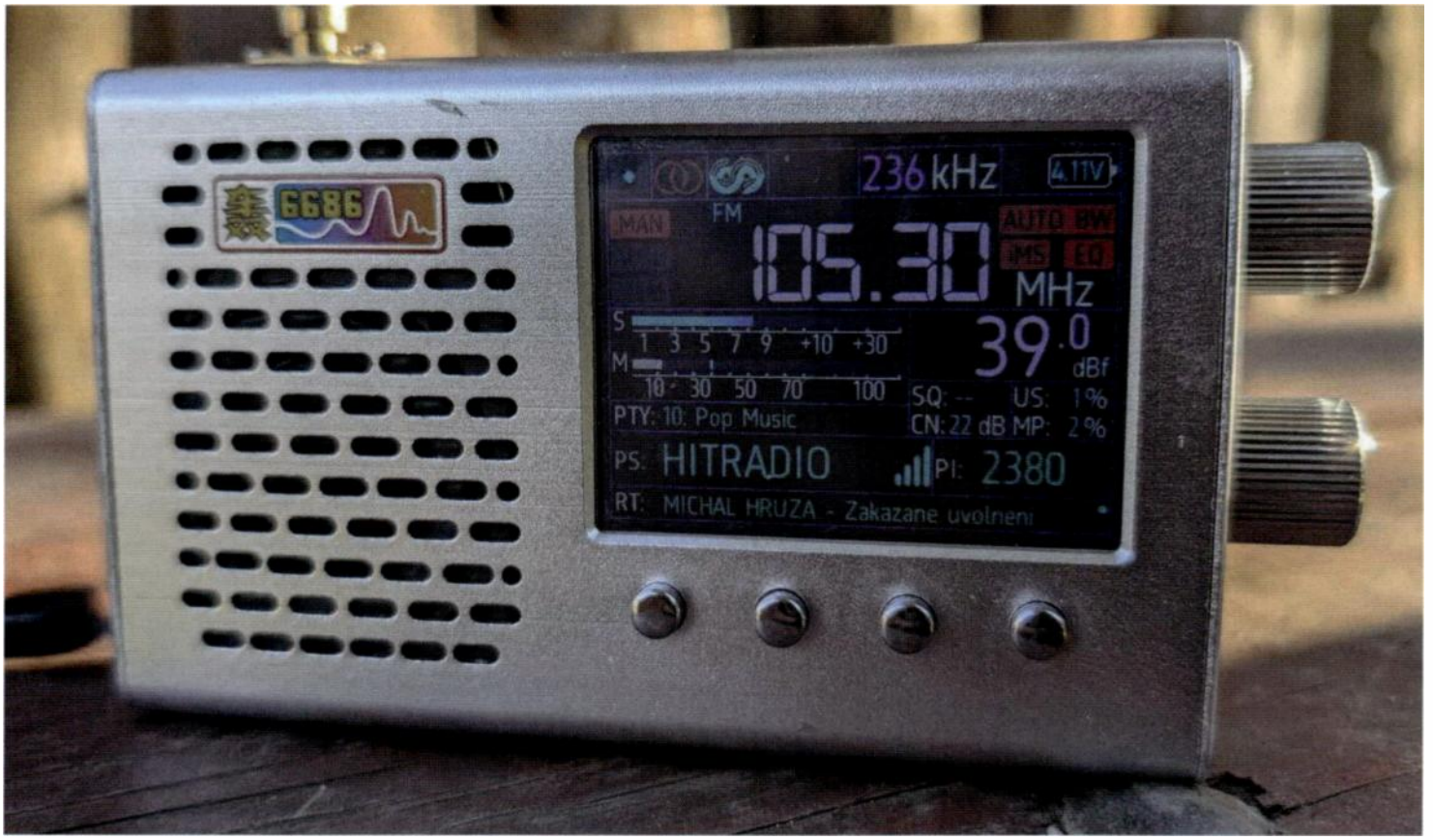
MA image courtesy DataVisual

Above
Decora-style panels and mounts from StudioHub, left, and Middle Atlantic.

Parts List

Costs are approximate

CG-3510S4 Hub	$40
PCB-MB-01	36 cents each, need two
Custom panel	$30
Misc. hardware	$2
TOTAL	~$75



Above
Marek Farkaš' TEF6686 receiver

Writer

Nick Langan

The author wrote about the impact of wildfires at Mount Wilson in our June 4 issue.

Meet the hobbyists behind today's smartest radios

Across generations and continents, FM DXers embrace open-source tools to tune into distant signals

Do you remember your first portable radio?

For Sjef Verhoeven, it was a Sony Walkman in 1993. As is common in the Netherlands, he would often ride his bike. That spring, he heard FM stations from the U.K. at a distance of about 300 kilometers. All day long, various BBC affiliates were audible.

"I had to find out why that was possible," he said.

Verhoeven, 47, eventually became an electrical engineer for a wholesaler in radio and TV equipment in the Eindhoven area of the Netherlands. He earned his amateur radio license (PE5PVB) in 1999.

Marek Farkaš, 27, represents a newer generation. He grew up in Slovakia and knew the local frequencies of radio stations he could receive at a young age. Now living in the Czech Republic, it was Farkaš' girlfriend, Ester Vlčková, who referred him to the FM DX Wikipedia page to shine light on the hobby of listening for distant FM signals in which now he invests a good deal of his time.

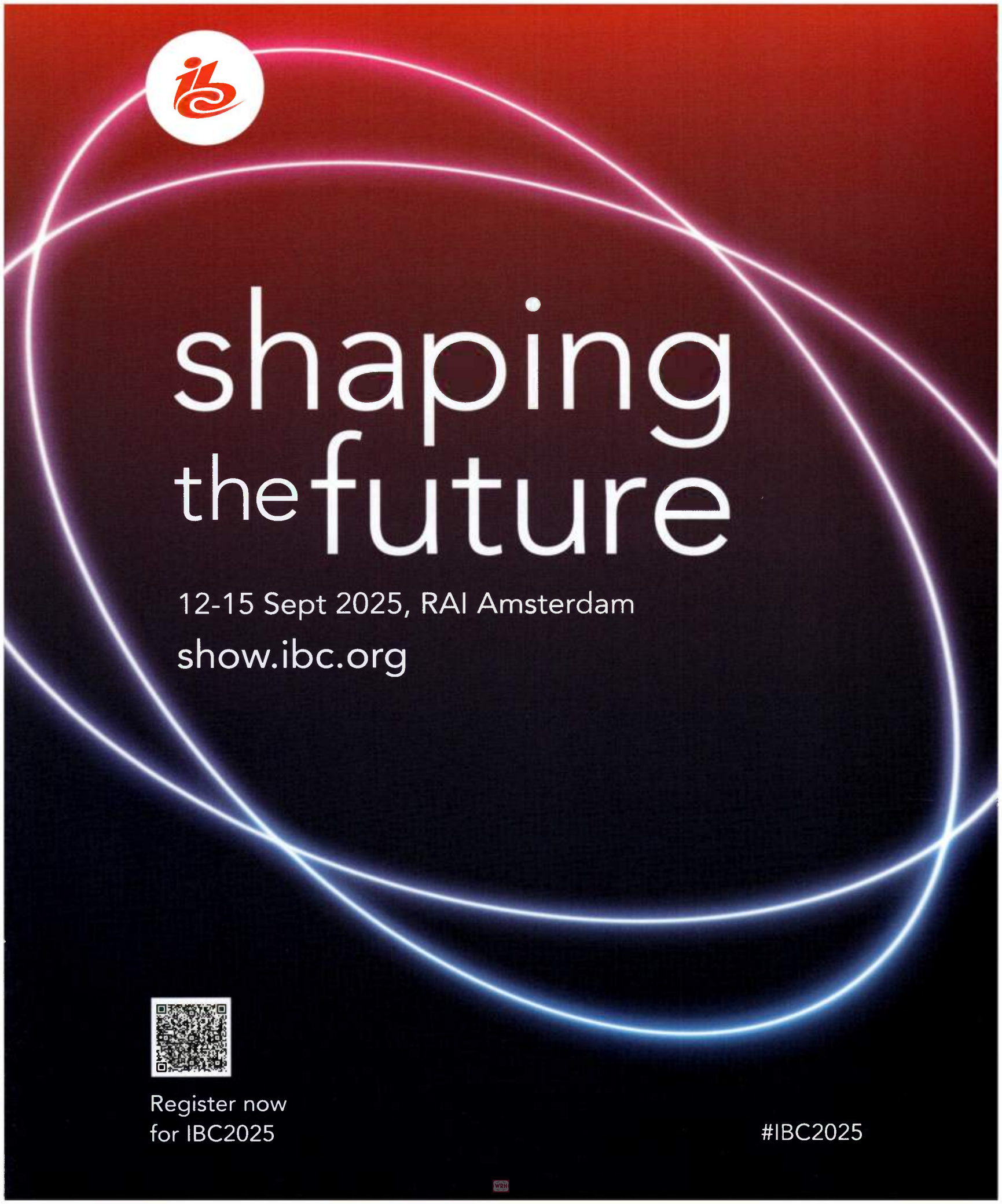
Despite their differences, Verhoeven and Farkaš have formed a unique partnership around the hobby of long-distance signal reception.

"We both share the common bond of annoying whoever we drive with by tuning around the car radio too much, looking for distant stations," Farkaš said.

The TEF6686 chip

Verhoeven penned an article for IEEE Spectrum last November about the TEF6686 chip. Introduced by NXP Semiconductors in 2013, the chip has undergone several revisions. It has been deployed in various car radios, including several Pioneer models.

As Verhoeven wrote, the chip's use of DSP technology makes it highly sensitive, capable of pulling in weak signals,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and highly selective, able to filter out adjacent-channel interference. It supports both FM and AM reception, as well as RDS decoding.

Verhoeven's fascination with the chip began during the Covid-19 lockdown in 2020.

"I was on holiday, had nowhere to go and I just started reading the available documentation," he said.

On the Chinese marketplace website AliExpress, TEF6686 tuner modules were for sale. Verhoeven began to program it with the Arduino IDE and he released an initial firmware in early 2021.

As some portable versions with the TEF chip began appearing publicly, Verhoeven noted their homebrewed nature.

"They looked like they were from the Commodore 64 age," he joked.

By fall 2021, he had released a version with a display that ran more efficiently.

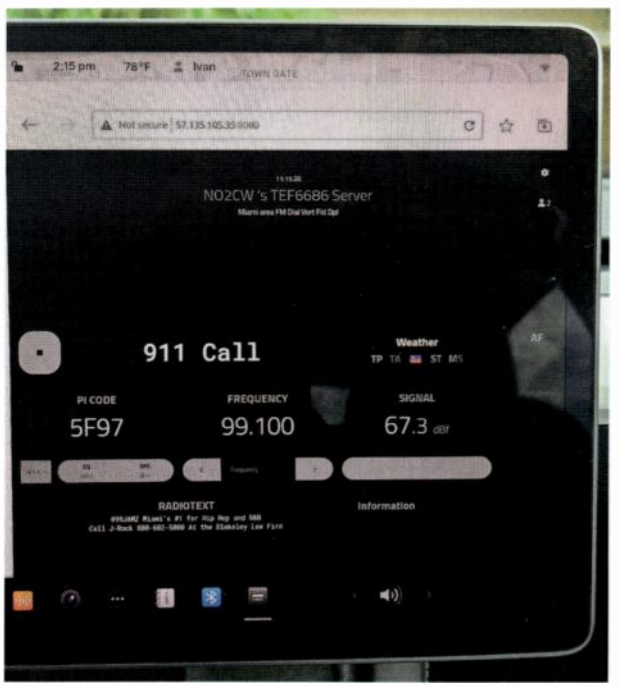
A DIYer can build this version themselves, Verhoeven said, estimating that assembling a printed circuit board would take about two hours of soldering.

In early 2022, Verhoeven was contacted by Chinese hobbyist Justin Peng, who informed him that he had built a portable version of the TEF radio using Verhoeven's firmware. By summer, the first versions of these radios appeared on AliExpress, sparking the open-source FM DX community's rapid growth.

Farkaš, meanwhile, had been using a TEF chip in a Pioneer car stereo since 2018. Four years later, he began conversing with Verhoeven in a Facebook group about the TEF chip.

Above
Sjef Verhoeven at Zugspitze in the Alps, the highest point in Germany at 9,718 feet.

Right
Community member Ivan Cholakov, NO2CW, uses a screen in his Tesla to listen to his TEF webserver in Florida.



He asked Verhoeven if he could connect the Pioneer stereo to his computer.

"Why would you want to do that," Verhoeven recalled responding, "when you can build your own fully open-source receiver?"

As development continued, users noticed Verhoeven's firmware had impressive RDS decode sensitivity. The RDS PI codes were linked to a database stored in the TEF's memory, containing PI codes for known U.S. stations, for example.

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Above
Marek Farkaš' FM antenna setup in Jaroměř, Czech Republic, features a horizontally mounted Körner 19.4 Yagi on top, along with dual vertically stacked Körner 15.12 Yagis.

How is the RDS so good?

Verhoeven designed the RDS decoder in his firmware, which taps directly into the TEF chip. It was improved upon further by Polish developer Konrad Kosmatka and the decoder itself is open-source. The approach allows for lesser error tolerance than consumer-grade radios. In testing, it proved highly effective — even during short meteor scatter bursts, RDS PI codes were more likely to be decoded.

As more hobbyists worked on the TEF chip, information-sharing increased. That's when the Facebook group transitioned to a Discord server.

> **"The proliferation of SDRs has drawn a younger contingent to FM DXing. The open-source TEF project has only reinforced this trend."**

Old school meets open source

Mike Bugaj of Enfield, Conn., has been interested in FM DXing since the early 1960s. After leaving the Navy in 1969, he joined the Worldwide TV-FM DX Association, which serves VHF propagation enthusiasts.

As its head since 2001, Bugaj is the reason the club still exists. He has heard FM signals from as far away as Mexico by E-Skip propagation and from Arkansas via tropospheric ducting. Over the years, he has used many stereo tuners like the Yamaha T-80. He owns several SDRs, including the SDRPlay RSPDuo.

Serious DXing requires an external outdoor antenna. As a result, he hadn't invested much in portable radios.

"I considered the Eton Traveler III a very good radio until the TEF came along," he said.

Bugaj, 78, discovered the TEF in 2023 and considers it a gamechanger. "The selectivity, sensitivity and RDS capturing are just phenomenal."

FM DXing has traditionally attracted a more experienced crowd, and the WTFDA's approximately 260 members skew older. However, the proliferation of SDRs over the past decade has drawn a younger contingent to FM DXing. The open-source TEF project has only reinforced this trend.

"I've never seen a project like this," Bugaj said. "Many of these guys are programmers, DXers or both, and they are all working to push this radio to its limit."

The Discord community has more than 1,800 members, mostly in Europe, but a growing number are in the U.S.

Farkaš noted that the youngest members are as young as 13 — the minimum age allowed by Discord's terms of service — and estimated that the average participant is around 25. But that hasn't deterred someone with seniority, like Bugaj.

While they all share a love for FM DXing, the more technologically inclined members are drawn to the TEF's modifiability and the firmware the team has developed.

The developer duo

Farkaš admits hardware isn't his forte. But fluent in multiple programming languages, the software developer has contributed significantly to the TEF firmware.

He took Verhoeven's original version and added unique graphic skins. His theme-switcher is now one of the main features of Verhoeven's firmware. He also added Wi-Fi support.

At the same time, Verhoeven produced several firmware iterations. In software development, what is known as "divergent change" occurred.

"I was about to move on to other projects until Marek started working on his mods," Verhoeven said.

Farkaš convinced Verhoeven to continue to enhance the TEF firmware. Throughout the process, the firmware has remained open source.

Left
Marek Farkaš visits 103.6 FM Fresh Radio in Ostrava, Czech Republic.

Right
The TEF6686 was used by DXer Allan Nosoff in March for tropospheric ducting reception, pictured, of 103.5 KBPA(FM) Austin, Texas, aboard a cruise ship in the Gulf of Mexico, at a distance of approximately 970 miles.

"When you open-source it, you can learn from each other," Verhoeven said.

As the TEF portables spread, skeptics doubted their performance — until they tried them firsthand.

The Discord server, originally dedicated to the TEF, evolved into OpenRadio, encompassing Farkaš' webserver project and Verhoeven's headless TEF initiative. The group ultimately registered *fmdx.org*, where you can keep up with their initiatives.

The many iterations of the TEF

Farkaš estimates that approximately 100,000 TEF6686 portables have been sold on AliExpress.

Sometimes, it is difficult for the pair to get across that they don't build the radios themselves.

"There are many different versions," Verhoeven said. "Some have a 'boot' button inside the headphone port, which is required for firmware updates. Others have it inside the radio, and some lack one entirely."

The "silver-metal" portable version is the model most DXers own, which is available on both AliExpress and Amazon.

On AliExpress, it is listed for $70 at this writing, but prices are subject to frequent fluctuations.

If there's any weakness with the silver-metal model, it is the build quality. Its SMA antenna connector has been widely reported to be delicate with the potential to be snapped by moving around the whip antenna that is included with the radio. Bugaj and others have noted a tuning knob that tends to wiggle.

That's why the DIY route might be attractive for the mechanically inclined. Verhoeven has published schematics to build the PCB for the TEF.

Farkaš also maintains a TEF receiver guide as part of the fmdx.org website, which lists popular models using the TEF chip on AliExpress. Farkaš and Verhoeven recommend joining their Discord group to ask which models support firmware updates and customization.

Some other developers have copied and redistributed the firmware, but Verhoeven and Farkaš remain committed to keeping their official releases open-source.

"If we were in it for the money, we'd make it proprietary," Verhoeven said.

Worldwide webservers

One of the biggest advancements the group has developed is the ability to listen and control the TEF remotely. There are now more than 280 TEF webservers online worldwide; see an interactive map at *https://servers.fmdx.org/*. A new server recently launched in Bermuda.

Farkaš had the idea after sharing audio from the XDR-GTK software, which allows remote access to a TEF or Sony XDR-F1HD tuner. He envisioned a web-based display showing frequency and RDS PI codes in real time.

Working with Kosmatka, he integrated RDS data display.

He then implemented low-latency audio streaming from the TEF.

Farkaš made the code public and several community members tested it. "We created a panel showing all users online with TEFs, but it quickly outgrew the available space," he said.

That led to today's interactive map. Community-developed plugins now allow users to record what they hear via the webserver.

Bugaj was an early adopter of the webserver in the U.S., after he solved access behind his local ISP's firewall. "When you set up a public webserver you share your radio dial with the world," he said. "I would think we all bring ourselves a little closer together in the process."

The fmdx.org team also paired up with Radio Data Center, the German company behind the popular website FMList, to provide locations of transmitters by country. FMList data fuels the RDS and station information seen on the webserver. "I think what we have is the most accurate system that's available worldwide for transmitter identification of what you're receiving," Farkaš said. Bugaj was one of the first hobbyists in the U.S. to set up a TEF webserver. "If you want to set up a webserver, they will help you until yours is up and running. They do it just for the pure satisfaction of helping you," Bugaj said.

From the Author

Nick Langan adds:

I own two TEF6686 portables — one that I use as a travel receiver and the other is connected to my rooftop APS-13 antenna and is part of the fmdx.org webserver platform. I bought my first on Alixepress and my second on Amazon.

My TEF webserver is free to check out and control from my Tabernacle, N.J., location; see *http://wnjl.ddns.net:8080/*. I'm able to connect coax from the antenna directly to the SMA connector on the radio.

The TEF's performance is exactly as others have stated: unmatched sensitivity and selectivity, up there with any "conventional" tuner I've used. The portables are delicate, however, and chances are that you will break the whip antenna that comes with the radio.

I recommend purchasing a Comet SMA-W100RX2 telescoping antenna as a replacement, available on Amazon.

If you use your TEF in the U.S., make sure to change the region from "Europe" to "Americas" for its RDS to display properly. That might be the best feature the receiver has — thanks to Sjef Verhoeven — it quickly displays RDS PI codes, and then converts the PI code to a U.S. callsign, based on its built-in database.

Verhoeven's headless TEF is a PCB board that connects directly to a computer to host a TEF webserver instance.

Demand surged, leading a Czech company to produce 40 boards — which quickly sold out. "Now we know how Nvidia feels," Farkaš joked.

Above Farkaš uses his TEF6686 silver metal portable in Strasbourg, France.

An open-source future

Verhoeven has been working on developing a DAB+ tuner, as the TEF chip lacks DAB support. The group is also considering other radio chips, such as the SI4735 for medium and shortwave.

There are also other versions of the TEF668x chip series. The TEF6688 and TEF6689 chips support HD Radio in the U.S., but according to the pair, those chips are not publicly available.

For now, Verhoeven will continue to maintain his firmware and release bug fixes, when warranted.

Further development efforts are fueled by donations to the community, which go directly to its operational costs.

Meanwhile, members of the growing Discord community continue to chip in with their own enhancements.

A user in Germany named Highpoint2000 built an Android mobile app (*https://github.com/Highpoint2000/TEFLoggerApp*) that matches the RDS being received on the TEF receiver and displays it on a mobile device in real time, which allows the user to log stations as they receive them. U.S.-based DXers can set their TEFs to log directly to RabbitEars.Info's FM autologger map, developed by Russ Dwarshuis (KB8U).

Verhoeven and Farkaš are considering forming an official nonprofit organization for the community.

A search on eBay reveals over 60 different radios with the TEF6686 chip — portable and desktop models in various shapes and colors.

In a world of streaming and smart speakers, it turns out the most modern radio may be the one you build yourself.

BROADCAST EQUIPMENT EXCHANGE

Snowville Memories

The letters on this page are in response to Mark Krieger's commentary "A Structure Is Gone, Its Memories Remain" in the March 1 issue.

Courtesy Mike Fitzpatrick/NECRAT.us

Thank you

Regarding the article "A Structure Is Gone, Its Memories Remain": Thank you very much for this informative, well-written article. So interesting the past history, it was an enjoyable read indeed!

Ross Langman, KB8NTY
Twinsburg, Ohio

Good times

The Smith Building, we used to call it ... 8200 Snowville Road. ... Thank you for publishing this story!

It was my work location for around 18 months as vice president of operations for Gore Broadcasting. We bought the old WIXY 1260 and located our offices and studios there; our tower site for 1260 was about two miles away. It was also home base for corporate operations.

Our calls at the time were WRDZ. We broadcast in C-Quam AM stereo. We occupied the whole second story and it was a blast, having the Smith operation on the first level. Great people. ... I learned a lot from them, and they had all of the engineering toys.

The whole interior of the building was clad in shiny copper. Nonetheless, you could hear 1100 AM singing through the filing cabinets.

Jonathon R. Yinger
President and CEO
The Christian Broadcasting System & Broadcast Properties LLC

Lasting impact

I came across Mark Krieger's piece. Indeed, those memories have a lasting impact.

When I was a young engineer in the Miami radio market, I landed my second radio job at a directional AM station. I had no experience with directional stations, and my only knowledge was to avoid turning the cranks on the phasor.

Fortunately, the ownership of the radio station recognized my potential and mentored me. The director of engineering crafted two invaluable booklets on AM directional arrays: one delved into the mathematics of directional antenna systems, while the other provided insights specific to the array I would be operating. He even traveled to Miami to guide me personally through the theory and functionality of directional arrays.

Later, I had the opportunity to attend a course offered by the NAB on directional antennas in Cleveland. It was my first encounter with snow, Christmas trees and seeing apples on the trees.

The course material was predominantly by Carl Smith, and I still vividly recall the "Analog Directional Array Calculator." To this day, I treasure the outstanding directional antenna books by Smith as well as those penned by George Ing, the director of engineering at Mission Broadcasting, my first mentor.

Beyond the snow, apples and Christmas trees, the highlight of that time was the trip to 3WE to experience the analog pattern generator. This experience was second only to my investment in a BSEE and was an invaluable leap forward in my professional journey.

E. Glynn Walden

Preserve our history

I have a love of older and historic buildings. My father was a handyman who often worked on repairing or upgrading buildings that were around for around 100 years. I learned not just the knowledge but the craftsmanship that it took to build these homes, businesses and landmarks. And I took much of this design philosophy into my later endeavors, including radio.

I've seen the sale of a legendary set of call letters in my home market, then the sale of the property with a nine-antenna array. I could talk a whole lot more about that travesty of history, but I won't. It is done.

I've seen Art Deco buildings torn down. I've seen all kinds of our history being tossed away. I would hope that more people will speak up to preserve some of these historic structures.

Archie Stulc

How to submit

Radio World welcomes comment on all relevant topics. Email *radioworld@futurenet.com* with "Letter to the Editor" in the subject field.

Hey who stole my AM?

I'm an engineer involved in broadcast here in Greece and neighboring countries. I recently test-drove a Ford Ranger pickup truck, marketed here as "Limited," but it's an XLT with many extra features.

What amazed me was the lack of AM radio. The system offers FM and DAB reception, but no AM capability.

We all know AM is not everyone's first choice (nor is DAB, if you think about it), but somebody at Ford should be informed that AM radio broadcasting is still active not only in the United States but also on the European continent and in almost all European Union countries.

Further, last year more and more EU countries legalized the private AM BCB use providing local radio station licenses all across Europe including the Netherlands, Italy, Spain, etc.

Meanwhile many AM professionals still work with and for AM radio stations. When they're shopping for a good 4x4 pickup, they need AM in the dash.

If you work in the broadcast industry and are looking for a new workhorse vehicle, the omission of AM capability means you can forget about the Ford Ranger. But if Ford doesn't care about it, maybe I'll use my wife's three-year-old Mercedes A200 class, which has DAB+, FM and the AM band.

Sotiris Papadimitriou
ASPiSYS Ltd.
Athens, Greece

When the car is the noise

It was interesting to read Cris Alexander's article about the National Radio Systems Committee study on AM band noise ("NRSC Studies RF Noise on Various Roadway Types," *http://radioworld.com*).

I too have experienced huge differences in "car-on" versus "car off" reception. Most recently I discovered this with a handheld FM receiver that had to be moved away from a non-electric vehicle for interference to disappear. Presumably AM was affected as well.

I would love to see a follow-up study measuring a few dozen vehicles for RF emissions. An interesting benchmark would be to see if they meet the FCC Title 47 Part 15 Subpart B standards for interference, as pretty much everything else is required to do. If they do, we might still have a problem, but if they don't, we should be very concerned.

If they can't meet these standards applied to everyday electronic equipment of every type, NAB needs to lobby for legislation to ensure vehicles come under the regulatory control of the FCC, and urge them to promulgate rules and enforce them for vehicle interference.

Rolf Taylor
Rocket Engineering and Consulting
Springfield, Va.

Clean up the band

When I was a teen, AM radio sounded great, and there was little or no noise on the band.

In order to save it now, the federal government needs to require manufacturers to eliminate the noise their products create. Reading the article by Cris Alexander, we find that there is more electromagnetic interference in our country than ever before. Until that noise is gone and audio bandwidth is expanded like we had it in the 1970s, AM will continue to lose listeners.

Translators helped owners of AM stations, but listeners would rather listen to the FM signals for better audio fidelity and no EMI noise. MA3 AM digital is great for AM, but that should have come many years ago and been heavily promoted.

I still listen to AM radio but I'm afraid I am in the minority. I'm rooting for it. Maybe listeners will return to the band before it loses all of its audience.

Steve Tuzeneu, CBT
Chief Engineer
WLKF(AM/FM), WONN(AM/FM), WPCV, WWRZ
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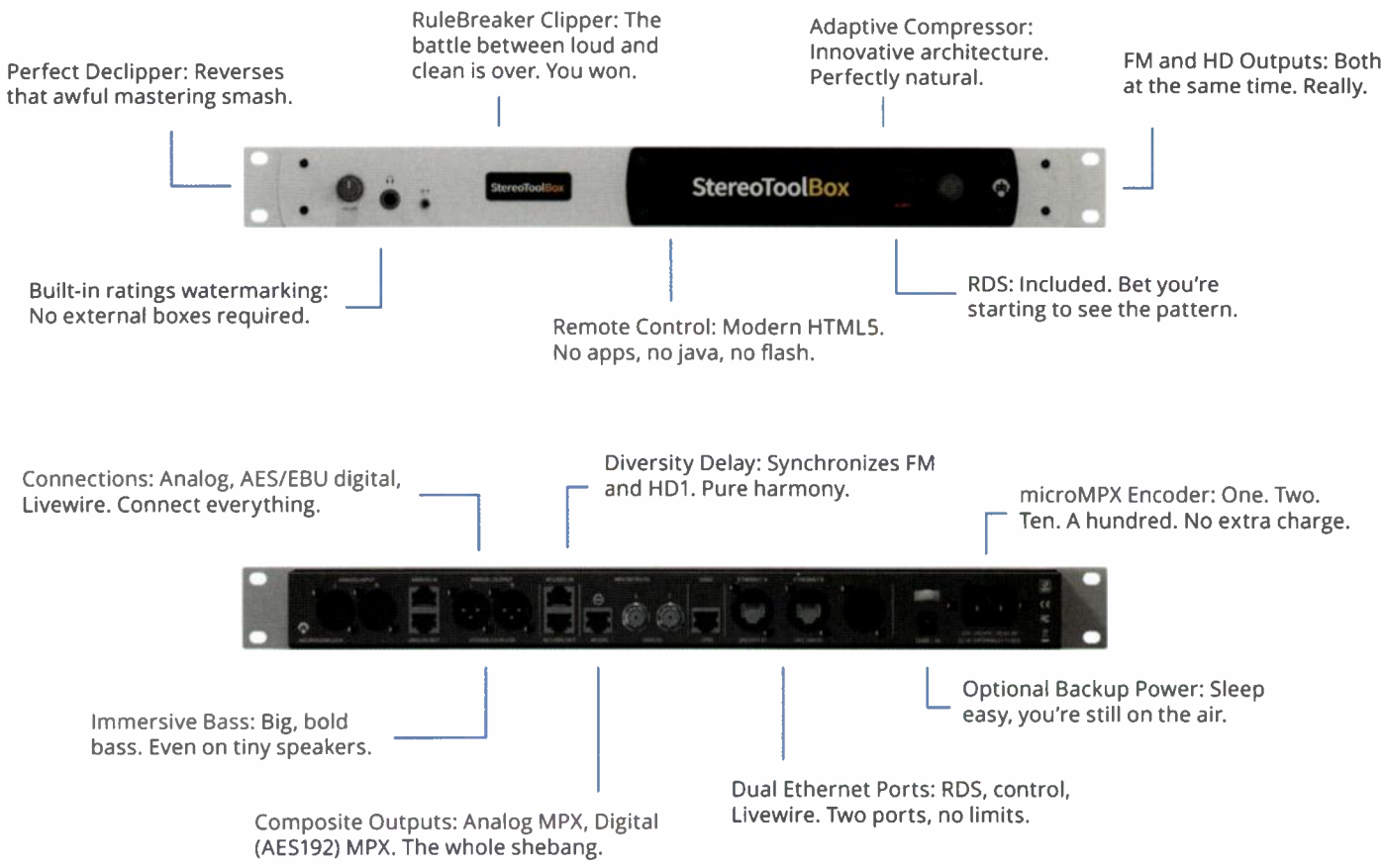
Remember when radio was fun? When beating the competition wasn't just a numbers game—it was a sound game. When tweaking your processing chain felt like tuning a race car. When you'd lean back, listen, and feel that rush—knowing your station sounded bigger, cleaner, louder than anyone else on the dial.

We remember, and we're here to bring that feeling back. StereoToolBox isn't just another processor—it's the one you've been waiting for. The one that makes radio exciting again. The one that crushes those $10K+ processors—for less than half the price. The one that puts the power back in your hands. No upcharges. No missing features. No shenanigans.

Put it on your station, and you won't just be in the race—you'll own the dial. Or, sure... blow $10K on their best and still get beat. Go budget and enjoy the sweet sound of compromise. Or get StereoToolBox and have it all. Your call.



LXE & GLASS LXE

Control it all, automagically.

One-touch event recall, smart soft controls, fader mirroring between LXE console surface and LXE under glass, and a powerful mix engine under the hood that handles hundreds of details for you, automagically.

DMX & REMOTE DMX

Audioarts Value. WheatNet IP Flexibility.

Now WheatNet IP compatible: Audioarts DMX console system including mix engine with local I/O, five-port Ethernet switch and automation plug-in for a fully self-contained AoIP system in one. Ideal for smaller facilities or for budget studios that serve as backup to a main.

STUDIO PROJECT PLANNING GUIDE

Smart Studio Planning eBook

Smart AoIP routing, control, touchscreens and console surfaces for handling workflows, automagically. Plan your studio project—download your FREE guide! Scan the QR code now.

Wheatstone
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