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Why WPR Cut Back on HD Radio

“We think streaming to smart speakers and to cars is the future”

NEWSMAKER

In October, Wisconsin Public Radio and the state agency that manages stations that carry WPR programming announced they were reducing their use of HD Radio.

They posted an announcement explaining the decision. They noted that their use of HD Radio dated to 2007 and that WPR and the Wisconsin Educational Communications Board had installed 13 HD Radio transmitters carrying existing WPR content that also allowed WPR to broadcast its All Classical network on HD2 multicasts.



Marta Bechtol

“Beginning Monday, Oct. 19 the ECB ... will turn off HD Radio broadcasts on seven of WPR’s 13 HD-capable stations,” they announced. Those are licensed to the communities of Superior, Brule-Superior, Ashland, Park Falls, Menomonie-Eau Claire, Adams-Wisconsin Rapids and Sister Bay.

The organization will continue to operate HD Radio “for now” on stations serving Delafield-Milwaukee, Madison, Highland, La Crosse, Wausau and Green Bay.

“WPR and the ECB received federal grants to install HD Radio technology, but the costs of maintaining the service state-

(continued on page 3)



The studios of iconic classical music outlet KING-FM are within this new Seattle Opera building near the Space Needle (far left).

KING-FM Studios Hit the High Notes

BY PAUL MCCLANE

KING-FM had occupied its studios in the Lower Queen Anne neighborhood of Seattle for more than two decades when its landlord informed management that the building would be torn down for condos.

The station began looking for a new long-term home.

Meanwhile the Seattle Opera had just moved into a new nearby building on the Seattle Center campus near the Space Needle, a building with multiple performance venues and space set aside on the second floor for a future tenant. Their desired tenant would be aligned with the goals of the arts community and payment that would help the opera meet operational costs of its \$60 million facility.

The space was a perfect fit for Seattle’s famous nonprofit, listener-supported classical music station KING-FM.

CEO Brenda Barnes said in 2019, “We are thrilled to be moving into this beautiful space, and to be in such close proximity to one of our most important partners.”

The station moved in February 2020.

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WPR

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wide are no longer justifiable based on audience use," they wrote.

The audience in question is the one listening to multicasts. ECB Executive Director Marta Bechtol estimated that fewer than 500 listeners would be affected and noted that the classical network continues online and via apps and smart speakers. She also emphasized to the public that WPR service on "their usual FM and AM stations" would not be affected.

"HD Radio was launched nationally in 2002 with a promise to provide higher-quality, digital audio to radio listeners. Stations purchased new equipment to broadcast HD Radio and listeners were required to purchase new radios to pick up the signals," the announcement continued.

"While many stations, like WPR, invested in the new technology, few consumers purchased the radios, which have become difficult to find. Despite some benefits, HD Radio has failed to attract enough listeners to offer a sustainable alternative to FM or even AM analog radio for many broadcasters."

We reached out to Bechtol and Crane for more insight.

Radio World: Can you expand on the thinking that went into this decision, given the time and money that had been invested in it?

Marta Bechtol: The Wisconsin Educational Communications Board, which holds the licenses for these stations, is an agency of the State of Wisconsin, and receives approximately 30% of its annual operating funds from the state. The agency has been issued a fiscal year budget lapse (\$245,000) due to the economic effects of COVID-19, so tough decisions had to be made. This action will help keep future capital costs down as well.

RW: The seven stations are turning off HD-1 digital radio service and associated multicasts?

Bechtol: All of these are multicast services. The analog/digital mix of HD-1 and the all-digital HD-2 are being turned off.

Mike Crane: All had HD-2 signals delivering an All Classical feed. We do have several HD-3 services on the remaining transmitters, used either to deliver signal to another transmitter as a form of STL, or because limited local analog service for one of our two networks suggests that we should leave them on for the time being.

RW: The announcement quotes Mike saying "the resources we were spending to maintain HD Radio will be redirected to sustain other services that audiences clearly prefer." Can you expand on which aspects of the operation created costs that can be saved?

Bechtol: We expect to see a reduction in utilities and maintenance costs, an extension of transmitter life, and

ease in demands on our technical staff that travel good distances to maintain these facilities.

RW: Mike what specifically will now be turned off?

Crane: Importers and exporters that are external to the transmitters. Transmitter exciters were changed by internal setting of FM/HD to FM-only. HD2 audio streams are disconnected to save bandwidth at transmitter sites.

RW: How much do you expect to save?

Bechtol: We'll see the bulk of savings in our transmitter replacement costs — size, tube life, HD-specific gear, etc. — which are on the immediate horizon. We expect to save around \$65,000 in utilities, an estimated 20% decrease in our annual utility costs. (Our average analog-only efficiency is 72%, and our average HD-Hybrid efficiency is 57%, so we'll see a 15% efficiency increase.) There will also be a small amount of savings related to HVAC/cooling. Additionally, this will save time and money in maintenance costs and relieve workload burdens on our technical staff.



Mike Crane

RW: The announcement quotes Marta as saying, "It's possible that some FM

listeners will experience an improved signal quality due to reduced interference from our HD broadcasts." How would you characterize any interference complaints?

Crane: These HD signals were activated a long time ago, and we don't have a record of interference complaints from that time, nor have we received any notable complaints recently. The idea that some listeners may get better reception is just based on what

With the current emphasis on Apple CarPlay and Android Auto, as well as on smart speaker listening, we believe focusing on our streams makes more sense.

— Mike Crane

we know about the effect of the HD sidebands on the analog signal.

RW: You estimated that fewer than 500 listeners will be affected; how do you determine that number?

Crane: Based on the Nielsen ratings, we generally do not see any reported listening to the HD-2 signals in question. But anecdotal evidence from listener comments over the years suggests that we do have a few who tuned in.

RW: The announcement noted that radios have become difficult to find; but advocates for HD Radio cite a growing presence in cars.

Crane: There are still a lot of cars that don't have HD, and some implementations leave a lot to be desired. And with the current emphasis on Apple CarPlay and Android Auto, as well as on smart speaker listening, we believe focusing on our streams makes more sense.

RW: An argument made by advocates has been that HD Radio and other digital formats bring more capabilities for metadata including visual elements important in the dash. Does WPR deploy visuals like Artist Experience or other metadata-based services?

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Happy 30 Years to RW's Workbench!

John Bisset began writing our popular tips column in 1990

BY PAUL McLANE

One of the best parts of my job is presenting the Workbench column in our pages.

Workbench was well established by the time I joined RW in 1996. Sometimes the smartest thing that the editor of a publication can do is support a good thing and get out of the way.

With this issue we celebrate 30 years of John Bisset writing Workbench, and salute the hundreds of readers who have provided the tips that are at the column's heart.

GETTING STARTED

When RW's founder Steve Dana sought to expand Radio World and its tech content, the Workbench column was born. At the time, John was a chief engineer who had written product

reviews for RW; he also taught a college-level broadcast engineering class part-time and enjoyed teaching.

Workbench quickly became popular and secured its place as a feature in every issue.

John had gotten his own start at age 12 by building what today would be considered a pirate top 40 station. (You don't know how often I hear stories like that from people in our biz). He hooked a Lafayette mike mixer up to a couple of turntables and a reel-to-reel fed a Lafayette Wireless Mike AM transmitter. The station had about a two-block coverage.

John was always hanging around radio stations (again, sound familiar?) His first professional job was at WFAX(AM) in northern Virginia, serving the Washington area.

"Program Director Roy Martin hired me as

a summer relief announcer, when I was 16. I worked there part-time through high school and college, and joined the full-time staff after graduation." Around that time he received training in technical writing with an influential teacher, Professor Joey Horobetz.

Eventually John was promoted to WFAX chief engineer, and the same year fellow engineer Henry Stewart and he started a contract engineering business.

"I got into equipment sales by learning from Joe Novak at Delta Electronics. Later stops included Harris, Dielectric, Broadcast Electronics, Nautel and Elenos." About eight years ago he joined Telos Alliance, where he is radio product sales manager for the western U.S.



John Bisset. "Sharing what we know with others in the business has been very rewarding," he said.

FROM THE EDITOR



Paul McLane

John and I both seek to make sure that the column's content is fair and thorough and not favoring any manufacturer, including those for which he has worked. John adds a hat tip to Telos for being so supportive in providing him time and opportunity to educate engineers on topics like AolP and studio construction, in RW as well as other platforms.

GRAB THE BUBBLE WRAP

The column's relationship with its readers is crucial.

"Over these 30 years, hundreds of engineers, programmers and managers

With this issue we celebrate 30 years of John Bisset writing Workbench, and salute the hundreds of readers who have provided the tips that are at the column's heart.

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BISSET

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have sent in tips and photos from all over the world." John pointed out.

"Published tips qualify for SBE recertification credit," John reminded me. But he's especially proud of the programming and management readership of the column.

"I try to explain the tips and subject matter in such a way that the non-technical or semi-technical reader can use them, as well as the seasoned broadcast engineer."

Have any reader tips stood out as most useful? He laughed.

"As I've gotten older, something to protect your knees when you're kneeling in the back of a rack, under a con-



John, center, at a 1977 holiday gathering with colleagues Roy Martin, left, and Bill Turkington.

sole or in a transmitter — with the power off — that's where bubble wrap cones in handy. Keep a few sheets in your service vehicle and at each site."

(John, this is classic Workbench stuff. MacGyver would be proud.)

"Using a cell phone camera to document things ranks a close second," he continued.

"Use the camera to take pictures of smoked components, animals you encounter and parts. Parts photos can be shared with a service department when you are missing a manual and need to identify something." A camera also lets you share pictures anonymously with Workbench or just with your own station staff.

"Let's face it, other than engineers.

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WPR

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Crane: We do deliver some metadata, and are eager to add more as we upgrade our systems. We currently deliver RDS data on the FMs and remaining HDs through Center Stage, which we hope to retire someday in favor of something newer like Artist Experience. We are not currently using other platforms for expanded HD metadata.

RW: What would you tell an industry colleague who was thinking of exploring HD Radio at this point?

Crane: There are certainly specific reasons to add HD service in some circumstances. But consumer uptake has been disappointing for a very long time, and we think streaming to smart speakers and to cars is the future. Additionally, few radio station owners invested in it, at least in Wisconsin: In some markets WPR has been the only HD signal for many years.

RW: Your announcement for the general public generally treats the reduction of service as being about the end of certain multicasts. Presumably some listeners were hearing the HD1 too.

Bechtol: Multicast was always the most exciting part for us.

RW: What else should we know about your experience with HD Radio?

Crane: It has helped us develop our All Classical network (the NPR News & Music Network is a mix of news and classical). But in the absence of special funding like we received from the Corporation for Public Broadcasting, HD has become less sustainable.

RW: On another topic, hybrid radio services seem to be on the uptick. What if anything is WPR planning in regard to hybrid radio?

Crane: We're certainly intrigued, and are following the news as it develops.

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Arno Meyer Remembered for Accuracy and Integrity

His contributions had a major impact on the technology of FM broadcasting.

BY TOM VERNON

When Arno Meyer passed away in the spring of last year, it marked the end of a notable chapter in radio broadcast engineering.

There's a good chance that virtually every experienced broadcast engineer, whether working in AM, FM or TV, has used Belar monitors for transmitter testing or proof of performance measurements at some time in their career.

If so, they are the beneficiary of the wisdom, knowledge and kindness of the founder of Belar Electronics Laboratory.

Meyer passed away at age 90 in May of 2019 at his Malvern, Pa., home, following a prolonged illness.

He'd been a member of the Institute of Electrical and Electronic Engineers and the Society of Broadcast Engineers. And while he is best remembered for his long career in broadcast monitoring and RF engineering, Meyer was a skilled woodworker and craftsman of stained glass windows.

ITA

Arno Mark Meyer was born in Munich, Germany, and emigrated to America with his mother when he was less than a year old. He spent his youth in Pittsburgh, where he soon developed an interest in electronics through the repair and construction of radios. He later graduated from Greenbrier Military School in West Virginia.

During the Second World War, he continued to develop his electronics knowledge by enrolling in the Signal Corps. He spent the duration stationed in Hawaii, where he was involved in the testing and development of radar and high-frequency communications systems.

After the war, Meyer lived in California, where he earned an undergraduate degree in physics from the University of California at Santa Barbara. He later moved to Philadelphia

and attended classes at the Moore School of Engineering at the University of Pennsylvania, and worked part-time for local electronics companies B&W and Jerrold.

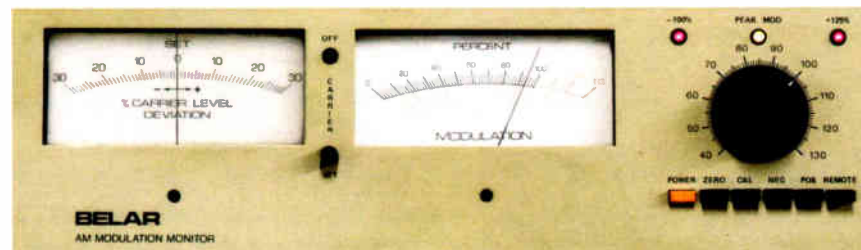
Meyer's first job after school was at ITA, which was involved at the time in industrial, military, broadcast and shortwave electronics. The first project he worked on was developing a transmitter for NASA's Project Nimbus, which involved remote sensing of the Earth with satellites.

As he recalled in a Radio World interview, "It involved modifying a 5 kW FM broadcast transmitter to operate at 150 MHz with AM modulation. Eimac



Meyer served in the Signal Corps during World War II. In Hawaii he was involved in the testing of radar and high-frequency communications systems.

The success of the SG-1D led Meyer to propose to the vice president of Triangle/ITA Electronics that the company pursue the wide-open market for FM stereo monitors. The VP responded that he had no interest in continuing in broadcast electronics. That setback turned into a defining moment for Meyer.



A Belar AM modulation monitor (showing overmodulation for a Radio World article by Mark Persons).

had no test data for the transmitter's 4CX5000 final tube with those parameters, and basically said 'Let us know how it works out.'" With some careful design and tweaking, the transmitter worked and was accepted by NASA.

Triangle Publishing, a media conglomerate that owned TV Guide and a host of radio and TV stations, eventually purchased ITA, and the company's focus shifted more towards broadcasting; Meyer's work projects changed accordingly.

ENTER FM

His first assignment was to develop the Documentor, one of the industry's

first program audio logging devices.

Meyer recalled, "It would record 24 hours of audio on a 9-inch disc. Ten years' worth of these Micro Discs could be stored on a bookshelf five feet long."

One of the most challenging aspects of the design was creating a ceramic cartridge with a 1 mil stylus. Meyer worked with ITA's mechanical engineer Buddy Wagner on the project.

By the mid 1950s interest in FM stereo was heating up. Eventually a standard was adopted, and the FCC authorized FM stereo broadcasting on June 1, 1961. Meyer was tasked with designing a stereo generator that could be paired

with the ITA FM-10D exciter.

His SG-1D was a 15-tube device that used a fully saturated, balanced bridge modulator to achieve separation greater than 40 dB from 50 to 15,000 kHz, with distortion below 0.25%. This low distortion worked to good advantage with the Serrasoid FM exciters of the day, which themselves had distortion below 0.25% from 100 to 15,000 kHz.

The success of the SG-1D led Meyer to propose to Roger W. Clipp, vice president of Triangle/ITA Electronics, that the company pursue the wide-open market for FM stereo monitors.

Clipp responded that he had no interest in continuing in broadcast electronics, and in fact, wanted to sell the company.

Despite the setback, this was a defining moment for Meyer, as it set the direction for the rest of his career. Soon after his meeting, he handed in his resignation at ITA.

No buyers were found for the firm, and ITA went out of business shortly thereafter.

ISOBEL+ARNO="BELAR"

In 1964, Meyer founded Belar Electronics Laboratory Inc. in the basement of his Drexel Hill, Pa., home.

The name Belar was formed by combining parts of the names of wife and husband Isobel and Arno, thus providing future customers with a great trivia question with which to challenge colleagues at trade shows.

Meyer set to work and released the company's first product in 1965. The FMD-1 tunable FM detector addressed the need by broadcasters to visualize components of the FM stereo signal.

This device demodulated an FM signal to baseband for display on an oscilloscope or other measurement device. It also functioned as an AM detector to indicate AM noise and synchronous AM noise. The initial price was \$89.50.

In fact, the FCC lab used the FMD-1 to verify their measurement of commercial FM broadcast stereo performance standards in the mid-1960s.

Sales of the FMD-1 were brisk, and Meyer used the revenue to fund the design of his first FM monitors, the FMM-1 and FMS-1. Fingers crossed, he sent the working prototypes off to the FCC.

"At that time, all RF monitoring equipment had to have type approval from the FCC before it could be sold to broadcasters," he later told Radio World.

"I received a call from Larry Miller at the FCC's Laurel, Md., labs who confirmed that our monitors not only passed the tests but were better than the commission's own measuring equipment."

Shortly thereafter, Meyer developed the SCM-1 SCA monitor and RFA-1 FM RF amp to round out the initial FM

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product line.

Then another stroke of good fortune occurred.

RAMPING UP

By the time Belar's FM monitors were approved by the FCC, it had already approved monitors from McMartin Industries and Collins Radio, and a deadline had been set for all FM stereo broadcasters to have type-approved stereo monitors installed.

But Meyer spotted a problem. He did the math and discovered that the FCC's deadline was, at best, unrealistic.

"We had an attorney present our case to the commission — that two manufacturers could not possibly build enough monitors to meet the deadline, but three manufacturers, with more time, could."

The FCC concurred, and the deadline was moved back.

Ramping up to meet this demand meant it was time for Belar to move out of Meyer's basement into real manufacturing facilities, so the company relocated to a plant in Upper Darby, Pa. His first big project in the new space was expanding the company's product line to include AM and TV monitors.

In the 1970s, interest in an AM stereo broadcasting heated up, and Belar partnered with RCA to develop their standard. The two companies already had a longstanding relationship, since Belar was private-labelling AM and FM monitors for RCA. Using an RCA Amphiphase exciter as a test bed, Meyer developed both the generator and decoder, which was first shown in 1974 at the NAB Show in Chicago.

RCA eventually dropped out of the AM stereo race, but the standard continued as the Belar AM-FM stereo system.

Mark Grant, Belar CEO, said the company has always worked closely with audio processor and transmitter manufacturers. "They use our monitors in the development of new products, and they are always pushing the state of the art forward. Questions would sometimes arise as to whether anomalies were in the monitors or the company prototypes. Arno was always heavily involved in the process because a lot of what he learned was used to advance the capabilities of Belar monitors."

Meyer was presented with the NAB's Radio Engineering Achievement award in 2001. Letters of nomination came from Bob Orban, recipient of the 1995 NAB Radio Engineering Achievement Award; Geoff Mendenhall, recipient of the 1999 NAB Radio Engineering Achievement Award; Larry Cervon, former president of Broadcast Electronics; and Steve Hemphill, founder of Solid Electronics Labs.

When asked in 2010 about the secret

to his success, Meyer chose one word: "Care. Care in design, care in manufacture, care in testing and care in customer service."

ALL ABOUT ACCURACY

Colleagues recalled Meyer not only for his relentless pursuit of excellence in developing products, but also for the generosity of his time and knowledge and the fairness with which he treated customers.

Jeff Keith, senior product development engineer at Wheatstone, recalled an early encounter.

"Around 1975, I was CE of an AM/

FM combo in Altoona, Pa. We'd been notified by the FCC that our FM was 3,600 Hz high, while our year-old Belar FMM-1 said we were -220 Hz. Measuring the FM carrier with two other means confirmed that we were indeed about 3,600 Hz high."

Keith called Belar and was surprised when Meyer answered the phone.

"I explained the situation. His reply was, 'Give me your shipping address and I'll send you a new crystal.' When I asked how much it would cost he said, 'I'm not going to charge you for the part. The monitor shouldn't have been lying to you.'"

When Keith began attending the NAB Show in 1980 he looked Meyer up to say hello and thank him for the support five years earlier.

"To my surprise, he actually remembered that incident. Every NAB thereafter, Arno was the very first person I'd go find to say hello."

Greg Ogonowski, president of StreamS/Modulation Index, LLC, has devoted considerable energy to addressing FM overshoot problems; Belar monitors were one of his key factors for success.

"In the early '80s, Gregg Laboratories

(continued on page 8)

"Comrex ACCESS is keeping us on the air while our anchors broadcast from home. Sounds great, so simple to set up, especially with Switchboard - thanks guys!"

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ARNO MEYER

(continued from page 7)

developed a precision overshoot-compensated low-pass filter for AM and FM audio processing, which later became the Orban '0' Card for Optimod-FM. Belar monitors were instrumental in this design because of their accuracy," he said.

"Shortly thereafter, using Belar monitors in our laboratory, Modulation Index LLC, we discovered some serious peak modulation control issues with many popular studio-to-transmitter links and FM exciters, as well as other monitors, which basically 'undid' the precision peak control your expensive audio processor was providing. Modulation Index then developed several modifications for these systems.

"The accuracy of the Belar monitors helped us achieve all these goals, allowing broadcasters a loud, legal signal, and became a very important part of our arsenal of trusted test instruments. There was never more truth in advertising than their slogan, 'When Accuracy Counts, Count on Belar.'"

A FASCINATION WITH PROBLEMS

Geoff Mendenhall, retired VP of Harris Broadcast and now consulting at Mendenhall Engineering LLC, had a close relationship with Meyer across several decades.

"After graduating from Georgia Tech, I wound up going to work for the Gates Radio Division of Harris Corp., where I became a long-term customer and reseller of Belar equipment," Mendenhall said.

"Arno was very personable and always willing to help with engineering challenges. We collaborated over a span of many years, constantly improving the design of FM exciters and FM modulation monitors, which had to be matched in measurement capabilities as the state of the art evolved and improved over time."

Mendenhall and Meyer often lent equipment to each other to verify measurement results, and in the process, Mendenhall said, he learned a lot about designing better and better FM modulators.

"When we needed a composite FM demodulator that was capable of measuring the analog FM signal to noise ratio down to and beyond 100 dB and distortion to less than 0.02%. Only the Belar FMM-2 could reliably do the job," he continued.

"I remember Arno's major involvement in the AM stereo initiative with the RCA/Belar AM+FM system, then later in the design of TV/BTS-TV stereo modulation monitors, and more recently, in the design of digital HD Radio modulation monitors. ... Arno had a major impact on the technical evolution of FM broadcasting."

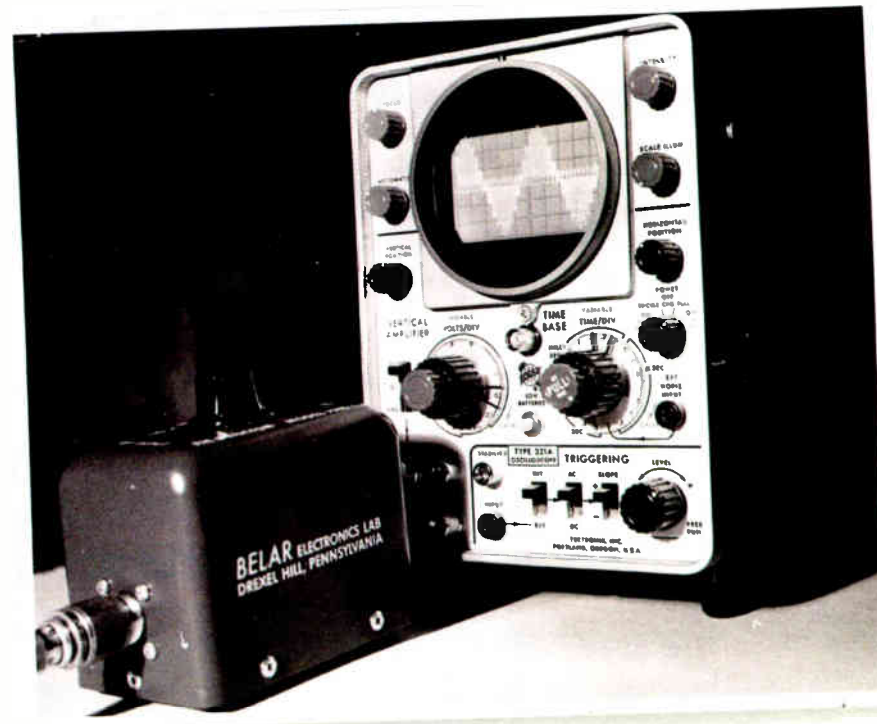
Bob Orban, consultant to Orban Labs, recalls that Meyer was instrumental in helping him to understand FM overshoot issues, and to bring his premiere product to market.

"In 1972 I built a custom stereo limiter that had no low-pass filters and relied on clipping for peak control. Without filtering, the clippers produced a lot of energy above 15 kHz," Orban said.

"A mystery arose when, with some program material, modulation peaks that were clearly well controlled at the studio produced egregious over modulation on the air as read on the FMM-1. A call to Arno revealed the reason: While removing the above-15 kHz energy produced by the clippers, the 15 kHz low-pass filters in the Collins stereo generator were overshooting and ringing. I took a scope up to the transmitter and, sure enough, Arno was right, that was exactly what was happening."

With that in mind, Orban next designed non-overshooting low-pass filters and packaged the compressor, limiter, high-frequency limiter, filters and stereo generator together, as a system.

"I proceeded to design and prototype a single channel of this processing and



Belar's first product was the FMD-1, introduced in 1965. A tunable FM detector that demodulated an FM signal to baseband for display on an oscilloscope or other device, it also functioned as an AM detector to indicate AM noise and synchronous AM noise. List price was \$89.50.



Meyer prepares to cut the cake in celebration of Belar's 50th anniversary at the 2014 NAB show.

build it on a perf-board. Upon consulting with Eric Small about package design, transmitter interfacing and regulatory requirements, I proceeded to prototype a stereo version of this processing, including built-in stereo generator. I called the result Optimod 8000A."

Again, Meyer stepped in to help. He offered space in Belar's 1975 NAB booth to Orban Associates to demonstrate the prototype 8000A, and how well it controlled modulation as indicated on Belar monitors.

"With this demo, Orban was off and running in the broadcast marketplace," Orban said.

Circuit design consultant Bill Gillman recalled a relationship with Meyer that spanned 40 years. "I met Arno at my first NAB convention. April 1980 in Las Vegas. I was a 21-year-old chief engineer at an AM/FM in Provo, Utah.

"Explaining that I had ran into difficulty completing the required annual proof of performance measurements on my FM, Arno carefully proctored me on the interconnection and grounding of the Belar FM Stereo Monitor and my associated test equipment. His advice delivered a set of excellent measurements. I admired his gentle, quiet and expert manner, a truly competent engineer and

business owner," Gillman said.

"Years later, I held the position of vice president of engineering at Gentner Communications, a broadcast equipment supplier. The Gentner and Belar NAB convention booths were often in close proximity. When booth traffic was low, Arno and I would get together and compare notes on everything in our respective designs and on everyone we knew at NAB.

"He was generous with his intellect and had a superior dry wit that I both admired and enjoyed. I am better and happier at my craft today because of Arno Meyer."

Mark Grant recalls his years working with Meyer as the company's monitors transitioned from analog to DSP devices. "Arno was always contributing, even though he wasn't a DSP guy. He saw the big picture and was always shooting for better specs. The concepts of broadcast monitoring are the same as always, they're just done with digital filters and firmware," Grant said.

"Arno also had a fascination with problems. If you injected a signal into a device and the response wasn't what you expected, he would pursue it to the very end to find out why. He saw it as a lesson to be learned."

Grant concludes that the culture that Meyer nurtured at the Belar plant was a testament to his values and leadership.

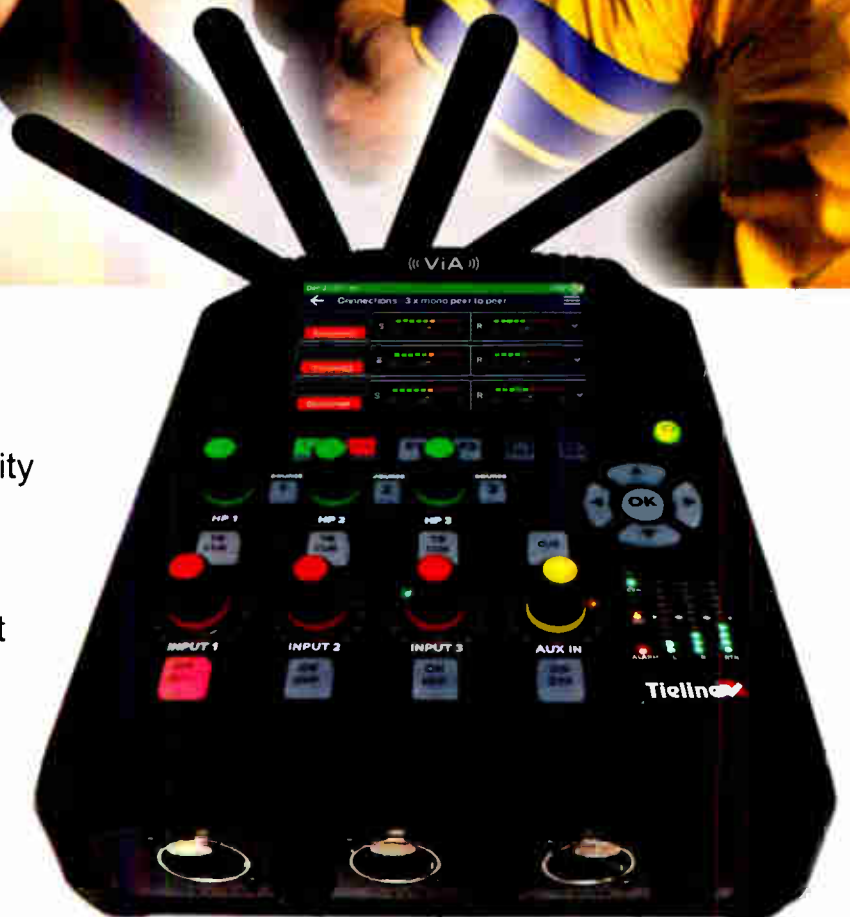
Perhaps the life and career of Arno Meyer may best be summed up by Steve Hemphill, who said, "Unlike his monitors, Arno's effect on the broadcast industry was truly unmeasurable."

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BISSET

(continued from page 5)

few employees of a radio or TV station understand what the transmitter site is all about. Posting pictures of exploded parts, dead snakes or raccoons that have taken up residence are great conversation starters."

What about strange or unexpected submissions?

"Shortly after the column started, an engineer sent in a modification to an old transmitter," he told me.

"The tube transmitter was atop a mountain several hours away, and occasionally the plate breaker would trip, turning the rig off."

The engineer could never identify the problem and got tired of the two-hour drive.

"Frustrated, he mounted a cart machine solenoid to the front of the transmitter, right above the tripping breaker. He drilled a hole in the end of the breaker and connected a line to the solenoid plunger. The solenoid was connected to the remote control, so that when the breaker tripped, it could be reset 'remotely' by energizing the solenoid." John related.

"I could see both sides of this solution. It's not necessarily good engineering practice to remotely switch a



Life is good with a dozen steamed oysters.

breaker, because you don't know why the breaker is tripping in the first place. But repeatedly driving two hours to simply flip a breaker on had to be pretty frustrating."

He took heat from some readers who felt this idea was reckless; but many thought it was a genius solution to a problem that a new transmitter later corrected.

EFFICIENCY

I asked John how the column has changed.

"In the early days, there were a lot more tips on modifying or troubleshooting equipment," he recalls. "There were engineering staffs consisting of a chief and a couple of maintenance engineers and maybe a transmitter tech. Today, one guy does it all." And "all" now includes multiple stations for many engineers.

With that evolution, he focuses more

WARM APPRECIATION

Marty Sacks, EVP of sales, support and marketing at Telos Alliance, has known John for decades and calls him an industry treasure. "He's the same gentleman I have always known. The service he has provided to so many, including me, all these years through his columns have truly been a labor of love."

Jim Wood, founder of Inovonics, calls Workbench "a turn-to in each issue." Ben Barber, president/CEO of Inovonics, saluted John for his expertise in collating and condensing useful information.

Reader Paul Sagi in Malaysia likes when John presents a reader's problem and invites solutions. "It is helpful, especially for newly minted engineers, to be able to ask for help." He said long before the term "crowdsourcing" was coined, "Workbench was bringing the experience, knowledge and wisdom of the radio engineering crowd to bear on the issues they faced."

Frank Hertel of Newman-Kees-Hertel RF Measurements & Engineering remembers attending a meet-and-greet with an FCC agent at which Frank posted a question.

"The agent did not have an answer, but John did! He nicely stepped in and saved the day for the agent. He presented the answer authoritatively but with a calmness that radiated true knowledge. After all, John was involved in writing the FCC ruling pertaining to low-power toroid RF Ammeter readings."

And Charles "Buc" Fitch — like John a past SBE Educator of the Year — has said that industry knowledge now seems to have a "half life" of about four years, meaning half of what we learn or buy may be useless in that amount of time.

"So how do we keep up at this aggressive pace?" Buc asks. "How do we learn?"

"We teach each other."

on improving an engineer's efficiency.

"The maturity of software-based products has made this possible. Features can be added or bugs addressed with a simple software update. The equipment is also more reliable, and in most cases modular, so many repairs involve simply swapping a module."

Parts may be swappable but it's hard to imagine Workbench without him.

Thank you John for your contributions and hard work.

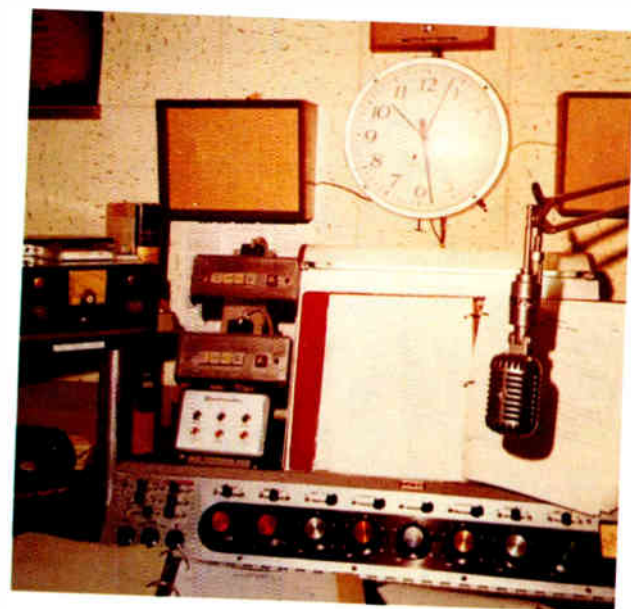
I can't end without sharing a little-known early career fact about John Bisset that also captures his elfish sense of humor.

"I started out with a parallel career. Intrigued by medicine, I wanted to be a doctor. To help me ace my anatomy classes, I started working as an embalmer and apprentice funeral director.

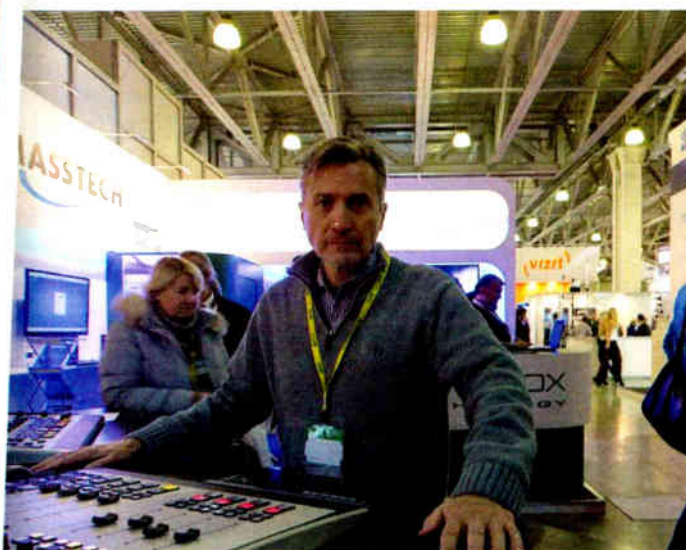
"My patients never complained!"



Contributor Dan Slentz has been reading Workbench over half his life. "John may have never known he's been a mentor to me and many, many others. But he has been. I'm looking forward to his flux capacitor and dilithium crystal-filled editions of Workbench over the next 30 years."



John started in the biz at age 16 doing summer relief announcing work at WFAX. "It seems like only yesterday we were replacing stylies and aligning cart machines."



Ken Skok is a Bisset colleague at Telos Alliance and longtime reader. He got to know John at SBE meetings and workshops, where "following or introducing John could be a little intimidating, as he is a consummate educator. He is committed to SBE and professional engineering practices in broadcasting."

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And the Tips Just Keep On Coming!

Join me in celebrating 30 years of your tips in Workbench

WORKBENCH

by John Bisset

Email Workbench tips to johnpbisset@gmail.com

Wow, time really flies, doesn't it? It's hard to believe that I've been bringing you Workbench tips for 30 years.

I'd like to take a few lines to express my appreciation to the contributors to this column over the years and all the readers who have supported Radio World and made the column so successful. Thank you! It's been a real honor to share these tips that help to make your jobs more efficient.

I also owe a tremendous debt of appreciation to my editor, Paul McLane, who has been around nearly as long as the column — coming up on 25 years with RW next summer. And thanks to the Radio World production folks, who make sure all those creepy pictures of animals found at transmitter sites look so good.

It's been a fun ride, and by no means is it over!

I received many comments about our discussion of WD-40.

Engineer Rob Atkinson writes from St. Charles, Ill., that if you have a wire-wound pot that's noisy or has a dead spot, put a spritz of WD-40 into the pot and work the wiper around a few times. The noise will go away and stay away. Rob credits this tip to Don Chester in Woodlawn, Tenn.

As we noted last time, WD-40 is a registered trademark for a specific multi-use product made by WD-40 Co.

While it has a thousand uses, you may find that for certain surfaces and applications in broadcasting, Caig Labs' DeoxIT may be a better lubricant choice; learn more about that product at www.caig.com.

John Seibels, K4AXV, has been a licensed ham for more than 65 years, and has done lots of building and experimenting with both electronics, outboard engines and automobiles.

John writes that he looks forward to every issue of Radio World, and finds the Workbench columns especially interesting, including the discussion of WD-40, which he said is without a doubt the most versatile all-around lubricant and cleaner. Like many of us, John has used gallons of it over the years.

John also mentioned a couple of



Fig. 1: Goo Gone from Weiman Products is offered in several application-specific versions.

Goo Gone and Houdini Lock Lube keep things clean and lubricated.

alternatives for engineers to consider. There is a hardware store product labeled "garage door lubricant" that is basically a lithium-based grease in a spray can. It will last longer on hinges and roller bearings on a garage door; the downside is that it will collect and hold the dirt as was pictured below the hinge in our earlier column.

John also uses it on small moving mechanical parts where a lubricant needs to stay in place longer than WD-40.

In his opinion, while WD-40 works OK to remove gummy labels or gaffers tape from mike cables used for remotes, Goo Gone is a better choice; it works more quickly and it can be dribbled on rather than sprayed, so it is less messy. Visit www.googone.com.

Fig. 2 shows a product known as Houdini Lock Lube. The website (www.houdinilocklube.com) has some interesting videos showing actual uses. It is usually sold to professional locksmiths. A 2.5 ounce "retail" size is available at Lowes.

John finds it to be suitable for out-



Fig. 2: A promotional image from the Houdini Lock Lube website, targeting professional locksmiths. The lubricant is made by Protexall Products.

door padlocks by keeping them lubricated without causing dust and dirt to stick as it seems to do with WD-40. (And speaking of door lubricants, readers in the northern hemisphere should spritz your tower fence locks before freezing season arrives.)

If you're looking for a dry lubricant for zippers, John recommends candle wax. Rub it on the zipper tangs, and it will stay between the teeth for years making for smooth operation.

WAIMIK. Bob Meister, is another engineering veteran who has used dish soap and water from a hose or sink to clean dirty gear.

Bob once inherited two-way radio equipment that had been kept in a barn that collapsed. Mice and birds had built nests inside.

The gear arrived on a wooden pallet. Before Bob touched any of it, he turned on the garden hose and sprayed what he could to remove hay, fur,

twigs, mouse droppings, bird droppings and anything else that water would flush away.

He then took each unit apart and rinsed each module under hot water, shook it dry and let it sit with covers off for 24 hours. (Nevertheless, some of the gear did have to be thrown out, with copper foil traces and component leads totally missing, eaten by corrosive liquid mouse waste.)

Similarly, in the 1970s Bob would wash old tube-based mobile radio TX and RX strips in the kitchen sink under hot water with liquid dishwashing soap, to remove years of oil and grime. After a few rinses, he would put them in the oven at the lowest temperature for a few hours to dry them off. All worked fine after that treatment.

By the way, this summer Bob worked on a Harris Digit CD FM exciter. Fortunately it was operable and he only needed to replace electrolytic capacitors per a Harris service bulletin. While he was inside, he decided to replace the various DIP switches used to set the operating frequency.

There are parts of this exciter that are a joy to work on, but others are not so easy, requiring him to strip the unit down so only the power supply and power amplifier remained in the chassis. It took Bob 15 minutes to get the final module out and exposed just to spend 15 seconds replacing three four-position DIP switches!

Bob adds that one of the good things about the exciter is that you only need two tools: a #2 Phillips screwdriver and a #10 (5/16-inch) nutdriver. The screwdriver is used to remove the top cover; the nutdriver handles everything else. All of the nuts have integral star lockwashers so there's little hardware to keep track of, and you can put it back anywhere.

We've gotten a lot of positive feedback on the recent construction projects we've shared. With that in mind, are there any problems you need to solve that a DIY (Do It Yourself) circuit would correct? Email your thoughts to johnpbisset@gmail.com.

The author has spent over 50 years in the broadcasting industry and with this issue celebrates 30 years writing the Workbench column. He handles western U.S. radio sales for the Telos Alliance. He holds CPBE certification with the Society of Broadcast Engineers. He is also a past recipient of the SBE's Educator of the Year Award. Workbench submissions are encouraged, qualify for SBE Recertification, and can be emailed to johnpbisset@gmail.com.

TRENDS IN AUDIO PROCESSING FOR RADIO

Radio World's latest free ebook provides insight into the changing ways in which radio organizations shape the sound of their over-the-air signals and those sent to smartphones, apps and smart speakers. It explores what users, leaders and manufacturers consider to be the most important recent or pending developments, and other timely questions.

Tom Lawler, Matt Levin and Mike Cooney provide engineering user perspectives, with Cooney adding insight from his work with the NAB Radio Technology Committee. David Bialik and John Kean offer opinions about issues around streaming and loudness, including work being done by the Audio Engineering Society on a document for online audio parameters.

Then manufacturers including our ebook sponsors weigh in; we hear from processing gurus at Wheatstone, The Telos Alliance, Orban, Inovonics, Circuit Research Labs and WorldCast Systems. And consultant Gary Kline wraps up our discussion with his trademark list of "things to think about."

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Others Were 'On the Air' in 1920

KDKA gets the attention but it had contemporaries that didn't make the "cut"

BY JAMES E. O'NEAL

In any important endeavor there seems to be a certain amount of contention as to who was really "first."

In aviation, the Wright's supremacy in making the first powered flight has been challenged by supporters of Clément Ader, Hiram Maxim, Gustave Whitehead and Richard Pearse. There are those who argue that Elisha Gray or Antonio Meucci should be given credit for inventing the telephone.

In broadcasting, there are serious contenders for the history book position of being the "world's first radio broadcaster," including one that aired election returns at the same time KDKA held its inaugural Nov. 2, 1920 broadcast.

As mentioned in our earlier account of the KDKA broadcast, there seems to be some agreement on what constitutes a broadcast service. At a minimum, these include (1) programming intended for

and certainly antedates the KDKA "big broadcast."

This was the establishment in December 1919 of 6 kW experimental radiotelephone station MZX at the large Marconi manufacturing facility in Chelmsford, England.

Documentation reveals that broadcasts of a sort began there on Jan. 15, 1920, with regular programs of speech and phonograph records. More than 200 reports of reception were received from amateur and shipboard radio operators. The station initially could be heard from Norway to Portugal, with one report coming from a listener 1,450 miles distant. Power was soon upped (15 kW input) and a regular schedule of two transmissions per day was established in late February with the airing of newscasts.

Following this round of testing, MZX added "readings from newspapers, gramophone records, and ... live musical performers," as Tim Wander writes

On November 2, the evening that KDKA made its debut broadcast with results of the Harding-Cox election, 9XM may also have been on the air, albeit only telegraphically.

— *Randall Davidson*

the general public, (2) the advertising of transmissions in advance and (3) a regular pattern of broadcasts.

Earlier "broadcasts" by Fessenden, de Forest and Herrold easily fall outside of these criteria.

SHOULD "MARCONI" GET THE PRIZE?

Interestingly, a British effort, initiated by Marconi employees no less, comes very close to passing the litmus test

in "2MT Writtle: The Story of British Broadcasting."

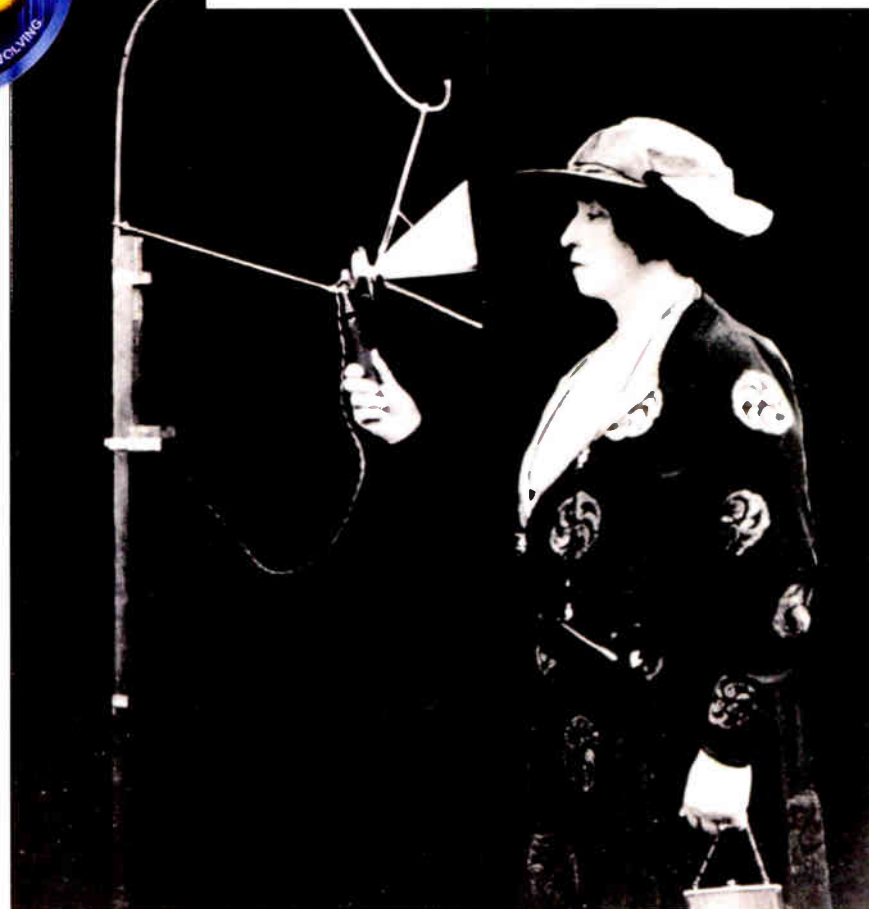
A still-extant telegram offers testimony that on March 20, 1920 the station's offerings were heard as far away as Australia. "Listening in" was not confined to "hams" and commercial operators, either.

Newspapers began to take notice, and one, London's Daily Mail, decided to make a broadcasting "splash" in a really big way by footing the bill for an international superstar of that era, opera soprano Dame Nellie Melba, to perform live at the fledgling station.

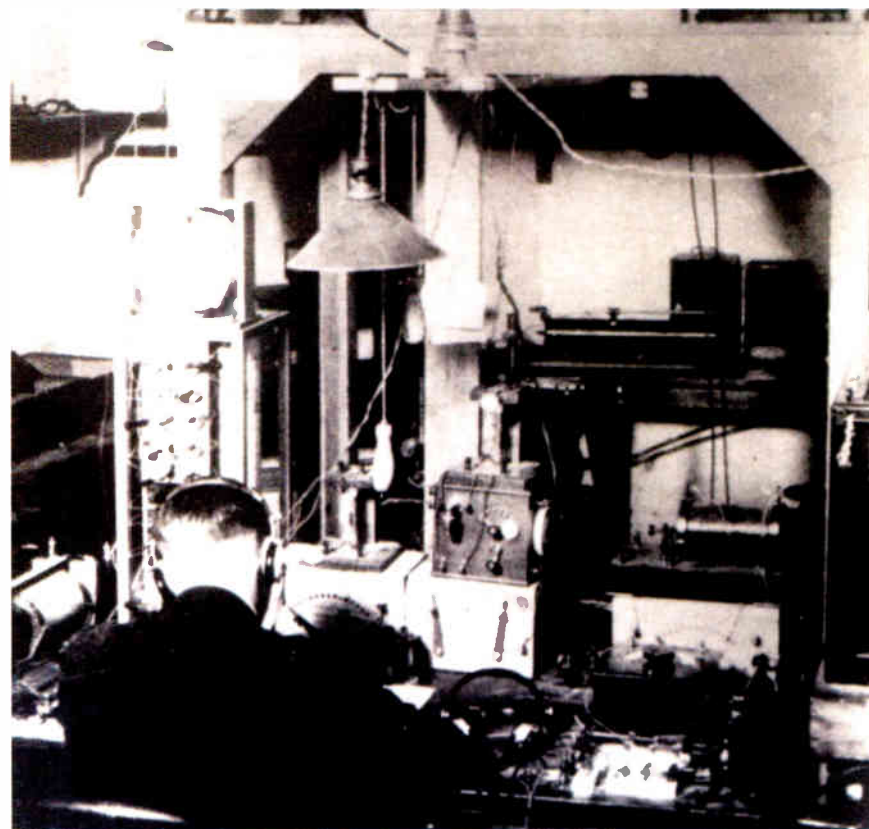
Melba (in whose honor "Peach Melba" and "Melba Toast" are said to have been created) was paid the huge sum of £1,000 — the buying power of about \$50,000 today — for a 20-minute performance on the evening of June 15, 1920. Obviously, the newspaper believed there was a future in broadcasting.



"Dame" Nellie Melba serenaded listeners all over Europe (and beyond) in a June 1920 broadcast from Chelmsford, England station MZX, which had begun transmitting a regular schedule of programming six months earlier. She was paid the princely sum of £1,000 for her 20-minute performance.



Pioneer University of Wisconsin station 9XM was broadcasting weather and other information to farmers on a regular basis before KDKA's Nov. 2, 1920 program of election returns, and may have transmitted information that election night too, if only in Morse code.



The Mail gave its "big broadcast" quite a buildup, with the British government issuing almost 600 new receiver licenses during the two-month runup. It was a truly international broadcast too, being heard in countries all over Europe, even as far away as New York. (A loud-speaker arrangement was deployed in Paris so people in the streets could hear Melba perform.)

So, with success spelled in such numbers (listeners and talent fee alike), why shouldn't MZX get the honors for being the premier broadcaster?

It boils down to lack of sustainability. Following a complaint made five months after the Melba musicale to the House of Commons by the Postmaster General about MZX's operations interfering with "legitimate services," the station was ordered closed.

As Wander put it in his book, "This view seemed to be echoed by the Navy and Army, who stoutly maintained that any civilian broadcasting would hamper 'genuine experiments' and would not be in the best interests of imperial defense. The critics of wireless broadcasting saw that the device was ideally equipped to be a servant of mankind, but were determined that it should never be considered as a toy to amuse children."

DO DITS AND DAHS COUNT?

On the U.S. side of the pond, KDKA had contenders also.

One frequently mentioned is the University of Wisconsin's 9XM, now WHA. It was licensed initially for experimental transmissions in June 1915 and, following the lead of similar stations at other schools, soon began a regular schedule of transmitting weather reports for the benefit of farmers and others. The rub: these were via radiotelegraphy, and those who wanted to benefit had to learn Morse code.

A couple of years into these daily code broadcasts, the station experimented with radiotelephony, broadcasting phonograph records and live announcements just as Frank Conrad did at his ham station.

Progress was slowed by the World War but resumed in early 1920 with a relicensing of the station, which had been engaged in research for the military.

Radiotelephone broadcasts of the regular weather reports were promised but did not become a reality, continuing in code instead. As noted in his 2006 history "9XM Talking: WHA Radio and the Wisconsin Idea," Randall Davidson wrote: "On November 2, the evening that KDKA made its debut broadcast with results of the Harding-Cox election, 9XM may also have been on the air, albeit only telegraphically."

These code-only transmissions went on into until early 1921, with only sporadic attempts to transmit speech and music — too late to best KDKA in meet-

ing the criterion of "being accessible by the general public."

WHY NOT DETROIT?

Perhaps the greatest challenge to KDKA's "first and foremost" status was Detroit's 8MK (later WBL, and now WWJ), which was owned by The Detroit News.

It commenced radiotelephone transmissions on Aug. 20, 1920 of news on a daily basis, more than two months before KDKA took to the air. Adding to the station's claim for priority was information printed in the News instructing

readers as to how they could take advantage of this wireless service.

There was a slight problem, however. 8MK was licensed as an amateur station and could operate only on wavelengths reserved for amateur use, in this case 200 meters (about 1500 kHz), and as such was subject to interference from ham operators. (KDKA had requested and obtained a commercial license from the Department of Commerce, which allowed operation on a lower frequency well separated from amateur transmissions.)

And to further handicap matters,

the de Forest "radiophone" transmitter leased by the News operated at one-fifth the power enjoyed at KDKA.

8MK initiated a rather serious broadcasting agenda beginning on Aug. 20 with reporting of returns from an election held on that date, and continued with daily transmissions of news reports interspersed with music. Records show that the station was on the air the night of Nov. 2, 1920 with a pre-announced broadcast of election returns, just as KDKA was doing some 200 miles away.

So why shouldn't this fledgling

(continued on page 20)

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Get More Out of Your Automation

Five things you didn't know that you could do in RCS Zetta

BEST PRACTICES

BY NATE MUMFORD

One in a series of articles about how to get the most out of popular radio broadcast products and platforms. The author of this commentary is director of sales engineering for RCS.

Zetta is a modern enterprise piece of radio automation software build by RCS, the worldwide leader in radio software, that can ingest mp3, wav and AAC files, convert them to a default audio format, automatically set the trim in, time out and segue points, and non-destructively normalize all audio with pitchless stretch and squeeze.

Needless to say, it's a very powerful piece of software that can cater to any broadcaster.

So let's dive into five things you may not have known that you can do in Zetta.

1 Starting with customizing your Zetta user experience, did you know that users can have their own layouts, color schemes, attributes, and Library folders, and Administrators can control their staff with proper user right restrictions? See Fig. 1, which also explains how to access these images online to see them in more detail.

Configure Zetta the way you interpret Zetta. Create multiple layouts — one for on-air and another for production.

Users can define their own asset types (Fig. 2) or folders within the Library:

Configuration | System | Asset Types

as well as their own custom fields, like an "Outcue for Spots":

Configuration | System | Custom Fields

See Fig. 3.

For Administrators, define a user Role and Organization, then assign it to a specific User:



Fig. 1: An RCS Zetta layout view. (View these images in more detail in the online version of this article. At radioworld.com, enter "5 things zetta" into the search tool, open the article and click on each image.)

Configuration | Roles, Organization, Users

2 What about integration? The majority of RCS products can make live, real-time updates within Zetta.

Users can automatically send their Aqira traffic log to Zetta with Aqira Sync, remotely broadcast live with Revma's Conference App and keep your library and schedules in sync with 100% live GSelector Music Scheduling integration. Maximize your staff's efficiency by adding audio, metadata and schedule changes — including live reconciliation, which are instantly reflected in GSelector or vice versa.

Users are no longer forced to make a change in automation and then repeat the process for your music scheduler.

3 Zetta also allows markets to stay connected and share assets with Site Replication or Z-Cast. Simply put, think of Site Replication as a "pull," in which users can share audio and metadata.

If Market A would like to be in sync with Market B, then we would configure Site Replication. If Market A merely wanted to send Market B certain audio, like spots, then they could utilize Z-Cast, which acts as a "push," sending Market B Market A's audio and metadata.

4 As we continue to develop remote workflows, Zetta is equipped with

(continued on page 20)

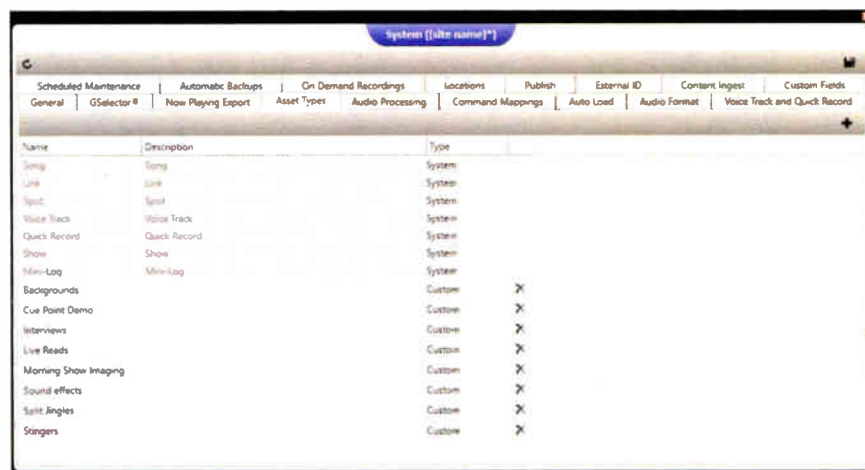


Fig. 2: RCS Zetta asset types.

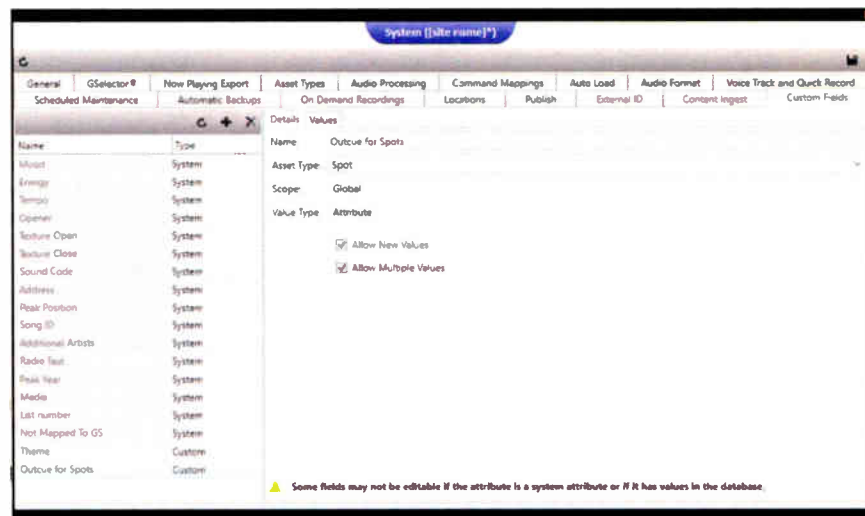
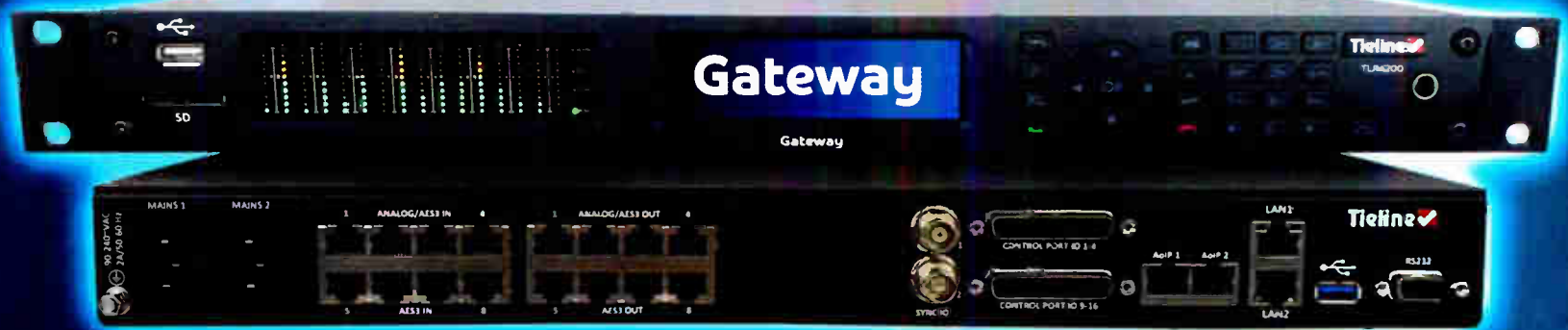


Fig. 3: Custom fields.



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ZETTA

(continued from page 18)

Zetta2GO. It's not an app or a download from an app store but a simple URL.

Zetta2GO allows users to continue to control the on-air product, broadcast live, add audio, make changes to the schedule and voice track from any device that has access to the Internet and proper securities, like a VPN.

Is your company limited on studio space? While in the office, quickly access Zetta2GO from any desk or have your production director work from home, importing mass audio files that are instantly available in your Library while your talent is safely broadcasting from the studio. Start with a Location:

Configuration | System | Location

and create a Zetta Auto Import folder:

Configuration | System | Auto Load

See Fig. 4.

5 Finally, it's time to talk about the cloud, specifically, Zetta Cloud Based Disaster Recovery.

Available now, create a next level of redundancy by automatically backing up your audio, metadata, schedules and SQL backups directly to the Cloud. Zetta Cloud is not a Virtual Machine, but rather designed using Amazon Web services, following best practices and securities. (See Fig. 5.)

When a disaster strikes — be it a natural disaster like a fire or flood or a malicious cryptoware attack — users can quickly pivot to Zetta Cloud and enable the sequencer from their phone, getting your product back on the air, allowing your staff to properly assess the situation.

Meanwhile, programmers can continue to control the air product, voice track and add new audio. When the disaster has passed, disable Zetta Cloud and return to normal operations.

Shortly, users will also be able to bypass their VPN, voice track from Zetta Cloud Based Disaster Recovery and the asset will properly land in your local Zetta Library.

Between user customizations, integration, market synergy, remote workflows and embracing the future of the Cloud, it's easy to see why Zetta is a modern, flexible, and powerful piece of radio software.

Radio World welcomes product tips, best practices and other articles to help readers get the most out of their product investments. Email radioworld@futurenet.com.

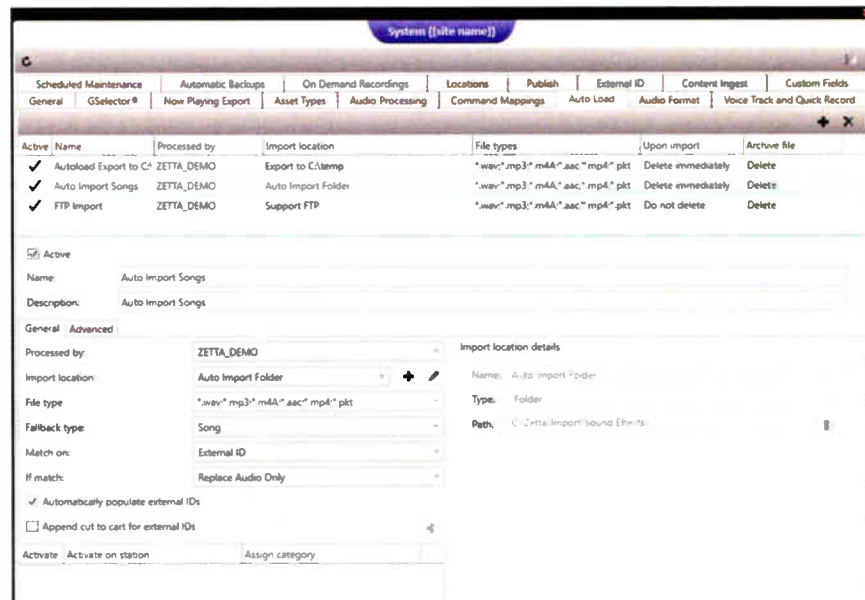


Fig. 4: RCS Zetta Auto Load

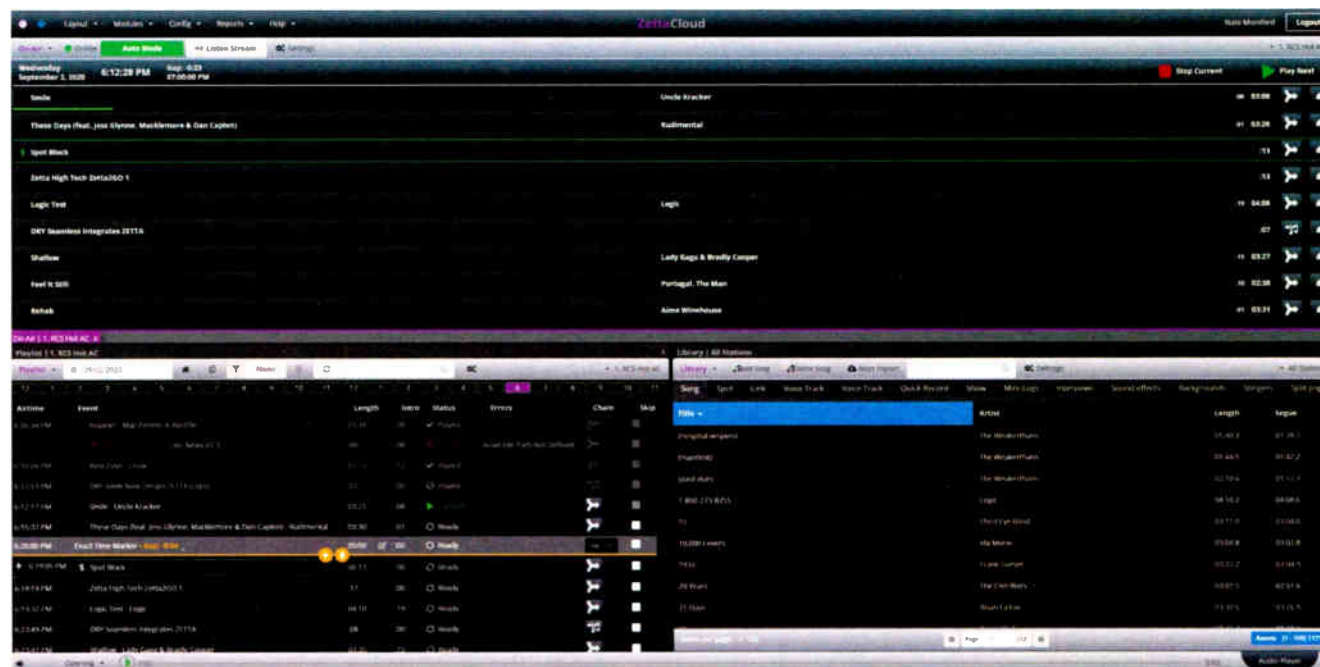


Fig. 5: Zetta Cloud Screen

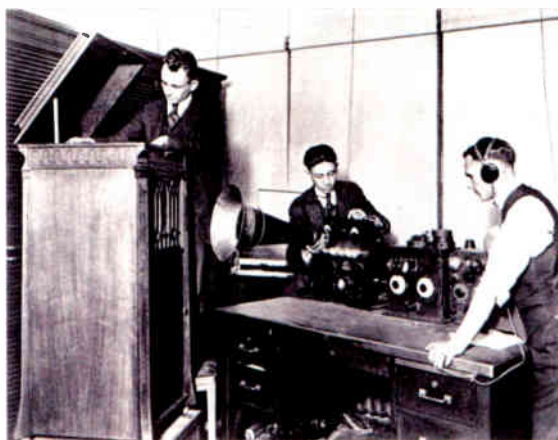
1920

(continued from page 15)

broadcaster get the honors for being first? They were on the air well in advance of KDKA, advertised their broadcasts in advance and continued on a regular schedule after the election eve reporting. (The station was licensed for limited commercial operation in late 1921 and received the call sign WBL. This was changed to WWJ the following year.)

Perhaps broadcast historians Chris Sterling and John Kittross explain it best in "Stay Tuned: A History of American Broadcasting," where they write:

"While it isn't easy to compare and adjudicate such conflicting claims, it can be done. As to broad-casting licenses, KDKA led WBL (WWJ) by nearly a year. Conrad's amateur station, 8XK, successor to the prewar station, went on the air more than a year before 8MK and was broadcasting music 10 months



Station 8MK in Detroit was on the air before KDKA, transmitting Victrola music along with news from the newspaper that owned it. The station aired election coverage on Nov. 2, 1920, just as KDKA did.

earlier. As to license holding, Westinghouse or one of its officers held a license before the Detroit News did. Only by maintaining that 8XK is not the precursor of KDKA, and that 8MK is the precursor of WWJ, can one uphold WWJ's claim — and both Conrad's status as a Westinghouse employee and the Detroit News' delay in applying for a broadcasting license belie that position."

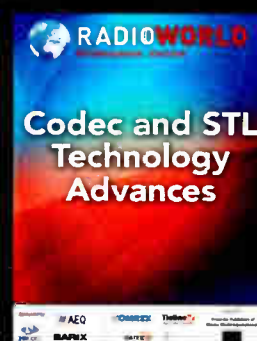
Doubtless, other claims could be made for supremacy in terms of "who was really on first." However, as the old saying goes, "close" only counts in the game of horseshoes.

The author thanks Mark Schubin for his assistance with the Dame Nellie Melba photo and information, and broadcast historian and author Tim Wander for information about the 1920 Marconi Melba broadcast. Wander has published a limited edition 270-page book "From Marconi to Melba, The Centenary of British Radio Broadcasting," which details the beginnings of radio broadcasting in the U.K.

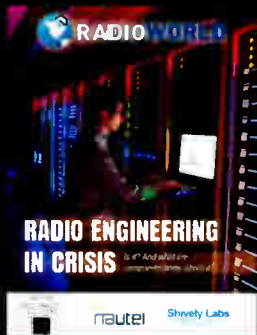
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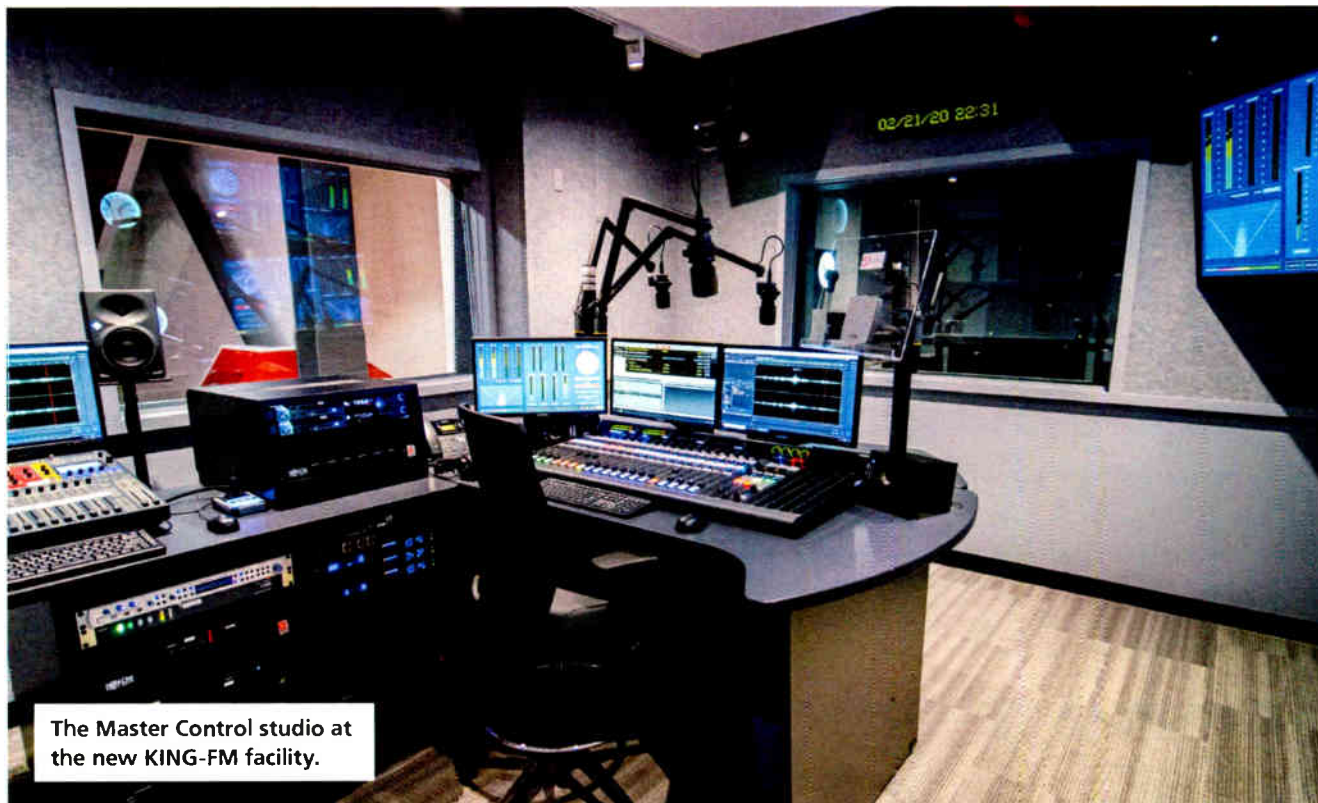
KING-FM

(continued from page 1)

Utter Associates was the turnkey system integrator. It is a Seattle-based engineering and consulting firm whose clients include broadcasters, corporations, educational facilities, government entities and architects.

Founder Erik Utter was design lead on the project. "KING-FM broadcasts on 98.1 with an analog, HD1, HD2 and seasonally an HD3," he said. "They also stream the same services to a variety of platforms. They host live concerts and events both in the building performance venues, and from remote locations such as Benaroya Hall, home of the Seattle Symphony."

The technical scope of the project included broadcast studios for air, production, interview, voicetracking and editing; a technical operations center room; processing, codecs, RF distribution and related broadcast facets; all IT infrastructure; links to performance venues; and a live performance system.



The Master Control studio at the new KING-FM facility.

We are thrilled to be moving into this beautiful space, and to be in such close proximity to one of our most important partners.

— Brenda Barnes, KING-FM

"Our scope of work started with consulting to set the project operational requirements, technical requirements and developing a budget," Utter said.

"We worked with Chief Engineer Michael Brooks — who was the SBE Chapter 16 Engineer of the Year — and Operations Manager Rachele Hales." Other key leaders were General Manager Brenda Barnes and board member Jim Duncan.

"Once the project requirements were defined, we made recommendations on technology, which culminated in a trip for the client to the NAB Show to confirm final selections and set the final budget."

An architectural, consultant and

construction team then was named by KING-FM; these included Owen Richards of ORA Architects; Basel Jurdy of Stantec for acoustics; and Sellen Construction.

"This was a wonderful team to work with," Utter said. "In all honesty, this was the smoothest project of its type we have been involved with."

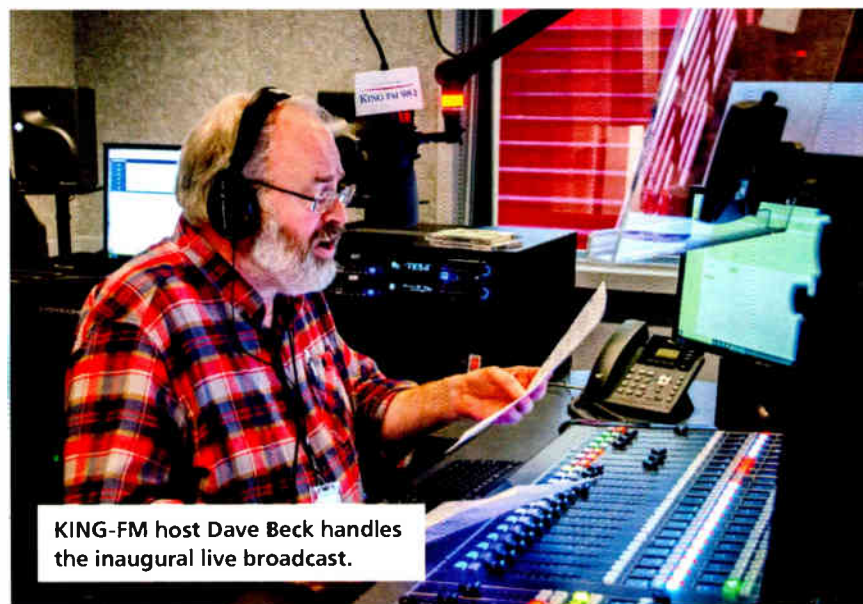
BUILDING FOR CHANGE

Utter worked with that team to develop the physical layout of the studios, mechanical systems for equipment cooling and backup cooling, electrical systems including power, backup power and low-voltage pathways.

"We also worked with the acoustical consultant to work through the acoustic requirements and design details. This is a critical phase of the project."

Through the lifetime of using the space, he said, technology will change and probably evolve in ways not yet evident.

"Correctly designing the core infrastructure to 'get it right' in the first place will make it easy for these changes to be implemented in the future with minimal cost and disruption."



KING-FM host Dave Beck handles the inaugural live broadcast.

Simultaneously to the architectural work, Utter began a detailed technical design in AutoCAD. Once the final detailed designs were approved, Utter began the procurement process, completing an inventory of all items received and configuring as much of the equipment in its shop ahead of the installation as possible.

When the construction was complete and a certificate of occupancy issued, the team began the integration portion. The installation phase took about two months, followed by testing, commissioning and training.

"We place a heavy emphasis on ergonomics, modifying casework and carefully adjusting equipment placement and sightlines as needed," Utter said.

"The changes to the RF system and

microwave STL were straightforward, with new STL and receive antennas placed on the roof and only a short initial hop to the KING-TV tower of about eight city blocks. Harrington Tower completed the STL antenna work. IP circuits were provisioned for the feeds to the primary and backup transmitter sites, relegating the microwave to backup purposes. Of course, we were there for the cutover, which went flawlessly."

(On the RF side, the station's main site is West Tiger Mountain, where a Nautel GV30 runs an HD1 and HD2. KING-FM is a Class C station operating at 68 kW ERP due to HAAT. The transmitter feeds an ERI master antenna, model ERI-1082 4CP-DA. The station runs its HDs under an experimental license allowing asymmetrical





Erik Utter stands in front of the new Seattle Opera/KING-FM building.



Guest positions with illuminated microphone tallies.

power of -10 dBc on the lower sideband and -14 dBc on the upper. An Inovonics Justin 808 keeps the HD aligned. A Continental 816 transmitter is on standby and an aux transmitter site is atop Cougar Mountain.)

HARDWARE CHOICES

Wheatstone and its WheatNet-IP network were chosen as the backbone studio system, including two LXE consoles, two L8 Consoles and a series of Blades. “We made extensive use of the tech-

nology for such things as audio processing, scripting and utility mixers for intercom, automated alarming, etc.,” Utter said. “We also used Dante for live performance mixing and venue interfacing.”

Key components also include RCS Zetta automation, Comrex Access NX Rack codecs, AKG C414 microphones, Neumann KH 310 and KH 120 audio monitors, Wheatstone furniture, Inovonics monitors for modulation and streaming, Intraplex HD Link and

legacy gear for STL, and HPE/Aruba networking.

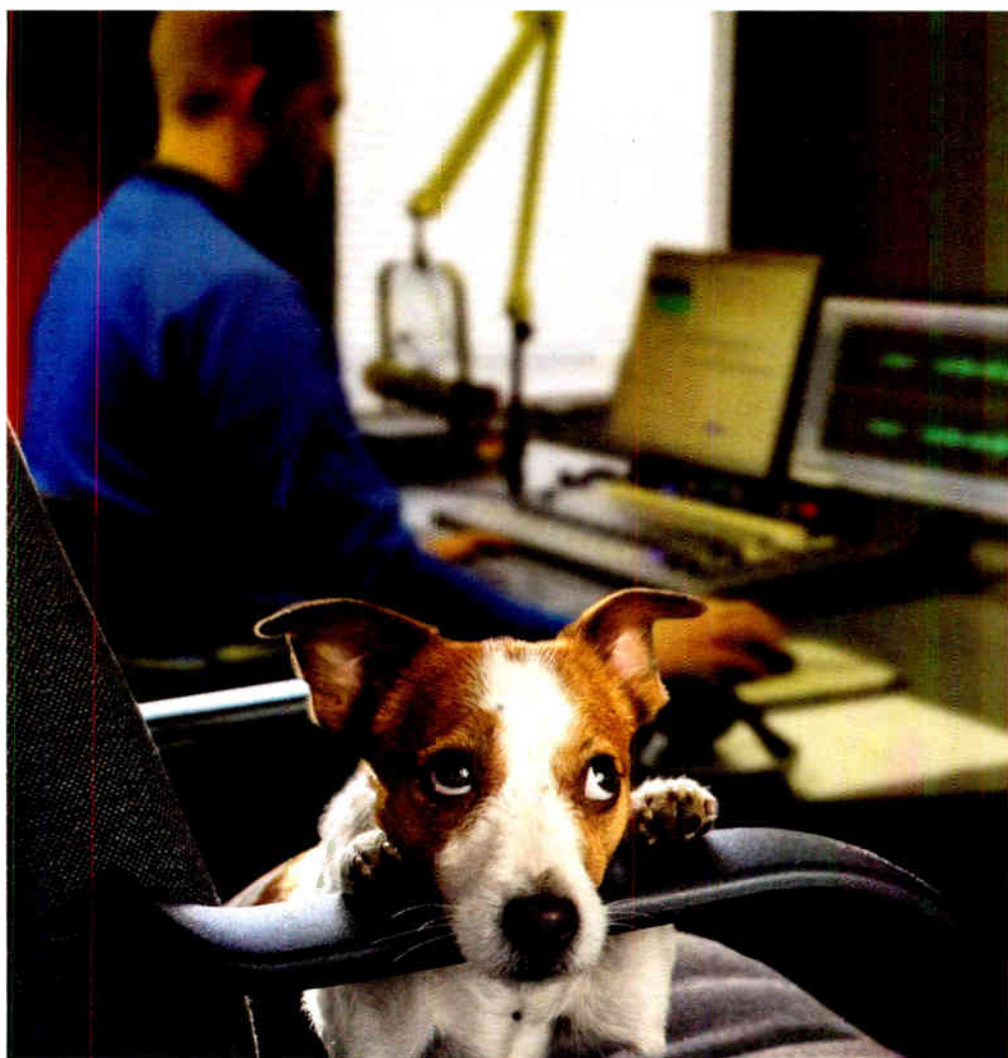
Studio accessories include ESE master clocks and Yellowtec mic arms and copy stands. The TOC has Middle Atlantic racks, Broadcast Tools DA, Sage EAS gear, Bittree patch bays, Burk transmitter control, a Marti system and Nielsen PPM gear.

The initial consulting for the project started in spring of 2019, and the cutover was in February, just prior to COVID.

“An interesting thing about that,” Utter said. “Prior to COVID the remote production capabilities of Wheatstone and Zetta were mostly novelties. Very quickly they became critical features that make operations now much easier.”

Utter related that shortly after everything shut down for the pandemic, KING-FM continued to provide live coverage of the Sunday night Compline Choir from St. Mark’s Episcopal Cathedral in Seattle.

(continued on page 24)



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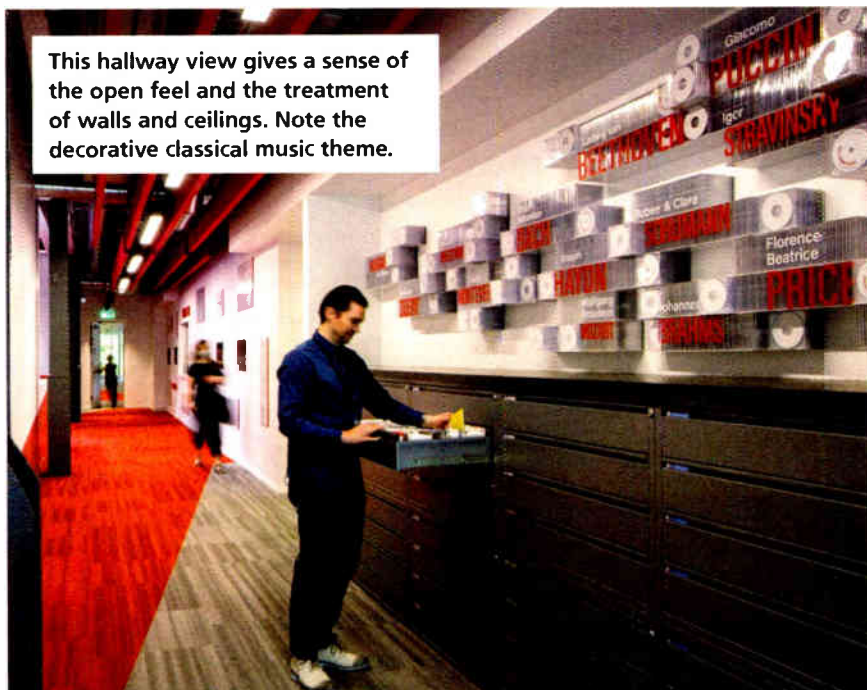


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This hallway view gives a sense of the open feel and the treatment of walls and ceilings. Note the decorative classical music theme.



Data patching in the TOC.

KING-FM

(continued from page 23)

“The choir was singing to an empty cathedral and broadcasting live on KING-FM as a public service, providing relaxing meditative music during a time of fear and uncertainty. The lone board op at KING-FM called me on a Sunday night, *four minutes to air*, explaining that she couldn’t get the remote source to come up on the LXE console.

“I was able to connect with my laptop and resolve multiple issues, and finally got up the source on the console, just in time. Something unimaginable just a short time ago.”

PLANNING FOR WORST-CASE

“One of the reasons the project went so well is that the systems integrator was brought in very early, just after the project was conceived,” he continued.

“This allowed for a deep partnership and understanding of the client’s needs. This also allowed us to bring up design considerations with the architectural team early enough to easily address, resulting very few compromises in the facility design.”

Utter is a big fan of WheatNet, saying it simplifies future routing changes and that its distributed architecture provides robustness.

In order to keep workmanship orderly in the long term and allow for inevitable changes to wiring, Utter connects all I/O of a Wheatstone Blade to a Bittree E3 bulkhead panel, passing through that to the equipment.

“The connections on the rear of a Blade are just too dense to be making changes while keeping up the level of workmanship and neatness in a larger facility.” Future equipment additions or



Interview Studio, looking into Master Control

Prior to COVID the remote production capabilities of Wheatstone and Zetta were mostly novelties. Very quickly they became critical features that make operations now much easier.

— Erik Utter, Utter Associates

wiring changes can be done easily on the E3 panel.

“As an engineer, I still need to imagine and prepare for what a worst-case failure situation may look like. ... All critical portions of the air chain are brought out to patch, so that if there were a massive networking failure, sig-

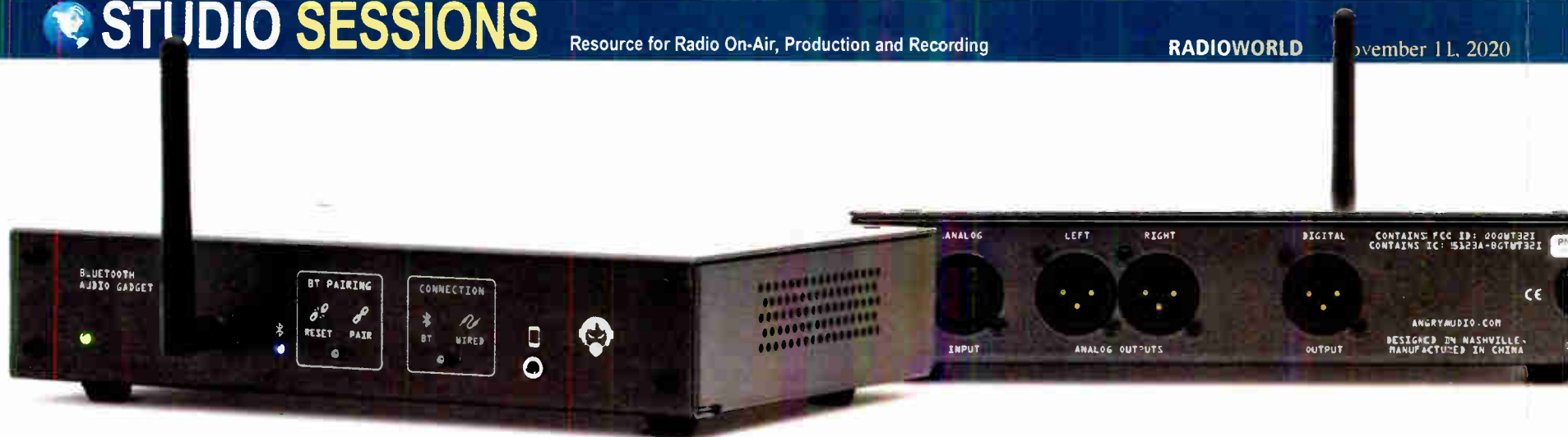
nal could still be quickly patched to air.”

KING-FM was founded in 1948 by Dorothy Stimson Bullitt; it is among the longest-running classical radio stations in the country.

Radio World welcomes suggestions for facility and project profiles. Email radioworld@futurenet.com.



Chief Engineer Michael Brooks works in the Technical Operations Center.



Angry Audio's Bluetooth Gadget Brings a Smile

Mission-critical Bluetooth connections are less stressful when using the Bluetooth Gadget

SHORT TAKE

BY PAUL KAMINSKI

It's more than likely that a broadcast engineer or multimedia technology professional will be called on at some time to connect a smartphone into a broadcast plant or multimedia studio. The Angry Audio Bluetooth Gadget makes that process much less stressful while providing great capabilities for the reception and transmission of audio, whether that audio is basic cellphone grade or comes from a codec app like Cleanfeed, Luci Live Lite, etc.

The Bluetooth Gadget uses Bluetooth 3.0 to receive and transmit audio. The device will select from one of three codecs (AAC, aptX or SBC) to optimize the connection's audio quality. Connections for a mix-minus analog input, and the left and right channel analog outputs are balanced +4 dBu XLR on the rear panel. There's another XLR output on that rear panel. It's a transformer balanced XLR male digital audio connection that can feed an AES digital device.

MAKING CONNECTIONS

On the front panel with the lights and switches, there's also a TRRS jack wired to the CTIA standard for connecting a smartphone directly, so a hot switch between a Bluetooth paired smartphone and a wired smartphone connection can be made without reconfiguring connections. Audio from the TRRS jack is unbalanced, with RFI filters on each input. Angry Audio provides an adapter for phones that use the OMTP standard for wiring. The device has a small antenna to help with reception; stated range for the device was

50 feet. Versions for North America (115 VAC) and export (230 VAC) are available along with plugs for Europe, Australia and the United Kingdom.

The Bluetooth Gadget is AoIP-friendly. Angry Audio includes a StudioHub XLR to RJ-45 adapter pair for the left and right outputs, and an XLR to RJ-45 adapter that can be used for the mix-minus input.

SIMPLE OPERATION

I tested the Bluetooth Gadget analog style with my Allen+Heath ZED 10 studio mixer and my Samsung Galaxy A6 smartphone. The balanced mix-minus audio came from the ZED 10's FX send bus's TRS jack; the balanced audio connected to an input channel via analog XLR. Pairing the Gadget to the phone involved flipping a switch on

the front and selecting the device on my smartphone. Once levels were set, making calls and recording them was simple. Basically, if the smartphone has service, a standard cell call can be recorded or broadcast. Angry Audio's Michael "Catfish" Dosch said other applications besides putting calls on the air were considered when developing the Bluetooth Gadget.

"Most Bluetooth audio devices are receivers (sinks) only, useful for playback but we thought a bidirectional

interface would let you use your smartphone as a phone and put calls on the air. Plus, you could use other communications apps such as Skype, FaceTime, SIP clients, Zoom and even some social media apps like LINE and Facebook Messenger. Once we started development, we added some new ideas like the high-fidelity audio codecs, the split analog and digital outputs and the wired smartphone connection."

The circuitry in the Bluetooth Gadget doesn't color the audio. The audio accurately reflects what's being sent and received. On a normal cell call with reasonable signal strength showing, the audio has sufficient quality that those calls wouldn't need heavy equalization to make them intelligible for broadcast or recording. The quality increases on those cell calls that are made and received in HD Voice, reflecting increased frequency response.

The Bluetooth Gadget provides great flexibility, for instance, if a program is being transmitted to one source on a wired connection, and a second, studio-quality feed (backup or second

(continued on page 26)



The device will select from one of three codecs (AAC, aptX or SBC) to optimize the connection's audio quality.

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Ramsey Show Rethinks Its Podcast Workflow

Its behind-the-scenes team retrains on audio production processes

BY JIM BEAUGEZ

The podcast team at Ramsey Solutions, home of the widely syndicated "The Dave Ramsey Show," had a problem — or what the company's can-do namesake would call an opportunity.

After experiencing rapid growth over six years with its lineup of eight recurring programs and a serialized podcast, the production team was strong but it was also "siloed."

"Before we knew it, we had a team of eight to 10 engineers, [with] one producer solely dedicated to their show," says Eric Cieslewicz, senior producer of podcasts at Ramsey Solutions, whose financial programming is aimed at helping listeners get out of debt and gain control of their money.

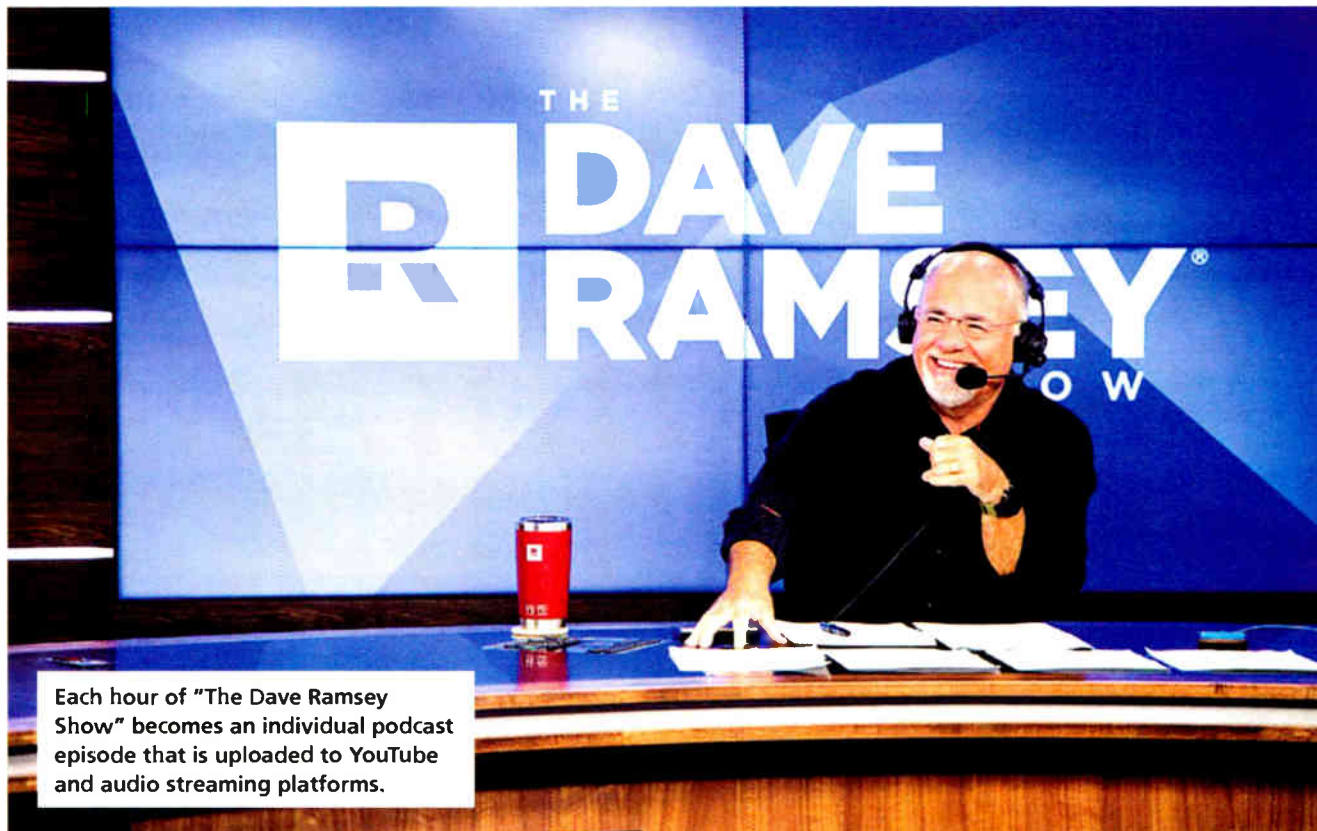
Production processes among the nine podcasts were working but far from uniform — something that the COVID-19 pandemic quickly exposed.

Some producers were taking a manual approach to show editing, while others used automated processes to move along the workflow for each episode. Cieslewicz saw an immediate need to cross train the production team in order to maintain operation standards and security during unpredictable times.

"We're trying to standardize our audio," he says, including "creating a better template in Pro Tools [so] everything would funnel through the right plug-ins. We've learned a lot from needing to work across different shows where it's not just one producer with their chosen software. We need producers to share the work [and] cover for each other."

In 2014, the team at Ramsey Solutions recognized that while millions of people were tuning into the show on terrestrial and satellite radio, listening habits were changing and the company needed to provide a friction-free experience for its audience.

"We see the value of diversifying and trying all of those things, because people have different touch points," he says. "We're [creating] life-change con-



Each hour of "The Dave Ramsey Show" becomes an individual podcast episode that is uploaded to YouTube and audio streaming platforms.



Eric Cieslewicz, senior producer of podcasts at Ramsey Solutions.

tent. It's empowering people to change their behavior [and] fill them with hope. So, we don't want to just go off air. We think it's important to show up daily, weekly."

Today, some podcast content is first broadcast via radio, primarily "The Dave Ramsey Show" and "The Ken Coleman Show," then uploaded to YouTube and audio streaming platforms. Each hour of "Dave Ramsey," for example, becomes an individual podcast episode, totaling 15 hours of new content each week.

The pandemic has also caused the podcast team to streamline and expand a process it established in 2015 when Ramsey Solutions published its

first podcast. While most of the talent records through Sennheiser headset mics in the studio at the company headquarters in Franklin, Tenn., the producers will often send a laptop-based mobile studio to high-profile guests instead of traveling or hiring a local tape synchronizer.

"We started sending a computer so we could control the quality of the audio," he says. "And because we had control over that recording, the audience couldn't tell [the difference]. We tested this out with 'EntreLeadership' first, and the audience couldn't tell if the person was in studio or not."

Cieslewicz says they have a dozen mobile setups, each custom-built around a Microsoft tablet with a Neat Bumblebee desktop USB microphone and housed in a protective Pelican road case. When it's time to record the segment, the remote guest logs onto the tablet and communicates with the producers and podcast host over SquadCast.

Financially, it makes sense over the long term to create these mobile studios they can deliver on demand, especially when gaining access to traditional recording studios can be unreliable and video conferencing platforms are dodgy. "When you get your huge, A-list celebrity you've been waiting to book," he says, "you don't want anything to go wrong."

The next frontier for podcasts under the Ramsey Solutions umbrella is to expand its presence with video on YouTube, which commands a large share of podcast listeners. "Radio is crushing still," he says. "It's just [like] any audio product — it's just exploding right now as people multitask. [But] it's mind boggling how many people listen to podcasts on YouTube."

ANGRY AUDIO

(continued from page 25)

destination) becomes necessary. Connection through an app like Cleanfeed or Luci Live Lite, etc. makes that possible. So mission-critical audio transmission becomes less stressful.

The Bluetooth Gadget has a suggested retail price of \$349. An optional rack mount is \$39. Online documentation from <https://angry-audio.com> is straightforward and answers the questions engineers and technologists might ask when installing devices.

Paul Kaminski, CBT, is the host of msrp.com's "Radio-Road-Test" and has been a Radio World contributor since 1997. Reach him at Twitter: [msrp_com](https://twitter.com/msrp_com) and Facebook: [PKaminski2468](https://www.facebook.com/PKaminski2468)

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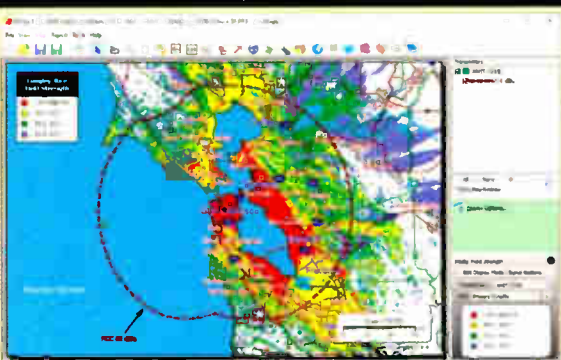
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I'm selling between 150 and 200 cassette tapes that consist of old-time radio shows, sports shows, some local New York radio talk shows, etc... Must take entire collection and the price is negotiable. Please call me for details and, my phone number is 925-284-5428.

WANT TO BUY

Looking for KSFY radio shows, Disco 104 FM, 1975-1978. R Tamm, 925-284-5428.

Wanted: ITC interconnect cables between ITC cart machine and record amp. Manual and idlers for Harris CB-1201 turntables. Don, k8drs1@gmail.com

Equipment Wanted: obsolete, or out of service broadcast and recording gear, amplifiers, processing, radio or mixing consoles, microphones, etc. Large lots preferred. Pickup or shipping can be discussed. 443-854-0725 or ajkivi@gmail.com.

HEADPHONES/ SPEAKERS/AMPS

WANT TO SELL

1934 RCA 77A double ribbon microphone, originally used by Arthur Godfrey at WFBR Baltimore. 100% perfect condition. Contact Bill Cook, 719-684-6010.

WANT TO BUY

RCA 77-DX's & 44-BX's, any other RCA ribbon mics, on-air lights, call after 3PM CST, 214 738-7873 or sixtiesradio@yahoo.com.

MISCELLANEOUS

WANT TO SELL

Radio broadcasts of Major League Baseball, NFL, and some college football games that are on cassette tapes, approx 100 to 125 games, time period of entire collection os from the 1950's - 1970's, BO. Must purchase entire collection. Contact Ron, 925-284-5428 or ronwtamm@yahoo.com

RECORDING & PLAYBACK HARDWARE

WANT TO BUY

1960s-vintage MacKenzie Repeater machines, magazines, spare parts and manuals, complete or "parts" machines considered, James, 870-777-4653.

RF CONNECTORS

WANT TO SELL

RF CONNECTORS & GADGETS - Parts, Products & More! www.W5SWL.com

TAX DEDUCTIBLE EQUIPMENT

Donate your broadcast facility; IRS approved 501(c)(3) non-profit charitable organization. Fair market value. License (AM/FM/FV), land, building, tower, equipment, etc. The Augustus Foundation, Inc., 2902 Main Street, La Marque, Texas 77568. (409) 359-3435. Contact Dr. M. Augustus

TRANSMITTERS/ EXCITERS/ TRANSLATORS

WANT TO SELL

BE-25T 25KW FM transmitter 2007 frequency agile tube transmitter in good working condition on 90.7 (all its life) when pulled from service. Approx. 6 mos. on rebuilt tube and a newly rebuilt fan motor, also spare optical modules, manuals and maintenance logbook. \$17,500/OBO. As-is, where-is: Hayward, CA, Jeff Cotton, 530-279-6262 or info@kdup.org.

TRANSCIVERS

WANT TO BUY

AM Stereo radio. Call 417-881-1846.

MISCELLANEOUS

WANT TO BUY

Looking for KFRC signoff radio broadcast from 1930 Andy Potter, running time is 0:22 & also the KLX kitchen the program guest is Susanne Caygill, a discussion of women's affairs with a long promotion for Caygill's appearance at a local store. Anne Truax, Susanne Caygill, running time is 13:44. Ron, 925-284-5428 or email ronwtamm@yahoo.com.

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AI Is Next Step in Redefining Ad Sales ROI

Artificial intelligence technology is poised to redefine radio advertising return on investment

COMMENTARY

BY PAUL CRAMER

The author is managing director, Enterprise Radio Solutions, for Veritone.

The plight of modern radio advertising can be summed up by a quote that's more than 100 years old.

"Half the money I spend on advertising is wasted; the trouble is, I don't know which half," John Wanamaker, an early marketing pioneer and merchandising maven, once lamented.

Decades after Wanamaker's merchandise empire became part of Macy's, the struggle remains — advertisers are

near real-time — usually in the form of software or a cloud platform. Typically, these platforms also give ad managers a dashboard with a suite of tools to analyze placements — allowing them to break down ad attribution in new ways for existing clients and uncover opportunities to find new ones.



Paul Cramer

But the real power comes from directly attributing ad spend to website traffic. With AI-enabled technology, advertisers can see when a radio spot or mention is driving people to their website — in real time.

AI is the only reliably effective way to track and record both unscheduled live reads and organic mentions and report on their metrics. This level of depth

With AI-enabled technology, advertisers can see when a radio spot or mention is driving people to their website — in real time.

skeptical of the ROI of their radio spots. With no data-backed method of attributing leads or new traffic to a format like radio, advertisers have historically been unsure whether their investments are lost to the airwaves, while at the same time, almost every dollar spent and impression achieved on digital is measurable. Like Wanamaker, they're stuck guessing how much budget is actually wasted.

But artificial intelligence technology is poised to redefine radio advertising ROI. By digitizing the airways and making content searchable, radio station advertising operations can finally give their clients the data they need to connect the dots on the ROI of their spend.

AI IN ACTION ON THE AIR

Rapid advances in speech-recognition and transcription have created opportunities for ad managers in the past. But a digital transcript does little to reveal value for advertisers on its own.

When we talk about AI in radio advertising, we're looking at advanced applications that analyze and standardize transcript and programming data in

can influence how advertising content is made and when it's aired, and allow advertisers to test the effectiveness of these shifts in strategy.

AI ALLOWS AD MANAGERS TO BE MORE SAVVY

AI isn't a far-flung concept in radio — many applications and use cases are already creating proactive and creative opportunities for radio advertising departments. Some examples of what's possible include:

- **Connecting to Client KPIs:** Advertisers have their own internal business goals they're trying to accomplish with a campaign, along with a set of metrics they use to measure success. AI applications can help prove the effectiveness of their placements toward these goals. For example, AI along with website analytics can correlate traffic spikes to a client's websites with the timing of an ad placement. Instead of the traditional estimated reach and value, it's now possible to show how advertising spots and campaigns track with client goals.

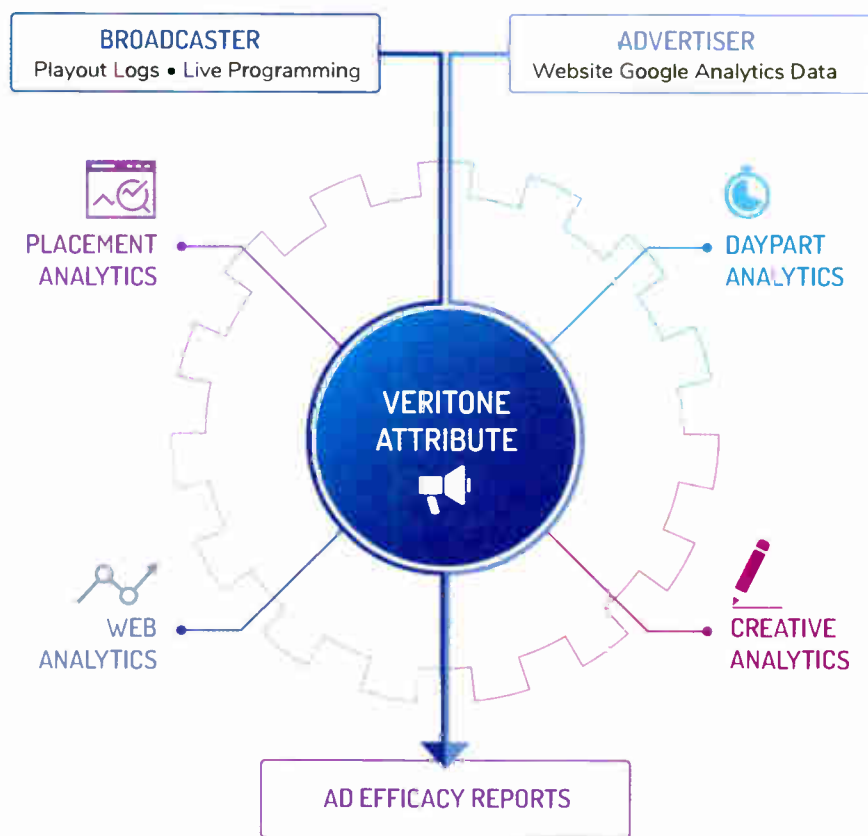


Fig. 1: Veritone Attribute correlates broadcast ad placements including spots, organic mentions and live reads with website interaction data in near real time.

- **Powering Earned Media Measurement:** From host reads and testimonials to contests and promotions, radio has long been known for its ability to deliver creative and valuable advertising integrations beyond just a spot buy. As advertisers ask for more added value in today's current economic climate, up until recently, earned media couldn't effectively be measured. AI can detect these earned media integrations and automatically apply them to the delivery goals of the campaign in terms of placement, frequency and impressions delivered. This allows the earned media to be part of the advertiser's ROI calculation so radio gets the full credit it deserves. (See Fig. 1.)
- **Enabling More Strategic Placements:** Advertisers are increasingly sensitive to where and when their ads appear, and AI can help promote contextual targeting and enhance brand safety. With the advent of digital audio and podcasting, many advertisers are purchasing digital audio ads programmatically and targeting based on a combination

of first and third-party audience data. Increasingly, advertisers also want to be associated with topics and content that are complementary to their brands and business — for instance, a fitness center that wants to target episodic content focused on health and wellness. AI can automatically determine the prevalence of topics and keywords discussed in each episode, allowing an advertiser's ads to be associated — or disassociated — accordingly.

AI is reshaping the way we talk about radio advertising ROI, and the discussion isn't dealing in hypotheticals. AI applications in radio are already firmly in place at many stations across the country — are you prepared to keep pace?

MISSING BYLINE

In the Oct. 28 issue's Opinion section, a byline was missing for the commentary "DRM Is Advanced Radio for All." The author is Ruxandra Obreja, chairman of DRM.

READER'S FORUM

LONG LOVE OF RADIO

The story "WWV/WWVH Stand Ready to Fight Global Chaos" mentioned mass solar ejections.

In the late 1960s and early 1970s this "sun-storm" began to peak interfere with shortwave communications in the worst way. I remember I could hardly hear WWV with my shortwave receiver.

At 12 years old I became a ham radio operator, WA2BQM but the activity by the sun discouraged me because I couldn't hear with my home-built equipment. I no longer found it fun to "work" the 80, 75, 40, 20, 15 and 10 meter amateur radio frequencies with code or voice.

I left off amateur radio but with a love for radio and electronics, and I have managed to have a great career as a New York radio personality on major stations in the New York tri-state area. In 1982 I produced, from my home studio, a weekly international radio syndicated show, "Jazz From the City," and since 2005 I have held down the morning show on Sirius/XM Channel #49, "Soultown."

I was able to pursue this path because of the technical training I received in my young days as a teen ham radio operator. Please read my story in Newsday at <https://tinyurl.com/rw-spiderwebb> and learn who took the time with a neighbor's son to teach a little guy to pursue what became a lifelong love of radio.

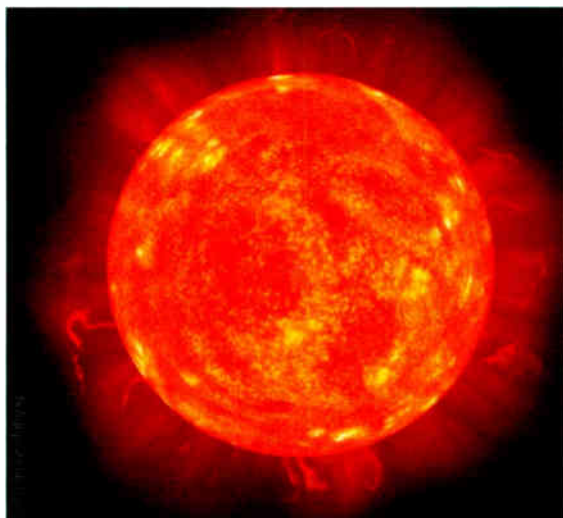
I also appreciated the Sept. 2 issue featuring Black engineers Tobias Poole, David Antoine and Ben Hill. I too have "pulled many a cable," "wired and soldered many a wire," built many a radio and TV studio and antennas, including my home studio. So I well relate to the many challenges that they overcame and still maintained a love for their work. "Right On."

Thanks for your time, and 73s.

Ken "Spider" Webb



Ken "Spider" Webb



A TIP FOR TWEAKING AUDIO FILES

Hi Radio World, I read the Dan Slentz commentary about overly compressed audio ("A Quality Audio Crisis in the Music Industry," radioworld.com), which included a suggestion on how to "help/tweak" the audio file so it would be less compressed.

I stumbled upon something that works quite well for me.

Using Audition, or any DAW that has this option, try out the Multiband Compressor. I start with a preset, or one I've come up with, comparing the file with the plugin applied and then without it. You want to make the least noticeable change to the file, leaving it still acceptable in quality overall.

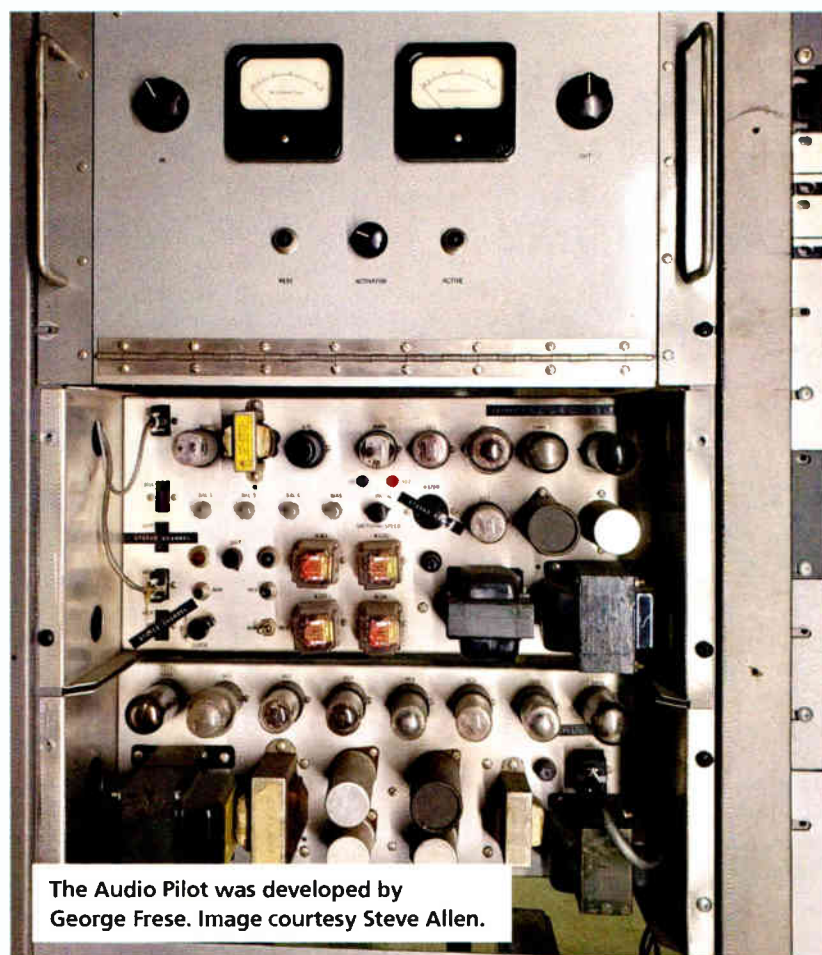
Once you find that point, process the file, even if the change is barely noticeable.

In my experience I end up with a file that is less compressed, even dramatically less compressed, than the original.

You can then adjust levels so you retain the dynamics and still meet a -1 dBTP point.

This has improved many overly compressed files for me with only a couple minutes of work on the file in question.

Ron Carlson
Production Manager
99.3 FM KTIA
Des Moines, Iowa



ON MODULATION LIMITS

Gary Peterson makes great points about the history of AM modulation (Reader's Forum, "Modulation Limits," Sept. 16 issue).

I'd like to add to that by including a note about one of the most unique audio processors ever developed, the Frese Audio Pilot.

The Audio Pilot was invented by a consulting engineer in Washington state named George M. Frese. Its unique aspect was the RF control, which was a unit that demoded a sample from the transmitter to provide the control voltage for the second compressor stage in the Pilot.

With a robust modulation transformer the Audio Pilot could modulate the transmitter with positive peaks well over 150%!

I remember on a Class IV station in Monterey, Calif., we were able to modulate (at low power, 250 watts) the Gates BC-1T out to 185% on positive peaks. The Audio Pilot could make a small Class-IV station sound bigger than the 5 kW or even 50 kW stations in the same market.

All Audio Pilots were hand-built and only about 43 or so were ever built. Most were located at radio stations in the western United States.

When the FCC instituted the 125% positive peak limit, Frese stopped building new Audio Pilots. They were \$2,500 new in 1968, which would be almost \$30K in 2020 money.

Any history written about AM processing will be incomplete without an examination of the Frese Audio Pilot.

PS — It had a small pre-emphasis with about a +3 dB spike around 3.5 kHz. When I used the AP in 1982, we replaced that section of the unit with an Orban parametric equalizer. It gave the unit a much more modern sound. I think the AP was the first AM audio processing with any kind of pre-emphasis.

BTW, George also invented the parapanel antenna for AM broadcast use. He never patented it and didn't make any money off of it. But there are several stations in the NW with parapanel antennas that Mr. Frese designed and built late in his career.

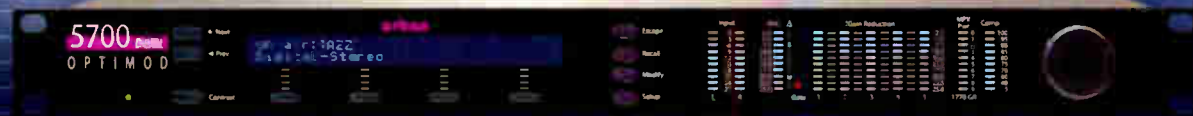
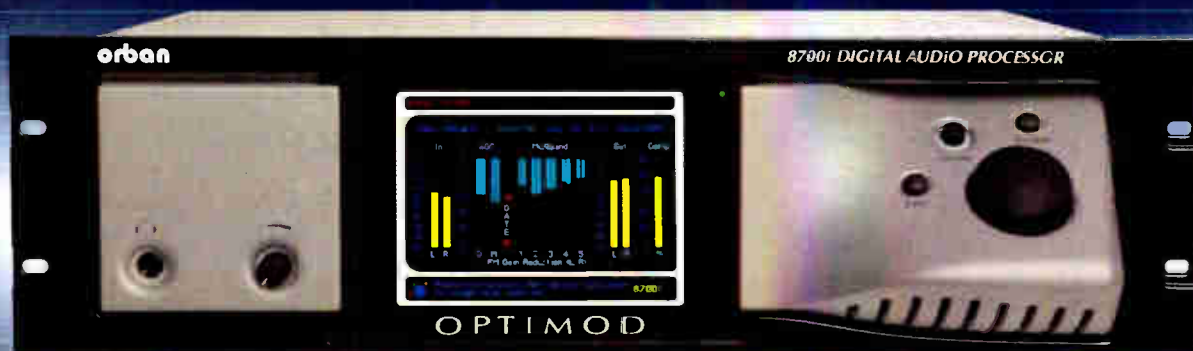
For an interview with the late George Frese, done by his grandson, search "George Frese radio" on YouTube. [Also see the notes under that video for time markers for various topics within that lengthy interview. — Ed.]

Mark Carbonaro
Monterey, Calif.



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