Radio

THE RADIO TECHNOLOGY LEADER

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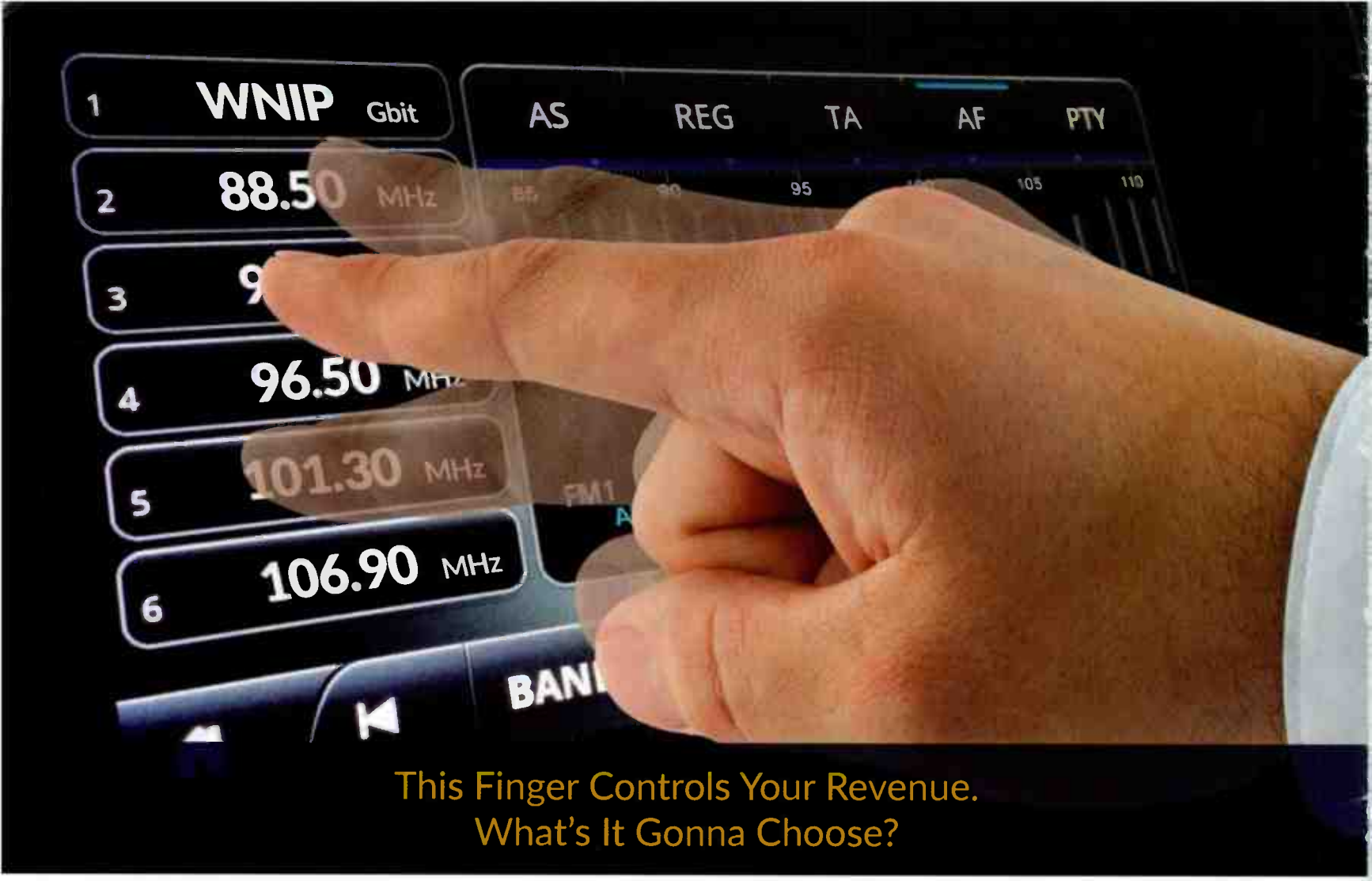
But the Sacramento stations maintain a strong radio identity

FEBRUARY 2017 | RADIOMAGONLINE.COM NewBay



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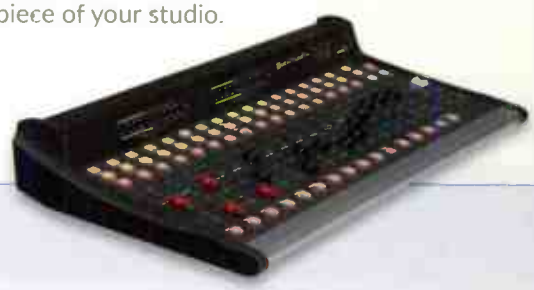

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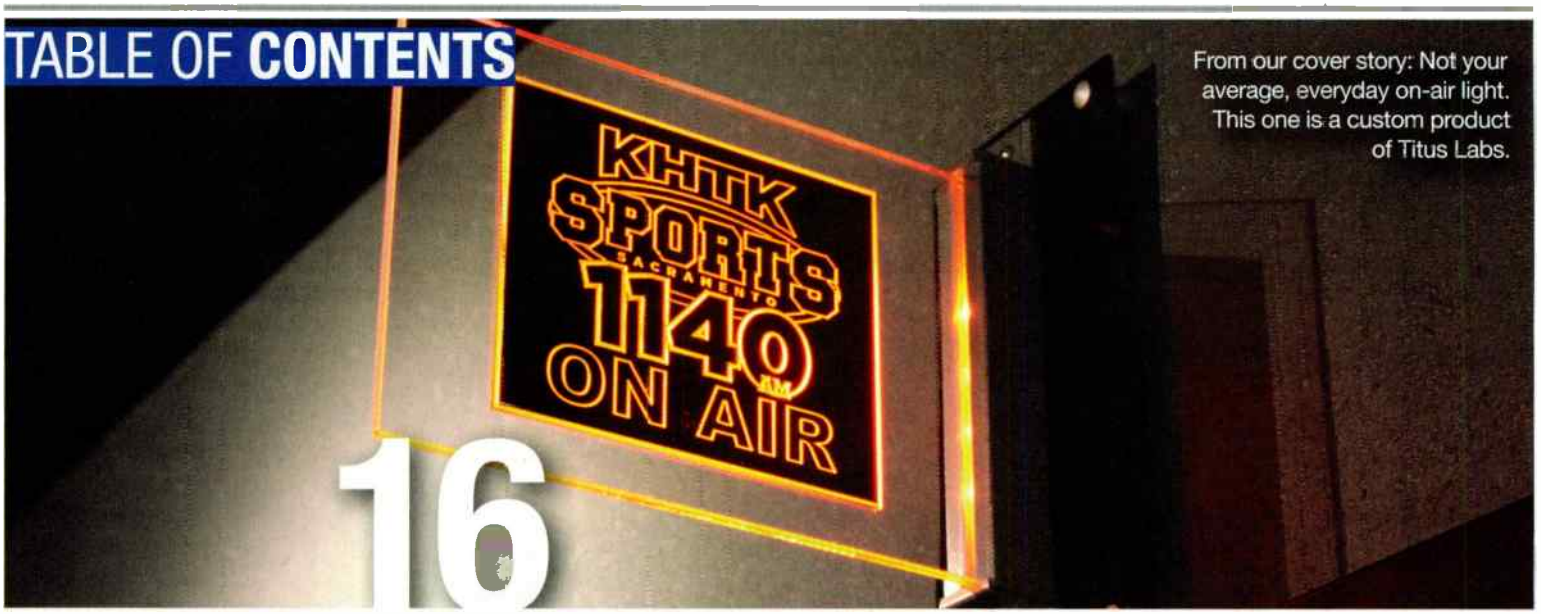

From our cover story: Not your average, everyday on-air light. This one is a custom product of Titus Labs.

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On the cover: Studio E is equipped with an SAS iSL 20.3 control surface and furniture by Omnirax.

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VIEWPOINT

Will Europe Foreshadow U.S. Broadcasting's Future?

Something happened last month that we all need to know about: Norway began a long-planned series of shut-downs of national network FM stations in favor of DAB.

The reasons given for the change are good ones. For starters, it's cheaper to use DAB multiplex transmitters (which often carry a dozen or more "stations") than it is to have an individual FM transmitter for each station. Secondly, the mux transmitters actually make for more broadcasting opportunities: They have more capacity to carry programming then the old FM transmitters they've replaced.

From my research, and yearly trips to the NAB Show, I would estimate that broadcasting technology in Europe is at least five years ahead of us here in North America. It's important to pay attention to what is going on over there to see what direction we might be headed here. Yes, it's not exactly an apples to apples comparison, but still, it's telling. Digital radio is much closer to critical mass in other parts of the world than here in the Americas.

With that in mind, streaming media considerations are becoming even more important around the radio station. You've probably heard "We're not just towers and transmitters anymore!"— and it's true. A substantial number of listeners now listen to your station via streaming media, and if you haven't already, it's time to start paying close attention to the technical aspects of that product — actually, way past time.

This month, we have a couple of articles to address those concerns.

First, James Cridland (a regular contributor to our thrice-weekly e-newsletter) has an article about how digital radio stations in other corners of the world are splitting their programming part-time, using their digital streams. This isn't something we really do in the U.S., though. It's been tough enough to get listeners to pay attention to long-term HD Radio formats — but is it time to think out of the box? If we offer programming listeners can't get access elsewhere, broadcasters should do all we can to make sure listeners know about it.

Audio processing considerations for streaming media makes up the topic of this month's Trends in Technology column. Specialists discuss the fine details of what they've learned, and how to apply this knowledge. If you set up audio processing for streaming media, this is an article you'll want to read.

Jason Ornellas recently showed us all about U Indy's WICR and how they train future radio engineers. This month, in our Facility Showcase, Jason shows what he and his team have recently done at CBS Radio in Sacramento, where he serves as director of engineering. (Don't tell me young people aren't getting into this business!)

Chris Cottingham is back, discussing details of Dante AoIP system implementation. If you are not quite in a position to go with one of the bigger players, then this is an application you should consider.

In Tech Tips, we continue to talk about the art of troubleshooting.

Lee Petro's FCC Update discusses details of political advertising.

We round out this month's issue with the revered spot on the last page, Sign Off — home for the Wandering Engineer. Why do radio engineers become station historians? Is it simply because the transmitter site turns into the catch-all, and none of us can throw stuff out? Or is it because someone needs to tell the station's story? You be the judge.

Doug Irwin, CPBE AMD DRB | Technical Editor

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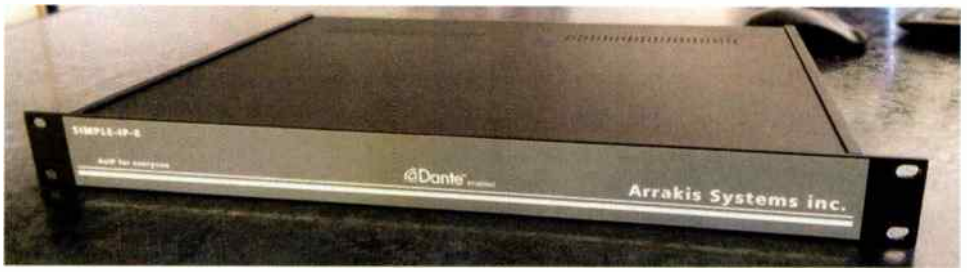
Dante Is a Great Tool to Add to Your Toolbox

by Chris Cottingham



An example of the many different devices that use Dante for AoIP, the Simple IP from Arrakis comes in two versions: one for eight analog sources/destinations, and one for four AES (stereo) sources/destinations.

In radio broadcasting, we have a few choices for the implementation of AoIP.

Telos' Axia and Wheatstone's Wheatnet are the predominate technologies. For complete broadcast solutions, these are the way to go.

But if you are a smaller broadcaster looking to implement AoIP or to eliminate analog cabling from your facility without spending a fortune, Dante AoIP from Audinate is something to consider.

Dante is only an audio path replacement. Broadcast AoIP packages include consoles, GPIO and scripting ability. Dante does not include any of these features.

THE ADVANTAGES

Where Dante shines is in cost and implementations.

A typical AoIP computer workstation audio driver from Telos or Wheatstone costs in the hundreds of dollars; the Dante equivalent costs about $30.

Both Axia and Wheatnet have IP driver pricing model charges based on the number of channels. Dante changes one flat rate for up to 64 channels of audio.

Full broadcast AoIP implantations require high-end network switches for operation, whereas Dante can run on less expensive network switches.

Dante AoIP is mostly unicast, with multicast available as needed. In a nutshell, unicast networking is a one-to-one network connection, and multicast networking is a one-to-many network connection. Multicast utilizes increased network resources and bandwidth to operate.

Dante keeps all networked audio unicast, unless the audio is set to go from one source to many destinations. This keeps the network utilization low and allows Dante to coexist with other network traffic. This also keeps cost down, since you can implement Dante on your current network infrastructure. It is not recommended to do so, but it can be done reliably.

ANALOG BREAKOUT

Since Dante is a computerized AoIP environment, breaking out analog audio can be quite expensive. This is where the cost starts adding up in a Dante AoIP implementation. As of this writing, there are hundreds of devices from major manufacturers that can be used to accomplish this task.

For example, Arrakis makes the Simple IP breakout box that will allow eight channels of analog audio to be brought out or into the Dante AoIP network. This is the least expensive solution, and it is priced right around $1,000.

Dante Via from Audinate is a software package that installs on a Windows workstation, allowing any audio source installed in the workstation to be available on the Dante network. The software is available for approximatel $60. It will also allow any program that is sending audio, such as Media Player and Web Browsers, to be available on the Dante Network.

An example: I bought a Digigram VX882HR PCI-X audio card, which has eight analog inputs and eight analog outputs. I placed this card in a HP XW8400 workstation running Windows 7, and thereafter all eight of my inputs and outputs were made available to the Dante network (after installing Dante Via). For the price of the card, workstation and Dante Via, I now have an eight-in and eight-out analog breakout for my Dante network. The total cost for this setup was around $500.

Dante is extremely sensitive to clocking. It uses the PTP protocol, and as such, requires a reliable clock source on the Dante network; without that audio will drop out, stutter and disappear from the controller.

The Digigram VX882HR audio interface card I just mentioned has a word clock interface but will also self-clock internally; I set up the Dante network to self-clock with the Digigram card and have experienced no problems. That being said, while the Dante network can run self-clocked from good hardware, I recommend an external word clock to ensure reliability.

Dante is a great tool to add to your toolbox. It is easy to implement and operate. And like other AoIP implementations, it provides great remote access, allowing engineers to manage studios from afar. Audio can be re-routed and assigned remotely by use of the Dante controller, a software utility that runs the Dante Network.

AoIP is here to stay in today's broadcast studio environment, and Dante provides a low-cost solution that can help even the smallest broadcaster take advantage of networked audio.

Cottingham is a former radio chief engineer, now working in streaming media.

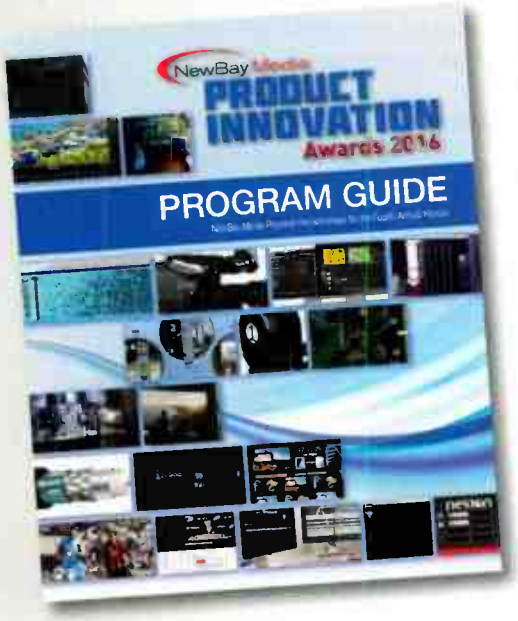
Radio PRODUCT INNOVATION Awards 2016

Award Winners and Nominees

Congratulations to the winners of NewBay's Product Innovation Awards. For Radio magazine, the winner is the Henry Engineering System Alert Monitor ("SAM"), shown at right in the accompanying photo above.

Every product nominated is featured in the special Product Innovation Awards Program Guide, which you can read at ***www.mazdigital.com/webreader/46767***. It's an overview of many introductions in broadcast and new media technology.

Evaluation criteria include innovation of concept and design, use of technology, price value and suitability for use in a broadcast TV/pro video or broadcast/online radio environment. Nominations are made by the companies, which pay a fee to enter; not all are chosen. Participating publications are TV Technology, Digital Video, Creative Planet Network, Government Video, Video Edge, Radio World and Radio magazine.



Political Advertising Rules "Clarified"

by Lee Petro

Despite atttempts on both sides of the political spectrum to try to forget the 2016 election, the FCC's Media Bureau issued two decisions seeking to "clarify" what information must be gathered by broadcasters in connection with their political public files.

The two orders did not impose any monetary forfeitures for television broadcasters' failure to comply with the FCC's rules, but it did put all broadcasters on notice that, moving forward, they would be held responsible for failing to comply with the now-clarified rules.

PUBLIC FILE

Generally, the Communications Act and the FCC's rules require broadcasters to retain "complete" records regarding requests for the purchase of broadcast time to communicate "a message relating to any political matter of national importance." The Communications Act provides three examples of advertisements that are covered, namely those that reference (i) a legally qualified candidate, (ii) any election to federal office or (iii) a national legislative issue of public importance.

In such cases, the information that must be collected by the broadcaster and placed in its political public file includes (i) the name of the candidate mentioned in the advertisement, (ii) the office sought by that candidate, (iii) the election to which the advertisement refers and (iv) the list of the chief executive officers or members of the executive committee or the board of directors of the advertiser.

Complaints were filed in October 2016 against broadcasters relating to the public file records for political advertisements that allegedly failed to contain all of the required information. For example, in connection with two advertisements run by one television broadcaster, the complaints noted that the public file records failed to identify any of the officials of one advertiser, and only used an acronym for identifying the second advertiser. The Media Bureau determined that the records for both advertisements failed to comply with the political file obligations, and admonished the broadcaster.

The second order collectively dealt with complaints filed against 11 television broadcast stations. These TV broadcasters faced similar complaints that their political public files were insufficient, and the Media Bureau issued an order both clarifying the recordkeeping requirements and admonishing the broadcasters. The Media Bureau's clarification addresses both the "completeness" of the records and the "context" that triggers the record-keeping requirements.

The Media Bureau indicated that it would consider context in determining if the advertisement was a "political matter of national importance."

First, the Media Bureau clarified that licensees must include in their records (i) the names of all candidates and the office they seek, (ii) all elections; and (iii) all national legislative issues of public importance mentioned in the advertisement.

Second, the Media Bureau clarified that the political public files must include all of the chief executive officers or members of the executive committee or board of directors of the party seeking to purchase the advertisement. In those instances where an advertiser only provides the name of one person, the Media Bureau clarified that the broadcaster is obligated to make a second inquiry to confirm that the advertiser has provided all of the names required under the Communications Act and the FCC's rules.

Finally, the Media Bureau indicated that it would consider context in determining if the advertisement was a "political matter of national importance." In reviewing the context, the Media Bureau expects that broadcasters will consider whether the advertisement discusses (i) legally qualified candidates; (ii) any election to federal office; (iii) a national legislative issue of public importance; and (iv) political issues that are the subject of continuing controversy or discussion at the national level.

Because the Media Bureau determined that clarification of these requirements was requested, the bureau admonished the broadcasters rather than imposing forfeiture. But because the two decisions seemingly create new record-keeping obligations for their political files, it is possible that this is not the last word on the "clarifications."

Just as enforcement action surrounding George Carlin's seven dirty words did not involve forfeiture, it is possible that one or more of these broadcasters may seek reconsideration of the "admonishment."

With the change in administration, it is likely that a new FCC may have a different view on whether the clarifications consisted of new rulemaking that should have been reviewed by the full commission.

UPDATE

The Media Bureau provided a last-minute stocking stuffer for all noncommercial broadcast stations that were to have filed Biennial Ownership Reports in 2017. In light of the new rule requiring that all biennial reports are now due on Dec. 1, 2017, the Media Bureau announced that NCE broadcasters that would have been required to submit a report earlier in the year may wait until the Dec. 1 deadline. Those reports, now for all broadcasters, are to contain information current as of Oct. 1, 2017.

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

Avoid Analysis Paralysis — But Don't Shotgun the Problem

by Doug Irwin, CPBE AMD DRB

In last month's column, I went over some of the most basic concepts of troubleshooting and ended the article with the repair of a hypothetical transmitter problem. In the real world, problems are rarely that easy to solve.

Let's look at some advanced troubleshooting concepts.

ANALYSIS PARALYSIS

I've talked about drilling down to the root cause of a problem when there are several candidates, and said that this is the real art of troubleshooting.

However, there is always the possibility that you can over-think the issue and find yourself wondering just which of many candidates you should examine first. Again, consider Occam's Razor; when faced with many possibilities, always try to the simplest one first and work your way up to the next most complex (assuming the simplest wasn't it).

If you find yourself unable to move or take the next step because you have the feeling what you are doing is simply wrong or a waste of time, I have news for you: It could very well be a waste of time. There's just no getting around that.

So if you find yourself suffering from analysis paralysis, my suggestion is to just try any one of the possibilities. Don't mull over which is the simplest — just test one. Even if the candidate you investigate doesn't reveal the real root cause, you might find that it uncovers something else that ultimately helps to solve the problem. Be careful not to let this approach devolve in to a shotgunning process, though (more on that below).

Sometimes troubleshooting is made easy by obviously burned components, like this RF contactor.

INTERMITTENT PROBLEMS

When a piece of gear just quits working, it isn't hard to fix (usually). However, when equipment does something odd just occasionally, leaving no concrete evidence behind, it can be very frustrating.

The intermittent nature of some problems can be vexing, but your ability to solve them can distinguish you from your colleagues.

We spend about a quarter of the week actually at work, and far less time than that at remote sites, and so the likelihood that you will be present when an intermittent problem occurs is quite remote. (It would be convenient if gear only acted up in your presence!)

More scorched components. Shotgunning not necessary in this case.

For example, I had a high-power transmitter that would, upon occasion, just drop off the air momentarily. (I should note that it used a vacuum-tube power amplifier.) The good news is that always came back up; the bad news was that the PD kept hearing it, and I never did.

I took the Occam's Razor approach. The most likely cause, in my estimation, was some issue with the final amplifier tube. So I changed it. At the same time, I inspected the HV blocking capacitor in the final compartment, thinking that was one step above the tube possibility. It looked fine. We put it all back together, and turned it back on. It ran fine for a while, until it dropped off momentarily, again.

The next most likely culprit, based on my experience, was an issue with the high-voltage filter capacitor. So I decided to get a new cap, and I changed it. The transmitter came back up and ran fine for the duration of my tenure. It turns out that cap would intermittently arc inside. The transmitter control circuits are designed to shut down the rig when excess current is drawn, and they worked correctly.

If you have high-power AMs in your portfolio, melted components may very well be familiar to you. Needless to say, spares (like this J-plug) should be kept on-hand.

The arc was quenched in other words; when it stopped, the rig came back up by itself.

SHOTGUNNING

Even earlier in my career, I had a transmitter problem similar to the one described above but far worse. The rig would crash overnight, always in the 3 a.m. hour. It pulled its main breaker (on the transmitter), and so it needed to be visited. And every time, I reset the breaker, and it came right back up.

I applied the Occam's Razor approach based on my prior experience at that point in my career. I changed the tube — no difference. I changed the filter cap — no difference.

At this point, I was starting to get desperate and began "shotgunning" the transmitter (meaning just changing components that could cause the problem, however remote the possibility). This wasted a lot of time and money, and didn't fix the issue.

It turns out the problem was a faulty circuit breaker — the one I kept resetting. It had just gotten weak. The faulty circuit breaker possibility got added to my Occam's Razor ladder from that day forward.

Try to avoid the shotgun approach. You will find yourself upon occasion needing to do something, anything, while trying to resolve an issue. But in my experience, more often than not, shotgunning is a waste of resources.

If you can, step back, and let the problem lie dormant for a day or two. Sometimes getting away from it for a brief time helps other ideas come in to your head. This is also a good time (if you haven't already) to consult colleagues for other ideas.

Next time, we'll talk about my "induction" technique.

Irwin is the vice president of engineering for iHeartMedia Los Angeles. Contact him at dirwin@nbmedia.com.

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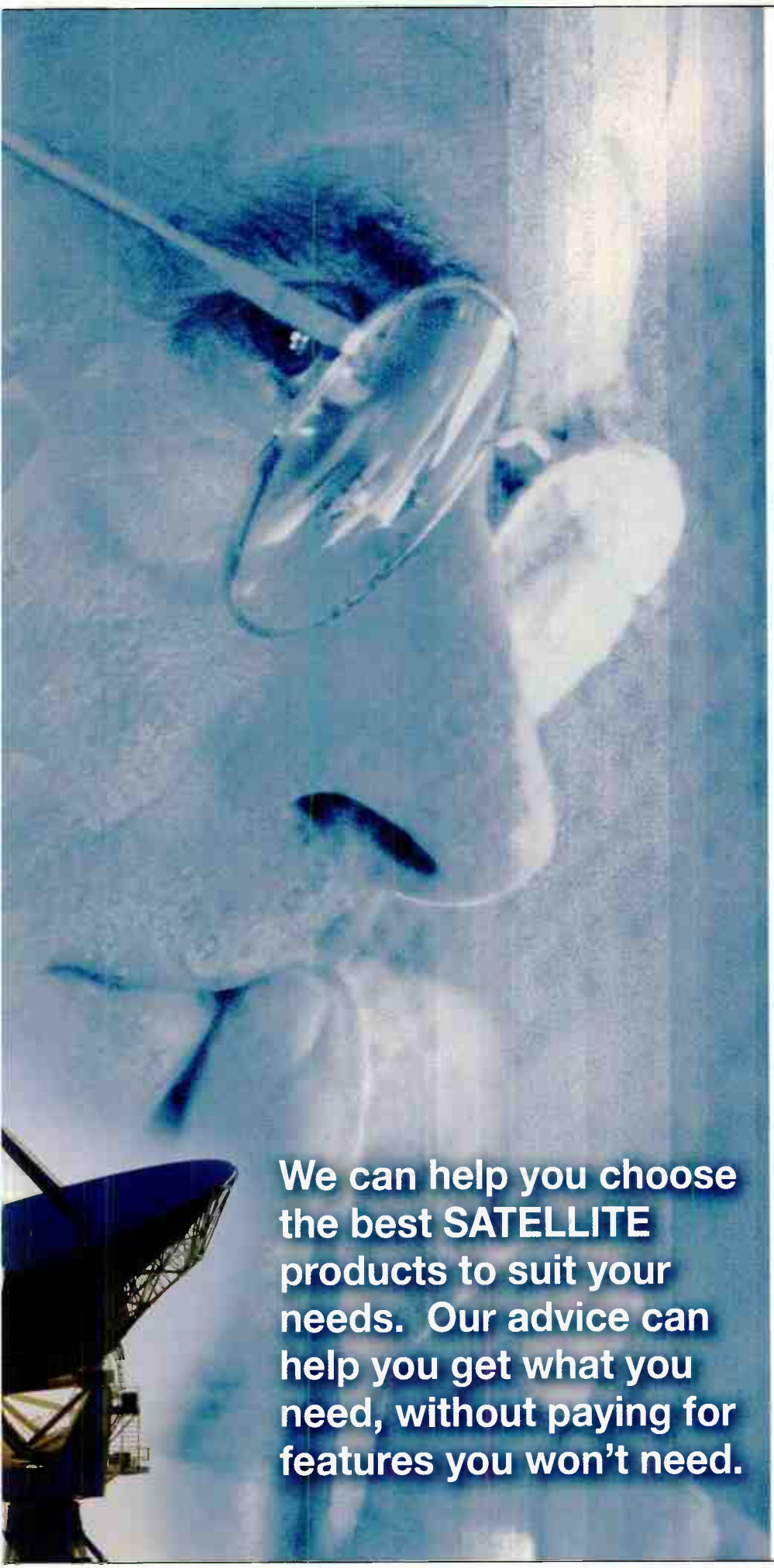

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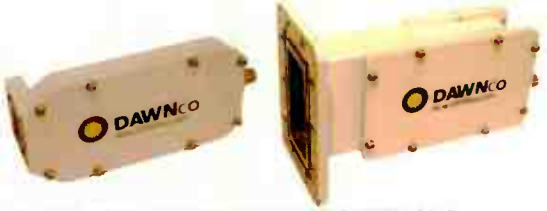

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CBS Radio Sacramento Shifts Away From Analog

by Jason Ornellas, CBRE, CRO

The author is director of engineering for CBS Radio Sacramento.

CBS Radio owns and operates five stations in Sacramento, Calif.: KSFM(FM), KZZO(FM) and KYMX(FM) reside in one facility, while KHTK(AM) and KNCI(FM) are based in another facility roughly 10 miles away.

The KHTK(AM) and KNCI(FM) facility was built over 20 years ago and consisted of seven total studios, four for production, a talk studio and two on-air studios. 105.1 KNCI is a heritage country station that features live dayparts. Down the hall is Sports 1140 KHTK, a CBS Sports Radio affiliate that runs live programming during the morning, middays and afternoons. In addition, KHTK is the flagship station of the Sacramento Kings and home of the Oakland As, Oakland Raiders and San Jose Sharks.

AWAY FROM ANALOG

After 20 years, the facility for these two stations needed updating. Considering where to take the KNCI and KHTK facility required a lot of planning. There was a complete shift from a facility with layers of undocumented analog wiring to a complete AES broadcast plant, from the microphones all the way through each air chain into the transmitters.

All audio inside the facility is now carried via 48 kHz sample rate, 24 bit-word length AES data streams with analog backups.

This rebuilding process was taken on over three separate phases: Phase one was expanding the TOC, installing the SAS 32KD Mainframe and rebuilding the KNCI control room. Phase two was renovating the KHTK talk studio and control room, as well as the Sports Update studio. Phase three was done to wrap up the remodel of the programming side of the building and to build out three identical production studios, which also serve as emergency studios for KSFM, KZZO and KYMX.

From left to right: SAS Vice President Al Salci, Director of Engineering Jason Ornellas, IT Director Mark McConnell and Chief Engineer Joe Foft.

FURNITURE AND STUDIO DESIGN

The CBS Radio Sacramento team created the design of the renovation. We adapted aspects and concepts from previous facility designs and buildouts in the new layout. The goal of the renovation was to open up the studios and to be ready for HD video, while not losing the radio studio atmosphere.

CBS Radio Sacramento continued the tradition of standup furniture, and the design was carefully planned with respect to colors, aesthetics and ease of access around the room.

Local HVAC, electricians and flooring contractors played key roles in completing each phase efficiently.

The engineering team worked together to decommission and rebuilding each studio without interrupting the air signals. Every wire in each studio and in the TOC has a heat shrink label stating what it is and where it goes.

Inheriting a facility where documentation was next to nonexistent was a turning point in the remodel plans, while the need to update the infrastructure was a key point in the design.

The technical operations center got an overhaul, and we wanted to show off the air chains and the 32KD mainframe as a centerpiece in the programming hallway. The rest of the TOC was rewired and redesigned with new electrical infrastructure, cable trays and wire management. Each studio already had multiple conduit runs from the TOC, which were reused. As we replaced a majority of the analog wiring, we left analog trunk cabling for backup to and from the studios and TOC.

A Sierra Automated Systems 32KD mainframe is the backbone of the facility. SAS provides synchronous, linear, low-latency performance with the flexibility to adapt as

CONTINUED ON PAGE 20


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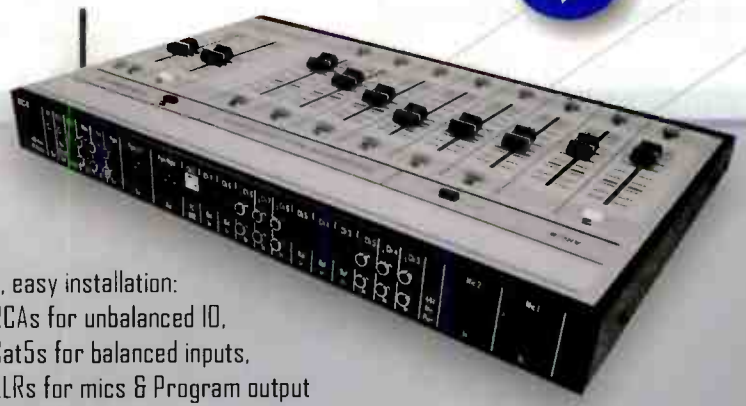

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CONTINUED FROM PAGE 17

the facility evolves. The 32KD mainframe has 21 slots for modules that carry out various functions, such as support for up to 512 inputs and outputs; audio switching, distribution, mixing, level control, silence detection, signal processing, intercom, IFB and mix-minus generation, all within a 6RU space. The 21 slots are truly universal, and any module type can plug into any slot. Each 32KD mainframe contains dual power supplies for redundancy.

CBS Radio Sacramento dedicated the first seven slots for KRL-16 cards, which are used to connect each studio's RIOLink to the mainframe over a single Cat5e cable (or fiber). The RIOLink performs like an "extension cord" to the 32KD, linking 32 channels of audio in and out, 16 serial RS485 control ports, 16 GPI optos and 16 GPO solid-state relays within a two RU chassis. RIOLink's audio inputs and outputs can be all digital, all analog, or half of each. The facility has multiple digital input and output modules (KDI-16 and KDO-16) and each module provides 16 AES/EDU digital inputs or output channels with DSP, and analog input and output modules (KAI-16 and KAO-16) which allow 32 input/output channels (16 stereo or 32 mono or any combination).

Polished black SAS iSL 20.3 console.

Hallway racks provide a great means for the engineering department to show off just what they can do. Don't limit quality to this spot though; build the whole place as if everyone will see it.

A DRC-16, a remote control module that provides extensive remote control capability throughout the system was also added and can be controlled from the TOC.

Lastly, an MCU-32e frame controller module, which is the primary control interface to the mainframe, generates main and standby clocks and stores all operating parameters and custom configurations of the network.

MOXY

CBS Radio Sacramento created a first for SAS: a web GUI interface to use in addition to the XY Soft Panel and router control software called Moxy. Initially, Moxy was a simple project designed to provide a way to view and connect SAS sources and destinations together using an alphabetically-ordered list in the web browser.

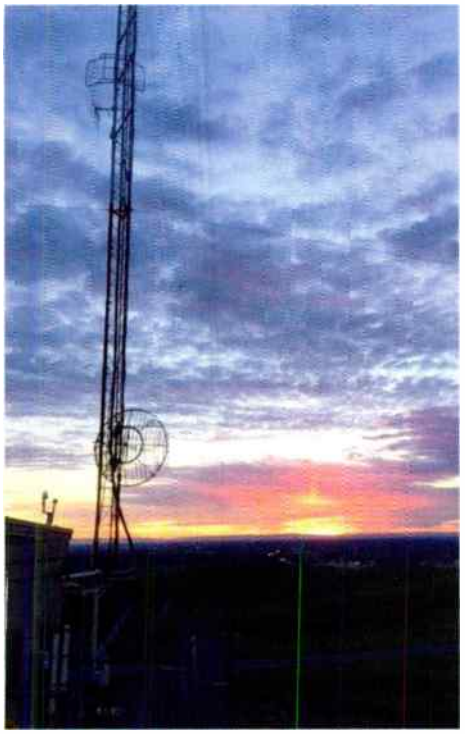
However, it has grown into an obsession for IT Director Mark McConnell, who built and designed it, and is now a multi-purpose tool for our entire broadcast staff.

Moxy can now stream any source in the


KHTK Talk studio with view into control room

system to the browser in under 50 milliseconds, allowing the user to monitor loudness and phase; control all consoles; and create visual krone/punchdown maps.

It still allows users to connect sources to destinations together, based upon a map of permissions that the engineering staff can manage for each individual user or group. Moxy has become the go-to platform for the engineering department for any router changes or cross point mapping.


Sunset over the Sacramento metro, as seen from the KNCI transmitter site.

Moxy has also now been offered to every CBS Radio market with an SAS System.

STUDIO EQUIPMENT

As mentioned earlier, each studio is equipped with a RIOLink and dual power supplies for redundancy. Both control rooms are running iSL 28.3 consoles; the Sports Update studio and three production rooms use iSL 20.3 consoles; and the talk studio has an eight-channel Rubi-T turret.

CBS Radio Sacramento has serial number one of the iSL console and worked closely with SAS to build three custom, polished-black iSL consoles for the production studios. Guest turret panels and headphone amps are also supplied by SAS.

Each studio also features Telos phone hybrid gear (Hx6, Hx1, VSet6 headsets) and Wheatstone M1 and M4 microphone processors, which are on their own VLAN network for web GUI accessibility across networks; each studio runs on a separate VLAN switch for security and network flexibility.

Røde Broadcaster and Electro-Voice RE-27 microphones and Denon USB players/recorders are found in the studios, as well. Automation is handled by Audio Vault.

A renovation can affect the quality of your work, lower maintenance costs and may also boost team morale. It is exciting to walk into a facility knowing its dependability and quality are true to the standards of CBS Radio.

The Sacramento team has now shifted its focus to the KYMX, KSFM and KZZO facility.

How to Process Audio for Streaming, Properly

by Doug Irwin, CPBE AMD DRB

The StreamS stand-alone encoder uses standard web server and web server infrastructure to stream live and files. It does not require any special web server module, allowing any web server on any platform, including simple cloud storage, to be used.

Those who started in our field fewer than ten years ago probably don't remember a time when there wasn't a streamed version of your radio station available online.

When streaming media first became of interest, most of us involved had no prior experience in that endeavor. Today, we have the benefit of about 15 years of pioneering work done by other engineers, and of course, processing manufacturers. So what have they learned, and what is now considered the appropriate way to process audio for streaming media?

There are several fundamental differences in configuring audio processing for streaming applications as opposed to those for over-the-air applications. For FM over-the-air processors we need to consider:

- The FM system is completely analog and linear (at least in the sense that there are no lossy-codecs used).
- The FM system uses emphasis (and thus pre-emphasis limiting).
- The 15 kHz audio bandwidth for FM means that a 32 kHz sample rate is adequate for A/D conversions.
- The noise floor obtainable in most FM receivers limits the overall system to a resolution equivalent to about a 12-bit word length in the digital world.

Contrasted with streaming media:

- Audio bandwidth is not limited to 15 kHz, and so sample rates may be far higher.
- 16-bit word length is common.
- There is no need for emphasis limiting, as there is in FM.
- Lossy-codecs are used to limit the overall data rate.

For this article, some of the best audio processing engineers in the field — Jeff Keith, Frank Foti, Bob Orban and Greg Ogonowski — agreed to answer two fundamental questions: "What are the design differences between OTA processors and those designed for streaming media?" and "How should ones approach to processing audio for streaming media or podcasts differ from that of on-air processing?"

Jeff Keith is a senior product development engineer at Wheatstone; Frank Foti is CEO of the Telos Alliance. Bob Orban is consultant to Orban Labs Inc., owned by DaySequerra. Greg Ogonowski is president of StreamS/Modulation Index LLC.

PRIMARY DIFFERENCES BETWEEN OTA AND STREAMING

Keith: The primary, and most important difference, is that the audio peak limiting schemes are completely different in on-air and streaming processors. Further, FM on-air processors also utilize a very aggressive boost of high frequencies [pre-emphasis], which is both unnecessary and undesirable in streaming applications.

Foti explained that the difference is not only in the functionality of the processing gear, but in the goals themselves.

Foti: Employ processing for consistent source-to-source level and tonal balance. While on-air processing also accomplishes this, there is the competitive loudness quest that broadcasters desire. This is not as prevalent in the streaming world, due to the buffering delay associated when connecting to another signal. Best to say that processing for sonic consistency and vocal intelligibility is most important.

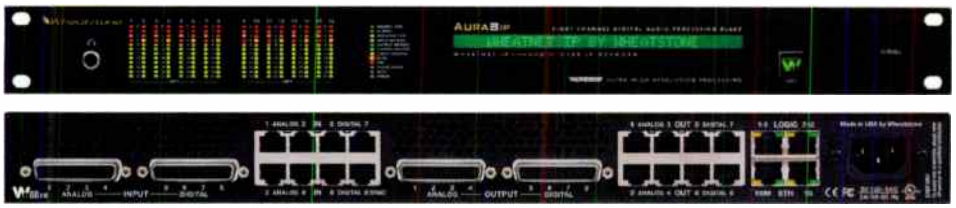
Another important factor regarding the coded system is headroom. Digital systems have an absolute maximum ceiling of 0 dBFS. Theoretically, audio levels for transmission should be able to be set right up to this level. But, depending upon the encode/decode implementation, overshoots may occur.

This is not consistent from codec to codec, but more so due to the implementation of the codec by various manufacturers. Additional input low pass filters in the encoder may cause headroom difficulties. A well-designed encoder will insure that any added input filters possess the same headroom as the system, along without generating overshoots that reduce headroom. Most filter overshoots are of the 2 dB – 3 dB magnitude, but can exceed this amount depending upon filter characteristics.

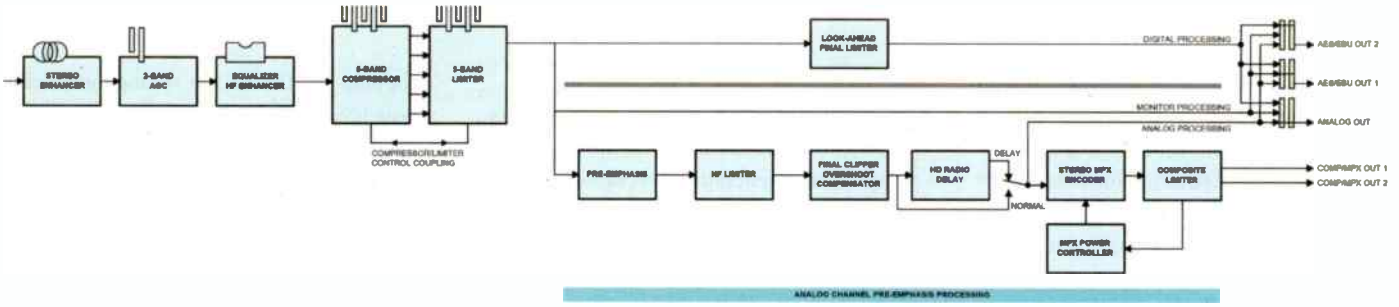
It would be wise to test any codecs within a specified infrastructure to make sure that 0dBFS is attainable without system overload or clipping. For this reason, setting the absolute peak level 2 dB – 3 dB below 0 dBFS, offers insurance to avoid clipping.

Orban: The analog [FM] channel requires state-of-the-art pre-emphasis limiting to achieve competitive loudness and minimize pre-emphasis-induced high frequency loss. This usually implies use of sophisticated distortion-canceled clipping. The streaming channel, on the other hand, has no pre-emphasis but is typically heavily bit-reduced via a perceptual codec. This creates an entirely different set of requirements: The peak limiting must not use clipping because there is no bit budget available to encode clipping-induced distortion products.

However, pre-emphasis limiting is unnecessary. The best technology for peak limiting the streaming channel is therefore look-ahead limiting, which can perform very clean peak reduction on flat channels, but which is unsuitable for pre-emphasized channels.



Wheatstone's Aura8ip is an option for processing of streaming audio. It can process up to eight stereo streams simultaneousl, via analog, digital or WheatnetIP I/O. An optional built-in wav/mp3 clip player can be set up to replace a missing audio source, if desired.



Block diagram of typical processor with parallel FM and streaming media outputs. *(Courtesy Greg Ogonowski)*

DIGITAL / FM AUDIO PROCESSING
SIMPLIFIED BLOCK DIAGRAM

CONSIDERATIONS FOR PROCESSING STREAMING MEDIA

As the importance of streamed versions of our radio stations continues to grow it's important to consider just what is involved in effectively processing that delivery method for audio. In the early days of streaming, the bandwidth available for the radio stations, as well as end-users, was far more limited than now; lossy-codecs were the order of the day.

Today there's more and more talk of high-resolution streaming, but even so, very few stations offer completely "loss-less" audio streams.

In the last several years, Ogonowski has turned his attention to focus on streaming media, and in answering my second question, he considered both linear and lossy-codecs.

Ogonowski: Audio processing considerations differ for linear PCM and coded digital audio. Linear PCM doesn't have perceptual audio encoders and decoders in the signal path that need special attention.

Both linear PCM and coded audio systems should use over-sampled limiters to prevent any 0 dBFS+ or true peak build up after A/D conversion. Anytime energy is removed or group delay is disturbed from a peak controlled audio signal, it runs the risk of peak overshoot, and hence system overload. Peak-controlled signals in linear PCM systems only need attention for the low and high frequency responses of the systems through which the signal is passed in order to maintain proper peak levels accurately.

In codec audio systems, such as AAC or MP3, there is another consideration that must be taken into account. Perceptual audio encoder/decoder signal paths remove energy within the audio pass-band, and hence disturb peak levels there as well. The more bit reduction, the more the overshoot. The overshoot happens at the output of the encoder, where it cannot be touched for additional peak limiting. Hence, the output of the decoder will also contain the peak overshoot.

Z/IPStream 9X/2 adds Omnia.9 processing to your internet stream, complete with Omnia's "Undo" technology, Solar Plexus technology and the full Omnia Audio Tool Box.

Audio codecs using SBR [Spectral Band Replication], such as HE-AACv1/v2 and the HD Radio codec need even more headroom, since the SBR causes additional overshoot. So, in order to prevent these systems from overload and clipping, the easiest way to insure against this is to reduce peak audio levels into the encoders to at least -3 dB and allow overshoot headroom. If adequate overshoot headroom is not given, bad things will happen, and it depends upon the exact system as to exactly what will happen.

Foti: It is possible for lower bitrate channels to offer high quality and clear intelligibility through the use of a dedicated processor that employs the means to understand and handle the challenges of the coded audio path. For those who wish to tweak on their own, with existing processing equipment, the following should be observed: Avoid dense processing that contains fast limiting time constants. Try to reduce the attack time on functions when 5 dB, or more, depth-of-compression is desired. This will reduce upper frequency processor induced IMD.

Make sure that the coding system provides full headroom. If the system clips on its own before 0dBFS, then reset the maximum input level to avoid system headroom problems.

Low bitrates benefit from bandwidth control. A static low pass filter will reduce artifacts. The tradeoff is perceived high frequencies vs. quality. A specialized processor for coded audio will offer some dynamic method to accomplish this.

Do not use any final limiter that contains a clipper. The THD generated by the clipping function will cause more trouble than it's worth. Precision peak control is needed in the coded system. A specialized processing system for this medium will provide a look-ahead limiter to accomplish this task.

Be mindful of system headroom. Set the processing system to operate with an output level set no greater than -3 dBfs. Allowing 3 dB of headroom will remove any possible distortion occurrences due to less than adequate digital-to-analog converters downstream.

If the above items are followed, improved coded audio will result.

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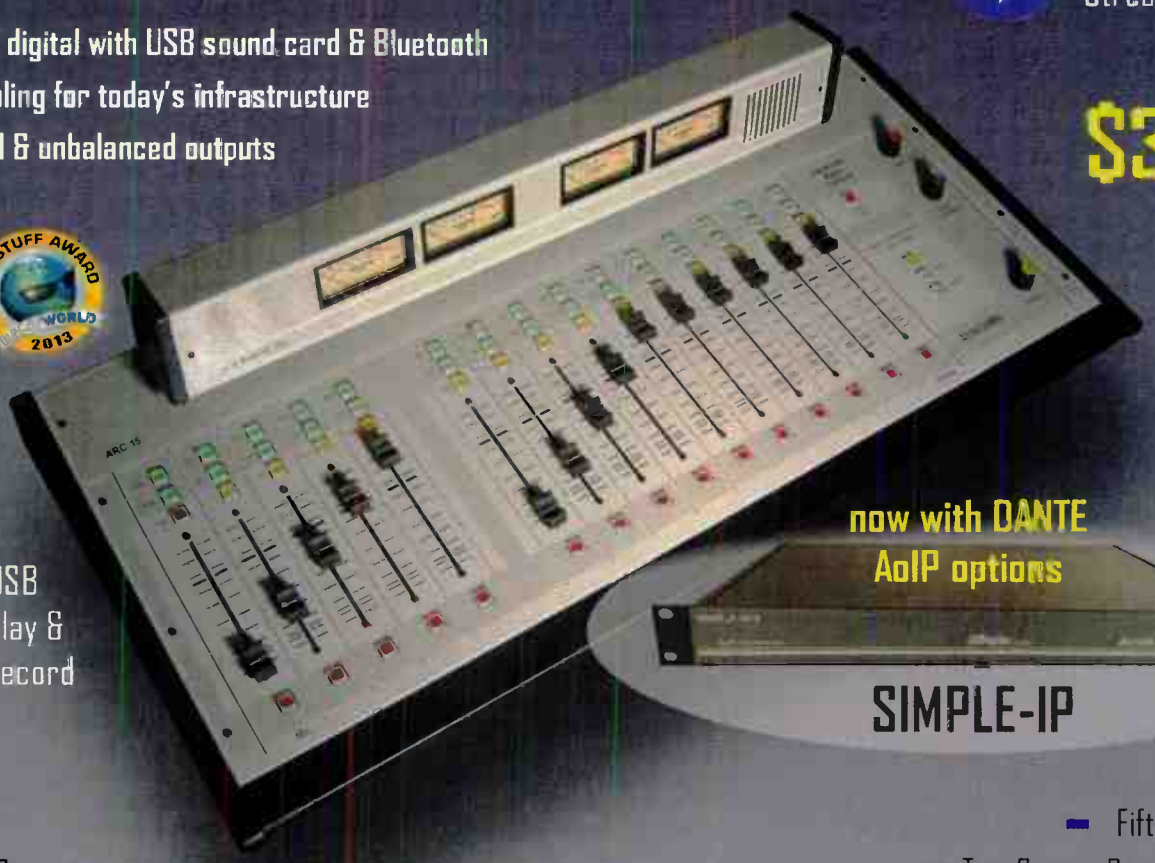

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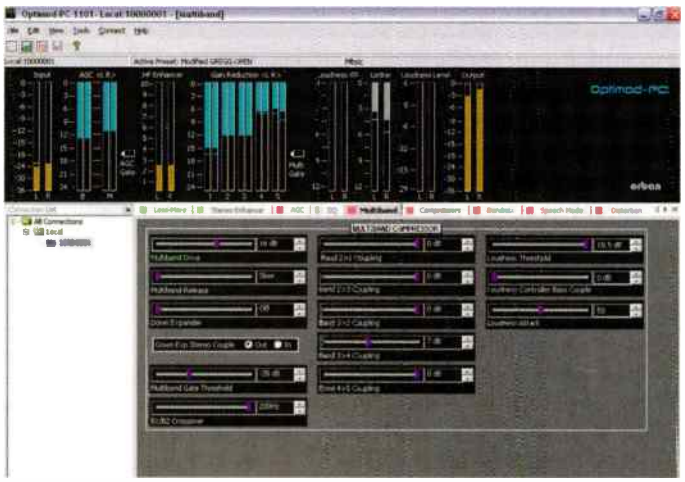
Orban: As for the differences in approaching processing, this depends on your goals. If you want the stream to sound like radio [i.e. a consistent, polished, "produced" sound], then except for the peak limiting, you can use the same processing chain, including elements like AGC, stereo enhancement, EQ, and multiband compression.

If you want to sound like the original recording, then the processing can be as simple as static normalization of the source file to a target BS.1770 integrated loudness. However, static loudness normalization can cause inconsistencies at program boundaries, so I prefer adding some sort of online audio processing such as a simple AGC that normally does perhaps 3- 4 dB of gain reduction. This is enough to smooth out most transitions, if the source files are already loudness-normalized. In either case, the program can often benefit from left/right phase skew correction, which makes the audio easier to encode, applied before other processing blocks.

In all cases, it is important in streaming to allow headroom for codec overshoots which can either cause clipping in player devices, or trigger a peak limiter of uncertain quality in the player. With typical low-bitrate streaming [32 or 48 kbps HE-AACv2], I recommend allowing 3 dB of headroom. It is also important for the peak limiter to be "true-peak" aware, so that it anticipates the peak level that will appear after the player's DAC, which can be several dB higher than the highest digital sample.

The AES document AES TD1004.1.15-10 ["Recommendation for Loudness of Audio Streaming and Network File Playback"] recommends a BS.1770 Integrated target loudness of -16 to -20 LUFS. This is low enough to produce little peak limiting, thereby allowing a simple look-ahead limiter to produce good results, while being high enough to achieve satisfying listening levels on typical player devices like iPhones.

Many streaming providers choose higher target loudness because of the usual loudness wars concerns of sounding wimpy and getting lost on the dial, or the streaming equivalent thereof. But if you allow 3 dB of peak headroom, then going more than a few dB above the AES recommendation is likely to degrade audio quality because of peak limiter artifacts.



The Orban Optimod-PC 1101e professional Microsoft Windows audio processing card for PCIe bus systems offers dedicated, broadcast-quality digital signal processing on-board for audio processing, mixing and routing, for both live streaming and on-demand programming.

Keith: One way to think of the difference is to compare the usual goals in both cases. On-air processing is typically quite aggressive, mainly because stations generally want to be louder than their competition. The loudness goal is further exacerbated by the ability to instantly flip back and forth between stations in order to compare loudness.

While radio people find loudness to be a critically important criteria, most listeners could care less about it.

In streaming applications, achieving maximum loudness isn't as important as creating a stream that can be listened to for long periods of time. Also, comparing loudness is much more difficult in the streaming case because of the buffering processes within the streaming technology and interconnecting networks that make it impossible to do instant loudness comparisons.

GARBAGE IN VS. GARBAGE OUT

Any radio engineer who has dealt with audio processing knows about the "garbage in versus garbage out" concept: If the audio going in to a processor sounds bad, the audio coming out of the processor will sound bad. The obvious implication is that you should do all you can to ensure the source material is as clean as possible.

Ogonowski: Good processed audio results are completely dependent upon the quality of the source audio. There is only so much that can be done to fix poor sources in audio processing, especially if sources are coded audio.

Storage is cheap today, and computer systems are more than fast enough to use linear PCM formats, such as .wav of .aiff. MP3 should never be used.

If coded audio must be used for whatever reason, AAC at 256 kbps should be used, such as that from the iTunes Music Store. It should be remembered that these sources will then be coded by the streaming or digital radio encoders, so encode-decode cycles should be kept to a minimum to deliver the best audio quality to the listener, which is what counts.

Many canned libraries available to broadcasters have varying levels of quality, ranging from OK to poor. If you want this done right, do it yourself, and get your own sources from known-quality CDs or record company files.

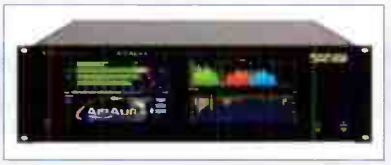
The media through which we reach our listeners has evolved over time, but certain fundamentals of audio processing remain the same. The final principle — and perhaps most important — is that you need to care about the end result.

Certain audio processing fundamentals remain the same. Perhaps most important, you need to care about the end result.

D&R CONSOLES FROM PROGRESSIVE CONCEPTS

Professional audio equipment supplier Progressive Concepts is now the exclusive U.S. distributor for Dutch console and mixer manufacturer D&R products. Now available are the Airence USB Broadcast Mixer, Airlab Broadcast Mixer, Airlite USB Mixer, Airmate USB Mixer and Studio Remote. Additionally, Progressive Concepts customers can purchase D&R Aircast automation software for Windows computers.

Progressive Concepts also offers transmission equipment, test and measurement products and many other kinds of radio broadcast equipment.



WHEATSTONE AIRAURA X3 PROCESSOR UPDATE

The AirAura X3 processor from Wheatstone is now capable of off-air monitoring, measurement and real-time correction of HD diversity delay, sans external gear, thanks to the addition of HD/FM time alignment.

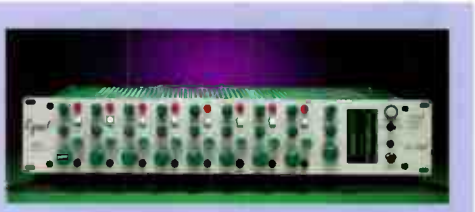
Wheatstone has embedded the diversity delay, as well as its measurement and correction, within the AirAura X3 audio processor. The goal of this is minimize listener tuneouts when the HD signal blends to analog at the fringes of a station's coverage. The diversity delay is kept in alignment, removing the need for outboard hardware.

CRANE SONG EGRET UPGRADED

Crane Song's digital hardware products is now in its fifth generation digital to analog converter technology, Quantum DAC, with its installation in the Egret eigh-channel D/A converter/summing mixer.

The Egret now joins Crane Song products Avocet monitor controller, HEDD 192 AD/DA converter and Solaris standalone digital to analog converter utilizing Quantum DAC.

The Quantum DAC uses a 32-bit converter and asynchronous sample rate conversion for jitter reduction with up sampling to 211 KHz. It features a reference clock with a proprietary



reconstruction filter for accurate time domain response.

Crane Song began shipping the Egret digital audio workstation with the fifth generation Quantum DAC.

DAC upgrades are also available for previous generation Crane Song digital hardware products.

First Natchez Radio Group Relies on DAD

First Natchez Radio Group's one AM and four FM stations broadcast a diverse range of programming from their Natchez, Miss., headquarters to listeners in southwest Mississippi, eastern and central Louisiana.

Not long ago, the group decided that its old radio automation system had finally reached its end-of-life. They sought a dependable solution that would also deliver functional and workflow improvements, and after extensive research decided to make use of the ENCO DAD automation system.

The broadcaster has now deployed the ENCO DAD radio automation platform across its five radio stations.

"The reliability of the new system was our first and foremost consideration, but we also wanted something that offered easy remote access and better voice tracking capabilities," said Josh Wells, First Natchez Radio Group technical operations manager.

First Natchez Radio Group Technical Operations Manager Josh Wells

> ***"The reliability of the new system was our first and foremost consideration, but we also wanted something that offered easy remote access."***
>
> *— Josh Wells*

"ENCO DAD met all of our criteria, giving us the robustness and feature-richness we need, while coming in less expensive than its closest competitors," he explained.

That affordability is enhanced by the DAD platform's ability to run multiple stations on a single machine. Wells elected to spread the group's five stations across three on-air systems in order to balance cost-effectiveness, concurrent live program control and redundancy.

The DAD software's interface has proven easy to learn for operators and its flexible configurability has delivered immediate productivity gains. First Natchez Radio Group also takes advantage of advanced DAD tools such as the DAD Dropbox utility, which eliminates manual conversion and import steps when bringing in audio files.

"When we want to bring songs, imagery or even full shows into the system, we can just drag and drop the files into a folder, and DAD automatically ingests them and inserts them into the library."

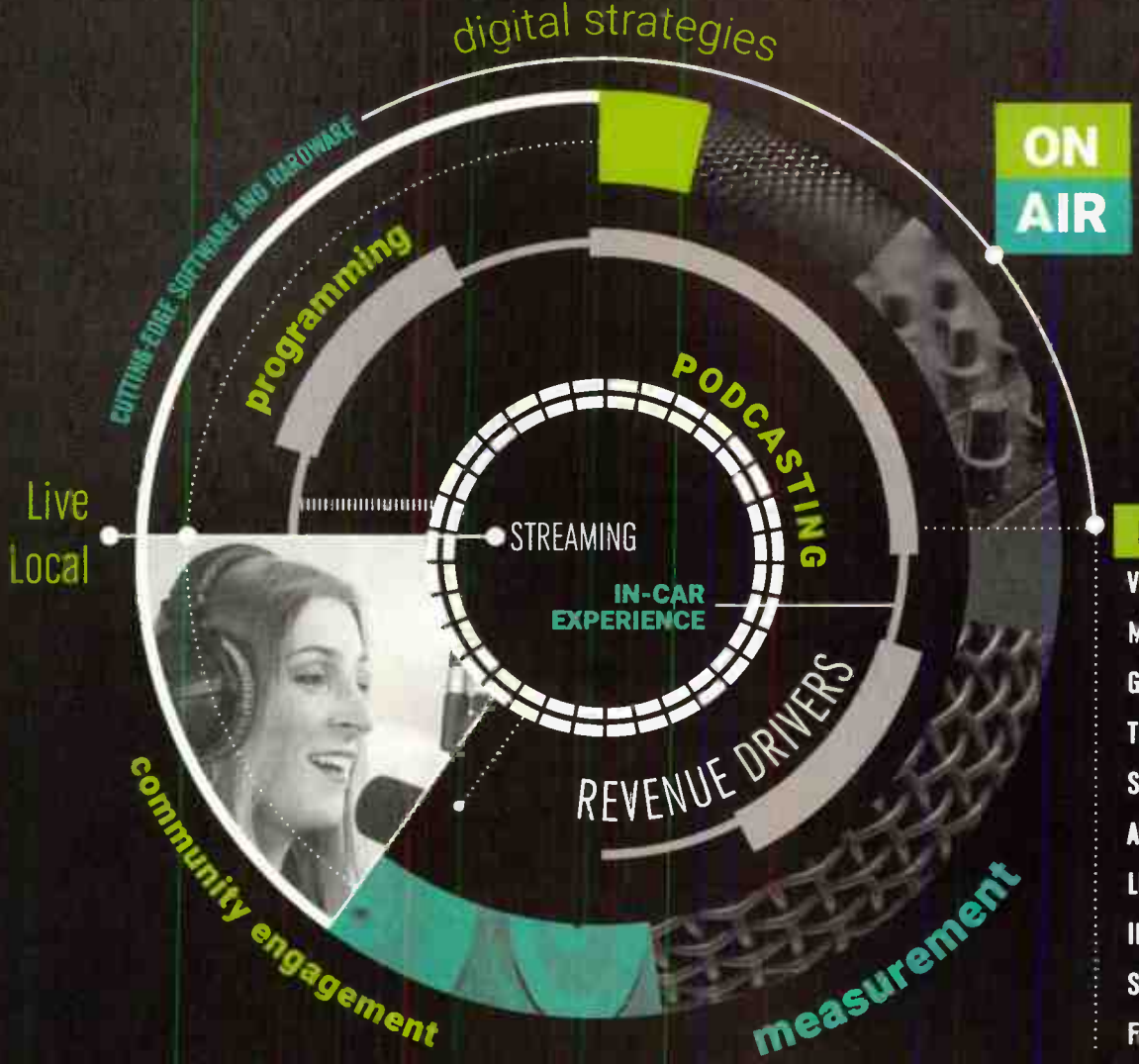
ENCO's remote voice tracking applications also has found uses. "We augment our local radio personalities with additional talent in Nebraska and Texas, and one of our local DJs is moving to another city, but we want to keep her on the air," he explained. "ENCO's fantastic voice tracking tools let us do that. The DAD system automatically sends playlist sections and clips of the songs' outros and intros to the remote jock, who then uses the DAD Remote Tracking Client to record the voice track and send it back for automatic integration into our playlist. It couldn't be easier."

The iDAD application is one of ENCO's enCloud family of mobile and browser-based tools. "Using the iDAD app, we can send remote commands to the system from our mobile devices through an easy interface, wherever we are," Wells said.

"iDAD also enables us to have multiple live users on a single system at the same time. While our stations are deployed across three separate computers, we often air four high school football games simultaneously. One live board operator can be in front of the machine using DAD with a mouse, while another operator triggers hot buttons and watches countdowns in a separate DAD array panel through an iPad."

Together, these capabilities have combined to give First Natchez Radio Group significant operational and workflow improvements.

"It has given us the reliability we need, it's straightforward to operate, and it saves everybody hours each day," Wells said.



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LET'S THRIVE.

The Digital Splits: When One Station Becomes Two

by James Cridland

Australia is a nation driven by rock music and cricket. But what happens when those two things collide?

In January rock station Triple M carried live commentary of the first Test Match between Australia and Pakistan at the Gabba in Brisbane — a match which Australia won by 39 runs.

Mixing sports and music is a dangerous thing for a radio station to do; sports commentary — which by its nature is all-talk — is a very different listen than music, after all. The differences are particularly large when matches occur during the workday, as this one did. Cricket matches are many hours long, too, exacerbating the problem. But Triple M ensured that fans of both were given a service — by splitting their digital signal from FM.

Listeners to Triple M on FM were given the cricket commentary. Listeners on DAB+ and online were, instead, given the non-stop rock that Triple M is famous for. Each cross-promoted the other.

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In Australia, this is a well-used technique. The ABC, the public service broadcaster, also carries sports output on AM while offering a different news program on DAB+ and online.

The opportunities available by digital broadcasting has meant similar "split broadcasts" in other parts of the world.

SPLITTING, INTERNATIONALLY

In the UK, Absolute Radio took commentary on some of their frequencies, while using digital to carry music programming. In London, the local station BBC Radio London will often cover two different soccer matches: one on FM and one on digital.

Nationally in the UK, the BBC broadcasts an "extra" station on digital, BBC Radio 5 Live Sports Extra, which is a part-time service carrying additional commentaries and programs. Unlike the other examples here, BBC Radio 5 Live Sports Extra is an additional station produced by removing bitrate from other radio stations on the same digital DAB multiplex, slightly reducing their quality, and using the saved bandwidth to produce a new service.

Mixing sports and music is a dangerous thing for a radio station to do.

In Germany, soccer DAB+ station 90elf also splits its DAB+ bitrate on Saturday afternoons to add a number of additional Bundesliga match commentaries for audiences to tune into.

In some cases, these split services are caused by rights issues — unavailability of sports rights for online streaming, for example. But increasingly, many stations are using it as an opportunity to promote digital radio, as well as acknowledging that audiences with a digital set are still, in most cases, able to switch back to analog.

It's not just news, either — in the UK, news station BBC Radio 4 also broadcasts an additional side-channel at certain times of the day, with religious programming. And for a while, Cornish station Pirate FM broadcast local community programs during the evening on DAB while continuing to broadcast music programming on FM.

Digital broadcasting's flexibility can sometimes be confusing: particularly when asking listeners to tune into part-time stations that often only exist on the multiplex while broadcasting. But the flexibility can offer additional programming for the listener and additional opportunities for the broadcaster.

Cridland is a radio futurologist in Australia. He contributes to RadioMagOnline.com regularly.

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Historians All

by the Wandering Engineer

There are a lot of tasks in my informal job description that don't appear in the formal one for broadcast engineer.

Personally, I like the Santa Claus role I've been lucky to play under at most stations. Whenever someone needs something — a new desk, computer, slave station clock, stereo, playback system, smoking fan in the GM's office — I got to procure it. You can buy the love of your fellow workers with the station checkbook, and someone has to do it. (Nothing like surprising a co-worker with something that improves their working conditions as the station benefits from investing in improved efficiency and performance.)

I also really like that broadcast engineers are the station historians.

Only we know the story of how the station started, some nearly a century ago, with long wires, 250 Watt transmitters and a single microphone in a living room-esque studio with a quartet and an announcer. Only the engineer knows some stories of challenge, hardship, hope and excelling against all odds with limited resources and technology. We also know the horror stories and the ever-eventful disasters punctuated with tales of heroism and selflessness. Lives and property saved, all the while making sound for the masses.

Our staff needs to know that they are part of a story that began long before many of them came through the doors.

Along the way, the station produced all sorts of promotional chits, programs preserved on paper scripts, vinyl, tape and now electronic files. The engineering catacombs might not be habitable, but they are a good place for all manner of memorabilia. Weird power tubes, maybe an 18-inch turntable platter, 2-inch recording tape, piles of black and white photos with unknown people working in almost-familiar studios.

Radio stations are happy places and nostalgic. Any opportunity to go back in time is welcome, whether for a station gathering or memorable promotional efforts. Some of our listeners really do like to hear and see what it was like back when. Our staff needs to know that they are part of a story that began long before many of them came through the doors or were even born, for that matter.

Somewhere, there is bound to be an antiquities box. I've found first-generation calculators, ribbon mikes, copies of "White Christmas" on 45 RPM records, transmitter crystals the size of a beer can, the very first sign-on log, a mercury bulb from an old tower light flasher, mike flags, a remote mixer with tubes... you know this box.

It would be most interesting if this old remote mixer could somehow repeat some of the things that have been said through it.

Who else, aside from a station engineer, would have any idea this was an old homebrewed transmitter, perhaps the station's original, that needed to be kept for posterity?

You also know its value. If the station were on fire, it's the one thing you bring with you. Everything else is covered by insurance and could use a refresh anyway. The content of this box is irreplaceable — and you are responsible for it.

Broadcast engineers are also responsible for dubbing off old media to new storage before tapes turn to dust and while you can still find a working 78 RPM turntable (or software that allows you to dub at 45 or 33-1/3 RPM). PCM files become MP3s, and someday something else.

We keep the station on the air, but we also keep its memories alive.

The Wandering Engineer is an industry stalwart who has been in broadcasting since the days of Marconi and Tesla. He gives his thoughts on the current state of broadcast engineering and the broadcast engineer.

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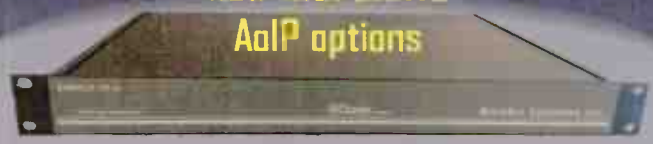

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