Radio Guide

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May-June 2015 – Vol. 23, No. 3

Transitioning to IP: Leaving ISDN For Good

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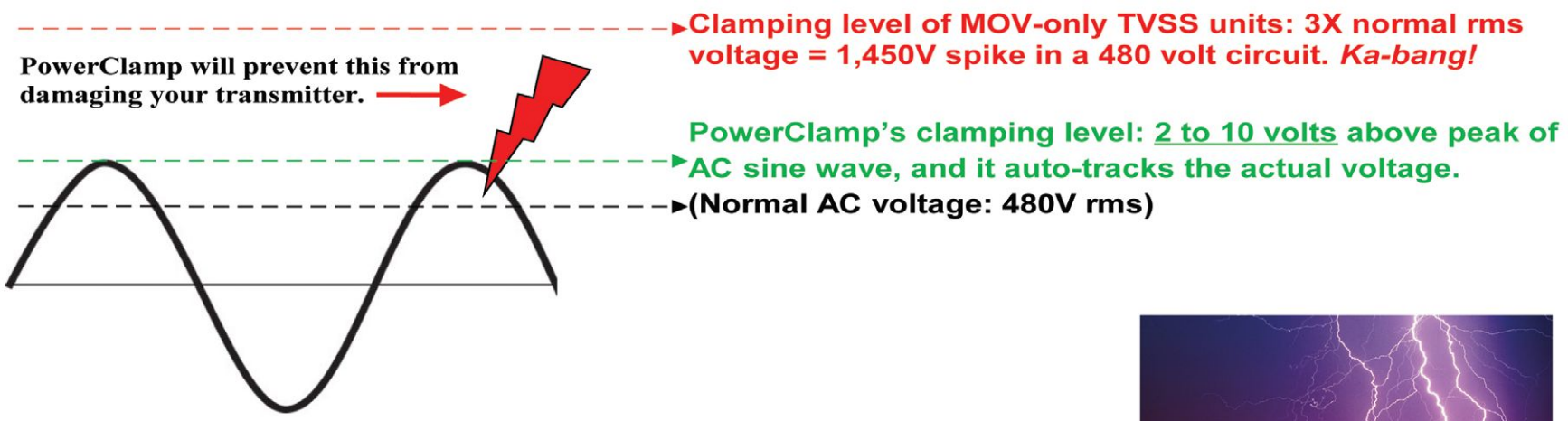

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Transitioning to IP: Leaving ISDN For Good

Tom Hartnett – Technical Director, Comrex

The transition from ISDN to IP is a fraught subject for the broadcast community. IP technology has been in use for over a decade – many early adopters have considered it a staple since its creation, and may be surprised that concerns still exist. But for many, the technology is still colored with skepticism. Can we really leave ISDN forever?

It's tough to get a read on engineers' feelings towards ISDN. A recent survey conducted by the Society of Broadcast Engineers reveals that broadcast engineers are split on the subject. Of respondents surveyed, 24% of respondents indicated that they never use ISDN for any reason. However, 28% reported that they use ISDN for the majority of their remotes. Throughout the survey, respondents expressed a deep skepticism for IP technology, especially for mission critical functions.

"We have T-1 circuits for backhaul service to our satellite uplink provider…backed up by autodialed ISDN circuits," one anonymous respondent wrote in one of the survey's open response sections. "This technology has and continues to serve us well. Our fear is that there won't be a suitable replacement with AoIP. There is no [quality of service] guarantee."

ISDN: Can't Live With It, Can't Live Without It

ISDN has become so deeply ingrained in the radio broadcasting community, it's hard to believe it's really going away. Many broadcasters can't imagine how telcos could rationalize eliminating the technology from their offerings, considering its importance in their own daily lives.

The beauty of ISDN lines is they are highly regulated – every ISDN line must meet a certain infrastructure standard, and must be able to deliver a maximum of 128 kbit/s in both the upstream and downstream directions. Even better, though – due to stringent regulations, ISDN lines are ISDN lines, no matter where you are. Although environmental factors can still interfere with the fidelity of a broadcast, the lines themselves provide predictable connections.

However, for its intended use case, ISDN was rendered obsolete almost immediately upon its creation, by the exact qualities that make it so beneficial for radio broadcast. ISDN (or Integrated Services for Digital Network) was developed in 1988, as a high-quality alternative to regular telephone lines for Internet service. But as the Internet continued to grow, data demands quickly outpaced the speeds that ISDN could provide. By 1999, WiFi connections already averaged 54 mbit/s in both directions – for comparison, that's 432 times more data than an ISDN connection is capable of moving.

IP: Here To Save The Day

So what's replacing ISDN?

Like it or not, the answer is IP technology. Codec manufacturers have been implementing IP (Internet Protocol) technology into their offerings for years, and IP networks are now a part of nearly every single aspect of the modern broadcast facility. IP networks have plenty of benefits – they're nearly everywhere, and they meet a variety of specifications (WiFi networks, 4G networks, and Ethernet networks are all IP networks).

But to successfully replace ISDN with IP technology, it's important to ensure that the new solution is just as good, if not better, than the outgoing technology. How does one ensure that happens? The key to reliable IP broadcasts is understanding the strengths and weaknesses of IP networks, and using them intelligently.

Anatomy of an IP Network

One of the notable ways that IP and ISDN differ is in their anatomy. As many readers are likely familiar, ISDN systems are based around circuit switched data (CSD) networks. CSD networks are much like conveyor belts, in that data flows through them in a linear fashion at a consistent rate, from point A to point B. If a connection is maintained, the data packets will reliably arrive at the end of the conveyor belt in the same order they were in when they entered. Compression encoders and decoders are used because the speed of the belt (128 kbit/s for ISDN lines) isn't fast enough to deliver raw, uncompressed digital audio – the encoders match the speed of the belt perfectly, they process frames of data, and everything is delivered tidily. This process is shown in **Figure 1**.

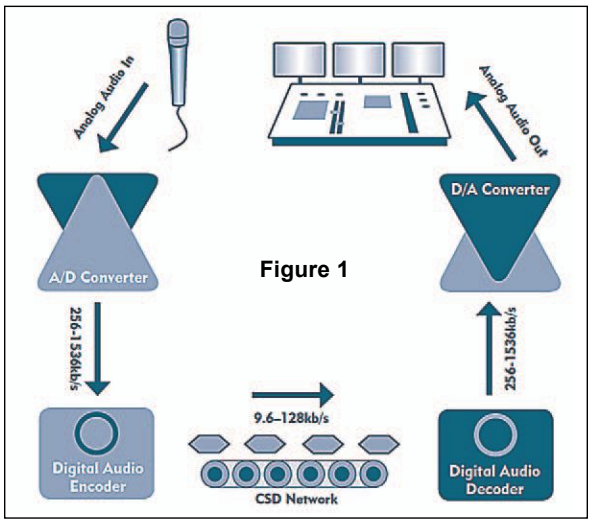

Figure 1

IP networks are a little different.

Called packet-switched data networks, IP networks rely on multiple relay stations, called routers, between points, rather than just two. So how does data get from point A to point B?

To begin, data is bundled together in packets, and sent into the network with a source and destination address attached as an IP header. This header is like a nametag, or an address on an envelope – as data travels through the various routers, this information ensures that the data will arrive at the desired destination, no matter what.

It's good that data has this identifying information, because unlike the conveyor belt of a CSD network, packet-switched data networks contain many possible paths down which data can travel. No physical connection is established between the endpoints, but the constant flow of data packets between the source and the destination address is a virtual connection, or a stream (shown in **Figure 2**).

Packets will arrive at different times in random order at the receiver. The term for varying delay and order of IP packets is called *jitter*. On IP decoders, a jitter buffer will hold packets in place until they've been arranged in the correct order. Any IP network can be made stable by adding lots of jitter buffer – however, this will increase the delay of your audio.

Bandwidth and Reliability

While the speed of an ISDN line is defined in terms of bitrate, IP network speeds are specified with a maximum rate, which is usually an order of magnitude higher than CSD network speeds. Considering this high capacity, why compress data? More importantly, why would there ever be delay?

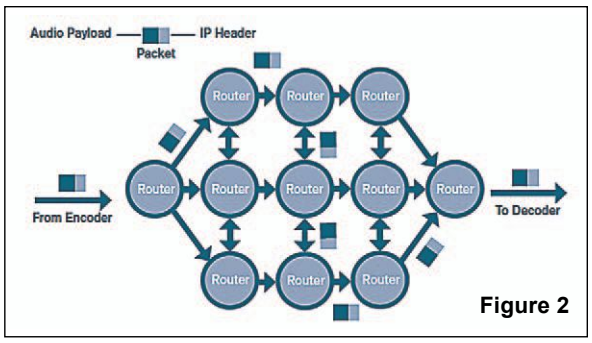

Figure 2

The answer is, if the network is closed or completely controlled by the user (i.e. no other devices can snatch up your bandwidth), then there's no need to compress, and there would be no delay. Managed networks, like local area networks (LANs) and some types of wide area networks (WANs) allow you to control quality of service (to give you the peace of mind that ISDN provides). If you have access to a network like this, all variables can be controlled, and IP is no less reliable than anything else!

However, the public Internet makes no quality of service promises. Although a public WiFi network may initially offer a very large bandwidth "pipe" for data, there are lots of other devices logging in, logging out, and using that data at undefined times. When the network is clogged, a broadcast that requires a lot of bandwidth will suffer.

Broadcasting Confidently

Keeping the benefits and challenges of IP networks in mind, there are a few things you can do to broadcast successfully over IP.

Use equipment with comprehensive error control: Find codecs with error concealment techniques and fall back/fall forward redundancy. Most importantly, find codecs that are designed to optimize these techniques to reduce bandwidth consumed. This will ensure a high-quality broadcast, with the lowest possible delay.

Look for high-quality encoding algorithms: Your audio will be compressed, but that doesn't mean quality needs to suffer. Finding something compatible with BRIC (Broadcast Reliable Internet Codec) standards, with a dynamic jitter buffer and sophisticated suite of tools, will provide a multitude of broadcasting options. Look for a codecs that provide lots of options to enable beautiful sounding audio over a variety of networks.

Think about compromised data networks: Is your codec designed to perform on a WiFi network at a stadium, where you're sharing bandwidth with a hundred thousand iPhones? Solutions for overloaded networks are key; finding a codec that can use multiple data networks simultaneously is crucial to ensure that you are getting the most out of your available resources.

User friendly interface: Can your staff understand your equipment? Can you readily solve problems, without spending hours clicking around? The user-interface should be friendly and approachable.

Employ network redundancy: Make sure you have a backup network available if you're doing a remote broadcast, just in case your intended network fails. If you're using IP for a mission critical application, having multiple networks from different ISPs available is also wise, just in case one happens to go down.

Choosing equipment that is capable of handling a real world environment is key to a successful IP broadcast. IP data networks are rapidly changing and improving, due to increased demand for bandwidth, and incentives for telcos. While broadcasters need to compete for that bandwidth, using equipment that is optimized for IP broadcasting is the best way to stay ahead of the game when it comes to transmitting broadcast quality content. We're just at the beginning of this story.

Tom Hartnett designed Comrex's first IP codec in the late 00's; to learn more about his work, visit www.comrex.com

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Studio Site

Audio With a Small Processing Fee

When do I need a mic processor?

by George Zahn

For some stations, it's a sign of status. For others, it may be a vital necessity. What does a microphone processor do, and do you need one at your station?

First, let's set a few basics. There are various types of microphone processors and pre-amplifiers. If you wish to have more flexibility than a basic preamp or an outboard or simple multi-channel console EQ for your microphone work, you may wish to invest in one of a wide range of mic processors.

A quick glance on Internet and catalogue pages shows that you can obtain a processor from a few hundred dollars, for a basic model, to more than three thousand dollars for units that handle multiple microphone inputs and have more "bells and whistles."

Audio Down the Tubes

What are you getting for the investment? First, even the most basic unit will allow you to use the unit as a pre-amplifier – but not all preamps are the same. As with speakers, headphones and microphones, you can ask five radio professionals and get six opinions. Some like the warm "tube" simulated warmth of a preamp, and there are processors/preamps that can emulate that sound.

Beyond the preamp quality, are some other basic features of a microphone processor. Even the most basic will have some of the following features: Input and Output Gain, High Pass Filter, Compressor, Expander, De-Esser, and basic EQ (usually on the low and high end). Most will also supply phantom power for use with condenser microphones.

While the input and output controls are self explanatory, the high pass filter is a nice feature. The high pass filter simply eliminates the low or bass end of the frequency spectrum. It may be pre-set on the less expensive models or it may have variable settings. High Pass means that every frequency higher than a set frequency will pass while the lower frequencies are filtered out.

If you have hired announcers with deep dulcet tones, why would you want to drop the lower bass frequencies? It depends on where the content voiced by the announcer will be heard. One quick tale out of school. Many years ago (before the advent of really nice home sound systems), we had one of our announcers with a beautiful deep voice announce a TV spot for our station. He worked the directional mic nice and close, milking every bit of proximity effect (which further exaggerates the bass).

It sounded great on our studio speakers, and when we took the recording to the TV station to produce the video, they too were monitoring on nice big JBLs. We produced the spot and loved it ... that was until we actually saw the spot on TV and heard what it sounded like on a 3-inch TV speaker – where we could barely decipher what the announcer was saying because the voice was so distorted by what we thought was rich, full extra bass. We were back to square one and had to re-voice the spot.

Lest you think that's an antiquated story because TV speakers are so much better and no one is listening on small transistor radios anymore, think about how much of your product is now consumed by computer audio streamers. No matter how good the manufacturer of your built-in laptop or cell phone speakers are today, we're now squeezing radio audio out of smaller elements than those old transistor radio and small TV speakers. With all due respect to Meghan Trainor, it's not always "All About That Bass."

Say Yes to De-Ess

Another feature of a mic processor is the De-Esser. This is usually a variable setting used to battle announcers who have trouble with naturally-occurring sibilance, or over enunciated "S" sounds. The De-Esser will generally have a sweep frequency setting to choose at which center frequency the sibilance is happening. Also, there's a threshold setting at which you can set a volume point at which the De-Esser kicks in.

Some argue that an outboard parametric, or even a graphic equalizer, will battle the sibilance better, but the De-Esser can be a fairly quick fix. Larger units which process for multiple microphones will have De-Essers and other controls for each mic, since these could be dramatically different for different voices. If you're only buying a processor for De-Essing, a patchable outboard EQ might also be an option.

Akin to the notch filter that is the De-Esser, are some basic High and Low Frequency EQ settings (higher end processors may allow for even more molding of the audio from an individual microphone). The High and Low EQ settings are basically shelving equalizers, similar to the high and low frequency EQ on a multi-channel console. If using the bass end of this control, make sure you check to see if the High Pass Filter is on or off.

Dynamic Duo

Another valuable feature of even the most basic mic processor is the Compressor and Expander. These controls act in opposite fashions. They affect dynamic range – the range of volume from softest to loudest. These features come in handy not just in studios, but also in live stage production. Here's how they can help in the studio and you can imagine how they help in a sound stage placement where feedback is a concern.

Without a Compressor or Expander, audio devices operate on a Unity Gain system. For every one decibel of audio that goes in, the device produces one decibel of output. Normally that's good, but there are times we want to manipulate that correlation.

The Compressor reduces dynamic range. Simply put, we can tell the mic processor that when the level of audio coming from a certain microphone gets too "loud," we want the processor to act as a regulator to reduce the output. We can set a threshold of audio level and a ratio of output that literally allows the Compressor to help us watch the overall audio level of that mic.

For instance, we can set a threshold of 85 dB and a ratio of 3:1. When the audio entering the Compressor exceeds 85 dB, after that point the Compressor will produce just 1 dB of output for each additional 3 dB of input. In effect, this helps "turn down" the microphone once its beyond a certain volume. Extreme settings of 9:1 or better create a Limiter and may have some "artifacts," depending on how hard you're pushing the device.

In a studio, the Compressor helps to keep mics at relatively closer levels, especially if you have shouting talent. On a stage, this (along with decent EQ settings) can help fight monitor and PA feedback.

The Expander operates in an opposite manner. Here we can set a threshold below which the device expands the dynamic range. We can set a threshold of 30 dB and also a variable ratio of let's say 5:1. That means that when the audio level coming into that microphone drops below 30 dB, it will drop the volume an additional 5 dB for every 1 dB the level drops – in effect automatically turning the microphone down. When the person on mic is silent, the mic gets attenuated. When they speak again, the device opens it back up. If you use extreme settings of 10:1, the expander is generally called a "Gate."

This feature helps in studios that use multiple microphones for discussions by "turning down" microphones which are not being used at the moment, but will be used very soon. It reduces unwanted extra sound (paper rattling, coffee mugs setting on the table, etc.) from getting into your mix. On stage, it helps eliminate any unwanted audio from mics not being used and fights feedback by expanding the mic's dynamic range.

If your studio is using condenser microphones, you may or may not be able to eliminate its power supply, depending on the phantom power voltage setting of the mic processor. Condenser mics can be persnickety about phantom power voltage, so the pre-set or selectable phantom power settings on a mic processor may or may not help your condenser microphone.

Multiple Personalities

As stated, some higher end processors offer simultaneous multi-microphone processing. Others may offer custom pre-sets so the processor can be switched for different on-air personalities as shifts change. Many stations use separate processors in the air and production studios, but just as choosing microphones, consistency of unit is very important. Properly used, microphone processors can add some depth and quality to the sound of your station, and may be able to help a marginal announcer's tonal quality to become better.

Enlisting Murphy's Law, with flexibility comes a chance to grossly overdo things. Before settling on a setting, test, test, and test again. Check the resulting audio by making a recording and playing it on a lower common denominator speaker on a computer or cell phone. Also make sure that you monitor closely to hear how your settings interact with your on-air processing. That's critical for use of an air studio processor, and especially for talent using a processor for pre-recorded announcements, if you're using a processor in you production facilities.

If the processor is where talent can adjust and tailor the settings for themselves, it's also vitally important to keep the processor where it can't be easily brushed against, making unwanted adjustments and turning a decent announcer into someone who sounds like he or she is lisping because the De-Esser was accidentally cranked up. Also make sure that your talent is well versed in the use and settings on the unit.

Do you have some tips or favorite mic processors or stories? Share them with me at *Radio Guide!*

George Zahn is a Peabody Award winning radio producer and Station Manager for WMKV-FM at Maple Knoll Communities in Springdale, Ohio. He is a regular contributor to ***Radio Guide*** *and welcomes your feedback. Share your stories with others by sending ideas and comments to: gzahn@mkcommunities.org*

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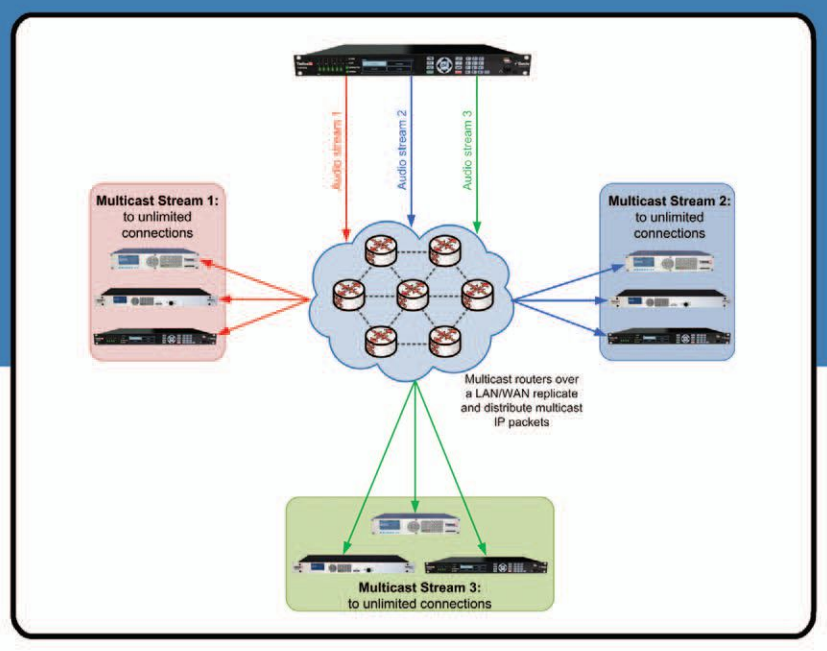

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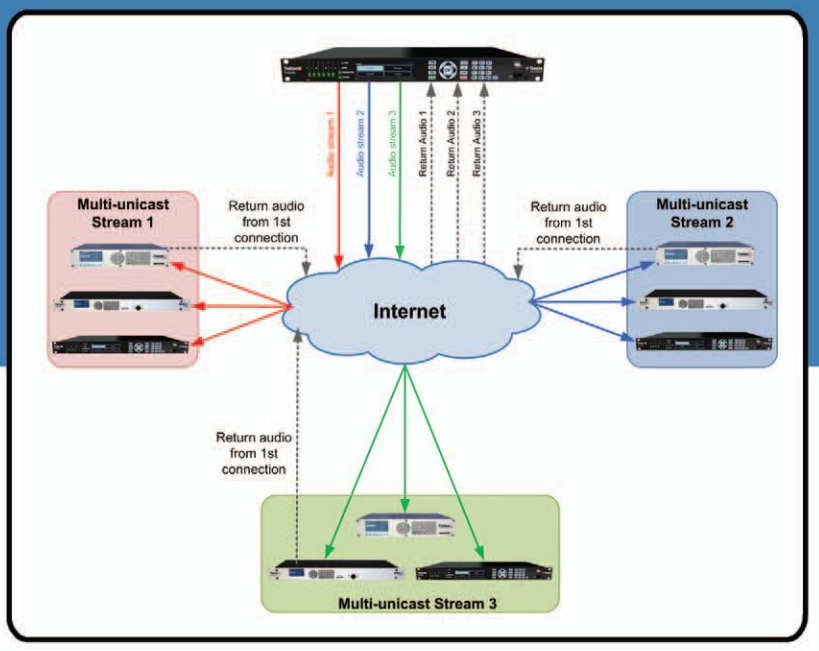

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Outside the Box

Finding the Options

by Chris Tarr

Besides the obvious stuff, like installing new equipment and repairing gear when it breaks, Engineers have another, very important job. We need to remove the obstacles that prevent people from creating great content, and helping station management by advising them and helping them spend their money wisely.

This really came to light a little while back when I has having lunch with a station owner. This particular guy has a single FM in a fairly crowded market. He's doing fine, but obviously has to keep overhead down – but – he wants to stay as local as possible. An admirable goal, if you ask me.

So we sat down for a chat. Right now it's a very lean operation. While the Public File and "main studio" is in town, all of the programming originates from the transmitter site. They have the playback system and EAS equipment there, and he can bring himself "live" on the air via remote control, using a computer or phone hybrid.

He's doing more and more live programming, so he was asking my advice on what to buy for studio equipment. We started talking about the typical studio gear, until it dawned on me – for years, he's done some really great programming without a real studio. A new studio wouldn't see much action since he'll often do a show wherever he's at.

The conversation quickly turned to a discussion on whether or not he even really needs to spend money on a "traditional" studio. After all, where is it written that we need have a fancy studio somewhere to be a "real" radio station? In his case, it's probably wasted money, since most of the time that nice studio would be empty.

So we went about talking of the things he does programming-wise, and what he wants to accomplish. By the end of the discussion, we had created something that was entirely different from what we had started out with. Essentially we came up with a portable studio that will allow him to basically have his studio wherever he is at. We discussed adding an IP codec, so that we can load up software codecs on his high school sports reporters smart phones so that he can get sports updates with much better quality than he's doing it now with cell phones. We then took it even further and looked at getting rid of his copper phone lines at the studio in favor of VoIP so that his phones go anywhere, and he can add local exchanges to other communities.

Had I not taken the time to not only learn about the technology that's out there, but then ask him to thoroughly explain his needs and visions, he would have been stuck with a really nice, empty studio, and a lot less money in his bank account. Neither thing being ideal.

That's why, as Engineers, we need to take the time to not only learn about new technology, but to think about all the possibilities that exist with implementation. For example, I was talking to our phone vendor about our office VoIP system, and asked if there was some reason I couldn't plug a headset into a laptop and do a live broadcast using the VoIP softphone. Not only *can* we do it, the vendor then started to think of new ways for us to stretch the limits of what we had in order to do even more things.

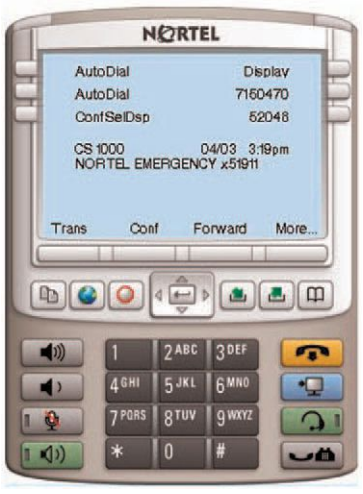
I think we tend to have a natural curiosity, and want to hack devices to get them to do things they were never designed to do. That's something that we need to do with everything! Find new ways to use other things, and constantly ask if we're doing things just because we've "always done it that way."

Many, many years ago, I wanted to come up with an easier way to view the status of my transmitters. We had Burk's Auto-Pilot for Windows, which had a great graphical display of all the status and metering. The problem was that it was meant to be viewed on a single computer, not a network. However, I got to asking why someone just couldn't put the computer out at the transmitter, connect it to the Internet, and access it through VNC? Back then, having an Internet connection at a transmitter site was unusual, so very few people had tried it. I couldn't think of a reason not to, and sure enough, it worked great. I had "IP" control of my sites long before it became common!

It's things like that, that make you especially valuable to smaller stations. Smaller stations, by necessity, need to stretch their technology dollar as much as possible. Any time you can come up with ways that they can compete and sound like the "big guns," while saving a buck, is much appreciated. It's certainly not easy to do all the time, but with some creativity, it's totally possible.

It is very hard to get your mind out of the mold. We've always done things certain ways, many times simply because we've been told it should be done that way, and we just go with it. Sometimes the hardest part is getting past that, and reminding yourself that it's OK to do things non-traditionally, or to use gear in ways that it wasn't intended to be used. As long as it gets the job done, everyone wins!

One of the better ways to accomplish this is to be prepared to ask lots of questions. If I go into the doctor and tell him I need medicine for my sore arm, he may not discover that I sprained it when I fell down the stairs! Our job is like that – the small station owner started out thinking he needed a new studio, when really he needed a portable one.



Nortel IP Softphone

It reminds me of another station owner who was tweaking on his processing. He kept asking me if the "numbers" on the settings were OK. I kept reminding him that the numbers were just someone's reference point, and really meant nothing. Does it sound good to you? If so (and you're not overmodulated) then you're good to go! I know of a least one small station using a limiter as a compressor by slowing down the attack and release times – it was a box that they got for free, and it helped improve the sound of their processor. Again, nothing wrong with using it in a way that it wasn't intended. They improved their audio for free, and everyone was happy. If I just told them "Nope! You can't use a limiter in place of a compressor!" They would have missed out, and I would have done them a disservice.

That's obviously not to say that you can always repurpose gear for other jobs, or even that you should, in all cases. Really, what this means is that the more creative we get, the more we can help stations get the job done and save money in the process.

This isn't always about saving money. Sometimes, you find yourself in a situation where you think you have to say no. We had a situation at one of my stations where we had our normal remote broadcast codec in the shop. While it was in repair, an opportunity came up to do a broadcast from a big event. The Program Director said he didn't want to do it, because our only option was to go "live" over a cell phone. I gave it a little thought and came up with a solution that used Skype. We had a small mixer that we plugged into a laptop on-site, and installed Skype at the studio. It all worked well, and the remote sounded great. All because I asked, "Why couldn't we use Skype for this?"

That's what makes Engineers valuable to owners and programmers – when you can quickly solve problems, sometimes in unconventional ways, and remove the existing technological barriers preventing content from being created, or money being made. It once again boils down to this: are you the kind of Engineer that tells people why things *can't* be done, or one that tells them that *anything* is possible.

I have a saying posted in my office, reminding me and my co-workers of my motto: "It may be difficult. It may be expensive. It may be crazy. But it can be done."

We need to think of ourselves as enablers. "No" is not an option.

Christopher Tarr holds the CSRE, CBNE, and DRB certifications from the Society of Broadcast Engineers, and is the Director of Engineering for Entercom's Wisconsin stations. He can be reached at chris@tarr.cc

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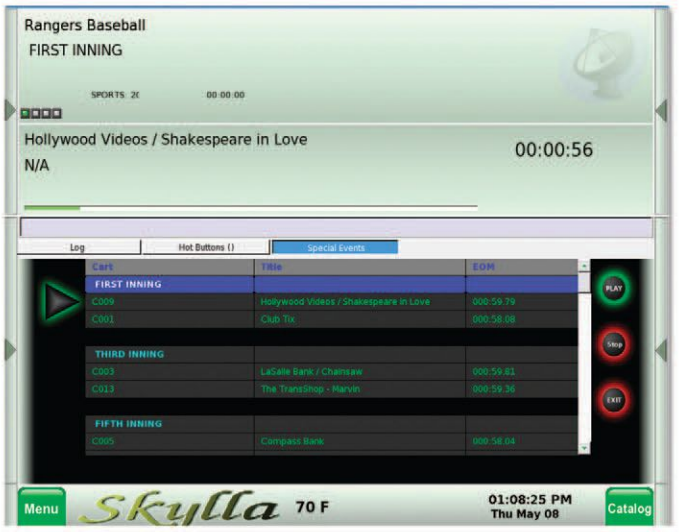

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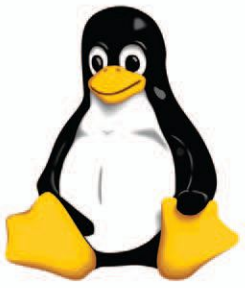

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Frequency Locking AM Stations

by Edward A. (Ted) Schober, PE

There have been many ideas for improvement of AM broadcasting, from changes in allocations, enforcement of FCC Part 15 (unintentional radiator) Rules, removing unnecessary rules and technical modifications. One of them, precision frequency control of AM stations, suggests a technological improvement that can be undertaken by stations without any regulatory changes: It is authorized by present rules.

Tom King of Kintronic Labs presented this as one of a number of "fixes" in his recent presentation to the FCC. As a bit of background, FCC Rule section 73.1545(a) requires that the carrier frequency be maintained within 20 Hz of the assigned frequency. All recently manufactured transmitters easily meet this loose specification over all normal operating conditions, and most are at least four times more accurate and stable than this value. Any frequency variation less than 20 Hz is permitted under the current rules.

Frequency locking improves only certain problems with AM broadcasting. It helps when the stations involved have same channel (co-channel) interference from another station. There is no benefit from interference from adjacent channel stations, or noise in the absence of co-channel interference.

Co-channel interference manifests itself in several ways. If the desired station and the interfering station were to be offset in opposite directions, and at or near the 20 Hz limit, the result would be primarily a low frequency "hum" due to the beat frequency that would be likely to be heard on radios with extended bass response. The more severe the interference, the louder the hum. If only one station were off frequency near the tolerance, and the other one exactly on frequency, or both stations were off by half the allowed tolerance in opposite directions, the hum would be likely to be inaudible except when a receiver had outstanding speakers or headphones. The second degradation of sound in this case would be a gravelly intermodulation distortion of the audio, because the demodulation of the desired signal in the receiver would be disturbed by the foreign carrier. The phase angle of the undesired carrier continuously precesses because the carrier frequency is not the same.

An AM station's carrier must phase align with its sidebands, for a receiver to detect the audio. When there is interference, the desired and interfering carriers add to misalign the phase of the received carrier with the sidebands, causing the audio gain of the detector to vary.

The symptom heard by the listener is like the radio's audio gain control is cranked up and down in time with the changing phase of the sum of the carriers to the sidebands. This happens because the desired station's carrier frequency isn't exactly the same as the interfering station's and the received carrier phase keeps changing.

This is what happens when the difference frequency is large, and the receiver's automatic gain control (AGC) does not follow the amplitude "bobbles" from the carrier beat. The receiver AGC time constant of typically 15-30 milliseconds is designed so that audio modulation does not vary the AGC voltage – only changes in signal level. When the carriers differ by less than 10 Hz in frequency, the AGC control voltage will fully track the beat. This exacerbates the pulsing of loudness (and noise) in the receiver's audio.

Ambient noise in the AM channel is not correlated (matched to) either carrier so its effect is to just "tag along" with the desired modulation – its detected amplitude is not affected by the beating of the carriers, it comes through at a constant rate. When the modulation audio is decreasing and increasing in loudness due to the disturbance of the detector's action by the carrier beat, and by the pulsing of the AGC gain, the relative level of the noise pulses up and down in relation to the program. This is very annoying if the noise level is high enough to be heard with the program.

AM HD radio, whether digital or hybrid, uses the carrier for synchronization. In the presence of interference, it is quite possible to lose lock simply due to phase errors in the detected carrier when there is beat from an interferer – analog or digital. DRM-30 synchronizes from several carriers clustered near the center of the channel and if implemented well, can be more robust in rejecting carrier offset interference from other DRM-30 stations. DRM-30 does not have a single strong carrier, so beat interference to or from analog or HD stations is not a factor.

In the daytime, AM stations, other than class C stations, usually only have co-channel interference issues with one other station, only at one edge of the service area. At night, co-channel interference limits most station's coverage area, and this is where frequency locking has its greatest value. Mitigating night interference is frequency locking's strong suit.

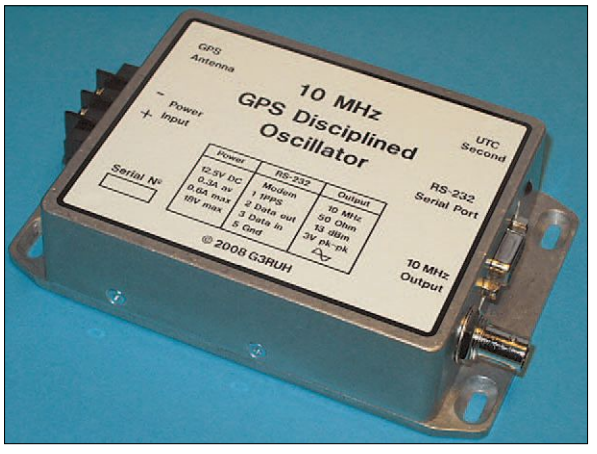
There is an economic problem with frequency lock. Both the station that causes the interference and the station(s) that receive the interference must implement frequency locking to gain any benefit. There is little economic benefit, for example, for a Class A 50 kW station to GPS train its frequency. The dozens of other stations that are on the channel protect the Class A station to a very weak signal level, but they receive massive nighttime interference – not the Class A powerhouse. The owners of the class A station have no incentive to install and maintain another piece of equipment. I suppose the Class B stations on the channel could each "chip in" and buy the Class A station frequency training equipment.

Class C "graveyard channel" stations probably stand to gain the most from frequency locking. These stations have tiny service areas at night because dozens of other stations rain co-channel interference on them. It would require most Class C stations on a channel to team up to train their frequencies to be truly effective. I am not sure that this could happen without forming some kind of channel alliance, such as "The 1490 kHz Club" to buy the units in quantity and in some cases finance and/or give units to financially strapped local stations.

In an effort to decrease the costs of electricity for high power transmitters, and improve a station's "carbon footprint," a number of "Modulation Dependent Carrier Control" systems have been implemented. These systems decrease the carrier level for moderate levels of modulation, sometimes decreasing the modulation depth to compensate for the increase in receiver gain as the AGC adjusts to the changing carrier level. These systems have been shown to be very effective in saving energy while having minimal effect on the received signal. Full carrier is usually provided for low modulation levels so that the receiver AGC will mute ambient noise, and at high modulation levels to support peak modulation. Mid level audio will normally mask quite a bit of ambient noise due to psycho-acoustic effects, so the carrier and modulation is reduced for those levels.

The plan works fine unless there is carrier beat from a cochannel station. I have listened to several stations that have implemented MDC systems at the edge of their night groundwave service areas, and found the noise pumping from co-channel beat to be quite pronounced compared to full carrier operation. Frequency training may strengthen the remaining weak link in implementing MDC systems.

Locking the carrier frequency of AM stations is not difficult for modern transmitters. Most of them provide a 10 MHz reference frequency input which, when fed with a GPS trained reference, will do the entire job. This can be provided by any of a number of commercially available GPS standardized reference oscillators. These can be available as one rack unit boxes that connect with a simple BNC cable to the transmitter reference input, and mounting the GPS antenna in the clear on the transmitter building. Multiple transmitters at a single site can be trained with a single reference. Older transmitters may need a locked reference at the carrier frequency or at a convenient multiple, such as two or four times the carrier frequency, which is a more complicated configuration, with the reference source being more expensive. Additionally, it may require a skilled technician to connect the equipment to older transmitters.



GPS standardized reference oscillator.

Frequency locking of AM stations is truly a good idea, in that it provides a modest measure of improvement to the service areas of stations operating at night and stations with daytime co-channel interference, within their market areas. The cost of implementation for modern transmitters is between $800 and $1,500, and somewhat more for older, crystal controlled transmitters. The largest impediment to its implementation is the fact that it requires both the station receiving interference and the station causing interference to cooperate, while the station causing interference has little incentive to install and maintain another piece of equipment. Stations implementing Modulation Dependent Carrier Control should certainly consider this as a part of the budget for its implementation, both for themselves and for the stations entering their AM "night limit."

Ted Schober, PE, is a consulting engineer, and the owner of Radiotechniques Engineering, LLC. He may be reached at: ted@radiotechniques.com

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FCC Focus

Radio and Net Neutrality

by Peter Gutmann

Following publication of the FCC's "open Internet" decision, most of the broadcast industry gurus have been conspicuously silent on the matter. That seems quite surprising, as the decision is bound to hold major significance for radio.

While I'm afraid I don't have a brilliant analysis to offer, it seems appropriate to consider an overview. Perhaps then you can draw your own conclusions.

The FCC Decision

The new FCC rules employ Title II of the Communications Act to classify Internet providers as common carriers and thus subject to its rules that prohibit most content-based discrimination. Among the categories of prohibited practices are outright blocking of lawful content, applications or services; discriminating among service providers; throttling (impairing or degrading quality); and interfering with or otherwise disadvantaging a consumer's ability to select, access and use the content of his or her choice.

Of paramount importance to radio is the ban on paid prioritization – favoring some traffic over other traffic, either in exchange for consideration or to benefit an affiliated entity. The intended purpose of these controls is to prevent the wealthiest competitors from paying for superior distribution or prioritization of their own content.

However, all of this is subject to a mammoth exception for "reasonable network management," broadly defined by the FCC as "a practice that has a primarily technical network management justification but does not include other business practices." The Commission elaborated somewhat as to how this amorphous standard is to be applied: "A network management practice is reasonable if it is primarily used for and tailored to achieving a legitimate network management purpose, taking into account the particular network architecture and technology of the broadband Internet access service."

While even that explanation seems vague, so far it is being understood in terms of ensuring network security and integrity by addressing traffic that is harmful to the network. Examples of such injurious conduct include denial-of-service attacks (DoS) and content unwanted by end users. On the other hand, the standard would permit limitations that alleviate congestion without regard to source or content, such as bandwidth limits or surcharges for heavy usage. Key factors in evaluating reasonable management will be when and how a practice is applied, as well as the architecture and technology of a particular Internet access service.

With such an expansive definition but without objective standards, it is easy to predict that "network management" is apt to be routinely claimed as the rationale for nearly any practice, including those that have an adverse impact that users deem unfair and discriminatory, such as slowing down some services under pretext of maintaining network integrity. As radio develops multi-platform delivery alternatives to over-air broadcasting, we will rely upon our ability to reach our listeners through the Internet. Should that become inhibited through efficiency or cost discrimination under a pretext of a requirement of "network management," the effect could be devastating.

Allegations of particular violations of the core principles are to be examined on a case-by-case basis. The Commission has provided some guidance for such evaluations. It has provided that the following factors are to be applied: the degree of end-user control (and the transparency of network controls from the perspective of end users); the extent to which practices enhance competition and consumer options (as opposed to practices that disadvantage edge providers' ability to reach consumers); the use of unfair or deceptive billing practices (including "cramming" [adding unauthorized charges to a phone bill] and "slamming" [switching a subscriber's telephone service without consent]); failures to protect the confidentiality of consumers' proprietary information; practices that stifle innovation or free expression; and the extent to which methods conform to best practices and technical standards adopted by broadly-representative, independent or industry standard-setting organizations.

Implementation

So ... what hath the Commission wrought? And just what does all that mean? Excellent questions! Clearly, it will take many cases and much time before meaningful practical guidelines will emerge to steer the industry toward navigating its way through these rather abstract parameters. To accelerate that process, the Commission has delegated authority to its Enforcement Bureau to issue advisory opinions, especially where there is a lack of FCC or court guidance on the conduct in question or where the decision will be of significant public interest.

But even that may never happen. The FCC vote was 3-2 along party lines, with the two Republican commissioners vehemently opposed, and so it might not survive a change of administration. Beyond the FCC level it already faces Congressional resistance, bolstered by heavy lobbying, and Congress can override the FCC through legislation whenever it wishes (subject, though, to a White House veto – and President Obama, for one, strongly supports the FCC action). Politics aside, the new rules will have to survive aggressive court challenges, which have already been filed. Social pressure is also bound to build, pitting freedom of expression against fear of government control – and recall that the FCC received millions of public comments while its proposals were pending. The debate is apt to be fueled by investors who fear that control may stifle innovation and returns on investment should the Internet become subject to the same oversight as any other public utility. So the final shape of the rules, as well as implementation itself, is far from certain at this point.

The Future

Assuming that the FCC's rules are put into practice without significant delay or alteration, what does all this mean for radio? That would seem to depend upon where we see our industry headed five, ten or even twenty years hence, rather than now.

For the immediate future, net neutrality probably won't have much impact on the current business model, in which our audiences continue to receive radio mostly over the air. Rather, the most immediate effect upon radio and most other small businesses might be as consumers – the ability to obtain Internet services relatively free of gatekeeper control and predatory pricing. A corollary benefit could be the transparency rules that the Commission adopted, which are intended to enable end users to make meaningful comparisons of services and costs offered by competing providers. (That, of course, assumes that there in fact is robust competition, which is hard to find in most markets and is bound to diminish even further as time progresses and providers grow, consolidate and solidify their dominance.)

Yet our audiences undoubtedly will continue to migrate to Internet platforms. As they do, radio will have an increasing stake in the extent to which gatekeepers are able to restrict or facilitate distribution of our programming streams. So as time passes, control over the Internet will wield an increasingly potent influence over the link between radio and our audiences.

Details may be hard to predict at this point, yet one aspect that seems beyond reasonable doubt is the magnitude and near-certainty of audience migration and thus its potent impact upon radio. As this is being written, Verizon announced its purchase of AOL, hard on the heels of earlier news that AT&T is buying DirecTV for nearly $49 billion, a clear indication of the perceived value of such mergers and the direction of industry leaders' thinking. Of course, both face regulatory hurdles of the type that derailed the Comcast/Time Warner deal.

The clear trend of these mergers is to consolidate content with its delivery platform – the medium and the message, as they used to say. And it is equally clear that industry leaders envision platforms of the future to be mobile and digital. Already phones and other mobile devices have supplanted computers to connect us to the Internet, and that trend has been led by the rising generation upon which the future of our industry will rely, and will only accelerate.

One way or another, it is essential that radio prepare to utilize and benefit from Internet delivery of its content, as we evolve from broadcasters to "edge providers" in the evolving terminology. Content surely will remain king, but distribution of that content will be an increasing challenge that must be met. That challenge only will rise as the former AOLs and other Internet service providers evolve from mere "dumb pipe" connectors to originators of their own content, thus creating opportunities for advertisers and competition for radio and others who formerly were comfortable in their role as unique content providers.

The NAB, which can be assumed to advocate on behalf of the overall industry, so far has taken a neutral stance. Perhaps this reflects a hesitancy to wade into the divided politics of its membership, or perhaps a schism between TV, which already is largely distributed through the same cable forces that control broadband, and radio, which for now mostly maintains its traditional over-the-air broadcasting technology. Or perhaps it merely reflects the uncertainty that pervades the thinking of many lay observers so far.

FCC Chairman Wheeler has urged broadcasters to support the new scheme so as to enable us to distribute programming directly to listeners on mobile devices over the Internet without fear of being blocked or subject to extra fees. Of course, as the primary architect and advocate of the new rules, his position is hardly surprising. Yet, once the industry continues to mature and adapt to Internet distribution, major players may indeed want to extend their dominance through various types of packaging or premium payment plans while smaller entities, innovators and start-ups would fear being shut out if their entitlement to equal treatment was not adequately protected.

Perhaps all that can be said with absolute certainty at this point is that whatever regulatory model develops for the Internet will define the future relationship between radio and our listeners.

Peter Gutmann is a partner in the Washington, DC office of the law firm of Womble Carlyle Sandridge & Rice, LLP. He specializes in broadcast regulation and transactions. His email is: pgutmann@wcsr.com

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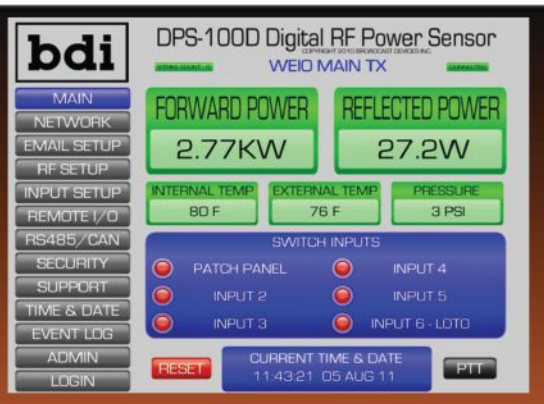

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Audio Guide

The EV 635A

The Dinosaur That Will Not Go Away

by George Zahn

Among the various microphones we have discussed, none has spurred so many comments as "The Hammer" – the Electro-Voice 635A. Witness the fact that I made a vague reference in ***Radio Guide*** back in 2006 to the 635A and an unorthodox demonstration.

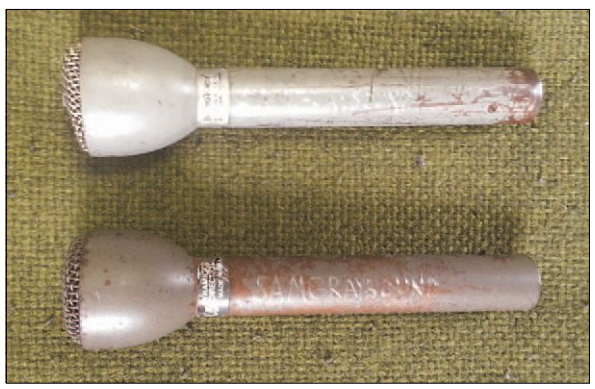
The Early EV 635 – Circa 1948
www.reel2reeltexas.com

I had described briefly what I now refer to as "The Legend," which dates back to the 1960's, when broadcasting's durable marvel was introduced to replace its earlier namesake. Little did I know then, that we would hear so much more about this iconic dynamic microphone, which has become a staple of electronic newsgathering over the decades.

It's "Hammer Time"

To recap a brief summary of my mention of the 635A almost eight years ago: "The Legend" goes that the demonstrator of the 635A spoke into the microphone to show its quality. He then potted the microphone down and proceeded to hammer a nail or two into a two-by-four, literally using that same demonstration microphone as a hammer.

The demonstrator then potted the microphone back up – and it sounded the same!



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Getting to Know the Hammer

The first feedback came on some clarification of the origins of the microphone that would become the 635A that we still know today.

Recording engineer Eric O'Brien of Imperial Sound Studios in Terre Haute, Indiana wrote and explained that the Electro-Voice Model 664 was the first to have the "hammer" nickname. EV "co-founder" Lou Burroughs (he formed Electro-Voice out of a partnership with Al Kahn) would hammer a few nails into a two-by-four, using the 664, and then use the same microphone for PA during sales pitches to prospective customers.

Thanks to O'Brien, we know that not only was the generic term "hammer" used, but also the moniker "Buchanan Hammer," because the microphones were originally built in Buchanan, Michigan.

Eyewitness Accounts

When I referred to Mr. O'Brien's recollections, the 635A story continued to grow. I started receiving more eyewitness stories of those who actually attended these demonstrations, thus verifying "The Legend." One, Chief Engineer Bill Draper from CC of Hudson Valley in Poughkeepsie, New York, emphatically stated, "I can tell you from first hand experience, it's no legend!"

Draper continued, "I was one of the founding members of New York City Chapter 15 of the SBE back in the late sixties. We held our meetings in the spacious performance studio of WQXR, courtesy of then CE 'Doc' Masoomian. At one of those first meetings our guest speaker was none other than Lou Burroughs who started his presentation using a 635A feeding the PA and then proceeded to pound a few nails into a two-by-four with it. Afterward the mic sounded as good as ever and I became a believer."

Draper said that if a microphone was needed for newsgathering or remote work, the 635A was the microphone he recommended.

Meeting The Challenge

Peter Boyce of Midamerica Electronics Service in New Albany, Indiana added that he observed a direct challenge to Burroughs at another SBE demonstration.

"Lou Burroughs was demonstrating the new 635A hand-held microphone, removed from a stack of new, boxed 635A's. Al Scherer, member of SBE chapter 35, took him to task and said it was a special mic for the demonstration, upon which Mr. Burroughs asked Al to come forward and choose which new, boxed mic he preferred him to use for demonstration. He simply took the new mic, and proceeded to drive more nails in the board."

Boyce even noted the reactions in the room of engineers, "There was noticeable cringing on the part of most engineers who were in attendance. Back in those days, the microphone was considered a precision instrument – not to be dropped or blown into. Ribbon mikes in fact failed when the ribbons were stretched from the 'blowing test.' Lou knew he had a good product, and the broadcasters bought them by the case-full. There are many 635A mikes still in use after more than forty years."

A New EV 635
Ready for the Tool Box

A Durable Product

In Mr. Boyce's correspondence, he added that the 635A can still be ordered today – and that is very true. A quick check of the Electro-Voice web site still touts the microphone for its durability, and features an article on one broadcaster who has used the same model for more than 30 years.

The EV 635A model is omnidirectional and not stunning to look at, although it does come in what EV calls a fawn beige (basically a gray) or black finish, either of which can be re-finished if the microphone gets nicked up. The listed frequency response of 80 to 13,000 Hz, +/- about 3 dB (from the EV response graph – the dB variation is not even listed on the official EV website), will not likely win any Grammy awards if you are recording a piano or a harp, but that is not its purpose.

It is obvious Burroughs was not really expecting this microphone to end up as a critical music recording device. The simple dynamic microphone design was forged to handle the pitfalls, and sometimes pratfalls, of mishandling in the field. It was designed to be used exclusively for voice work – not critical areas, but for the news reporter who needs a disaster proof microphone. From the stories about these microphones being dropped or accidentally run over, the steel encased microphone's legend continued to grow.

Noteworthy Drawback

Lest you think from the exulted lore that this is the perfect microphone, please keep in mind that – in addition to the marginal frequency response for anything other than voice – this is also an *omnidirectional* microphone. I imagine a few novice news reporters may have had less than ideal audio brought back while interviewing a fire chief on the job, while standing a bit to close to a noisy firefighter pumper truck. And obviously, the omnidirectional pattern is a detriment to its use as a PA microphone due to the risk of feedback.

Even today, you can still buy the 635A in single boxes or six-packs. The price point of under $225 list (you can find it new retail for $130+) makes it an attractive buy for multiple microphone purchases at large news organizations. It is lightweight, about six ounces, and most companies that make custom logo clip-on microphone flags have designs that are made for the handle dimensions of the 635A.

In today's digital domain, we are constantly bombarded with new criteria and a host of improvements to everything technical; sometimes it seems some of our technology is already outmoded as we remove it from its original box.

Yet, while there may be crypto-zoologists out there still searching for the Loch Ness Monster or other creatures that were thought extinct, the EV 635A is alive and well. As proof, we offer many sightings, thanks to many of our readers who can confirm that this 40 year-old "dinosaur" from the 1960's can still hold its own.

George Zahn is a Peabody Award winning radio producer and Station Manager for WMKV-FM at Maple Knoll Communities in Springdale, Ohio. He is a regular contributor to ***Radio Guide*** *and welcomes your feedback. Share your stories with others by sending your ideas and comments to: gzahn@mkcommunities.org*

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Simian Remote clients are completely free. All you need is the Simian Gateway and you can install and run a Simian Remote client on as many devices as you wish. There are Simian Remote client versions for both Windows PC and iPad.

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Rules & Regs

A World Without the FCC?

by Steve Callahan

Yes, the title of this article is a bit over-exaggerated, but not by much. Back in the 1920's, there was no Federal Communications Commission because the early days of regulating commercial radio fell under the responsibility of the Department of Commerce, which was headed by future president Herbert Hoover.

Back in the very early days of radio, stations picked a frequency and just operated at whatever power level they could achieve, both technically and financially. Of course, that led to a lot of interference among the ever growing number of new radio stations coming on the air.

Fast forward almost 100 years to today's media landscape. It seems like every sliver of the electromagnetic spectrum is occupied, or *will* be occupied. The Federal Communications Commission is charged with regulating the ever-expanding world of radio, wireless, broadband, and satellite communications. One very important aspect of the FCC's mission is their network of field offices which act as the local point-of-contact with the FCC. Unfortunately, the FCC's Enforcement Bureau plans to ask the full Commission to cut its local field offices by a third and eliminate nearly one half of their field agents. It's quite clear that FCC Chairman Tom Wheeler supports this proposal strictly from a budgetary perspective. He said, at the recent NAB Show, that it's been two decades since the FCC assessed its field operations, and "any manager who only reviewed operations every 20 years would be a former employee." However, Mr. Wheeler is new to the FCC and judging by the industry uproar, his decision is very simply, a mistake.

An internal memo sent back in March to the FCC's field staff said that the Enforcement Bureau needed to take a "fresh look" at the Bureau's operating model in light of technology changes and tighter budgets. Phase One of that modernization scheme would reduce the number of field agents from 63 to 33, and to compensate for that reduction in local presence, a "Tiger Team" of agents would be established to support "high priority initiatives." Additionally, 21 director positions would be reduced to 5, and 10 administrative jobs would shrink to just 3. The number of field offices would be cut from 24 to 8, with offices in New York City, Columbia, Maryland, Chicago, Atlanta, Miami, Dallas, Los Angeles and San Francisco. Equipment for RF spectrum enforcement would be "pre-positioned" in Kansas City, Salt Lake City, Phoenix, Seattle, San Juan, Anchorage, Honolulu and Billings, Montana.

When I first started working in radio, I thought that if I missed a station ID or an hourly meter reading, then the FCC would soon be standing in the station lobby. Because of this belief that they were out there and listening, we were all ready at any time for an official FCC inspection. As the sheer number of stations increased, those inspections were less common, except if they were prompted by a specific complaint or enforcement sweep, such as tower light performance or EAS participation.

The local FCC offices also started to take the brunt of finding and shutting down the flood of pirate radio stations that have appeared in every major city in the country. Pirates interfering with airport frequencies and first responder frequencies are a real danger, and at some FCC field offices they have asked for and have received assistance from local law enforcement to arrest the pirates and confiscate their equipment.

In the Boston area, I have seen the time and effort that our local FCC Field Office has expended to try to squash the number of pirate stations that seem to pop up daily, but they have also been extremely responsive to the local radio engineering community.

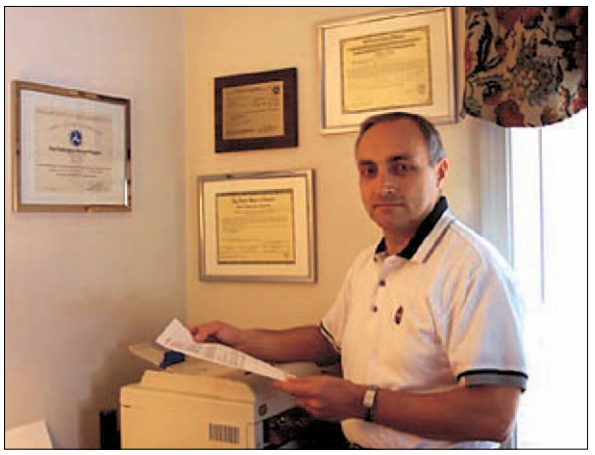
Some folks still erroneously think that the FCC just sits around their office waiting for a reason to go out on station enforcement calls. However, the FCC's field office engineers have a lot on their plates. If they are on a shoreline, they are actively involved in marine communications. If there are reports of signal leakage in a cable system which has the potential to interfere with aircraft frequencies, the local FCC Field Office has to provide the legwork to investigate the complaint. They answer complaints not only about pirate stations and full power stations, but also interference from Part 15 low power devices like baby monitors and garage door openers.

The local FCC field offices also are invaluable to assist public service communications like police, fire and EMT first responders when their radio systems have interference issues. It's a bad idea to have to depend on an out-of-town "tiger team" with little or no experience in a particular area, and no knowledge of the local terrain, to try to identify, and then resolve interference problems and to conduct much needed timely enforcement.

I have had very positive experiences with the Boston Field Office of the FCC on several projects over the years and I know I can pick up the phone and ask their guidance on a variety of questions concerning the FCC's Rules and procedures. I once had a problem with power line interference to an AM signal along a particular road. The local field agent showed me how to confirm that the problem was a bad insulator on a power pole. When I noticed that a tower in my area had been unlit for several months, the local Boston office acted immediately on my report. When I asked the field office to confirm some out-of-band emissions I found on a station, they immediately visited the offending station.

Boston-area engineer John Mullaney related several stories of how the local FCC field office addressed, and in one case shut down a pirate within a week, and he's glad there is a local Boston-based FCC office to call for assistance. David Maxson, engineering consultant at Isotrope LLC, also based in the Boston area, said, "Considering that the combined population of the radio markets in New England rivals Los Angeles, being without a Boston field office would put an unreasonable burden on a New York City based field office that also has to cover the NYC, New Jersey and Pennsylvania areas."

Robert Shotwell, who coordinates the Alternate Broadcast Inspection Program in New England, says the greatest disappointment about closing the local FCC field offices is the loss of, "the field agents who were the people that everyone at the local stations got to know." Bob added, "the field office personnel were likewise familiar with those in the local broadcast industry, in particular the engineers, and they knew who played things straight at the stations and who played fast and loose." Bob said, "As for how this proposal will affect the Alternative Broadcast Inspection (ABIP) Program, of course only time will tell." The ABIP program is not a replacement for FCC field enforcement or a "get out of jail free card" but it provides another set of eyes on potential issues that can, if neglected or ignored, become fineable offenses.



Robert Shotwell – coordinator, New England Alternate Broadcast Inspection Program

In this writer's humble opinion, closing local FCC Field Offices, with a documentable history of a growing pirate problem, would open the door to many more pirate stations and would legitimize illegal operations which would be a major step backward to the 1920's. Rather than closing field offices, more effort, manpower and resources should be devoted to the field offices that have documentable need for more, rather than less, manpower to help deal with the obvious explosion in pirate stations and interference complaints.

I'm sure your station has, just like mine, a steady stream of legislators stopping by to appear on your talk shows. Grab them in the hall, call them, or better still, take a few minutes and send an email to their offices to get their support. Tell them your story and let your elected officials know how important the Field Offices are to licensed stations in their constituent areas.

As I like to say, "If it ain't broken, don't try to fix it," and that goes double for the local FCC Field Offices.

Steve Callahan, CBRE, AMD, is the owner of WVBF, Middleboro, Mass. Email at: wvbf1530@yahoo.com

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Chief Engineer

Summer's Coming – Keep Your Cool!

by Scott Schmeling

Summer is coming – I promise! As I write this, we *should* be seeing temps in the 70's here in Minnesota. But it's 43 right now! Hopefully soon, the warm weather *will* be here. With that in mind, let's talk about getting a good supply of fresh clean air to your transmitters.

Let's face it, in addition to generating an RF signal, our transmitters are also very good *heat* generators. They run all day and night, pumping out tunes and hot air. (In the case of some talk stations, maybe HOT AIR and hot air!) If we want a happy transmitter, we need to get the hot air out.

I know I'm stating the obvious here, but most tube-type transmitters have blowers inside that force air across the PA tube and out of the cabinet. If we look at the building and transmitter as a system, we need to provide an ample supply of air for the transmitter to take in, and remove that transmitter-heated air from the building. A key word here is ample. If we aren't providing enough air – if we are exhausting more than we are providing – we will be creating a partial vacuum and the transmitter will literally be starving for air.

I remember as a young Engineerling, reading in one of the trade magazines, that a blower should be used to pressurize an area (like a transmitter room) and a fan should be used for exhaust. We want to create positive air pressure in the transmitter room. I've mentioned in previous articles that I like to use regular home furnace blowers to force air inside the room. I've always been able to have a local heating and air conditioning contractor build an enclosure with the blower and air filter. Generally speaking, home furnace blowers are rated at about 1,200 CFM.

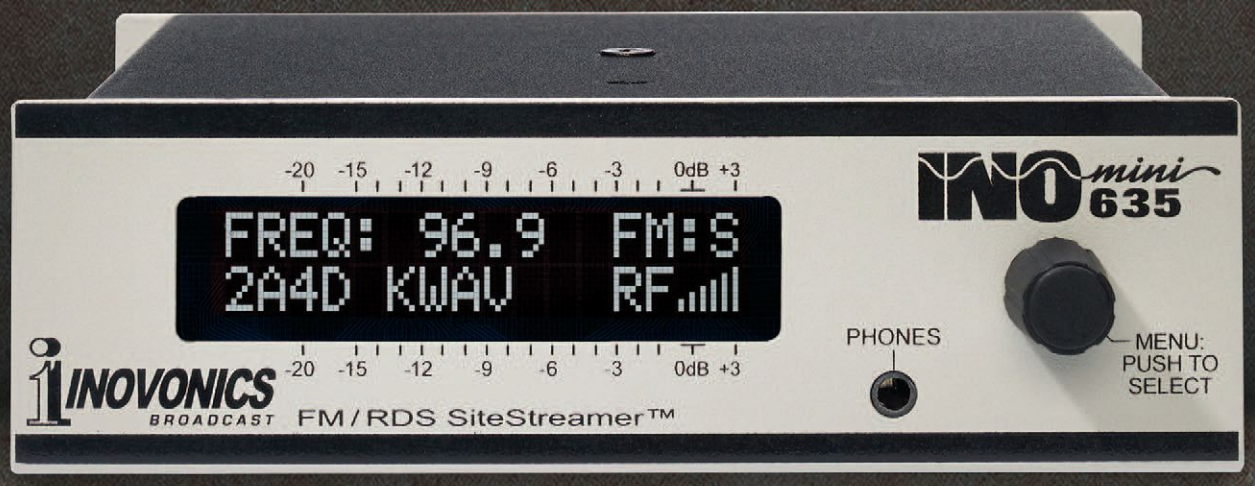
Time For a Cleaning

There's an easy test to see if you have positive pressure and it's right there at the entrance door. Assume your door opens out, if you have positive pressure, the door will tend to push itself open as soon as you turn the knob (inward opening doors will need to be pushed a little harder). If you have to pull on the door to open it, you have negative pressure and you need to force more air into the room.

If you already have a well-working air ventilation system in place, this would be an excellent time to check it, clean it if necessary, and be sure the air filtration is good. Most of our transmitter sites are out in the middle of a field. Every year the fields get plowed, planted, and harvested. All of that puts a lot of "stuff" in the air. The air filters catch most of it – *most* of the time. But invariably, some will get through the filters and collect on the blades of the blower. The volume of air flow drops dramatically as that "stuff" collects on the blower blades.

I have used a number of things for cleaning those blades. Anything from a flat screw driver blade to a wire brush to (and this is my favorite) a piece of dried vegetation from outside. As long as it's sturdy, it will get into the small spaces quite nicely. Also be sure you are using a shop vac to suck up as many of the chunks as you can.

(Continued on Page 22)



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Chief Engineer

– Continued from Page 20 –

And while you're cleaning blower blades, check the transmitter blower and the entire air path, including any screening or "honeycomb" assemblies inside the transmitter near the tube sockets. Chances are it could use a good cleaning, too.

Clean and Bright

One of my sites, in particular, has always been a challenge. We've tried various filters but no matter what filter we used it was always dirty inside. The dirt was fine enough to get through the filter and settled on everything. I will admit that we didn't always visit this site as often as we should and sometimes the filter would get covered and collapse, allowing *un-filtered* air inside.

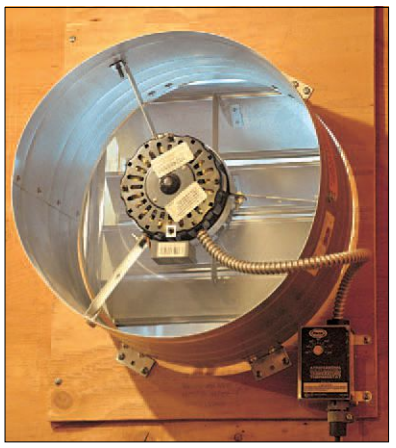
I discussed this with my favorite HVAC guy and we decided to re-vamp the system by doubling the filter surface area and adding additional filtration. We installed a larger intake hood outdoors, with two 16x20x1 washable metal filters side by side (essentially a 16x40 filter). Likewise, inside we have two 16x20x1 poly-fiber filters. The new blower enclosure also includes a layer of expanded metal on the blower side of the filters to prevent them from collapsing and being sucked into the blower blades.

By doubling the surface area of the filters we lower the velocity of air through them. In theory, they should be less likely to plug up. The washable metal filters will get the big chunks and the poly fiber filters will stop considerably more than the "standard" fiberglass filters we had been using. Let me note here, that we had tried other filters types, like the pleated filters, but they would plug up and collapse. The hope here is the outside metal filters will stop enough to prevent the inside filters from being damaged.

We also changed the other part of the system – the exhaust. This site has two 10 kW transmitters and two lower power solid state transmitters. The 10 kW's originally routed their hot air up through the ceiling and into the attic space – the building has a ridge vent. (When we only had one transmitter it worked just fine!) Over time, we added the second transmitter, then the smaller two. Then, one winter a chunk of ice fell from the tower and scored a direct hit on one of the ridge vent assemblies which allowed snow to fall directly into one of the transmitters. (Water and transmitters do not mix!)

We pulled the exhaust duct out and plugged the hole to the attic. The ridge vent was repaired, but we continued to dump the hot exhaust air into the room. Needless to say, the room would get pretty warm.

Our thought now was to add an attic vent fan to the room on the opposite corner of the air intake so the fresh filtered air could travel through the building. We did this at another site and it worked extremely well.



New "Attic Fan" Exhaust

We may have taken this one step too far, however. We removed the exhaust duct from the *other* transmitter as well. Now, *both* transmitters exhaust into the room and the attic access has been closed. Our expectation was that the newly added exhaust fan would pull the heated air out and the room would be clean and comfortable. When everything was finished, the room temperature was just over 80 degrees. That doesn't sound too bad, except the outdoor supply air temp was about 50 degrees. That's a 30-degree temp rise. Which means when it's 95 outside the indoor temp could conceivably be 125 degrees.

We are not calling this project a success ... yet. We're going to watch the temp, and if it does get too high, we will probably direct the transmitter exhaust back up into the attic. I'll let you know how it works.

I would be very interested in hearing how you handle transmitter site ventilation. Please e-mail me a description of your system and how well it works.

Have a great summer – and keep it between 90 and 105!

Scott Schmeling is the Chief Engineer for Minnesota Valley Broadcasting. You may email him at: scottschmeling@radiomankato.com

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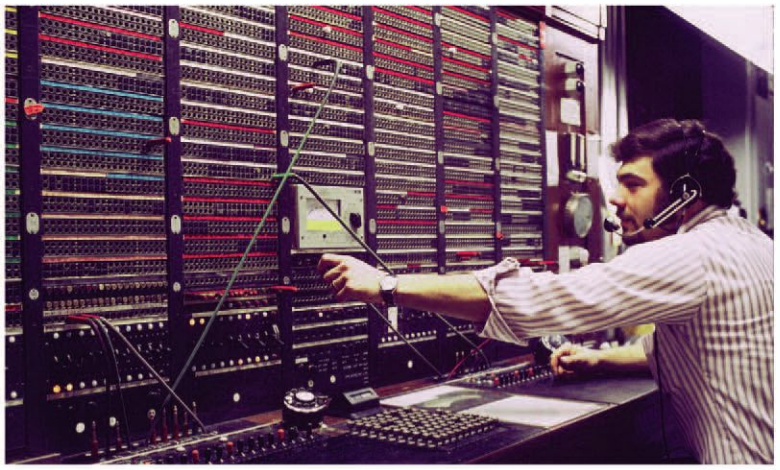

Which Switch for AoIP?

IP audio networks are very different from standard enterprise or office networks in almost every way, but none more spectacular than the nature and volume of traffic.

For this reason, the Ethernet switches used in an IP audio network like WheatNet-IP need to have a high-capacity fabric, which is the actual mechanism that allows the switch to pass data among its ports. There are different ways that switches handle traffic – store and forward, cut-through, fragment-free, adaptive switching – but regardless of fabric used, it needs to be of sufficient capacity to handle full bandwidth traffic without blocking. Also imperative: the switch needs to be a managed switch and it has to be able to snoop IGMP packets and switch them appropriately. Otherwise, multicast traffic is going to flood everywhere. For other tips and an in-depth look at switches for IP audio networking, go to:

For the entire story... INN23.wheatstone.com

IP Consoles 101

Sometimes, even we forget that our IP networked consoles don't actually have live audio in the board itself. (That's why we call them control surfaces – so we'll remember that they control the audio, not store it!)

Shown is web radio OWWR's number-one studio with IP-12 control surface, M-2 dual mic processor, and just the right amount of WheatNet-IP audio networking. Check out those baby-proof covers on the Tripp-Lite power module!

We don't envy guys like Joseph Manfredi, who has to explain IP control surfaces to a group of new students every year as a faculty member in the American Studies/Media & Communications department and station manager for OWWR web radio at SUNY College in Old Westbury, New York. "I'll never convince them that there's nothing under that fader," says Joe, referring to the station's new IP-12 control surface.

Joe has four studios that he teaches out of and streams 25 live shows from weekly, the most up-to-date one being his "Studio A," with the IP-12, M-2 dual-channel mic processor and WheatNet-IP audio network that he and his chief engineer installed last year. The IP-12 is an ideal entry into AoIP for small studios, providing a self-contained digital audio board with WheatNet-IP audio network BLADE engine for flexible access to sources and destinations. "My 'yesterday' studios look and function okay, but this is the one that gets it done," says Joe.

For the entire story... INN23.wheatstone.com

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Safety Guide

"Think Twice, Act Once" Prevents Accidents

by Dave Dunsmoor

To paraphrase one of my favorite comics, Ron White, "Has this ever happened to you? It has to me, I've seen it."

Of course, it is one thing to know (philosophically) about all the potential ways to get hurt, or worse, at our job. It is quite another to get your "diploma" the hard way. The school of hard knocks can be unforgiving.

Now, I know that none of you electronic veterans have done any of the following things, but these stories are for the benefit of the new guys to consider – and to learn from them without having to do the "lab" portion of the lessons.

It *Was* a Quiet Morning

One day my co-worker was working quietly at his desk while I was working up a little circuit on an old Heathkit protoboard; we had wanted to check the operation of a new piece of test equipment.

When I first scoped the circuit, I noticed that it was essentially flatlined, instead of having the desired waveform. After looking things over, I noticed that I had inserted a tantalum capacitor backwards across the power supply terminals.

However, instead of stopping and turning off the power, I immediately grabbed the capacitor so as to remove it from the board. Of course, as soon as I tugged on it the slightest bit, it exploded.

It left my fingers stinging, my ears ringing, a little bit of a mess on the board, and a co-worker who had a slight bruise on his knee after his jump.

A backwards capacitor in an energized circuit is not exactly something you should want to touch.

Ka-Boom!

A slightly different – but even louder experience – occurred some years ago when I replaced four large electrolytic capacitors in a transmitter power supply. My co-worker and I carefully put things back together, and powered the transmitter up. We completed the necessary paperwork and were about to leave the building.

You probably can already guess exactly what came next: there was a very loud explosion, followed by a loud hissing and the sounds of electrical arcing, and then flames started blowing out the top of the transmitter cabinet.

It seemed like far too much time had elapsed before I got to the breaker panel and pulled the power, then grabbed for the fire extinguisher – but really, I think it was probably five seconds at the most. I shot the Halon into the crack between drawers, and the remaining fire was extinguished immediately.

At this point, I was quite puzzled. We had been quite careful to be sure that the capacitors were installed correctly with regard to the polarity. To calm down, we went for lunch.

After lunch we inspected the wreckage. Sure enough all the caps were installed correctly. So what had gone wrong? As it turned out, the replacement caps were rated with a working voltage of 75 VDC in a power supply circuit running at a nominal 67 Volts. Clearly there was not much headroom there, and that is what caused the catastrophic failure. We replaced the caps with some rated at 100 Volts – and that solved the problem.

The Capacitor Charged Itself Out of Thin Air

Some years ago I removed the main power supply filter capacitor from a tube rig, replaced it with a newer, smaller one, and got the noise figure back down to where it was supposed to be. I placed a strip of RG-8 shield around the terminals of the old capacitor and took it back to the shop. All well and good so far.

A few weeks later I removed the shorting jumper and left the capacitor on the floor in the back room. The plan was to go back and test it, to see what was wrong with the capacitor that had caused it to not filter very well.

Fortunately, between the time that I had removed it and when I went back to inspect it more closely, I remembered a comment made by an old Navy sonar man, to the effect that, "the capacitors in the bottom of the boat would pick up a charge out of the air." *(Continued on Page 28)*

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SiteSentry4 SiteSentry2 WAM-2

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- DTMF-16 and DS-8 DTMF tone decoders.

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"Think Twice, Act Once"

– Continued from Page 26 –

That did not make sense, given what I knew at the time, but I knew this guy was a straight shooter, so I took him at his word.

It was a good thing I had listened. I shorted the capacitor one more time with a screwdriver before clipping the test leads onto it. A loud snap and an arc convinced me that his observation was certainly correct, even if the explanation did not make sense.

Later on, I attended a seminar put on by Sencore, a test equipment manufacturer. A small portion of the presentation dealt with high voltage capacitors, and an explanation of "dielectric absorption." This explained the apparent "charge out of the air" phenomenon.

The Wrong Touch

Then there was the story about the Motorola tube business-band transceiver that had spent its life under the seat of a concrete truck.

I was a young tech at the time, troubleshooting the high voltage power supply – an old "vibrator type" which supplied around 550 VDC to the RF power amplifier (PA). For whatever reason – the logic of this decision having long since expired – I operated the transmit/receive relay with the index finger of my right hand.

Although I was careful to keep my left hand in my pocket, I felt the resulting shock far more in my chest than in my fingers. That is to say, that experience gave me an "Associate Degree" in being much more careful in the future. At least, it should have done so.

Working When You Are Tired

One Friday, some years later, a pal and I went to the State Fair to see some band. What sounded like a good idea at the time (a couple of beers, a little music, go home), somehow stretched out a bit. We got home a bit on the late side – he dropped me off at my house as the sun was rising.

It was only an hour or so later when I received an anxious call from a station, informing me that the cantankerous old AM transmitter was off and the Saturday morning "sell lots of stuff" show really needed to go on. I found my way to the transmitter, somehow decided that the RF PA tube needed to be changed, and did so.

The next day I was a bit more clear-headed. As I was rethinking the events of the previous day, I recalled that I had not used the shorting stick before I reached in and removed the old PA tube. That recollection gave me perhaps a "Bachelors Degree" in being careful around high voltage.

Know Where The Power Is

My final story recalls the time I was measuring distances on the ATU platform of a self-supported AM tower with a skirt feed. The project was to replace the old two-by-fours that were used to support the feed ring, with something more appropriate.

As I swung the trusty old Stanley tape around, I briefly brushed against one of the skirt wires and, before I could pull my hand back, there was a small puff of smoke from my finger and an arc at the tape. My finger eventually healed with no other ill effects, but that tape has the reminder permanently embossed. Now, perhaps, I have earned that "Masters Degree" I have been working all these years to get.

Learning From Others

These stories are meant to illustrate three things. The first is something my dad tried to tell me when I was a kid: "Think about what you're going to do *before* you do it." That one sometimes seems to have taken a while to really sink in.

Waving a metal tape around under a tower may result in more than a measurement of distance.

Secondly, if at all possible, learn from other people's experience. This one seems to be the tough one, but can really pay off when done well. And it is really handy if, once you have learned something really useful, you *remember* it.

Finally, even when you have carefully thought out what you are going to do and have done it as well as you can – occasionally things do go wrong.

This is where emergency preparation and planning come into play as in the episode of the exploding power supply capacitors. The breaker panel was readily accessible and the fire extinguisher was nearby. This prevented the fire from getting out of hand and perhaps destroying the entire building.

After many years as an FAA technician in Minot, ND, Dave Dunsmoor has retired and plans to restore aircraft and do some contract engineering. Contact Dave at: mrfixit@min.midco.net

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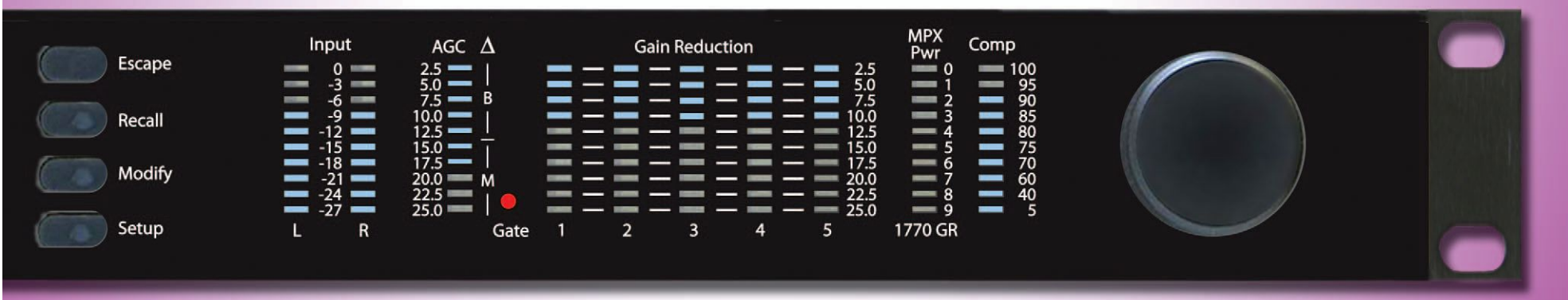

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Tech Management

Paying it Forward!

Mentoring the Next Generation of Engineers

by Tommy Gray, CBRTE CBNE K3ZF

I still have fond memories of sitting in the back of my Dad's Radio and TV shop watching he and his techs fix TV and Radio sets. Shops like these are, for the most part, unheard of these days. We live in a throw-away society where things have become complicated and are usually either sent back to the manufacturer or trashed and replaced when they die. A great many of us came from the age when you repaired everything until there was almost nothing left to repair. As a result of the way things are handled today, competent component-level technicians and engineers are becoming scarce.

One way we as engineers can keep things going for the future is by mentoring. Yes, there are still a lot of kids and young folks around who, with a little enticement, can be interested in becoming technicians. As a result of the ever-growing shortage of competent techs, many stations just do not have a good engineer available. Admittedly, some of this has been caused by stations not paying good engineers a salary that is anywhere close to the pay received by techs of equal training in other fields. Many good engineers have gone into other fields just to make a decent living. I am not going to tell you that is going to change, but I *can* tell you that a good broadcast engineer is still needed and in demand in a lot of places.

Many of us are goldmines of useful information and skills that need to be mined by newcomers. I spend a fair amount of time talking to people about different things we once did, that are rare these days, just to get them to consider alternatives. The knowledge we have acquired from a lifetime of in-the-field work is something you cannot get in textbooks or from the Internet. YouTube videos are good and useful but there is nothing like having someone who knows what to do sharing their knowledge with you.

Helping the Needy

This sounds something like a mission project in the inner-city. However the "needy" come in a lot of forms. Since we are talking about the broadcast industry, let's focus there. One thing we do around here is mentoring. We actually have a mentoring department believe it or not. We believe in "sharing the wealth," so to speak, with regard to training others in the business. Now we don't do the work for them – we teach them how to do it. We do not share proprietary information, but help them in places where they need it. We are perpetuating the industry and helping a lot of folks in the process.

I am currently working with a couple of groups around the world with technical assistance, and help of various kinds. I do not like to travel outside the U.S. these days, so I use Skype™ to do one-on-one video chatting with the people in other countries, as well as a lot of email, all of which usually costs us nothing but a little time. Currently I am working with a new startup in Tanzania for example.

A lot of smaller stations would welcome your expertise in the industry. This is especially true when you consider that most of them either do not have highly trained technical help or, in many cases, virtually no help at all. You will find that your assistance is appreciated and you will get a lot of respect for what you know. Trust me, you help some guy in a small market or a mission organization in a foreign country, and you are their hero for life!

Tight Budgets? No Problem!

Many stations cannot add additional staff to the technical departments due to budgetary constraints. You can get help in your department though, by cultivating your own. There are still those people out there who find electronics and engineering interesting, even in these days of our throw-away device mentality. There are those who are not satisfied with being told to "just replace it." They want to know how it works. Guess what? You can be the person who tells them "how it works" and in doing so you can pique the interest of someone who may end up being the next great broadcast engineer!

Look for the opportunities that come by you on a daily basis. Sometimes it is the facilities guy who has mechanical abilities and a lot of curiosity. Sometimes it is the kid whose parents work at the station and who loves to follow you around with ten thousand questions. In my office, I have a display of a bunch of old ham gear I used back in the early 70's. Just seeing the gear there is a real conversation starter. I have yet to have someone visit the office that did not look at the old transmitters, receivers, etc., without saying, "Wow!" Sometimes I fire up an old receiver just to have the tubes glow. They see the inside of the box and marvel every time. *(Continued on Page 32)*

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Tech Management

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When you do things like this you usually end up with a good candidate for an intern or trainee. One thing I will say here is that you should choose your trainees carefully. Nothing is more frustrating than to invest a lot of time in someone who walks away and does not care. When you find a serious candidate, latch onto them and dig in. One reminder though, talk to management about it first, as there may be insurance or liability considerations you need to walk through. The great benefit of training someone is that you end up getting help, and what busy engineer could not use a little additional help from time to time?

Training For the future

There are a great number of valuable resources available for free on the Internet that will help you to share the wealth with the uninitiated. Navy Electronics courses are good for basic electronics and RF training. You can find them several places on the web in the form of a set of PDF files – just Google™ "Navy Electronics Courses" and you will find them. Also have your "mentee" read the pertinent FCC regulations for the broadcast service they are interested in. These two resources will get them well on their way. Again, one word of caution, get approval from management, and also give them appropriate safety training up front before letting them get into anything dangerous to themselves and others.

I had one young man who was a competent technician in an unrelated field, but who had an interest in broadcasting. With a little supplemental assistance he is now capable to maintaining several smaller stations by himself. The staff is happy with the part time help they get from him, he picks up a few extra bucks each month, and he loves it!

Group Training

One of my performance goals for this year is to again hold basic electronics courses for the staff once a month, to teach the students basic electronics and electricity. I teach them interesting things that capture their attention, and the topics and instruction methods are very basic and kept on a humorous but interesting note. I teach things like "How many strands of Christmas lights can I plug into that 16 gauge extension cord before I burn my house down?" Or, "Can I plug my electric heater into the little UPS thingy by my desk without roasting my computer?"

I keep the questions light-hearted and interesting, and also very practical. I get a mixture of guys and gals, office workers, techs, and even allow family members of staff who want to attend. I teach the classes as a "Brown Bag" lunch at noon so as to not interrupt the work day. Basic theory is taught along with calculations, formulas, etc., so that they can "do the math" for themselves. There is usually a free conference room with multimedia capability available at lunch time. I use a lot of pictures and illustrations to keep it exciting.

The classes have benefitted not only the attendees, but the station as well. On numerous occasions, I have been walking down a hallway and overheard a conversation that went something like this, "Hey, you can't plug that heater into your UPS! Remember what we learned in the class?" The classes benefit on a lot of different levels!

On several occasions, I have had someone from class volunteer to learn more and help out around the station. I have also had someone tell me that they know of a person who would love the courses and that person ends up being a great helper, or eventually a good engineer themselves!

My First Mentor

I think sometimes that my career could very well have been spurred on by a little guy we all called "Weeks," who worked for my dad in the radio and TV shop. He would answer my endless questions and let me as a kid look over his shoulder as he worked. He was so short that he could not reach the bench sitting on the stool. He would squat on the top of the stool and work there all day. I thought it was funny so I started to watch him. I would marvel as he would "thump" tubes, and make adjustments to a set that had a lousy picture – repair a radio with no audio, or some other problem – then the TV would straighten up, stop rolling and look or sound great after a little tweaking. Had he told me to go away, he was too busy. But who knows, if not for "Weeks," I might not be an engineer today!

Tommy Gray, CBRTE, CBNE, KG5FAN/AE, is the Director of Broadcast Engineering/Technology/Facilities at KSBJ/NGEN Radio Networks. He may be reached at: tgray@ksbj.org

Engineering Perspective

Having a Good Outlook

by Jim Turvaville

Radio Engineers have a reputation for being dull, boring or anti-social – especially to Management and the General Station Staff. Admittedly, as a lifelong Radio Engineer myself, much of that reputation is probably founded in reality; or at the very least, we've not went out of our way to disprove it at times. If one looks at some of the humor about and by Engineers, there are some lessons which bear to be repeated about the very qualities of our personality that makes us who we are as a whole. While all of these following bits of humor are unaccredited, they have been in circulation so long that no one probably has a clue where they originated, but suffice to say they are not original with me. As I remind everyone, "if you steal it from me you're stealing twice – it was stolen when I got it." So let's stop and smile.

Single Mindedness

Engineers must be quite single minded in order to be proficient at their work. Those of us born with "the knack" or who caught "the radio bug" at an early age (I was 9 myself) tend to think about our work – a lot. OK, maybe all the time.

Q: How do you spot the Broadcast Engineer on the Empire State Building observation deck?

A: They're the only ones looking UP!

We have also been accused of pointing out towers to dates/spouses while traveling, and being able to identify the brand and model of antennas from upwards of a half a mile away. As odd or irritating as this may be, it sure comes in handy when the GM asks you about the new station that just went on the air. All we have to do is check the FCC databases and then make a casual drive by their site and can pick out their gear – even doing a mental TPO vs ERP calculation to see if they have better vertical radiation characteristics from their antenna than our own station.

Dedication

As a natural progression of thought, that single-mindedness of our work leads to dedication in many areas of our lives. We are not only dedicated to the science that is our beloved Engineering industry, we believe everyone should share that same dedication. In fact, it often irritates us when they do not; some of the most brutal work relationships I've seen are between Engineering and Programming. While Engineers 'doze but never close' they perceive the Programming staff as clocking out and going home every day. It also takes someone special to be married to an Engineer; for those who are fortunate to have a spouse that understands your work, the sense of personal security is immense.

You know you're an engineer when your wife answers the phone at 1:00 a.m. and hands it to you, saying "it's your girlfriend" – because it's the transmitter remote control calling with a fault alarm.

She also knows that's your only girlfriend, and you're lucky you got married in the first place.

In our younger years, being a tech geek tended to keep the girls at bay; until the richest man in America turned out to be a geek who dropped out of college – then our fortunes tended to turn in our favor. I'm especially blessed that my bride is a career radio gal – howbeit as a Business Manager – but having been around the biz and around engineers for 34 years we have a comfortable relationship that accepts the idiosyncrasies of both of our work. It also makes for some crazy wonderful pillow talk, but I digress.

Creativity

In our work, as well as our relationships, there is a careful balance required between professional and personal time. Engineers are always keenly aware of time; everything we do revolves around it and how to manage it best.

An architect, an artist and an engineer were discussing whether it was better to spend time with the wife or a mistress.

The architect said he enjoyed time with his wife, building a solid foundation for an enduring relationship.

The artist said he enjoyed time with his mistress, because of the passion and mystery he found there.

The engineer said, "I like both."

"Both?"

Engineer: "Yeah. If you have both a wife and a mistress, they will each assume you are spending time with the other woman, and you can go get some actual work done."

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Engineering Perspective

Having a Good Outlook

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I certainly understand the feeling of never having time to get work done in a manner desired; as a staff engineer I could do what the boss directed, be on call for the weekend and be happy. But as I got promoted into Management, there never seemed to be enough time to get projects planned, direct a staff, manage budgets and keep the bean counters and bosses happy. Those occasional afternoons at a tower site with my staff guys were a welcomed relief and made for a better working relationship with the team. It eventually became policy (for which upper management paid) to take half a day every quarter and just go with the staff and just hang out – lunch, bowling, whatever – just to get some time together and keep the work environment bearable.

Perspective

It is one trait of an Engineer to bring a unique perspective to the situation at hand. This quality is very helpful in times of trouble when others are freaked out, but it can be inappropriate or at least irritating at times.

Optimist: The glass is half full.

Pessimist: The glass is half empty.

Engineer: The glass is twice as large as it needs to be.

When situations arise, the Engineer is often the last to be informed but the first to provide a solution. If there is a good relationship with Management, they often do recognize the value of the Engineer's perspective, but that has to be earned over many months and years of working together.

Ingenuity

As a part of the unique perspective that Engineers bring to situations, they have an attitude of ingenuity which most often can save the day. Those of us with "the knack" can take this for granted after many years of technical work. Probably one of the most frustrating things to endure is the "some assembly required" kind of projects. Those are usually the, "hey, we need this piece of furniture assembled for the conference room – call the Engineer" kinds of things that get handed down from management.

Three surgeons were taking a coffee break and were discussing their work. The first said, "I think accountants are the easiest to operate on. You open them up and everything inside is numbered." The second said, "I think librarians are the easiest to operate on. You open them up and everything inside is in alphabetical order." The third surgeon said, "I like Engineers ... they always understand when you have a few parts left over at the end."

Don't' tell me that you've not had parts left over after those projects! At my last job, I kept all of those parts left over from all of those projects (never know when we need a replacement for that 2.5mm hex head screw!) and literally had a half gallon bucket full of them after a few years. I not only had those as spare parts for the pieces of furniture for which they were intended, I cannot tell you how many other projects got finished with those odd pieces. In the same way, we find the need for the "miscellaneous" box at every tower site with assorted bolts, connectors, etc. which are left over from some other project that will inevitably save the day ... one day.

Engineers are valuable pieces to the station puzzle, and often their quirky personalities are just the things that make them best at what they do on a daily basis. We should not take offense when staff and management does not understand or appreciate us; rather, we should work to help them realize that all of those pieces in the station puzzle are important to make the whole greater than the sum of its parts. That is why we love this business, after all.

And by all means, keep a good attitude! It is having and sharing that good attitude which makes this business so amazing and wonderful. Just remember that no matter your place in the Engineering community, with great power comes ... great current ... squared ... times resistance.

Jim "Turbo" Turvaville is semi- retired from 36 years in full-time Radio Engineering and maintains a small clientele of stations under his Turbo Technical Services (www.jimturbo.net) operation providing FCC application preparation and field work.

Monitors & Meters

HD Radio and the Modulation Monitor

Oft-forgotten part of air chain brings significant value to quality and performance.

by Mark Grant – Belar Electronics

The modulation monitor's significance to on-air signal quality is often overlooked. Recent developments in the HD Radio air chain, drive home the improvements that modulation monitors offer when used to their full potential.

Perhaps no technical development in radio garnered as much interest as HD diversity delay at the 2015 NAB Show. Engineers have long dealt with the headaches of HD main and analog FM programming "blending" where the digital signal strength begins to fade. That blending causes an especially unpleasant listening experience due to the roughly eight-second delay between the analog and digital signal. As stations with HD programming well know, this is mainly a problem on the outer edges of the market where coverage is less robust.

However, new innovations driven by mod monitor manufacturers are addressing these HD diversity delay challenges head on. In addition to helping broadcasters create a smoother, market-wide HD Radio listening experience for consumers – and reducing headaches for the engineer – these innovations are returning some attention to what the mod monitor can offer to broadcasters.

Reflections

Let's first establish a brief history to best understand how far the technology has come.

The early days of IBOC introduced an entirely new system – and associated product development – that was essentially laid over the top of the existing FM system.

The wideband design of analog equipment presented immediate difficulties in early HD Radio deployments. In the presence of the IBOC signal, wideband monitors would produce high measurements, making it far more challenging to make analog readings – and very specifically, total modulation readings. Often, engineers were forced to turn off their HD carriers to simply make effective analog measurements. This created a frustrating cycle of turning HD carriers on and off to simply take in effective analog readings.

To compensate, mod monitor vendors were forced to reduce bandwidth in the new digital monitors through more intensive filtering. That enhancement in digital filtering continues to this day, with new innovations that eliminate the adverse effects on total modulation readings when operating elevated HD sidebands up to -10dB.

Early HD Delay Innovations

It took about three to four years for manufacturers to bring truly reliable HD mod monitors to market that addressed the next big challenge: diversity delay. And the efficiency across various models varied greatly. Some offered a direct, continuous real-time measurement for time alignment between the analog and HD signals. Others were quite primitive, employing a pair of headphones to compare analog in the left ear versus digital in the right – or use of a special radio to simply listen to and align the signals. Naturally, all of these early products required some level of manual intervention for signal correction, though some were clearly more advanced than others.

However, as with most technology, HD Radio has evolved over the years. The power threshold has of course been adjusted, first from -20 dB to -14 and finally to -10. This has boosted market coverage near the fringes to the best it will likely be for some time. And with the influx of HD car radios added to the consumer space in the last two years, we have the reached the point where this is a signal quality problem that matters outside of the RF plant.

Innovations for Today

For most broadcasters, the main reason to own a mod monitor is to address the FCC's legal requirement today for staying within 75 kHz deviation of the total modulation limit. However, there are increasingly more benefits of the mod monitor in the HD Radio air chain, even beyond diversity delay.

For one, there is much more information in the HD Radio signal beyond the typical analog FM signal with left and right outputs. Today's premium mod monitors recognize the presence of richer PAD and station information data sets enabled in the HD Radio stream. Improvements have additionally been made to monitor multiple audio streams for program loss (silence), or simply more easily view overall modulation levels to ensure consistency across the different HD Radio programs. Belar has developed a way to install up to four decoders into a single monitor for simultaneous monitoring of four program streams.

Another interesting development is measuring HD carrier power levels relative to analog carriers. The HD monitor, when set to the appropriate mode on the spectrum, measures the power in the upper and lower HD sidebands and the analog region; and then calculates the ratio. These measurements are subsequently displayed on the front panel screen to visually determine the ratio between the two.

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Monitors & Meters

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At present, the mask is the chief legal requirement to operating an HD Radio service. Recent mod monitor innovations now make it possible to overlay the NRSC mask on top of the spectrum to understand how these measurements combine with the mask. The mask is even adjustable for assymetric power levels if the broadcaster is running different power levels in the upper and lower sidebands.

These benefits are naturally significant to both legal and quality needs in various ways. However, nothing benefits the listener more than the key advances in HD diversity delay.

So Many Roads

There are three distinct architectural paths in the HD Radio chain to support diversity delay:

Separate Delay Lines: These were the first true innovations, with 25-Seven Systems laying the foundation. With the absence of built-in delay lines in other air chain components, a separate delay line was essentially the only viable option for good-quality diversity delay. It remains a strong option for broadcasters with older-generation or low-priced processors.

However, there are still technical benefits to using a separate delay line over newer innovations with built-in lines. First, the best delay lines can very slickly adjust the delay through compression and time-shifting. Through time compression and expansion, a broadcaster can accelerate songs without changing the pitch – and without any perceived difference in the audio. This introduces the added benefit of more time at the end of the hour for a few extra ad spots. It remains the most sophisticated algorithm for adjusting delay, with sample-accurate delay time adjustments in fractions of a second.

On-Air Audio Processors: There is a very large base of high-end processors in the field today with built-in delay lines. Omnia, Orban and Wheatstone are all leading the charge in this space, each with distinct feature sets to integrate with mod monitors.

One example is Wheatstone's integration with Belar via its AirAura and FM-55 processors. Belar's Automatic Delay Correction algorithm is introduced through Wheatstone's network protocol, called ACI (short for Automatic Control Interface). Belar's algorithm in its FMHD-1 mod monitor continuously measures FM/HD time alignment, and transmits closed-loop diversity delay corrections back to the on-air processor through the ACI interface. Omnia and Orban have built similar interfaces into their processors.

HD Radio Exporters: In the case of HD Radio broadcasters lacking a processor with a built-in delay line, companies like GatesAir, Nautel and Broadcast Electronics can support diversity delay. GatesAir offers this connectivity via its HDE-200 Exporter control protocol, through constant monitoring and correlation of analog-to-digital diversity delay timing to generate a correction message. As an HD Radio-specific product, these innovations from GatesAir and Nautel intuitively compensate for network timing and synchronization issues that cause continual drift or sudden shifts in otherwise well-aligned installations.

Regardless of the chosen method – or your chosen mod monitor – these recent technological advances all provide an important service: Automatic detection, correlation and correction of signal blending misalignments at regular intervals to improve the listener experience. It should be noted that while every mod monitor offers distinct benefits, Belar achieves this task without pushing the audio through the mod monitor. Instead, the adjustment is fed back toward the front of the air chain, with corrections taking place in the audio processor, HD exporter, or standalone precision delay line.

The Future is Bright

Perhaps the greatest benefit of a software-defined system is the ability to continuously tweak and improve the platform without significant technical overhaul, which reduces the cost burden to broadcasters over time. In addition to these continuous improvements, it also means the ability to do more in a single box, reducing the number of components – and associated costs and complexity – in the air chain.

Since NAB, there are some fresh developments on the diversity delay front ready to emerge. First is the ability to expand the delay window. The current correction window is within 350 milliseconds in either direction. That measurement resolution equates to one collective sample of a series of 44.1kHz audio samples.

New enhancements will allow adjustments of measurement accuracy from one to eight samples, expanding the time window by up to eight times. That increases the correction window to approximately plus or minus 2.4 seconds. Working in cooperation with HD time alignment, an auto range mode can track the delay and automatically open the correction window if the delay creeps outside the allotted range. The algorithm simply decreases or increases the sample resolution as needed to pull the delay back within the window.

An additional benefit is the integration of a scan function to correct up to six preset stations in a market. Using an automatic scan function to cycle through the presets, while establishing unique connections to each stations delay device, the appropriate corrections can be applied.

Finally, new innovations are incorporating the ability to ramp between time adjustments in processors, offering a smoother transition similar to the algorithm used in exporters and separate precision delays. The goal is for these adjustments to be imperceptible to the listener – i.e., no obvious time jump – regardless of the componentry in the architecture.

As more functions are added and more processes are integrated into a single box, there is no doubt that this ongoing challenge will continue to improve. All of these discussed features and improvements are making the job easier for engineers. The days of requiring several receivers, spectrum analyzers or separate car and tabletop radios are history. The future is bright for the broadcast engineer, as well as the increasing value of the mod monitor in the air chain.

Mark Grant is CEO of Belar Electronics in West Chester, PA.

Small Market Guide

Treat Street – More Than Giving Candy

by Roger Paskvan

First, thank you for all the positive feedback from my last article in our March/April issue of Small Market *(Turn the Annual January Slump into Dollars)*. With the given interest shown, I wanted to offer another great promotion that our stations have done for almost 15 years.

Our community is no different than hundreds of other small markets served by many ma-and-pa owned radio stations throughout America. The small market sales in these communities follow a distinct pattern from year to year. There is a second slump in sales before the Christmas rush, usually in October. After facing this dilemma on a yearly basis we decided to fix the problem and take advantage of a yearly event: Halloween.

Every small market station deals with the same community problems of this event. Parents naturally want a safe place for their kids to go trick or treating. The kids want more candy and they all want to dress up and be ... just kids. The radio station wants the merchants involved in a community event and of course we all would like to make some dollars from the event. As a staff, we codified these options and tried to find a way to provide that safe environment for our community children on Halloween, while getting our local merchants closely involved.

In our strategy meeting it became abundantly clear that we would have to involve the merchants in a non-traditional approach to small market radio. Just seeing clients wasn't the answer; we wanted them to buy booth space, dress up and become part of the active Halloween show. The event would be free to the general public with the station income derived from participating merchants' advertising. Later we refined this idea, asking each participant to bring a canned food item that is later donated to the local food shelf. Liability insurance and police protection provide the confidence that parents appreciate.

Figure1

The event is held on a Saturday at the local high school gym. Our staff arrives early in the morning, decorating the halls and lining most of the exhibit areas with hundreds of helium balloons. The merchants line the hallways with tables and booths. Many merchants go all out, dressing up for the occasion. (See Fig 2)

Figure 2

Our staff makes sure all our sponsors have adequate signage. It is a fun and safe time for all. At noon we open the doors, being greeted by a long line of anxious children in cute Halloween costumes with one or more parents/friends accompanying each youngster. (See Fig 1) The kids give a food item, pick up some candy bags and start down the long halls of waiting merchants.

Parents respect the fact that the local businesses are helping out at the event and this sure promotes small town growth. The kids eventually make it to the gym where they play a number of set up games receiving candy at each station. A photographer takes pictures and local law enforcement has a booth for positive PR. Prizes for best dressed merchant are given, and by 5:00 p.m. the staff is exhausted, with some 4,000 kids having participated in the event. Everybody wins and we all go home happy, knowing that we pleased so many little smiling faces. "Treat Street" is a way for our small market clients to show their products and get their name into the general public. The miracle of small market radio shines again, making October a positive month.

Roger Paskvan is a Professor of Mass Communications at Bemidji State University, Bemidji, MN. You may contact him at: rpaskvan@bemidjistate.edu

State of the Station

Compliance is Cost-Effective

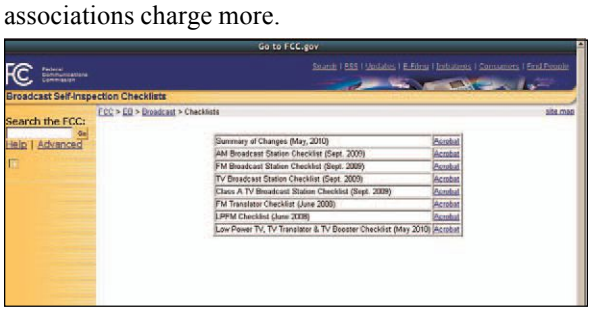
by Steve Tuzeneu

It never ceases to amaze me how many radio stations get into big trouble with the FCC for relatively simple matters. Secular stations, Christian stations, AM, FM, high power, low power – many seem to wander into the violation trap.

A station in West Virginia was fined $7,000 for filing their Form 302 four years late! An LPFM station was fined $10,000 for not having EAS equipment installed and working properly. A station in Puerto Rico was fined $20,000 for not having their tower painted or lit. A Christian radio station in the South was fined $10,000 for not keeping its Public File current.

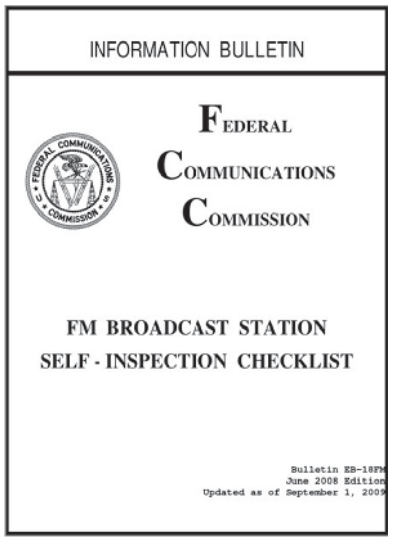
These violations are just a small sampling of the trouble radio stations all over America find themselves in. These difficulties could just as easily be avoided with routine self-inspections conducted by the station engineer, contract engineer, or someone on staff. Additionally, many of your local broadcasting associations conduct what's called the Alternative Broadcast Inspection Program, or ABIP for short.

For a few hundred dollars, an independent engineer works with your station and state broadcasting association to conduct the ABIP. This inspection usually lasts a day, and includes a checkup of technical standards and a careful look at the Public File. Assuming the station passes, the broadcasting association issues a certificate of compliance. This certificate does not prevent the FCC from inspecting your station, but it does go a long way to keeping you legal. Some inspectors will see your certificate and honor the time and money you invested in keeping your station legal, by going on to the next station on the list. The inspection costs about $400. Some associations charge more.



http://transition.fcc.gov/eb/bc-chklsts/

Another method of avoiding FCC fines is the do-it-yourself method. On the FCC website above are check lists for seven categories of broadcasting stations, one of which will apply to your situation. These check lists are located at: http://transition.fcc.gov/eb/bc-chklsts/. The do-it-yourself method, if carefully conducted, should save you thousands of dollars in fines if you take prompt action to correct any violations.


INFORMATION BULLETIN

FEDERAL COMMUNICATIONS COMMISSION

FM BROADCAST STATION
SELF - INSPECTION CHECKLIST

Bulletin EB-18FM
June 2008 Edition
Updated as of September 1, 2009

Keeping your station in compliance with FCC rules and regulations is an ongoing process, a process most often the responsibility of your engineering department. Like all engineering expenditures, the task of keeping your station legal should be seen as an investment, not as an expense. Whatever you invest in keeping compliant will pay for itself by avoiding fines that could dramatically affect your bottom line.

Steve Tuzeneu is an experienced radio station manager and engineer and is the Director of Engineering for Sonshine Media, LLC. You may reach him at: stuzeneu@sbe.org

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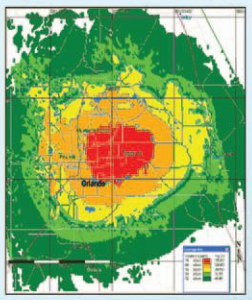

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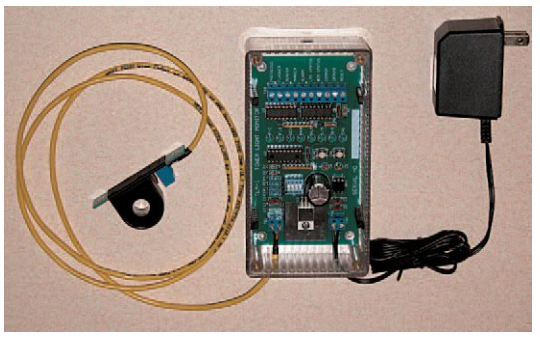

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The Radio Guide Event Register

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June 20, July 13-17, August 14,
ABA Training Center, Hoover, Alabama
http://al-ba.com/wp2/aba-engineering-academy/

Texas Association of Broadcsters (TAB)
August 5-6, 2015
Renaissance Austin Hotel
www.tab.org/convention-and-trade-show

Nebraska Broadcasters Association
August 11-12, 2015
Omaha, Nebraska
http://ne-ba.org/news_and_events-convention.asp

WBA Broadcasters Clinic
September 13-15, 2015
Madison Marriot West, Madision, Wisconsin
www.wi-broadcasters.org

NAB Radio Show
September 30 - October 2, 2015
Atlanta, Georgia
www.radioshowweb.com

Ohio Association of Broadcasters (OAB)
October Dates to be Announced
Columbus, Ohio
http://oab.org/engineering/obec/

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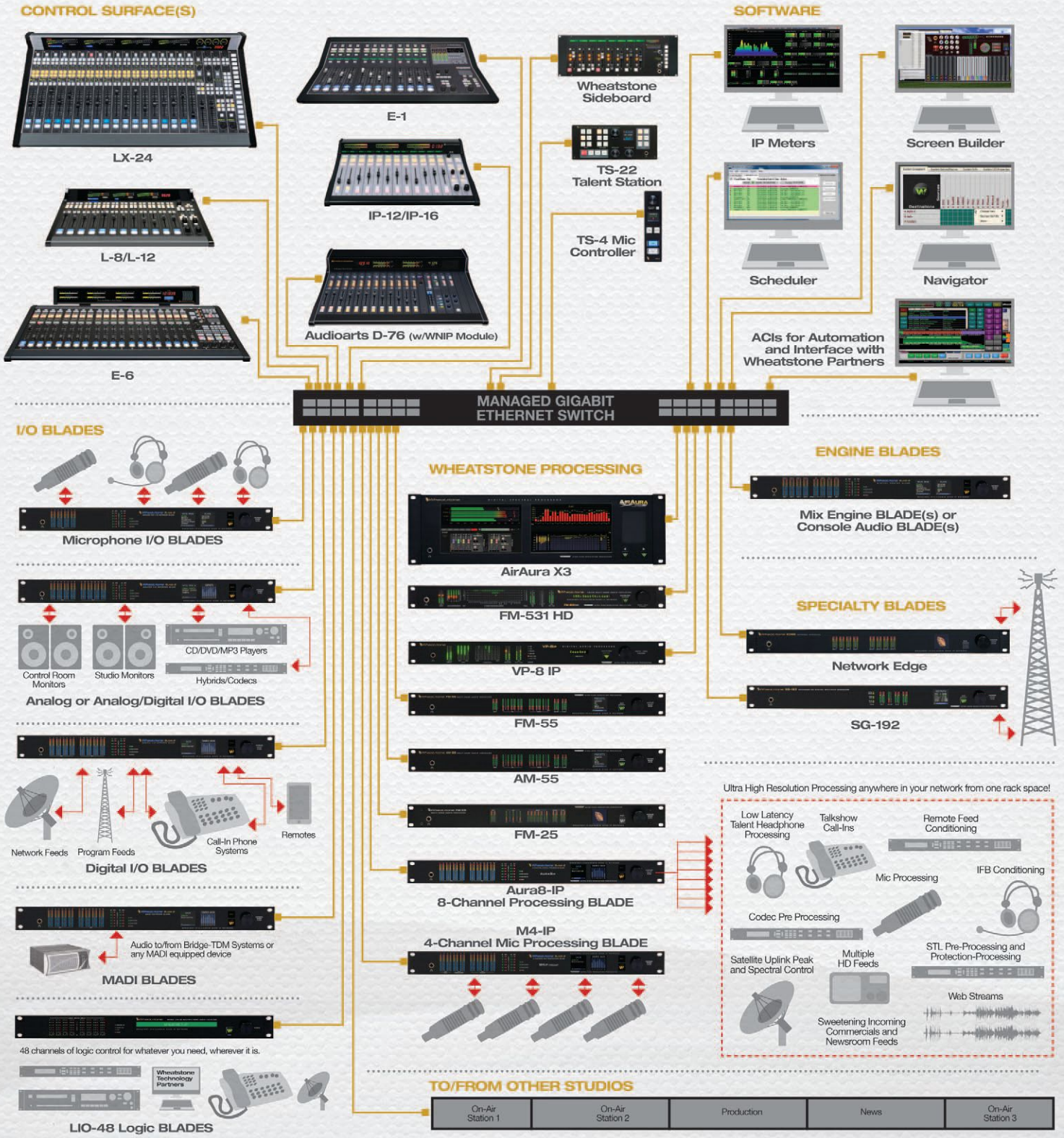

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