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May-June 2019 – Vol. 27, No. 3

R∃LAY VPB: IP Audio Meets the Virtual Machine

AoIP Studio Build in Progress
(WJOP Washington DC)

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AM All Digital: *"The NAB field tests of all-digital in-band on-channel AM radio demonstrate that MA-3 all-digital provides greater coverage, more data capacity and less interference, with superior audio quality that compares well to FM stereo reception."*

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Reducing AM Operating Expenses Via MDC: *"... for example, the most recent (April) electric utility billing for 50 kW KLTT in Denver shows a peak billing demand of 54.12 kW ... a more typical value for a non-MDCL 50 kW station would be 85 kW – and speaks not only to the direct/indirect power savings from MDCL but to the overall efficiency of the transmitter itself."*

R3LAY VPB: IP Audio Meets the Virtual Machine

By Michael "Catfish" Dosch

Not that long ago, broadcast devices were all connected by discrete analog cabling. Then, Audio-over-IP arrived. Now you'll find it everywhere from broadcast studios to recording studios. Without a doubt, broadcasters have embraced AoIP in a big way.

"Return With Us Now..."

In 2003, I had the privilege of founding Axia Audio for Telos. Alongside my friend and mentor, Steve Church, we introduced broadcasters to IP-Audio, a/k/a Livewire. Livewire brought two big ideas to broadcasting: first, that we could use ordinary computer networks for studio audio, and second, that we could use the PC's native Ethernet port to eliminate sound cards.

A vintage PCI-bus balanced audio card. Street price was $1,200 for this bad boy.

Professional sound cards were very expensive. Typical offerings from vendors like AudioScience or Digigram cost $1,500 or more. At Axia, we had our sights set on eliminating this unnecessary expense, so we invented the "virtual sound card," or AoIP driver. To the audio applications, this behaved exactly as a sound card would, but was actually packetizing audio and sending it to the network.

There are now proprietary IP audio drivers such as Livewire, Wheatnet, et cetera, from several companies. These drivers did a brilliant job of eliminating the need for sound cards. But today, the market is demanding less expensive non-proprietary solutions, such as AES67.

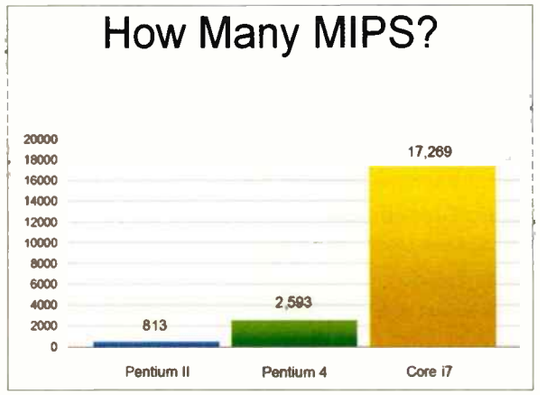
So at Lawo, we took the idea of a virtual sound card and gave it an upgrade. R3LAY VSC was designed as a pure AES67 driver, allowing it to be vendor-agnostic and work with virtually any AoIP system for about 20% of the price of hardware sound cards.

And we can do even more.

Virtual Sound Card Plus Virtual Audio Processing

In 2003, your playout computer had its virtual hands full just handling the basics. The fastest computer then, a Pentium 4 running at 3 GHz often consumed 90% or more of system resources just playing four audio files simultaneously. There simply wasn't enough headroom in those machines to do much else.

But computer technology marches on, and Moore's Law is still at work. Today, for less than the price you paid for that old P4, you can get a computer with a CPU that's at least 30 times more powerful.



PC processing power has improved tremendously since the introduction of AoIP.

Although the PC's power has risen dramatically, most radio stations' playout requirements haven't. Four channels of playout plus one channel of ingest still satisfy most station needs – work that doesn't even cause that shiny new PC to break a sweat. There's a ton of excess computing power simply idling.

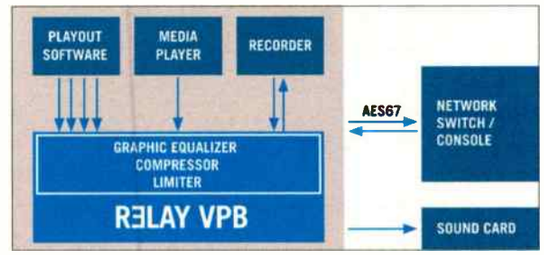
So what could we do by tapping into that latent power? What if we – wait for it – *fused audio processing with our virtual sound card?* We could process signals from playout software right in the computer, just as if it was going through the studio mixing console. We could apply AGC to audio as we capture it. We could even extract information, monitoring loudness over time to confirm compliance with OTA loudness requirements. Insert your own great idea here ...

Introducing R3LAY VPB

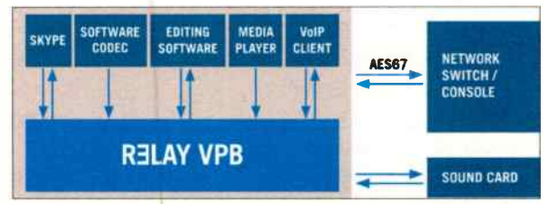
R3LAY VPB, from Lawo, is a virtual sound card on steroids – one with audio DSP capabilities. In addition to providing 64x64 channels of AES67 playout and ingest, it leverages today's enormous CPU power to let you shape, sweeten and process audio *before* it leaves your playout or production PC.

R3LAY VPB is easy to use. All of your audio devices (inbound and outbound AES67 streams, physical sound cards, installed audio software) are inventoried by the software and presented as color-coded "patch points" that you use to apply processing. A full suite of DSP functions – compression, expansion, limiting, delay, graphic and parametric EQ – can be applied to any audio source. You can even insert third-party VST apps to process audio (and there are thousands of them out there).

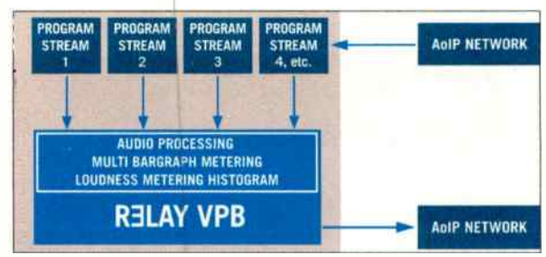
What can you do with R3LAY VPB? Here are a few example applications.



Playout Server: R3LAY VPB running on your studio playout machine can apply EQ, dynamics, and even mix signals for unattended playout. For live operation, the AES67 output can be sent to your studio mixing console; during automated dayparts; the stream can be routed directly to your airchain. Non-AoIP facilities can take VPB's processed output from the PC's installed sound card.



Virtual Studio: Today's off-the-shelf PCs have so much power, they can easily run multiple audio apps simultaneously. So why not add a few more apps to your studio's playout machine? A software codec, VoIP phone client, a Web audio client, perhaps more processing and production applications. Now your playout PC is a "virtual studio" that talent can use for recording, processing, editing and assembling audio for later playout – or even live on-the-air.



Loudness Metering Platform: What about a loudness metering / assurance application? You could ingest audio streams from your AES67 network, analyze, process and meter them to assure that programming loudness guidelines are met, before returning them to the network for distribution and broadcast.

The Future?

Innovation happens at the intersection of IT and broadcasting. AoIP was the result of adapting VoIP technology to the needs of radio broadcasters. Virtual sound cards became possible when computers grew powerful enough to process real-time digital audio without sound cards. And speaking of powerful computers – they just keep getting faster. Which is why we can now do advanced signal processing natively, on the same PC we use to run our audio applications. So if you're looking for me, I'll be daydreaming at the intersection of IT and broadcasting. – *Radio Guide* –

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Channel Your Inner Sportscaster

Henry Claims to Have Found the "Missing Link"

by George Zahn

As a former color commentator/engineer for University of Cincinnati basketball and with many a high school game broadcaster under my belt, I have to marvel at today's sports and special event broadcast equipment. One of the items talked about by many, at and after the NAB, was the Henry Engineering Sportscaster.

Henry Engineering Sportscaster
Sports Broadcast Audio Control System

Some may consider it overkill for small station, high school football broadcasts, but the price point isn't bad – I've found it on-line in the $1,200 range for the master control Sportscaster and around $500 each for the Microphone/Headphone controller "Sports Pods." This puts this combo (even with 2-3 Sports Pods) well within budget for college sports broadcasts and stations with hearty pro sports contracts.

Not to date myself, but some say I graduated right after the discovery of fire and the invention of that round thing – no, not a capstan, but the wheel – but the days of the good old standby Shure mixer and phone couplers are long past for most of us. Using wireless connections, the Internet, CODEC, and maybe still the occasional dedicated phone line for some needs, have given us a myriad of choices for getting our signal back to the station in better fidelity than the dial-up lines many started with.

Everybody Talks

What is really nice now is the communication and mixing of announcers, both in the booth and on the sideline, and spotters who often let us know who made the tackle or set us straight if we, as announcers, make errors, – and even producers alerting us to breaks or other game news. The Sportscaster allows "channeling" of the main air signal with multiple other inputs, so our listeners hear only we want them to, but also allows for talk back channels for the spotter, producer, etc., to communicate off air to the talent and other crew.

This sounds like a dream for TV, as it can be used to cue camera operators, and it can be quite handy for the radio side as well. The Sportscaster central unit is one rack unit high and features plenty of controls.

There are eight total XLR inputs on the Sportscaster: three microphone inputs (generally the announcer, color person and spotter), an input for the field reporter, plus two auxiliary inputs for recorded interviews/highlight clips playback/etc., along with local and return inputs. The extra inputs also allow for connection and control of a crowd microphone and/or a referee mic feed. There's also a cue buss to allow for cueing of the auxiliary inputs.

It's Rout, Rout, Rout for the Home Team!

What makes the Sportscaster a hit is the duplex and/or "party line" communication that allows off-air direction and discussion between a producer/spotter/field report/camera operator and the talent. There's a separate head phone mix to the cameras and field reporter. All this packed into one single unit ... well, pretty much.

As mentioned above, there are separate controls for the announcer/color/and potentially spotter. What makes these three inputs special are the use of Henry's Sports Pods, small table top units (about 8"x6"x2") that are powered by a separate power supply. One power supply can power several units via Cat5 interconnection from pod to pod.

The Sports Pod is designed for the "non technical user." Each Sports Pod has a lighted mic on-off switch, cough button, and talk back switch with variable headphone controls, to mix the off-air talk-back and program audio. The Cat5 connection also helps to distribute the headphone audio as well as the aforementioned power.

Blasts From The Past

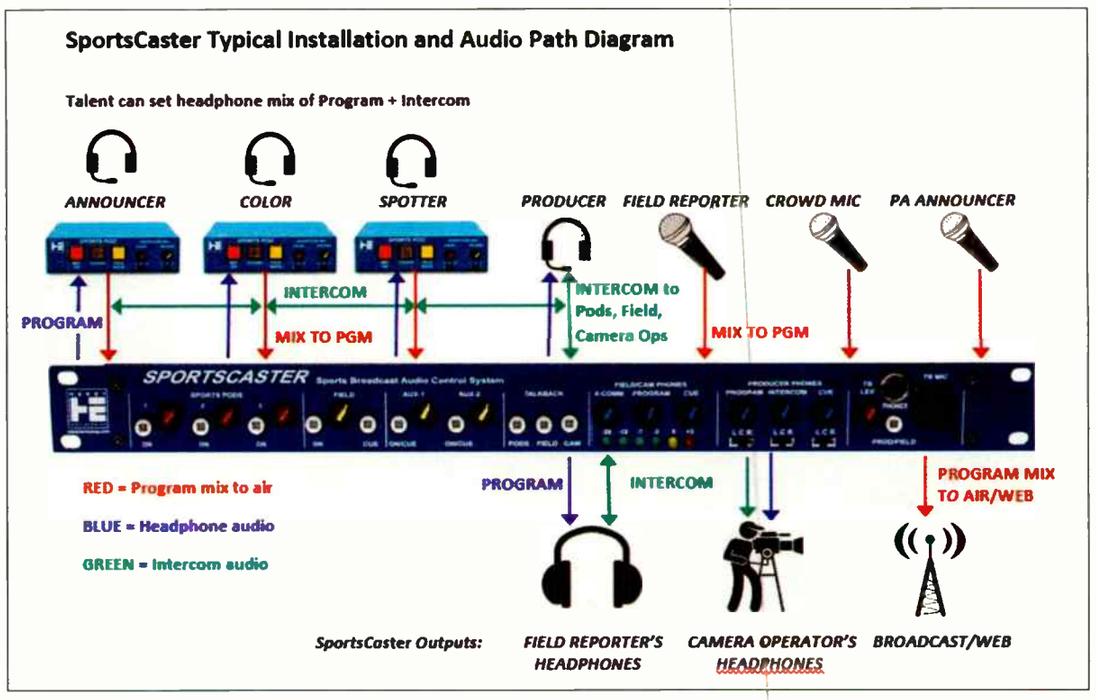
A quick indulgence from this former sportscaster: Here are two quick old sports stories from high school football broadcasts where we had to improvise technically back in the 80s. We were using a Marti at one game, but sitting the Marti atop or just outside the press box gave us inadequate and noisy signal. We found that if we ran power and audio to the top end corner of the stadium stands, and placed the Marti there, we had excellent line of sight and clean signal. The problem was, that place was almost 40 yards from the press box.

We wanted to make sure no one got near the Marti and that no one would move the antenna, so I sat about 25 feet from the antenna, which was pointed away from me. I guarded the Marti and plugged a mic into the extra input. That vantage point where I sat to do color had me high up in the stands but at the goal line, so when a team was on the verge of scoring at my end of the field, our team threw it to me with the "goal line" mic report.

Another time, we had three people to fit into a press box that would only hold two of us. The school allowed us to put a chair on the press box roof next to the staff filming the game. We ran an extended mic cable up there, and we made that member of the team "the bird's eye" or "sky" reporter – he was only about 8 feet above us – but it made for great fun.

One Box – Many Uses

Back to the Sportscaster, there are uses well beyond sportscasting. One resource I found indicated that the Sportscaster unit was being used in a situation where audio interpretation was needed. The talk back and channeling of audio sources allow for significant advantages. The sheer ability to rout audio sources on "closed channels" or even "party lines" presents so many options.



These boxes typically run about $500, but make the individual mix for each announcer a true advantage. The boxes even allow the announcers to speak off-air to each other.

The Sportscaster has a balanced XLR Program output as well as audio outputs to Camera and Field sources. The isolated headphone outputs to the camera and field reporters allow them to concentrate on what the producer is telling them, without the distraction of other crosstalk. It's been creating a buzz since the NAB.

Have you used the Sportscaster yet, and if so how have you used it, and how has it worked for you? Let me know, and we'll learn together!

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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Chief Engineer

Sometimes LIFE Happens!

by Scott Schmeling

I'd like to start this article with some personal information.

Some of you may have noticed my absence from these pages for the last few issues. I haven't written for a while, and I hadn't been working for a while either. On November 6th (election day) my wife Paulette was struck by a pickup truck while she was crossing the street to vote! She was air-lifted to the Level I Trauma Center at Hennepin County Medical Center in Minneapolis – she was there for four weeks and had multiple surgeries.

Very early on, I was told by my employer that my place was with her and I should stay as long as it took. I should not worry about any engineering issues ... they would take care of things and would call me only if necessary.

After Hennepin County Medical Center, Paulette was transferred to Bethesda Hospital, an acute care facility across the river in St. Paul. She was there for another four weeks before being transferred to a transitional care facility back home in New Ulm, for physical and occupational therapies. She was there just short of two months.

Paulette's spirits and attitude were good. She amazed people by how positive she was. One day I remember very well is Thanksgiving Day. She had been intubated and sedated for nearly two weeks. The Tuesday before Thanksgiving they performed a tracheotomy and brought her out of sedation. That Wednesday all three of our daughters and all three grandchildren were there and, on Thanksgiving Day, her mother and one of her brothers came. We reflected on what could have been and how truly lucky (and *thankful*) we were.

Every step of the way, her care was top notch. I really came to appreciate the compassion with which the medical professionals attended to her. Family and friends from around the country added us to their prayers. We felt those prayers every day.

Paulette went back to work on May 13th – 27 weeks (half-a-year plus a week) after the accident! She's working shorter days for now, and gets tired ... but the outcome could have been *so* much worse! We are thankful for every day we have! And words cannot express the importance of my employer's willingness to allow me to stay at Paulette's side during her healing and recovery.

For the most part, things operated smoothly in my absence. I *did* come down three or four times to take care of specific things and spent a fair amount of time on the phone talking people through things. For instance, here in Minnesota we had a period of *very* cold temperatures (even by Minnesota standards!). We had a couple sites where the temperature alarm was calling out because the inside temp had gone *below* the lower threshold.

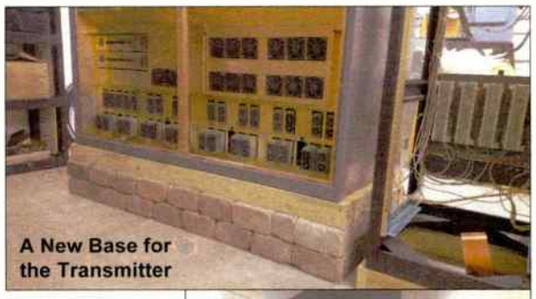
At another site, the AM power had been dropping. That site was running a solid state backup because the exciter portion of the main transmitter had gone to the factory for repair. (This is going to read like a Keystone Cops episode...) When we got to the site, I discovered I didn't have my key! More accurately, the door had been replaced and the new key had not been sent to me. Andy, the Program Director, brought my key out ... that's when we discovered the lock was *frozen!* We called Brad (who farms nearby) and he brought out a small torch to thaw the lock. *That's* when we discovered the entire *door* was frozen shut!

A careful application of torch heat around the perimeter of the door and it was open at last.

Inside was almost as cold as outside! The building relies primarily on heat from the transmitter to keep the inside warm. As I mentioned, we had a 1 kW solid state running – it didn't generate much heat. We also have an electric heater hanging from the ceiling, but a mouse had gotten into the fan blades, causing the heater to shut down and trip the breaker. Once we cleaned out the mouse and reset the breaker, we started getting heat again ... and the 1 kW's output slowly rose to where it was supposed to be.

The lesson learned here is: it's important to have temperature sensors at all transmitter sites. (We didn't have one here.) And they should be configured as monitored channels with upper and lower limits, so you will be notified when something goes wrong. (This site didn't have that either.)

On April 1st, our part of the region was experiencing wonderful thawing temperatures and *heavy rains.* This turned out to be a nasty combination. The water from the melting snow and rain could not soak into the soil because it was still frozen. We had high water at two sites. (One I wrote about last year.) Our flood damage prevention measures were successful there. But at another site we had about four inches of water on the floor. We've never had a water issue here.



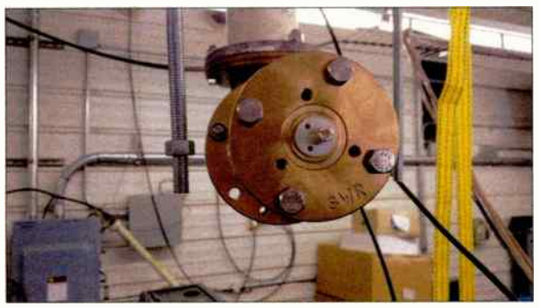
A New Base for the Transmitter

This site has a Nautel NV30It transmitter. The water was just high enough to take out the bottom row of power supplies inside the Nautel cabinet. We shut down power to the main transmitter and switched to a 2.5 kW backup. Then we made plans to raise the transmitter up and build a platform under it. This would elevate the bottom of the transmitter about a foot above the floor.

Heavy Lifting

This project would take some time to complete. The ground was soft and muddy at the site and we had to walk in – there was no way a vehicle was going to drive in here! With that in mind, we wanted to move that 2.5 kW from its 2-bay antenna to the main 8-bay. I had all the connectors and adaptors I needed, so I went out to make it happen.

Sounds pretty simple – put reducers on the 3" flange connector on the cable, to reduce it down so a 7/8" flange that can be connected. After all, I *had* all the parts.



With the reducers in place, I started to connect the 7/8" flange. Both pieces were manufactured by SWR, so imagine my surprise when they wouldn't go together properly. On closer observation I found the 7/8" flange connector had the customary index pin. The reducer *did not!* I had to get rid of that pin.

Fortunately I had a grinder at the site and could take care of it quickly. (Note to SWR, please drill the hole for the index pin on your reducers.)

The piece of 7/8" Heliax I used was longer than it needed to be, to the point where I felt it needed to be supported. For that, I used a "come-a-long" strap to lift the cable up out of the way.

Once the project was completed and we were able to put the main back on-line, we were delighted to find that the only damage was to those power supplies. A little disassembly and cleaning, and replacing the 16 supplies, and the transmitter came right up to full power again!

Paulette continues to improve as we move closer to our new normal. It's good to be back to work, and I look forward to sharing more with you in future issues. But for now ... 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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FCC Focus

AM All Digital

The Time has Come!

by Gregg P. Skall – Womble Bond Dickinson (US) LLP

Readers of this column will know that I have been an advocate for, and a fan of, the FCC's AM Revitalization effort for quite some time. In my work, I still come upon rural and semi-rural areas where the only truly local radio service is the legacy AM station, even in areas that get good technical quality FM radio service from nearby FM stations. Truly local radio is important to many small towns, and today even more important now that print, except for a few large metropolitan newspapers that seem to be vying to become national newspapers, seems to be on an irreversible course towards extinction.

I well remember accompanying a client to visit a small cluster of stations in a Midwestern town that had recently been bought by a larger group owner who had cut staff and made other changes. A representative group of local business owners came to the meeting and pleaded with my client to buy and rebuild the station group, stating that they really needed their local stations back in their town.

As has been frequently recognized by FCC Chairman Pai, the legacy AM station is the real workhorse of local service for many of these communities. That is why I wrote the column *AM Revitalization: The 800 Pound Gorilla is Still in the Closet* [www.mydigitalpublication.com/publication/?i=429250] for the July/August 2017 edition of this publication, arguing for revision of the AM protection standards by revising the protected service contour definitions to recognize modern-day noise and interference. While that remains an important goal, another development has risen to the level that it requires immediate adoption by the FCC. That development is the adoption of a voluntary standard for AM broadcasters to convert their stations to all digital format. Recently, I submitted comments in support of that proposal for the California and Missouri Broadcasters Associations.

The proposal was filed as a Petition for Rulemaking by Bryan Broadcasting Corporation of Texas. The petition asks the FCC to create a rule that would allow a voluntary transition to the MA-3 All-Digital Mode of Operation by AM broadcast radio stations.

Of the various proposals for revitalization of AM broadcasting considered and adopted since the first notice of proposed rulemaking, *Revitalization of the AM Radio Service* MB Docket No. 13-249 (2013), aside from a change in the AM protection standard, allowing a voluntary switch to MA-3 service mode for all-digital AM broadcasting could be the most effective and useful.

When the Commission issued the AM Revitalization docket, it noted the critical need to enhance AM broadcast quality so that AM broadcasters may better serve the public to advance the Commission's fundamental goals for localism, competition, and diversity in broadcast media. Despite the many forms of media that have come along in the last fifty years, AM radio remains an important source of broadcast entertainment and information programming, particularly for locally-oriented content. Many AM broadcasters continue to provide unique, community-based programming that distinguishes them from other media sources in an increasingly competitive mass media market. This local focus and community service was recently emphasized in an article from POLITICO Magazine titled *The Lo-Fi Voices That Speak for America.* [https://www.politico.com/interactives/2019/magazine-am-radio-still-matters]

POLITICO reports that even today in 2019, thousands of AM stations remain on the air, "many of them thriving – in part because they service unique sets of people whose voices aren't always heard loudly." AM makes ownership "more accessible to people of color, immigrants, non-English speakers and those with political views outside the mainstream." On the technical side, POLITICO notes that AM radio is not restricted to line-of-sight reception and can cover vast geographic areas, making it a useful staple for rural America. AM's utility to diverse and minority audiences is demonstrated by reference to AM radio programming that serves diverse populations. Examples include a minority-oriented Baltimore, Maryland station serving the city's neighborhoods with community-oriented discussion and opinion, a Navajo language station in Arizona, a rural station in Nebraska serving the farm community and a Cajun culture station in the Louisiana outback, among others.

This local service capability is important. For example, based on data from BIA Media Access Pro, of 268 California AM radio stations, 34% serve specific minority communities, including 33 Spanish language, 13 Asian format, 4 Korean format, 21 Asian or South Asian format and 20 stations programmed "Mexican" as distinguished from Spanish. Notably, 41 of those stations, roughly 15%, are located outside all markets.

It's a little different in the Midwest. In Missouri, for example, residents are served by 114 AM radio stations located either in Missouri or a border state, of which 67, or 59%, are located outside all rated markets, providing service to rural farm market audiences.

In 2013, Chairman Pai, then a Commissioner, addressed the Missouri Broadcasters Association with these comments:

. . . I was reminded of the critical role that broadcasters play when disaster strikes. When severe weather threatened central Oklahoma, local radio and television stations warned residents to take cover. Those warnings saved more than a few lives when an EF-5 tornado barreled through the Town of Moore [Oklahoma] . . . the tragedy in Oklahoma probably brought back memories of a catastrophic tornado in Joplin just a little over two years ago. In the wake of the Joplin tornado, the mobile phone service and the Internet were all but wiped out, broadcasters, led by KZRG AM 1310, provided around the clock uninterrupted coverage for nine consecutive days. KZRG told residents how to get disaster relief and it connected people in need with people who could help . . .

The story of KZRG demonstrates the importance of AM radio in times of crisis. But AM radio plays an important role in towns throughout the United States every single day. AM stations cover local politics and host debates about local issues. They cover community events such as high school sports, and they reach out to all parts of society and programming targeted to minorities, people who speak foreign languages and the elderly, among others. We all know that AM broadcasters today face a lot of challenges. Statistics tell the story. In 1978 half of all radio listening was on the AM dial. In 2010 that number was only 17% . . .

Based on my own experience, AM signal quality seems to be a major factor. Due to widespread interference, it seems tougher, each day, to receive a clear AM signal. So to address these challenges, I proposed last year that the FCC launch an AM radio revitalization initiative . . . And what about the long term future of the band? Should our goal be to transition AM stations to all-digital . . . ?

Many AM broadcasters have thought about it and the answer is YES! Here's why.

The NAB field tests of all-digital in-band on-channel AM radio demonstrate that MA-3 all-digital provides greater coverage, more data capacity and less interference, with superior audio quality that compares well to FM stereo reception. The daytime signal provided solid coverage well beyond the .5 mV/m analog contour on most of the test routes. Nighttime also provided solid all-digital coverage well beyond the .5 mV/m analog contour. Indoor performance was good within the .5 mV/m analog contour.

Reports from NAB Labs suggest also that AM all-digital offers important improvements over the legacy analog mode. In addition to better audio quality and as-good or better daytime coverage than the analog-only, very significantly, MA-3 yielded more immunity to noise and interference. Furthermore, troublesome first-adjacent-channel interference is all but eliminated with the reduced-bandwidth MA-3 mode of all-digital.

In past discussions, critics have claimed three principal drawbacks to all-digital AM radio:

- All-digital signals are not receivable on analog only radios.
- The cost of conversion.
- All-digital is not authorized by the FCC.

However, new data from Xperi shows that the receivers are now out there, with HD radio equipped cars in the U.S. growing almost exponentially to a total of over 50 million HD receivers equipped cars in 2018 and over 9 million are being added annually.

Xperi also suggests that the cost for converting an analog AM station is now down from about $45,000 for GEN II in 2002 to around only $12,000 for current GEN IV equipment.

It seems that the only remaining obstacle to AM All-Digital operation is the need for FCC authority to make a voluntary conversion for those broadcasters who believe their communities will be better served and who wish to make the transition.

This column is provided for general information purposes only and should not be relied upon as legal advice pertaining to any specific factual situation. Legal decisions should be made only after proper consultation with a legal professional of your choosing.

Gregg Skall is a partner of the law firm Womble Bond Dickinson (US) LLP. He frequently lectures on FCC rules and regulations, represents several state broadcaster associations and individual broadcasters and other parties before the Federal Communications Commission in their commercial business dealings.

Antenna Topics

It's Not a Hat Rack

by Gary Minker

Has your day started at 03:28 with your mechanical girlfriend calling your Cell Phone whispering, Plate Off, High VSWR, Output Zero? If this story is one of the sweeter things in your chapter of "Never let this happen to you," you might be a Broadcast Engineer.

Interestingly enough, many tower climbers who get to venture to the high steel and climb all over your shiny antenna somehow feel that the sturdy looking metal is there for their climbing convenience. Hat racks, foot rests, climbing pegs, safety tie off points ... these are all what tower climbers identify your antenna as when they are up enjoying the view. Unfortunately, when one of them decides to perform some reconstructive metal bending on your number 4 bay, if your VSWR monitoring is not up to snuff along with your shut down circuit, some very entertaining things can happen.

Using the radiating element as a foot rest is never good for the pattern, let alone the good of the operation. This kink in the arm tube of this FM bay was actually 3/4" deep and the arms were nearly touching each other at the tips when we found it.

This changed the impedance of the bay dramatically. If this were a 6 or 10 bay antenna, the change may have gone somewhat undetected, but as a 4 bay, the impedance change was a bit more dramatic than the system could reasonably handle. The change in VSWR resulted in a dramatic change in the currents in the tuner. This antenna already had a slugging issue forced by another situation with the installation, and the four port tuner was only there to put the "fine" hair on the frog.

Things upstairs usually ran kind of warm already, as the antenna only had four bays and was running around 30,000 Watts, so any mismatch, anywhere in the system, would prove to be an issue.

I know, you are sitting there in your arm chair with your whistle and football thinking, the transmitter should have just shut off, right? Well, yes, if the shut down circuitry was working and if the two devices watching the transmitter were actually awake. You would think that when something went wrong after the climb, that upon start-up that the transmitter would have just complained and took a siesta, but for some reason the Engineer did not notice the higher than usual readings, nor did the electronic safeguards. The night of the climb, and subsequent damage, left the transmitter on the air, the group dispersed, and one whole day elapsed before things got very quiet.

Heat in Tight Places

We all know that low Wattage, concentrated in a small space without sufficient dissipation, will generate dynamically high temperatures. Many thanks to Uncle Weller. We have all seen sooty photos (I said sooty not smutty) and I should not deprive you of at least one – but none were generated in this fire. This was a very unique failure. High Heat In Tight Places might not be complete without a small arcing fire. This insulator arc was actually the third failure in the cavalcade of failures in this show.

Failure one was the crushing of the FM bay arm. Failure two was the extreme heat that the inner conductor of the tuner and its associated slug all tried to absorb. This heat festered for some considerable length of time and elevated the temperature of the inner conductor to a point where the heat actually melted the solder connection to the bay arm and, at that point, the arcing fire in the tuner added to the joy of the failing situation and down went the transmitter – but not from a VSWR failure. It tripped the Screen.

This was a full circle failure. It began with the crushing of the bay arm and ended up with the desoldering of the bullet cup of the same bay arm, after going round the mulberry bush to burn up the inner conductor of the tuner and arc-flash the number one tuner plunger insulator.

Fortunately, after some considerable disassembly and cleaning, the system limped back on to the air at greatly reduced power, but the tuner would never be the same, nor would it ever be ready for high power again – so back to its maker it went for rehabilitation.

Lessons to Learn

What can we learn from this simple game of round robin? While the failure rarely starts and ends in the same place, and is rarely contained in such a neat and tidy way with little soot and just a few simple parts to replace, even the bay survived and did not need rehabilitation. There are some lessons to be taken away here. Let's start with the arm chair obvious.

Test your VSWR circuits semi-annually. Figure out what makes your various types and styles of sensors tick and what makes them work – and more importantly what makes them mad, and irritates them (in a controlled way) so that you can see the progression of the failure test, and confirm that this might not happen to you. Very often a 1K Ohm pot with a 9 Volt battery and some clip leads will do the trick along with a helper to turn the pot or watch the meters.

Get rid of your -20 dB slugs and samples. Sure, the major manufacturers only guarantee the sample sections for 20 dB (heh, heh, heh ... sorry) – *so what* – buy -30 dB slugs. You are not going for accuracy, you are going for sensitivity. Buy two slugs. Put one in. (If you have twin reflected meters, buy three slugs.) Change them out every other month to compare them. If you come into the site, and you have an issue showing on a slug, put in the spare slug – if there is no issue showing, you just blew a slug. If you put the spare slug in and it *also* shows issues, you have a fire brewing and you should have your favorite Line Sweeper and Tower Crew on speed dial.

This stuff needs attention. You have to touch it, watch it, look at it, and be familiar with it, or it will bite you. Do not trust that protection circuits work. Don't trust meters that just lay there, and don't trust coily shorting stick cords with your life. The first discharge could vaporizes the metal in the cord and when you encounter the next live device, both your stick – and you – are dead.

When you have people on the tower, even if it is not your tower, demand photos. Tell them that a minimum of 100 photos are required, to document all locations that they climbed, worked, installed or removed equipment from, or ate their lunch on. If you do not get your photos, do not pay the crew. If there are issues with equipment after a climb, bring them to the attention of everyone on the site right away, so that everyone can weigh in on their systems to be sure that there is no other lurking issue that have not been seen yet. Sure, accidents happen but most of them are caused by carelessness or a lack of training with those who climb.

Only you can prevent forest fires.

Gary Minker owns Radio Works R.F. Consulting Email him at: gary@RadioWorksRFConsulting.com or call 561-346-8494. Find Gary on the web at www.RadioWorksRFConsulting.com

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Radio History

The Vintage Radio and Communications Museum of Connecticut

by Steve Callahan

I admit it. I love little, local museums that are off the beaten path. I stop at them anytime I have the opportunity and the time to enjoy what they are offering. Of course, large metropolitan museums have their place, but a small museum is a very special place. They are almost always run by volunteers and are a labor of love. Quite often they start off with someone's life-long collection that is showcased and then it grows from there.

You can learn a lot when you take the time to pull off the road and enjoy the offerings of a local museum.

I was traveling on Interstate 91, north of Hartford, Connecticut, when I saw a sign announcing that there was a "Vintage Radio Museum" off of the next exit. How could I *not* stop and visit? The State of Connecticut had thoughtfully placed signs directing visitors through the quiet colonial hamlet of Windsor, right to the front door of the Vintage Radio and Communications Museum of Connecticut. I easily found the nondescript industrial building right across the road from a tobacco field and the sign out front said it was open.

Tour Guide Dan Thomas

Dan Thomas, NC1J, was manning the reception desk and after a few minutes of explaining who I was and what I did for a living, he offered to give me a "behind the scenes" tour of the museum. The first room we went into had the largest selection of antique microphones I have ever seen in one place. I have a modest collection of old radios and microphones, but I was not ready for what I was about to see. The museum had a working radio studio with a lot of equipment that I have used over the years like triple deck ITC Delta cart machines, Ampex reel to reels, SP-25 turntables and the upside down Magnecord reel-to-reel. They have a just-like-new Nagra portable tape recorder that I have only seen in pictures that was simply beautiful.

The museum itself is so much more than just radio. It is organized in decades and featured early phonographs with horn speakers. Then on to the section with telephones and something I hadn't seen in awhile, a wooden telephone booth.

The next section featured classic television equipment like switchers and cameras – and they even broadcast classic television shows throughout the building. Of course, there was a classic Ham shack with some beautiful gear, but they were in need of a new tower when it jumped out in front of a neighbor's car. They have an area with some very familiar looking classic personal computers. All of the equipment in the visitor display area was operational and restored by volunteers like Dan.

Now it was time for the special behind the scenes part of the museum tour. Dan opened a door and, as we went through, the back half of the building came into view with the largest selection of anything electronic you could imagine. This was the recently donated equipment waiting to be restored and there was a lot of restoration to be done. Fortunately, Dan has a lot of dedicated volunteers and the restoration area was always humming on Saturdays when everyone comes in to lend a hand.

A classic radio set from the museum's collection.

The behind the scenes tour wasn't finished yet. Further back in the building were storage rooms A and B. When the lights in those two rooms were snapped on, I was speechless. What I saw was floor-to-ceiling shelving along every inch of the walls, containing the largest selection of antique radios and television sets I could ever imagine. They had both familiar manufacturer's names and some names that I had never heard of before. There were literally hundreds of classic and antique radio sets all awaiting restoration and eventual display.

Dave told me that donations walk in the front door practically every day and there are often some amazing donations. Local radio and TV stations also donate their classic equipment so it can be appreciated by folks rather than going to the landfill.

The museum has duplicates of many donations so some are sold on-line to raise money for the museum operating expenses and restoration costs.

The museum has a very well equipped restoration workshop with a surprising variety of very nice test equipment. They have shelf after shelf of Sams Photo Facts back to pre-WW2 that sure do come in handy when you need a schematic for restoring a classic radio or TV. One radio awaiting it's restoration had a tag on it that said "smokes!"

We then entered another room that also surprised me. In this room there were again shelves from floor to ceiling and they contained thousands upon thousands of tubes from the very early vacuum tubes to cathode ray oscilloscope tubes. The tubes were neatly organized by number and type and filled all of the available shelf space. The museum gets box after box of tubes all the time and I would be very confident to say that they have at least one of every tube you could every need or want in the restoration process.

The museum also has had an interesting history. It's had to move several times and, as their collection grew larger and larger, it must have been harder and harder to find a place to call home. Finally good fortune prevailed and they bought the building they are in now.

We returned to the public display area to see and hear, several beautiful Juke Boxes that had been restored and one that came in the door in perfect condition. They also have a classic record lathe that has never been used and is now on display.

Can you identify this transmitter?

While I was there, two other curious folks came in and were also being given personal tours of the collection. I had noticed two large Tesla coils and, as I expected, they did work and, to those two uninitiated visitors, the arcs came as quite a surprise.

Before I left, I was treated to a demonstration of some very impressive classic stereo equipment that was donated and then restored and sounded as good, or even better, than I remembered.

Take a few minutes to search the Interweb to see if there is a classic radio museum near you. If there is, make the time to stop and visit, and appreciate the work that the volunteers do to rescue the equipment that we have all used over the years. You'll get a wealth of information from the volunteers who give of their time and talents to keep that equipment alive for all to see and hear. And if you are cleaning out a transmitter site, rather than fill a landfill, consider donating your old equipment to your local museum or Ham club. The Ham radio operators just love old tube AM transmitters and they do a great job of restoring the classic transmitters with the glowing tubes of yesteryear, I could have spent the entire day at the Vintage Radio and Communications Museum of Connecticut but there were radio stations to visit and work to do. I will make time in the future to visit the museum again and I'll bring along some donations that I'm sure they will appreciate.

Many thanks to Dave Thomas for his hospitality during my visit. The museum is located at 115 Pierson Lane in Windsor Center, Connecticut. You can learn more about the museum at www.vrcmct.org

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

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From the Ground Up

Testing Your Ground System

by Wiely Boswell

I have been working with grounding for a long time. It first started in Florida when I worked for the telephone company, as the new digital switches were coming on the scene. What was a good ground for an old mechanical telephone switch was not near enough for an early IC based system. We had lightning storms every afternoon it seemed. A strike one afternoon took out 130 circuit cards and took down the switch. New grounding practices were written and about 200 thousand dollars later it had a grounding makeover.

I have always been very impressed by lightning, and living in central Florida at the time, I was given a share of it late one afternoon. A storm came over and there were nearby strikes every 45 seconds for 30 minutes or longer. Two houses caught on fire and one burned down. My tree in the back yard was hit – seriously it was like an attack. Well, unknown to me, when the water works came in and changed the meter they reconnected it with a PVC compression coupler. It was in essence an isolation gap. It was blown wide open and flooded the front yard.

Talking to the repair crew, it had happened all over the neighborhood. I got a metal compression fitting from them and proceeded to clamp and strap across the meter and the coupler – it is always a good idea for those who actually have a metallic line. One mistake I had made was leaving an extension cord run up in our little tree house. Lightning had run down the tree and had blown "into" the cord and got into the house. So wiring extending out of a building will allow lightning to sneak into the power system and bypass service entrance protection. It would make sense to bring it out to where the power and feed lines come in on the same side of the building and protect it. My point here is, if you have a great ground system it can be compromised by lightning hits, corrosion, or changes made by vandals or contractors.

Some of my worst damage has been due to a ground bar being stolen off a tower and taking a lightning hit before I caught it missing. In another case, a primary protector on a transformer was blown to pieces and then the next hit had no protection. Being on the tail end of a high voltage service line is the worse place to be. If you can get the power company to continue the line at least one more pole past your service, with a protector, it is worth the effort. So you need to look hard every time you visit a site. Inspect connections and clamps. Look for burn marks (gives you hints). Even look at the power company's service. They are bad about having sharp loops at their ground rod connections – that would be found in a visual audit. You should also have a routine that tests for changes due to connections you might not have access to, or be able to see. Here is where ground testers made by Megger, Fluke, and several others meet the need.

Two types of ground resistance testers are needed and can be combined in to one instrument. One application tests a single disconnected ground rod, using the "fall of potential method," using test stakes up to 120 feet from the ground rod. The "stake-less" or clamp type meter will test a more complicated interconnected ground system, where disconnecting ground rods may not be practical or possible.

Many factors determine the resistivity of various soil types. A professional can tell as they drive up to a site by just looking at the side of the road where drainage is exposing deeper soil formations. Soil resistance changes by depth, temperature, by moisture content, and of course soil type. Rocky or sandy soil will present the biggest challenge obtaining a low resistance ground and swampy is the best, as all AM guys know. Ground impedance is also a consideration in handling 60 Hz power faults on power company substations or transmission lines. The complex impedance of the system can be calculated.

Clamp-on type meters generate AC test current in the conductor. Fluke uses a 55 Hz signal to take into account inductance in its Ohms calculation.

Figure 1 is a simple case of a building with a power service drop. The building is grounded with interconnected grounds and has air terminals on top. This interconnected system can have building steel, water line, and power drop multi-grounded neutral (MGN) all tied together. It also has rod C placed out on its own for illustrating testing options.

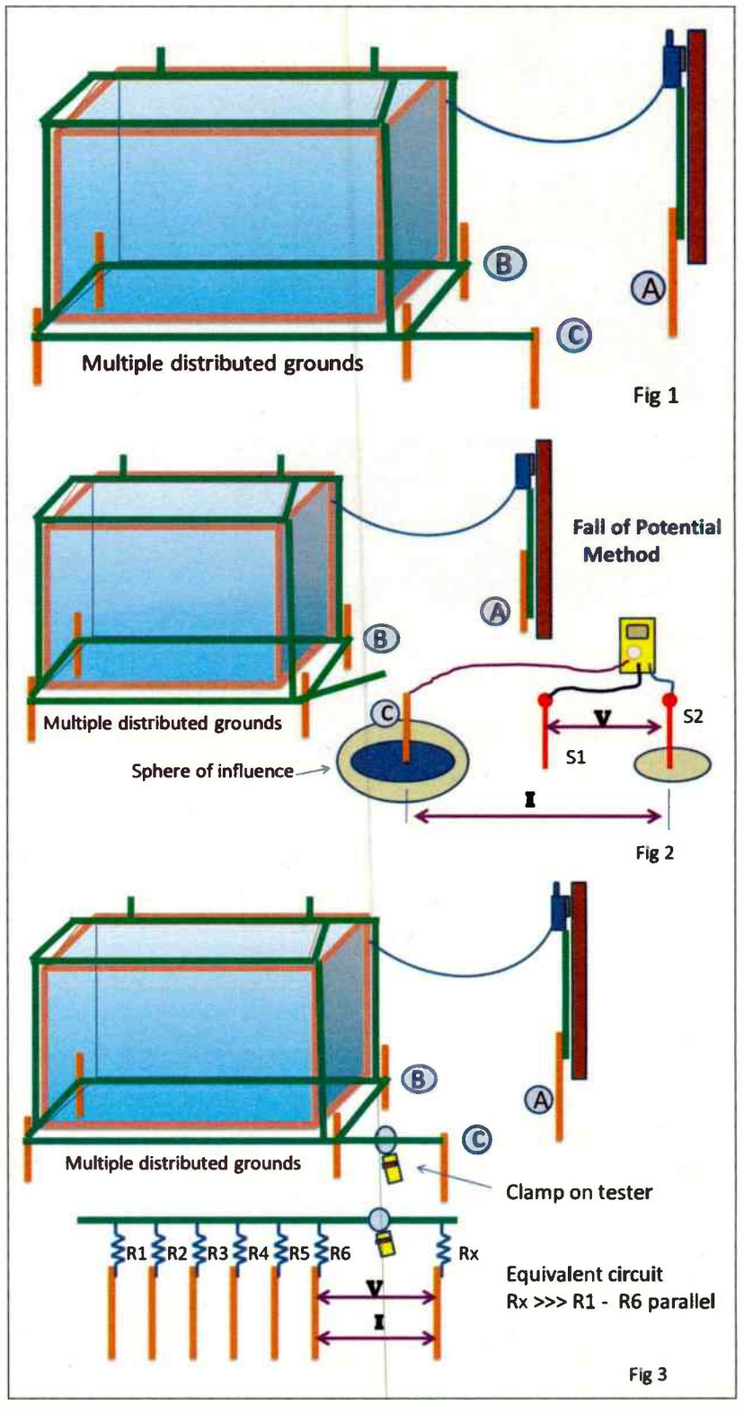
Figure 2 shows the ground connection lifted off of rod "C." The constant current **I** is created between rod "C" and stake "S2." The value of "**V**" is determined and therefore the Ohm value of "C" is calculated. This is the original oldest type of test. Stake S1 can be moved back and forth between rod "C" and S2 and plot out results. As S1 gets close to rod "C" or S2, the sphere of influence will distort the readings. The sphere is roughly the depth of the rod. The graph will show a flat resistance when outside the influence. Stray ground voltages will also distort readings and some testers will test for this type of interference.

There are times when a hundred or more feet of room, to space out stakes, is not available and disconnecting ground rods that have been Cadwelded is also difficult.

The newer technology uses two clamp-on coils. One to induce current and another to read results – an example of this is the Fluke 1625. Some clamps have both coils in one hand held clamp. The opening needs to be big enough to clamp around 1" copper strap or at an angle when clamping around a ground rod placed in a recessed hole. The clamp may have exposed mating laminations that need to be kept clean to get correct readings.

Amp-clamps have been around for a long time. The Megger DET14C clamp has a protected clamp face to keep dirt out of laminations. Megger has been around a long time making Fall of Potential type test sets. Note here, not to confuse a megger high voltage breakdown test set to a low Ohm ground tester. (There are very useful high voltage breakdown testers for different type surge protectors.)

Figure 3 shows a very simple example of multiple grounds and its basic schematic.



What is important is understanding the limitations. It will not test a rod that is not connected to other grounds. In this case, the ground is connected to the building ground ring. The induced current is flowing thru rod "C," thru the soil, and then thru all the other grounds in parallel. The resistance of the ground system which includes the MGN, building steel, and ground ring, will be very low. It will be so low, compared to rod "C," it can be neglected and the reading will be value of "C" resistance.

It gets tricky from here. If the clamp was around one of the building ground risers you would be testing the combined path of loops around the building. It tells you there is a loop and neither end is open. It is not telling you actual resistance to the earth. In testing you are looking for changes over time during routine maintenance tests. So in conclusion, when inspecting grounding, make a list of access test points, their resistance, and method used. You have got to stay grounded.

Wiely Boswell is Chief Engineer of Faith Broadcasting, Montgomery, AL; CBRE, CBNE, and SBE 118 Chairman. He may be contacted at: Wiely@faithradio.org

RETHINK Radio

Welcome to Broadcast 3.0

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Power Core can handle up to 128 MADI channels standard. 4 front-panel ports (two dual-redundant pairs) with SFP make it easy to bridge your AoIP and baseband digital signals.

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Information please: high-resolution color display with rotary encoder provides easy front-panel access to network information and settings.

Power Core is 100% standards-compliant - because proprietary AoIP is so 2003. Up to 256 channels of true AES67 and RAVENNA streaming, on two front-panel Ethernet ports. Even complies with the ST2110-30 standard. Because you can't be too future-proof.

Power Core supplies 64 channels of GPIO via standard RAVENNA and open-source Ember+ protocols. Need physical connections? Use the front-panel interface. Highly logical.

The Lawo logo. Your assurance of meticulous engineering and premium components, uncompromisingly crafted to the highest German standards.

Power Core is the only broadcast AoIP node with ST2022-7 Seamless Protection Switching, giving you dual discrete links to your network core. Completely redundant, with automatic, inaudible switching. Now that's what we call peace of mind.

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Impressive, yes? But audio I/O isn't the end of Power Core's capabilities. There's DSP; a lot of it — 96 channels of EQ, dynamics and mixing. AutoMix, too. Plus routing: 1,920 crosspoints, enough to switch an entire multi-station broadcast facility.

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System Solutions

Comparison of Computer Remote Access Systems

by Bob Reite CBT

Many times one needs to access a computer system by remote control. There are several types in general use, but they can be broken down into to categories. The first is a server/client setup that requires nothing except a route between the two computers, but on the host end the user must be able to open specific ports in order to allow the client to communicate. The second type requires a connection to a third party server, the advantage of which is that no firewall or port forwarding is needed. If the host and client can connect to the third party server, the connection can be made.

Stand Alone Host/Client Systems

Perhaps the best known is VNC (Virtual Network Computing) of which there are several flavors. Tight VNC and UltraVNC add file transfer capability, but the transfer formats are not compatible with each other. The Tight VNC client will run on Windows, Mac OS X, Linux and FreeBSD, but the server is not available for Mac OS X.

UltraVNC is a Windows only program. TightVNC and UltraVNC are free for both personal and commercial use.

Remote Desktop Software Using Third Party Server

Perhaps the best known remote desktop software of this category is Team Viewer. Servers and Clients are available for Windows, Mac OS X and Linux, but oddly enough, not FreeBSD. Team Viewer will let you hear audio playing on the remote machine if it's a Windows or Linux box. It has built in AES-256 encryption. It is free for personal use, but even controlling a non-commercial radio station with Team Viewer is considered "Commercial Use" for which the company wants $49.00 a month for "One Seat, 1 Session." Other well known systems of this type are LogMeIn, which is now branded as GoToMyPC. GoToMyPC requires payment for any use, starting at $35.00 a month for a single user license. Like Team Viewer, GoToMyPC will let you hear the audio playing on the remote machine, however there is no server for Linux.

DW Service

A relative newcomer to this category is DW Service. It is unique in that no client program is needed.

All that needs to be installed is the server software which is available for Windows, Linux and Mac OS.

Any web browser that is HTML-5 compliant will serve as the client program. Besides remote screen access, the following features are available for the various operating systems.

Windows: View files as well as upload and download files. A simple text editor, Log Watch, lets you monitor a log file, similar to tail -f on a Unix machine. Resource Monitor, which displays CPU percent usage, memory usage, disks and partitions, general information about the system, including the operating system version, CPU type and architecture and the computer name. Finally, running tasks and running services are displayed. One can stop and start services as well.

Linux: View files as well as upload and download files. A simple text editor, Log Watch, lets you monitor a log file, similar to tail -f from a Linux terminal window. Resource Monitor, which displays CPU percent usage, memory usage, disks and partitions, general information about the system, including the Operating system version, CPU type and architecture and the computer name. Finally running tasks and running services are displayed. One can stop and start services as well. The Linux variant adds the ability to run a shell. Be warned, opening a shell from here will log you in as root. It is probably safer to use the screen viewer and open a terminal window there, as an ordinary user.

Mac OS X: As might be expected, the same features are available on the Mac as on a Linux machine, as Mac OS X at the core is a Unix-like operating system similar to Linux.

Installation:

Installation couldn't be easier. Start off by visiting **https://dwservice.net** and set up an account. Be sure to choose a very secure password, as this system has the capability of gaining root access to Mac OS X and Linux machines. Once that is done, download the file offered. The site correctly recognizes what operating system you are running and will offer the correct installer. The Windows installer is a .exe file. The Mac OS X installer is a .dmg image and the Linux installer is a shell script which

(Continued on Page 22)

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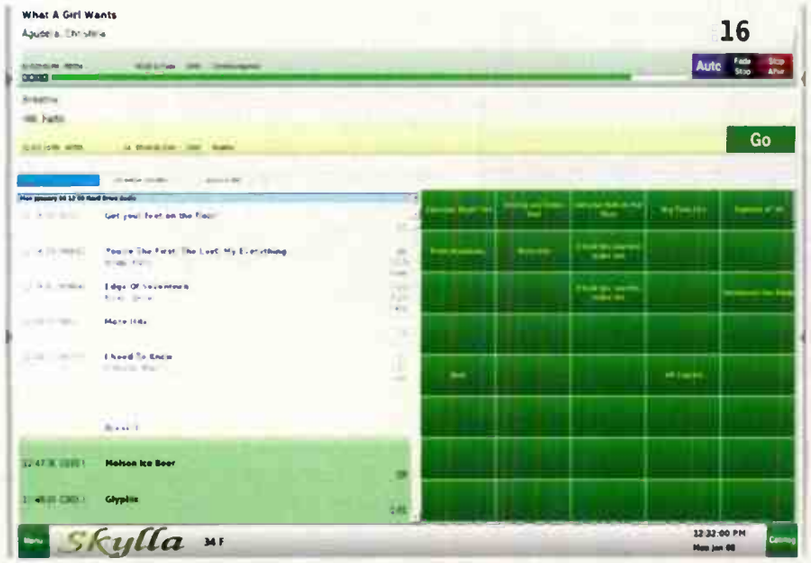

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35
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SMARTS Broadcast Systems

Comparison of Computer Remote Access Systems

– *Continued from Page 20* –

is actually a self extracting archive. The Linux install is a bit more complicated. You must become root and change the permissions to read and execute for owner, group and everyone before you can successfully run the installer. For all three systems, choose "create a new agent" then enter your account name and password. You will also need to choose a name for that computer, which will appear in the list of your computers.

Use:

Log into your account and you will see a listing of all the computers that you have installed, be they running or not. Computers that are not running or have the DWService program disabled will be listed as "Unavailable" and the OS Icon greyed out.

Clicking on any of the available computers will bring up the feature selection screen. I suspect that most users will want a screen session.

As can be seen in the screen shot below of a Windows remote session, one can issue ctrl-esc (the "Windows key") Ctrl-alt-del, paste text *to* the remote, and copy text by remote, from this window. These features are not available on Mac OS X or Linux hosts, but full screen mode and disabling the remote computer keyboard and mouse are available on any host. The session defaults are Maximum quality and Fit-to-Screen. Since I have a fast connection at each end, I haven't had to choose the lower quality options, but they are there if you need them. Fit-to-screen may look a bit odd if the host monitor is the same size or larger, but I find it OK for the most part. If I want it to look "real," I use the full screen option. During full screen one can bring up a floating left sidebar to get access to ctrl-alt-del and ctrl-esc while in full screen mode.

In a pinch, you can even log into dwservice.net from a cell phone web browser. The DWService.net website knows that you are logging in from a device without a keyboard, so adds a keyboard icon that you can tap to bring up the cell phone virtual keyboard.

Another feature of DWService is the ability to create "shares." As a contract engineer, I need to be able to access computers at many stations. But the station manager or program director may want to access their computers as well. The program director can either set up their own DWService account, then you can choose an "Allow User" and insert the login name of the program director. Alternatively, set it up as "Allow Login" and specify a password. DW Service will generate a user code that can be used with the specified password to access DWService and start using that share.

DWService does log when users sign on and off and what computers they have accessed, although it does not go into detail on what anyone did with the computer during the session.

Minor quibbles. If you want to change the name you picked for a computer, I know of no other way except to uninstall the agent, deleting it from the computer menu as well and start over. The uninstall on Linux is not documented. The "whereis" command showed it as being installed at /usr/share/dwagent and the path statement at /etc/dwagent. Deleting these files and folders got rid of it. Uninstalling is easier under Mac OS X and Windows. Just search for the DWAgent.app (mac) or Dwagent (Windows) and choose "Uninstall."

Bottom Line

In my opinion, DW Service is the winner hands down. It works well cross platform and you can't beat the price of *FREE* for any use, personal or commercial.

Bob Reite operates his contract engineering firm, Telecentral Electronics, Inc. servicing radio stations in Pennsylvania and New York state and may be contacted at br@telcen.com

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Engineering Perspective

How to Find Your Next Engineer

by Steve Tuzeneu, CBT

I read a number of publications that serve the radio and television community. Some of these are technical and some are not. Some of these arrive in my email, some are on-line, and some arrive at my office in paper form. If it has to do with broadcasting, especially radio, I read it. I am usually drawn to the technical articles first, and then I read the "newsy" items last.

I have noticed a few of these publications have published articles about how hard it is to find a qualified engineer for a radio station, radio group, or network. I have also observed a lot more job postings on-line and in some print publications for engineers. Some of these help wanted ads have shown up in places that don't seem appropriate to the occupation, in my opinion.

While there have been articles on the hardship of finding an engineer, I have not read an article about *how* to find one. It is more difficult than 20 or 30 years ago, but not impossible.

This shortage began in 1992, when the FCC gave radio groups permission to own more than one or two stations in a market. Corporate leaders and "bean-counters" got the idea that profits could be enhanced by laying off a number of staff and requiring the remaining personnel to operate five or more signals.

Now corporations require engineers to maintain five, ten, 15, or more stations. Some engineers stayed and juggled as best they could, and some left for greener pastures. I personally know an engineer that left a radio "cluster" and never looked back. He went into IT and got a pay raise, along with a lot less stress, and a predictable, rotating "on call" schedule.

Additionally, I have noticed a large gap between the salaries companies are offering and what some currently-employed engineers are being paid. All you have to do is get a look at the salary survey conducted by the Society of Broadcast Engineers (SBE). With the cost of living as high as it is, I don't know how some companies get applicants when they offer salaries comparable to what an assistant manager at McDonald's is paid – which isn't a lot. The assistant manager at McDonald's doesn't have to roll out of bed at 2:00 in the morning for a hamburger emergency, but a radio engineer has to head to a transmitter shack to get a station back on the air. Often these "station-off-the-air" emergencies come in the middle of the night, in bad weather, and sometimes even during family gatherings or during the holidays.

If you have read this far, you are probably wondering what all this has to do with finding an engineer, and you would be right to think that. I think it is important to understand how we got into this mess, so we can understand the "why." Maybe learning *what* happened and *why* it happened will prepare us for the concerns that engineers have when looking for a new job.

Now let's get to the steps involved in hiring your next engineer.

1. Determine your engineering needs and goals. Do you need someone right away? That may make it lot harder to get someone. Is your current engineer planning to retire soon? Having an engineer who has announced his or her retirement makes the situation less urgent and a little easier to deal with. The best place to start your search for a new engineer is with your current one. He or she is most likely aware of other engineers in the market who would gladly come to work for your company, but that depends on a number of factors.

2. Can you offer a competitive salary? With the pool of engineers smaller than it has ever been, you may need to offer more than you think. If you contact the SBE, they may be able to give you an idea of what engineers across America are getting paid. If you already have an idea, and are thinking you can't afford to pay a full-time engineer, you may want to hire a contract engineer. Some contract engineers have all the business they can handle, so your first question to one is: "Are you able to handle more stations?"

3. Do you offer good benefits? Many people today are looking for a job with great benefits, especially where the cost of having those benefits does not greatly impact the paycheck. Engineers with families can't afford $1,500 a month to cover their health care needs; at least this engineer can't. Therefore, benefits are just as important as the salary you offer.

(Continued on Page 28)

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How to Find Your Next Engineer

– Continued from Page 26 –

4. In what kind of place of employment will your future engineer be working? Has the equipment been kept up, or will one or more stations often go off the air because your last engineer was not allowed to spend money for parts and repairs? Has your company won an award for being one of the best places in America to work? Work environment is a very important factor when trying to interest a prospective engineer. No engineer wants to battle office politics and cranky equipment.

At this point in the article I feel I need to address help wanted ads. What kind of employment ads do you write? Is it a winner or a loser? This is an area of recruiting that very few people put any thought into. Think of writing your help wanted ad like the copy writer for a commercial. Does your help wanted ad sell? I know what you're thinking: "I'm not selling cars or retail merchandise; I'm trying to hire an engineer." Yes, you are correct, but if your help wanted ad is going to get a good response, it needs to be written to address the wants and needs of an engineer, much like you would in commercial copy. Here's an ad that reads: "Reports to the director of engineering ... supports corporate initiatives ... extensive experience in RF and IT." While an ad like that communicates what the company wants, how about what the engineer wants? A winning help wanted ad reads more like: "Come work for a world class facility where your hard work is rewarded with a very competitive salary and benefits. Our company was voted the best place to work by XYZ rating organization, and we value and appreciate our engineering team." Now that's an ad that sells, provided everything in your ad is true, and not merely the fiction I just made up.

If you place ads on regular broadcasting websites, you may or may not get a response. Many of the broadcasting websites are tailored to announcers, news people, and non-engineering types.

As already mentioned in this article, the SBE should be your first resource. You can list your job on their website for free. For a small fee, you can see the resumes of engineers who are actively looking for work, and what specialty they prefer – radio, TV, or something else.

If you have placed an ad on the SBE website, searched the resumes, and still don't have an attractive candidate, look again at the website for your local SBE chapter. The chair person of your local chapter may be able to help you find an engineer or contract engineer to maintain your facility.

Another place to find an engineer is your local technical school or college, especially if they offer training in electrical engineering. I know of some colleges that have closed their electrical engineering schools due to dwindling enrollment, so you may need to look outside of your town. Contact these schools or colleges and ask to become a part of their career fairs, where you can recruit for little or no money.

I have heard of two-way radio shops taking on a broadcast radio station as a client. While they may not have high power transmitter experience, the work they do is much like what a broadcast engineer does, only on a smaller scale. That two-way radio shop may or may not be interested in late night, weekend, or overnight emergencies, so you will have to explore those possibilities before committing to a contract of any kind.

One of the most unusual places you might find your next engineer is at your local amateur radio club. Also known as "Ham" radio – these guys and gals talk about RF, antennas, and technical things all the time. They rarely hear from a radio station looking to hire an engineer, so you might find a great engineer there. See if you can get permission to attend one of their meetings to make a presentation and present your opportunity. Among the group, look first of all for an "Extra" class amateur. In order to get that license, one has to know something about transmission systems, antennas, and other theory that often has a direct correlation to the world of radio broadcasting. The training time needed for an extra class radio amateur to become your chief engineer should be relatively short.

However you recruit your new engineer, you need to be aware of a special secret network. Yes, that's right, there is a special secret network. Engineers talk to each other about radio stations and groups and what it's like to work there. If you have a reputation for being a great place to work, the word will get around and it will be much easier to hire staff. If, however, you treat your engineers in undesirable ways, or your equipment is falling apart and you don't ever have a budget to repair or replace equipment, the word will get around about that, too.

I wish you all the best in hiring your next engineer. He or she is out there, and you will find your next engineer soon. If I may be of some help, my email address is: stuzeneu@sbe.org.

Steve Tuzeneu, CBT, is a staff engineer with the Bible Broadcasting Network in Charlotte, NC. He is a member of the SBE, and an extra class radio amateur.

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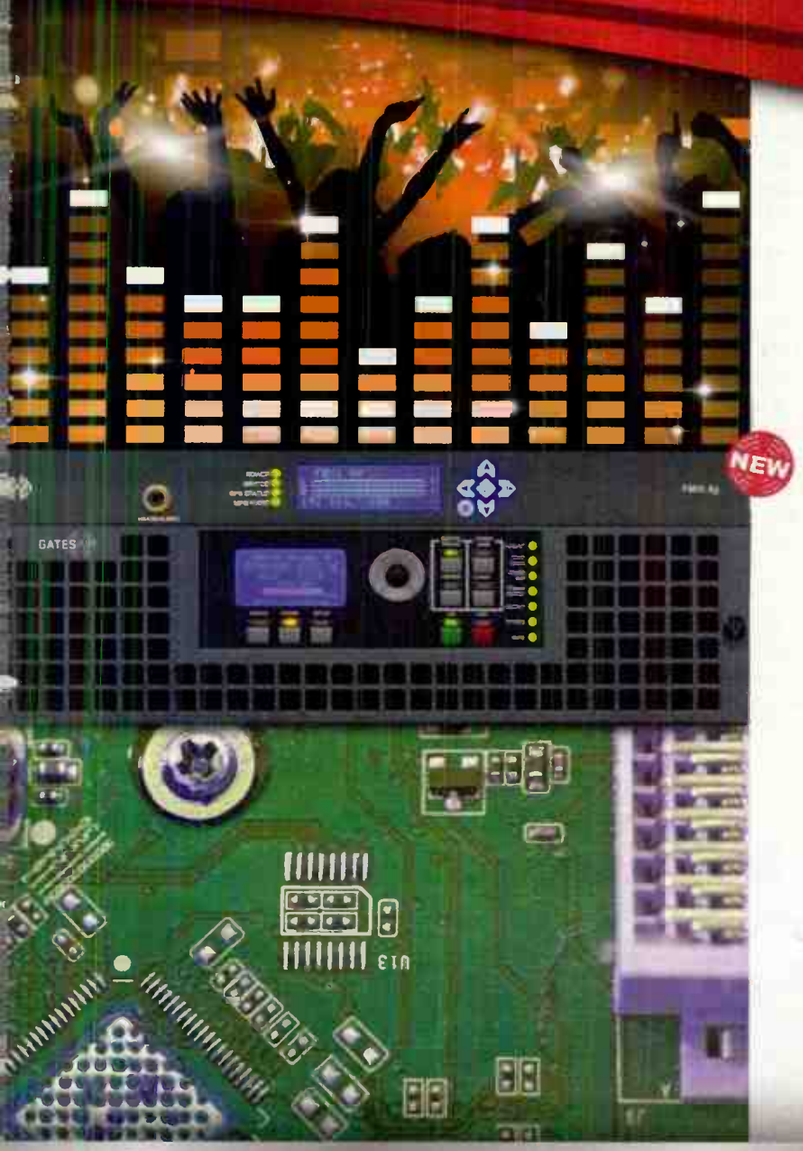

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IT Guide

Installing Linux for the Newbie

Getting Around the Windows Obsolescence Situation – Part Seven

by Tommy Gray – CPBE, CBNE

Putting Linux to Work!

In our last issue, we concluded the install of the Linux Mint Cinnamon operating system on our old Windows machine and started populating it with usable software. At that time I put you onto several great (and free) programs. There was "GIMP" for graphics editing, there was "GQRX" for Software Defined Radio. There was "CHIRP" to program your HAM Radios, if you might be a licensed Amateur Radio operator.

I also mentioned earlier, the complete "LibreOffice" suite which comes with the Linux Mint Cinnamon install and gives you a complete suite of office apps that compare to Microsoft Office™, just to mention a few. To start with this time, as promised, I want to talk about the included audio editor that a great many of you are already using on your Windows machines – the "Audacity Audio Editor." It *is* included in the Linux Mint Software Manager.

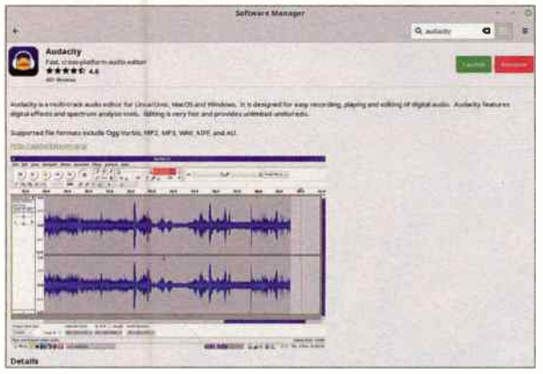
Installing software on Linux Mint Cinnamon is a very easy and simple process for the most part. A few more obscure apps might install quicker using a terminal but these are rare and only to make your install and setup faster in many cases. Generally, the Mint Software Manager is the way to go. Primarily, the reason to start with the Software Manager is because it pulls files from the Linux Mint repository where the files have been tested, and verified, and are more secure. There is a lot of software out on the Internet that will work with your new Linux machine, but using some of it may open you up to malware.

As I mentioned early on in this series, I do not use an antivirus program. I get all my software from trusted sources starting with the Software Manager, and though I spend a great deal of time on the Internet, I have never encountered any malware.

Installing Audacity on Your Linux Mint Cinnamon Machine

First click on the Linux Mint Icon at the lower left of the screen and on the menu, select "Administration." From that menu, select "Software Manager." When you get to the main Software Manager screen at the upper right, in the search bar, type "Audacity." You will be taken to a screen showing available software that includes the name you typed in. In the case of my machines, I only have two options that show up. I chose the one that simply says "Audacity" and shows to be the cross platform audio editor.

Once you click on that option you will see the install screen for your app with all the informational details, as well as several reviews from other users. The feedback from other users might be of interest to you, so take a few minutes to read some of it if you have questions about the program.



Linux Mint Cinnamon Software Manager

On the screen above from one of my machines, you will see the exact screen you will see, with one exception. On mine, the software is already installed, so instead of the normal large green button at the upper right that says "Install" mine shows that it is already installed and gives me the options to launch the program or remove it. Once you install, yours will also look like the one in the picture. In the next image, on page 32, I have opened up an existing .mp3 file from my archives just to show you an example. This file came from my pocket recorder and was a recording of a meeting I hosted. If you will notice there is space at the bottom for additional tracks. Audacity allows you to do multi-track editing and recording much like many expensive packages and once again it is totally free.

(Continued on Page 32)

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– Continued from Page 30 –

Multi-Track Editing

Choose the "Tracks" option at the top of the screen and then choose "Add New." You will be presented with options for several different types of tracks. Choose what you want and continue. If you are an experienced editor, you will find that this is an easy-to-use program that can do a lot that very expensive software can do. As with any audio or graphics editors, the more RAM you have in your computer the faster everything will run. I would strongly suggest that, if you do more than just an occasional quick edit, you have plenty of computing power (fast processor, and plenty of RAM, and a good graphics card).

Audacity Audio Editor Main Operating Screen

However, the primary point of this entire exercise of converting an old machine to Linux Mint cinnamon was to allow you to use an old machine with an obsolete version of Windows, and not throw away a perfectly good computer just because Microsoft decided to leave you holding the bag, so to speak. I am sure that I am not alone when I say that I have had perfectly great machines I enjoyed using become totally worthless by Windows updates! Having said that, the machine you are seeing the screen shots from, is an old Dell Latitude laptop with 4GB RAM I picked up off Ebay for $40. I have a KVM switch with six of the exact same machines connected to Dell docking stations, and all feeding a very nice large monitor. The main reason I like to use the laptops with the docking stations is that if I keep good batteries in them, I do not have to have a USP to counter those occasional power interruptions that invariably happen just when you are right in the middle of something important (not to mention they don't take up much space).

I use these machines for different applications and though I still have a couple of very fast Windows computers available, I rarely even turn them on. I also keep one of the old laptops as a mirror with the same software, same hardware, and same files I have on my main machine, so if it were ever to fail, all I have to do is to just push a button on the switch and I am back in business. Also on the KVM switch is an old desktop computer with Windows XP SP3 and a lot of great (and expensive) software that was obsoleted in the Windows upgrade/update scenario several years ago. I do not have it connected to the Internet so malware is not a problem.

Remote Control Anyone?

I use another piece of software, you are all probably familiar with, to run some of the software on my local LAN. What do I use? You guessed it! "VNC." Well actually "TightVNC" is my personal preference. Now before I touch on, it let me mention one thing here.

If all you need to do is to access files stored on your Windows machines you can use a Secure Shell. If you are running a dual boot machine (Windows and Linux both on the same computer), you can access files on the Windows drives while you are running Linux Mint . You can simply use the file manager and go into most of the files on your Windows computer and either copy from, or to, the Windows machine. The Windows drives will show up in the file manager as just another drive.

If you want full desktop remote, then go to your trusty software manager and type "VNC" and there you will be presented with all the available VNC options. As I said, I use "TightVnc," primarily because I used it for years on the Windows computers and found it to be very good for my purposes. When I was responsible for multiple groups of stations many miles apart, I would have one copy of "GoToMyPC™" running on a computer in my office at the remote location, and then I would VNC into all the other machines such as automation computers, servers, etc., from it. The Linux Mint Cinnamon Software Manager has both the client and the server versions of "TightVNC," I have a total of 11 machines in my office and I have easy access to everything on them all using a combination of "TightVNC" and "OpenSSH" (which I mentioned in a previous article).

Well my space is used up for this issue. I will talk more about the remote control options in a future article. I hope these articles have been helpful to you and that you have, once again, been able to take an old favorite machine and breathe new life into it. With Linux, "There is life after Windows!" Enjoy!

Tommy Gray is a semi-retired veteran broadcast engineer currently staying busy doing engineering in the gulf south, through "Broadcast Engineering & Technology LLC", a Louisiana based Consulting and Contract Engineering Firm, serving the US. www.BEandT.com

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Transmission Guide

I'm *All* Mixed Up Now

by Jim Turvaville

One of the early fundamentals one learns about, in radio engineering, involves the mixing of radio signals for a desired purpose. In the old days of AM and FM receivers, a local oscillator ran on a specific frequency to mix with the incoming RF signal in order to be received and demodulated by a tuning circuit. Microprocessor technology allows replacing the superheterodyne receiver design by a software-defined radio architecture, where the IF processing after the initial IF filter is implemented in software. This technique is already in use in certain designs, such as very low-cost FM radios incorporated into mobile phones, since the system already has the necessary microprocessor.

In the years since Edwin Armstrong developed the superhetrodyne receiver circuit in World War 1, for the military to improve direction finding radar units, the mixing of frequencies to improve the function of receivers became commonplace. There is, however, the mixing of frequencies for more of an undesired purpose, and I have recently had a protracted experience in such a situation, in which I have had some opportunities for learning. Let me share.

I have recently installed a new FM antenna on a broadcast tower of one of my clients, who also was leasing space to another client for a full power station. The two clients shared the tower crew and expenses, and on initial construction all seemed to be well. The specifics of the installation involved a tower with a full power station – 99.7 MHz at 22 kW ERP – which was replacing an older 8-bay with a brand new 6-bay antenna, to which we added a full power NCE – 88.3 MHz at 20 kW – 8-bay antenna on the same tower. The vertical spacing allowed us to mount the 6-bay for the 99.7 below the pole at the top of the tower, then the 8-bay for the 88.3 in sequence below the 99.7. With no bays interleaved, and the full power stations with narrow band antennas, coupling between the 99.7 and 88.3 were expected to be minimal.

I had the luxury of being the install engineer for both full power stations, so we turned on the 99.7 at full power, and the new 10 kW transmitter seemed happy into the new 6-bay antenna. We then turned on the 88.3, and observed there was no added reflected power on the 99.7 as a result of the new signal being added. I also was able to observe the reflected power on the 88.3 while turning off the 99.7 and noted no change in reflected power for it either. That, at least, initially led me to believe there was at least a smaller likelihood of there being any added spurs created as a result of the two antennas being so close vertically.

When dealing with multiple sources of RF on a tower, it is necessary to be certain that the installation meets the requirements of 47CFR Section 73.317(b)-(d). That rule section outlines the maximum allowed out-of-band emissions permissible from any radiating antenna, applicable especially in situations where multiple antennas share a common tower structure. With rare exception, the FCC processing staff will note the co-location of a proposed facility, and attach a Special Operating Condition requiring certification of compliance with these rules prior to Program Tests being allowed to commence on the new station. My situation here, however, was one of those rare occasions when that was not a stipulation on the CP, so I attempted to be as diligent as possible in meeting compliance apart from a declaratory showing being presented on the license application.

Figure 1

Harmonic	Product	Actual Frequency	Comment
Fundamental "A"	A	88.3 Mhz	FM Band
Fundamental "B"	B	99.7 Mhz	FM Band
2nd Order	A + B	188.0 Mhz	TV Broadcast CH 7
2nd Order	A – B	11.4 Mhz	Aeronautical Mobile
3rd Order	2A - B	79.6 Mhz	TV Broadcast CH 5
3rd Order	2B – A	111.1 Mhz	Aeronautical Navigation
5th Order	3A – 2B	65.5 Mhz	TV Broadcast CH 3
5th Order	3B – 2A	122.5 Mhz	Aeronautical Mobile

The first course of self-examination for compliance involved the simple math of signal mixing. It is customary to consider the way that two fundamental frequencies

(Continued on Page 36)

The light bulb moment.
Now in two colors!

You splurged. You bought gorgeous new M!KA microphone arms for the studio. And you got the ones with the tally lights. Good thinking. In the Smartphone era, guests get distracted. You need a way to get their attention and the mic arm tally lights are um, brilliant.

So how exactly do you light those up anyway? With our Mic Tally Gizmo, of course! The 5-pin XLR topside carries the microphone audio and the signal voltage for the tally light. The microphone signal is passed through to a 3-pin XLR connector on the bottom.

Dual logic inputs drive the tally either red or white. Red is usually the color for on-air. White can be used for an alternate signal. Ready light, talkback indicator, phone ringer, pizza delivery. You'll come up with a bright idea.

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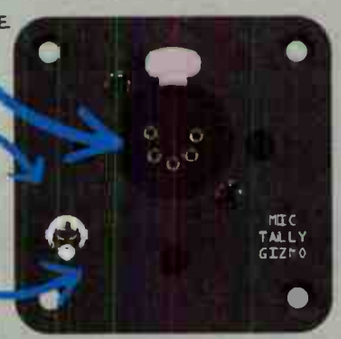

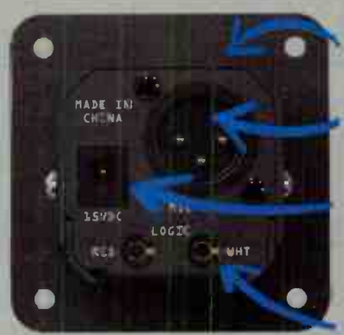

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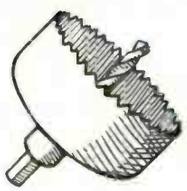

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I'm *All* Mixed Up Now

– Continued from Page 34 –

can mix and check for the presence of signal on those frequencies. The fundamental frequencies can mix into 2nd, 3rd and 5th order products most easily, so those are the starting place for review. As the power decreases for each of those orders of mixing, the higher products are more difficult to measure, and are usually the most critical.

To know what needs to be checked, I first made a chart of the possible combinations. **(See Figure 1)**

It's easy to see how a couple of frequencies, not that close on the FM dial, can have consequences to not only FM, but TV and Aviation services. In a situation like this, it will be necessary to find a good broad spectrum analyzer to be able to see all of the affected bands of potential interference. The spectrum should be carefully analyzed from a distance of about 1 km from the tower, with both of the new services in a non-operational state, for a snapshot of the potential spectrum to be made for comparison. Then a second snapshot taken with both of the new services operating at licensed power, for an accurate depiction of any changes that may have appeared in the spectrum, with the addition of the new signals. Attention should be paid specifically on the frequencies found from the potential calculations of 2nd, 3rd and 5th order products. Should any new signals appear on those frequencies, a careful measurement should be made to insure they are compliant with 73.317 limits and an immediate cessation of operation if they do not comply. In the case of products which appear, that are not compliant with the limits in the rules, then the stations cannot operate until appropriate filters are installed and a subsequent check of the spectrum is made, and you are sure that any signals which remain meet the limits.

When the two fundamental frequencies are closer together, then the consequences to fellow FM stations become much more pronounced. See this from another example I installed a few years ago when we added a 92.1 signal to a tower with a co-owned 96.1. Again, the bays were not interleaved, but were immediately next to each other in the vertical landscape. That calculation chart then looked like this. **(See Figure 2)**

Figure 2

Harmonic	Product	Actual Frequency	Comment
Fundamental "A"	A	92.1 Mhz	FM Band
Fundamental "B"	B	96.1 Mhz	FM Band
2nd Order	A + B	188.2 Mhz	TV Broadcast Ch 7
2nd Order	A – B	4.0 Mhz	Maritime Mobile
3rd Order	2A - B	88.1 Mhz	FM Band
3rd Order	2B – A	100.1 Mhz	FM Band
5th Order	3A – 2B	84.1 Mhz	TV Broadcast Ch 5-6
5th Order	3B – 2A	104.1 Mhz	FM Band

As you can see, one of the 2nd order and one of the 5th order products fell into the TV band, but both 3rd order and one of the 5th order fell back into the FM band. In this case, I was immediately able to detect the presence of 2 of those 3 signals on a radio, and a quick measurement on my hand-held signal meter told me they did not meet the limits in 73.317. It was a simple matter to install a bandpass filter on the new 92.1 transmitter output – the lower power of the 2 stations, and the only one with a solid state transmitter – and all of the products went away.

I can also report from first-hand experience, that the FCC takes compliance with 73.317 quite seriously, even if a Special Operating Condition was not placed on a Construction Permit and the certification was not required to be filed with a license application. In another recent installation, the addition of a translator 13.6 MHz away from another full power FM signal on the same tower created a nice 3rd order mixing product that fell exactly in the middle of the aviation communications band. A small plane flying over the tower on approach to an airstrip nearby could hear both the FM translator and the FM station audio mixed on his aviation radio. The FAA summoned the nearest FCC field agent and an all-day party was held at the tower site. Having been made aware of the matter earlier from a fellow engineer who was knowledgeable of the pilot's report, I had already installed a filter and eliminated the interference by the time anyone came to check. But the team from the FAA had to formally make resolution to the pilot complaint, and a full investigation was still made. It was one time when the casual omission of a Special Operating Condition on a Construction Permit taught me a valuable lesson – double check even if they don't ask you to do it. I heartily encourage you to learn from my mistake as well.

Jim "Turbo" Turvaville is semi- retired from 40 years in full-time Radio Engineering and lives in Rural Wheeler County Texas in a "tiny house" where he maintains a small clientele of stations under his Turbo Technical Services (www.jimturbo.net) operation providing FCC application preparation and field work.

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Shop Talk

by Steve Tuzeneu, CBT

In Search of an EAS Receiver

I have always wanted to write at least one article reviewing a product that I had experience with. I didn't start out looking for a product to review, instead I was looking for a product I could use that did not seem to be available anymore.

A few years ago, when you installed a new EAS receiver or had to replace an old receiver, you had at least a couple of options.

The first option was to go down to your local Radio Shack and purchase one of those walnut-colored, table top, analog radios. There you had an EAS radio on the cheap. I have done this before, and I know other engineers who have.

Some engineers preferred something that would sit in the transmitter building along with the EAS unit, where it would be subject to a lot of RF. It that case you bought a Dayton Industrial receiver.

The Dayton AF200A SCA Receiver

The Dayton radios were enclosed in a metallic case and were quite selective. You connected an antenna, the "wall wart," and your audio output, and you were good to go.

Now Dayton is just a distant memory, and it seems all of the available units, new or used, have been snapped up. If you loved the performance of the Dayton radios, your options today are very limited, especially if your EAS unit and receivers will be located at the transmitter.

If your EAS unit, whatever the brand, will be at your studio location where RF is not present, there are a number of things you can do. Just about any radio that will stay locked on the frequency of your LP-1 or LP-2 will meet your EAS requirements.

Rolls makes a nice small FM tuner with a digital read-out that will do nicely. However, the audio output levels are a bit on the low side. I connected a Rolls to a Sage EAS unit and had to turn the audio output knob all the way up. Even turning up the audio input levels on the Sage didn't help much. The Rolls receiver I was using was intended for a stereo system and only came equipped with a pre-amp. Additional amplification would be necessary to get the audio output where it needed to be. Price is between $140 and $250, depending on the model and where you buy it.

Another nice option is the FM Guardian, made by a company called RF Engineers (rfengineers.com). I really like the features of this radio.

The FM Guardian is small, the size of a pack of playing cards, can be programmed using a browser, and has enough audio to make our Sage units happy.

Audio output terminates to a 1/8" female jack, and the antenna connection is a female BNC. You can download a smart phone app and program it from there, but if you change the IP address with the smart phone app, you can't log back in using the same app. You will be able to get in with your browser. The guys at RF Engineers said they would be fixing that.

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Shop Talk

In Search of an EAS Receiver

– Continued from Page 38 –

The radio comes with an Ethernet jack built in, so you can put it on your network and log in from anywhere. It is also equipped with a "Bluetooth" radio for a wireless connection.

While the FM Guardian is a great little radio, it is not meant to be used in a high RF environment. I know; I tested it to see what it would handle. When the high-power FM transmitter went on, 50% of the received signal was white noise. That noise is going to interfere with the EAS data chirps your EAS unit is supposed to hear. Street price for this great little radio is about $250.

The Watch Dog (WD1) is a professional AM / FM / NOAA Weather receiver. It has user definable alarm states. The WD1 tracks RSS, SNR, Audio, RDS. Pilot and NOAA 1050Hz for presence/validity. It can be programmed using a Windows program, which is available.

RF Engineers also makes a radio called the Watch Dog that comes in an RF-resistant metallic case about the size of a pack of playing cards. It costs a bit more than the FM Guardian (more than $500), but in preliminary tests, seems to resist all outside RF.

The Watch Dog will receive AM, FM, or weather radio, and performed well in high RF environments. I tested it near a 5 kW AM transmitter, and we tuned in some fairly strong local AM stations with no noise or interference from the nearby transmitter. It has been tested near a high power FM transmitter and also performed very well.

Audio output from the Watch Dog is the same as the FM Guardian; there's a 1/8" female jack to connect to a 1/8" male. The amplitude is like its little sister, loud enough to drive your Sage or other EAS unit. There is no Ethernet jack or Bluetooth radio built in. The only connection is through the smaller USB jack like you find on smart phones. Once connected to your computer, you will need the instructions from their website and a terminal program.

Let me know what you are using for your EAS set up. Feel free to contact me at: stuzeneu@sbe.org

Steve Tuzeneu, CBT, is a staff engineer with the Bible Broadcasting Network in Charlotte, NC. He is a member of the SBE, and an extra class radio amateur.

Small Market Guide

Taming the Ghost

by Roger Paskvan

A lot of strange occurrences happen in small market radio. I'm sure the same things happen in the larger markets but never get reported. This tale is about an unusual parasite that crippled our transmitter system for a several year period, causing a lot of damage.

Our tower site shares two transmitters on a common tower, with two well-made filters in each line to do the dirty work of keeping each station from bothering the other on the same Heliax. This problem developed over time – actually years – and caught us right off guard. **(See Figure 1)**

Figure 1

I was listening to one of our FM stations in the middle of the day and I noticed that the highs in the audio had a raspy sound. After eliminating the studio end of things plus the STL, I finally made it out to the tower building. Upon opening the door, there was that distinct odor of ozone in the building. What was even more unusual was, I could hear music playing and the FM tuner was shut off. It was loud enough to overpower the fan noise.

Okay, this is quite common for AM stations where every dissimilar metal rectifies the signal and sings away. But this was a 100 kW FM and the music was coming out of the filters mounted on the ceiling. I shut the transmitter off and everything quit. Turning it back on, no music, all was well. Well, now what? After a good half an hour I left, since the spook decided not to show up anymore today.

A few weeks later, the same thing happened. Going to the tower site exposed the ozone factory and music coming out of the filter. This time, I carefully removed the cover plate on the back of the filter while the transmitter was running. Granted, not the smartest thing I've done, but I needed to see what was going on inside. I knew the problem would go away if I shut anything off so I slowly removed the bolts and the cover plate, exposing the inside of the filter.

I was met with an eerie yellow light emitting from the end of the filter tuning probe and arcing to the top of the cabinet. A better word would be, not an arc, but a flame that was at least 12 inches long and dancing all around the end of the probe. You guessed it, the flame was playing our station and emitting music with remarkable fidelity and clarity. This was amazing to watch, as this one inch wide flame just danced all around the probe singing away on its path to the top of the can. It was spooky and seemed to have a mind of its own. The transmitter folded back about 20% when this happened. Shutting off the transmitter stopped the flame and it didn't come back until it felt like it. It was almost like a ghost. **(See Figure 2)**

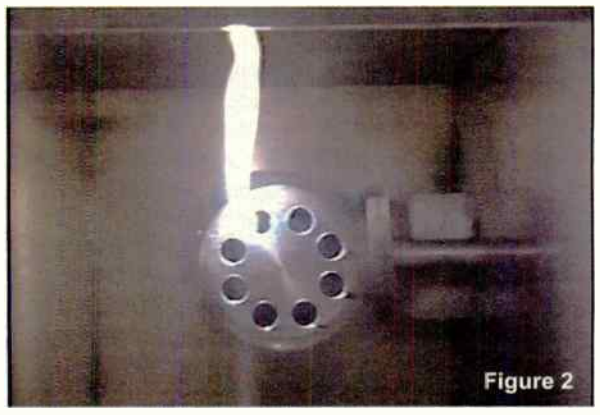

Figure 2

The next day, I called the filter manufacturer and discussed the issue. Most of the conclusion was that it was not possible to have a sustained arc 12 inches long in that filter. Okay, but we did. They didn't believe me, so I told them I would get some video of this ghost and send it to them. Well, that wasn't so easy since it only did this when it wanted and several weeks went by teasing me.

(Continued on Page 42)

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Either way, I had the camera set up and waiting. Finally, it surfaced and I recorded about 30 minutes of this dancing ghostly flame that sings!

I put the video in the mail the very next day. The manufacture's response was, "wow, we have never seen anything like this." My response was, okay how do we fix it ... they would get back to me. A week passed and the transmitter was behaving. It almost seemed to follow humid weather patterns but I had real proof of that. The filter company eventually called back and said we needed to retune the filter, verifying the bandwidth. Possessing a network analyzer, I followed their instructions to the letter, and some minor bandwidth changes were made. Putting power into the system, it all seemed to work fine. Wouldn't it be nice if this was the happy ending and we all went home smiling.

The fix helped and the crazy ghost flame did not return for over a year. Then, one day in November, that raspy sound returned and my PD called saying the station had an awful sound, with listeners calling in complaining. Going to the tower site, sure enough, the flame had returned and the ozone filled the air. How disappointing – now what do we do? That evening, we shut the system down and looked up inside the cavity. There were many arc pits on the center probe that seemed to have developed over time, making it easy for the arc to start. It was building its own ladder, from the probe to the side of the cabinet. The next several hours were spent filing the arc pits off the smooth end of the probe and sanding the very badly damaged surface, being careful to vacuum up all the filings. Can you imagine what metal filings could add to this kind of problem?

Well, after the cleaning and filing, the filter behaved itself for several months but started the same thing with the coming of the wet spring weather. A visual showed the probe end had deteriorated to the point where replacement was the only viable option. Discussing this with the factory, for a nice cool $1,800, they would manufacture a new probe for our out-of-production filter model. I said, "Let's do it."

The components arrived in about a month and sat at the station until we could figure a day that both stations could be off the air for 6-8 hours. This was not a pretty picture in the PD's world. On the big day the project began. The three inch plumbing was removed from the filter input and output coupling. This was quite the project in itself – mostly heavy and bulky fittings and a lot of stainless bolts. Once the in/out ends were exposed, three-inch adapters to "N connectors" were attached. Utilizing a network analyzer, a complete map of the filter, before anything was done, was made as a recorded starting point.

After a while, the center probe was removed and slowly taken out of the square access openings. This was a delicate matter since there was finger stock and a lot of small bolts in some really hard to get places. The guy that built this had to be a three foot midget to get way back into those tight places.

The new probe was installed and set at the same distance as the original. This was critical for resonance on the station frequency. Things didn't go in easily and the large Invar tube became quite stubborn, fighting us all the way. After securing the probe in place, the filter was swept again with a network analyzer and the coupling adjusted for proper waveform. This tedious process took several hours to attain perfection – a bandpass slightly greater than 400 kHz. Our feed-through loss was a few tenths of a dB, so all was well on the books. Now for the acid test. **(See figure 3)**

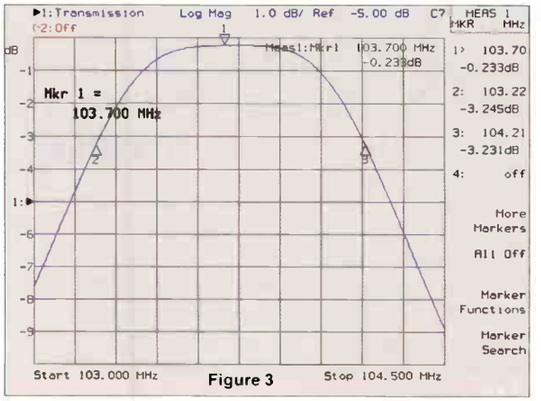

Figure 3

The plumbing, now laying all over the floor, had to go back to its rightful place. As usual, the silver bullets never cooperate and fought back at each junction. Eventually, all the three-inch plumbing miraculously came together, and we were connected back to the radio transmission world.

Who was going to push the HV button on the transmitter? We started at 500 Watts and it all came up okay. Reflected power was low, so we slowly raised the power to 22 kW and watched. No side show, no arcs and no smoke. What a great day in small market radioville! In the weeks that followed, everything was still running with no more raspy arc flame teasing the filter probe. The ghost had been tamed, possibly gone forever. Hopefully this ghost will not relocate to a station near you, if you happen to collocate two transmitters on the same antenna. A word of Caution!

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

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Service Guide Radio Equipment Products and Services

Gear Guide

Towers, Lights and Other Things

by Ron Erickson

With a nod and a wink to a song by The Beatles, if I were a *Paperback Writer,* I might suggest that any mystery, romance or allure in broadcasting might be found at a radio station tower site. As you know of course, towers come in all sizes and configurations. In the case of AM, the tower is part of the antenna but an FM tower is just the support structure.

No matter what the tower looks like, it stands alone through every inclement weather condition known to man. From freezing cold, during the deepest, darkest winter nights, to scorching hot summer afternoons. Sometimes the location is on a metropolitan hill overlooking a city. It might even be one of those giant metal structures that seems to "stand watch." It might be energized with multiple stations radiating from a shared antenna array. Just the sight of one of these "iron men" seem to shout out "there's a lot happening here 24/7."

On the other hand you have those sad towers that can seem so lonely. Maybe you've seen one like this, a single AM stick located in a misty valley just outside of some little town. This one is badly in need of new paint, with a less than well cared for base fence, quite broken down. There is vegetation growing over the base insulator and a wooden door hanging by one hinge from the ATU "dog-house." One could speculate as to why any licensee would let this go so far ... but I have seen one like this first hand. It's usually because the station is off the air for some reason. Still, it's a sad thing to see.

Have you ever wondered who first came up with the idea to paint towers in the orange and white scheme? What about the lights? When did this start and who determined how it should be? Usually an Internet search provides all the answers, but not this time. We know that the Wright Brothers got off the ground in 1903 and experimental radio stations started popping up all around within a few years of that first flight. It is generally agreed that the first commercial license went to KDKA in Pittsburgh which signed on the air November 2nd, 1920.

Not finding the answers, I contacted the FAA historians in Washington D.C. to see what they could tell me. The search led to William P. McCracken Jr. He had just established a legal practice as an attorney in Chicago, when WW1 interrupted his plans. He enlisted in the U.S. Air Service and received flight training. It would be safe to say that flying became a passion for him and he eventually became a flight instructor. After the war ended, unregulated flying was a new past-time. President Calvin Coolidge saw the need for regulations. McCracken not only wrote the first 45-page publication called *Air Commerce Regulations,* he also received the very first pilots license.

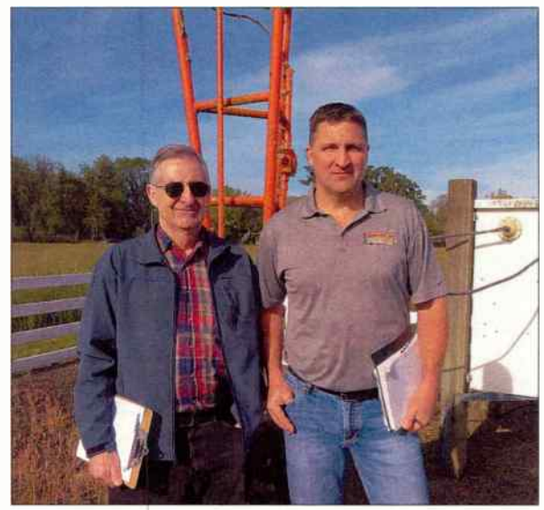
His book of regulations was first published in December 1926 and covered Licensing of Aircraft, Air Traffic Rules, Marking of Aircraft, Operation of Aircraft, Licensing of Pilots and Mechanics, together with a Miscellaneous section. Of course broadcasting was regulated too when the Congress passed *The Radio Act Of 1927.*

The helpful historians at the FAA sent me photocopies from the pages of the regulations largely written by Mr. McCracken; this one dated 1932. It describes tower painting as such: *For maximum visibility, skeleton towers should be painted throughout their height with either bands of chrome yellow or international orange and black, or alternate bands of international orange and white, terminating with either chrome yellow or international orange bands at both the top and bottom.* I would be curious to discover if any station ever used chrome yellow or black in a paint scheme.

The lighting plan written way back then is described this way: *For night marking, a red obstruction light consisting of a 100 Watt lamp, in a high transmission red waterproof globe, shall be mounted at the top of the structure and exhibited from sunset to sunrise. For radio towers, additional fixed lights, consisting of 50 Watt lamps in waterproof globes, shall be mounted on diagonal corners at one-third and two thirds points and arranged as to be visible from any angle of approach.*

The original plans for towers to be painted and lit have certainly stood the test of time – up until technology brought forth a better plan with lights that will last longer than any energizer bunny. With these newest LED tower lights, even improved over the first models, it is now possible to change your tower lights *one more time* and then move on. Chances are you won't need to do it again in your lifetime of management or ownership. Not only that, but the LED tower lights will cost less to operate.

The FAA in the past few years has updated the requirements for tower marking and lighting. Broadcasters may choose one of two schemes. If you have a galvanized tower, as almost all modern towers are, and you would like to forever hang up your paint brush, there is a plan in place that will allow you to do just that. Allow you to never paint your tower again! It requires you to upgrade to the new white strobe lighting plan. The new top light flashes white during the day and switches automatically to red at night. The new sidelights flash in sync with the one on top. Should you decide to keep your tower painted, you may choose to upgrade to a less expensive, but still red in color, LED upgrade for existing tower beacon and side-lights.



I was visiting with Al and Mike Slater (pictured) from Slatercom at the diplexed tower site of AM 1580 KGAL and AM 920 KSHO in Lebanon, Oregon. Their family run company, Slatercom, is based in Salem, Oregon. On this sunny day in May, the father and son duo were at the stations of Eads Broadcasting Corporation to offer owner Charlie Eads a bid on upgrading his two, 250-foot towers. Because it is a measure that saves electricity, the Oregon Energy Trust will rebate some small amount of the cost to replace the current lighting with the new LED system. Other rebate programs exist elsewhere, perhaps one that could pay you for a similar upgrade.

While Slatercom Lighting Solutions certainly knows what the FAA requires today and they work direct with broadcasters on upgrading tower lights nationwide, they also specialize in all facets of commercial lighting. A visit to their website will give you the information you need: www.slatercom.com

Ron Erickson is a regular reviewer for Radio Guide. He is also a broadcast consultant, engineer and air talent. You may contact him at 541-460-0249 or write ronerickson@gmx.com

Final Stage

RADIO ROUNDUP

The Radio Guide Event Register

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www.tab.org/convention-and-trade-show

2019 Nebraska Broadcasters Assn. Convention
August 13-14, 2019
Embassy Suites, LaVista, NE
http://ne-ba.org/news_and_events-convention.asp

NAB Radio Show
September 24-27, 2019
Hilton Anatole – Dallas, Texas
www.radioshowweb.com

2019 IEEE Broadcast Symposium
October 1-3, 2019
Hartford Marriot Downtown, Hartford, CT
http://bts.ieee.org/broadcastsymposium/

WBA Broadcasters Clinic
October 15-17, 2019
Madison Marriot West – Madison, Wisconsin
www.wi-broadcasters.org/events/broadcasters-clinic-2/

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