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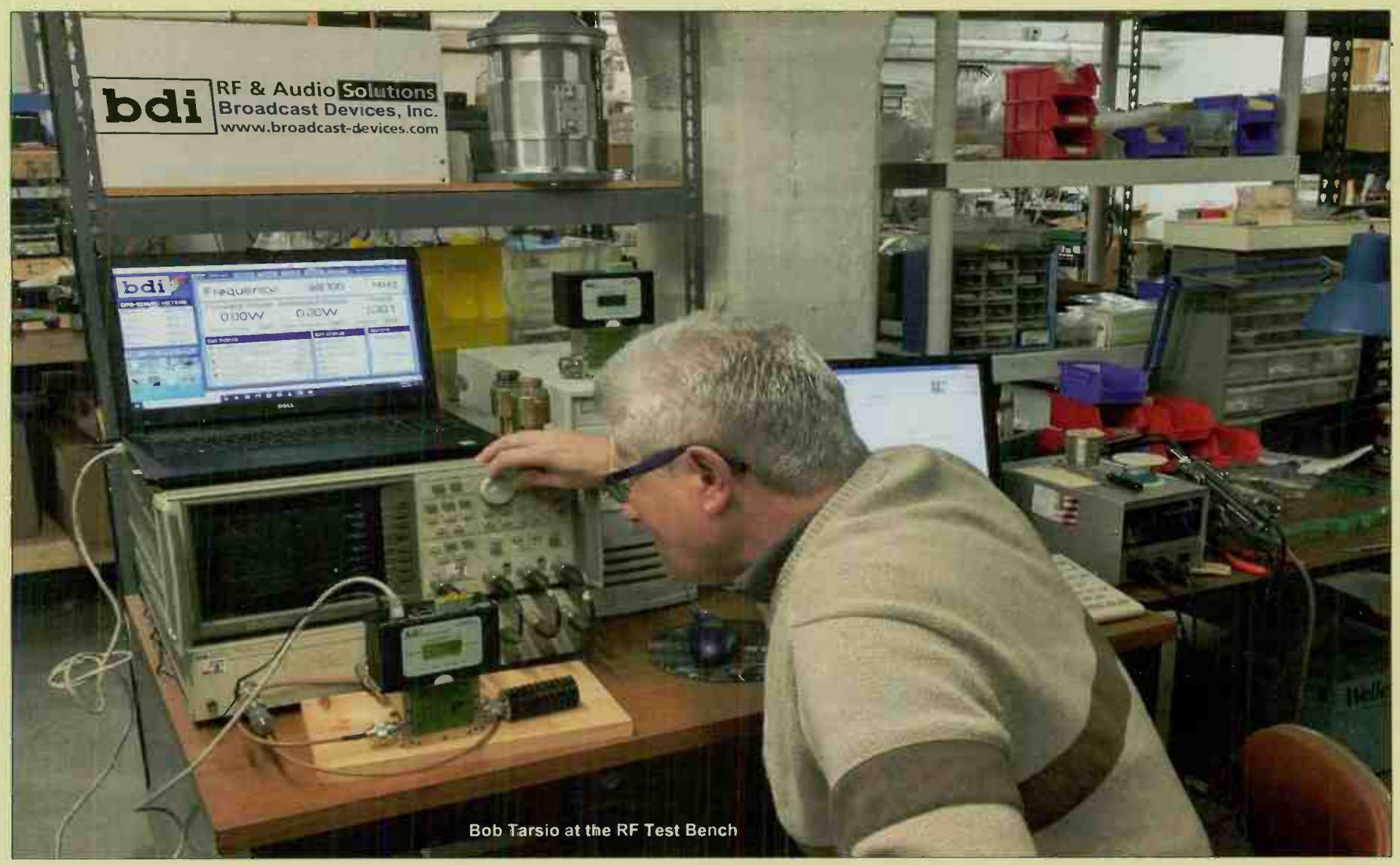
Digital Issue Now On-Line

November-December 2020 – Vol. 28, No. 6

Problem Solving by Iterative Design



Bob Tarsio at the RF Test Bench

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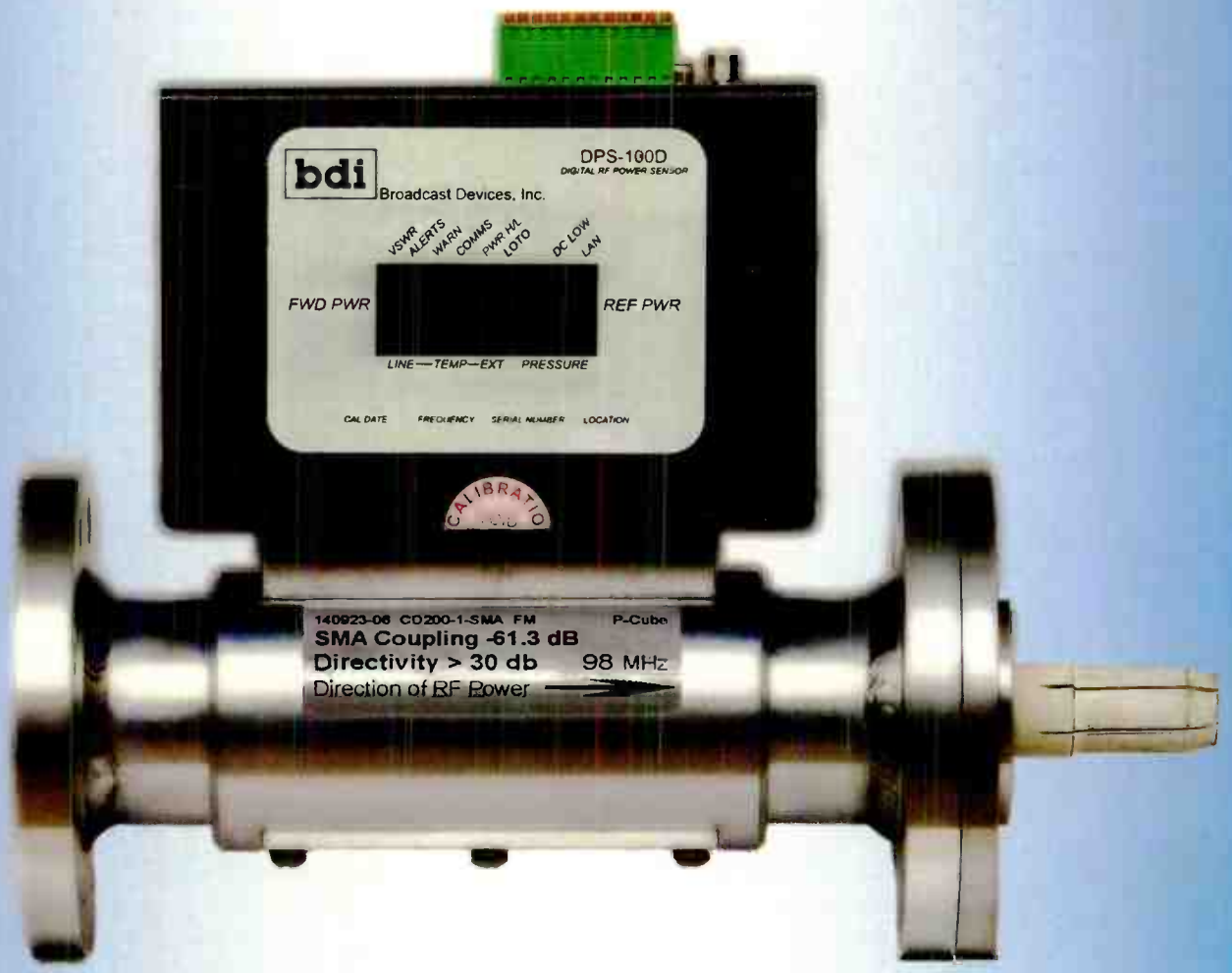

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In This Issue

Critical Content for Radio

Cover Story – *by Bob Tarsio (page 6)*

Problem Solving: *So what is the problem solved with a product like the DPS-100D? Lost air time. With a system that can provide timely information about impending problems such as rising VSWR, falling transmission line pressure or rising temperature you can avoid costly lost air time and repairs. The other hidden problem solved is that you aren't wasting a lot of time trying to get support. Two big problems solved."*

Chief Engineer – *by Scott Schmeling (page 10)*

Fool Me Once: *"In this transmitter, wiring for high power is fairly standard. A contactor applies each side of 220 VAC to the two primary terminals of the high voltage transformer. For low power, a different contactor applies one side of the 220 to one primary terminal and ground to the other, providing roughly half the normal plate voltage. By design, when this transmitter starts up (after a 120 second delay for the tubes to warm up) the low power contactor energizes, bringing the transmitter up at half power."*

FCC Focus – *by Gregg Skall (page 12)*

All Digital AM – The Time Has Come: *"It may seem that it has taken forever to get here, but the Commission has finally adopted rules that allow an AM station's voluntary conversion to all-digital broadcasting. Just released at the end of October, it is a cause to rejoice for many. Research on the potential for a voluntary conversion to all-digital AM has spanned the better part of a decade. At the 2014 Radio Show, a panel of broadcasters and radio engineers presented the results of their tests indicating that AM all-digital could be a long-term solution to the decline of AM radio due to increased noise and the quality of FM."*

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Cover Story

Problem Solving by Iterative Design

by Robert Tarsio – Broadcast Devices Inc. BDI

Solving problems sometimes takes a somewhat hidden form. BDI has been a problem solver company since its inception in 1985. Our very first products solved a big problem: bridging the gap of PNP germanium technology to the world of silicon and integrated circuits. Our first products were designed to retrofit into existing audio consoles. Keeping older equipment running and being serviceable to a station, while at the same time keeping a budget intact. Problem solved.

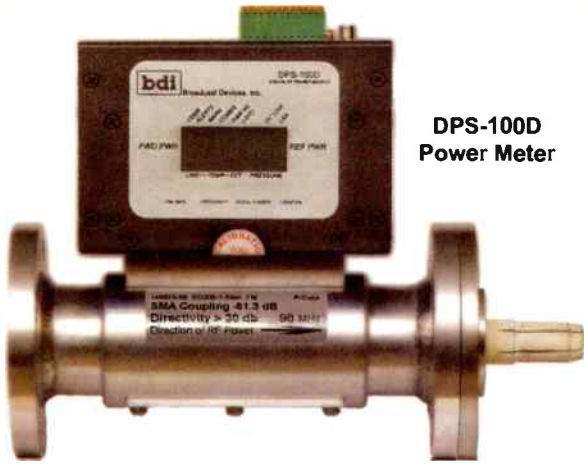
We recognized then, as we do now, that broadcaster's budgets are tight and that stretching every dollar with value is what a manufacturer should keep in mind when offering products. Often folks are looking for a free or cheap solution to a problem only to find that, in the end, they get what they pay for. For 35 years since BDI started with audio products and entered the world of RF power measurement, RF plant management and now remote control, we have understood the value proposition. Provide more value and utility for the dollar spent and you have something.

In today's broadcast environment the biggest problems are budgets stretched thin and lack of time to do the things that used to be routine or actually fun. So a manufacturer has to look at what can make an engineer's time more productive and try and offer products that will meet that value proposition. When we started building RF power meters the goal was to provide an antenna protection system. The more we got into the design phase, we took a look at the marketplace and realized that the products being offered at the time did not offer much in the way of this value proposition. We created a system that not only provided the needed information, like forward and reflected power, but also provided other information and most importantly protected the broadcast plant investment by safeguarding antenna and transmission systems from damage.

Diode Style Meters Have Reduced Accuracy

You might ask: Why would I need this product? I already have that old meter with the slugs and friendly analog dial. Well that old slugged meter may not be as accurate as you think and it is obsolete in terms of digital broadcast standards. Diode style meters are only accurate in terms of their full scale indication. They have reduced accuracy at lower power levels – well below the full scale rating. Another factor that renders them obsolete for digital broadcasting is that all digital broadcast standards have high crest factors and a diode style meter can't represent them accurately. In addition, some standards are multi carrier such as the digital radio standard in the US. Diode style detectors are not suitable for multi carrier use, which renders them non-suitable for combined carrier measurement such as the output of a combiner system.

Our **DPS-100D** series power meters have become an industry standard, I believe, because we have provided not only a better product but also have stood behind the product with customer support. Customer support is often not thought of in terms of value. If you purchase anything today, support is often an afterthought on the part of the manufacturer. It can be costly to you, the consumer, if you need it and can't get it when you need it, or in the quantity necessary. Without considering support in terms of quality and quantity, you can't evaluate the product in terms of its overall value and return on investment. So what is the problem solved with a product like the DPS-100D? Lost air time. With a system that can provide timely information about impending problems such as rising VSWR, falling transmission line pressure or rising temperature you can avoid costly lost air time and repairs. The other hidden problem solved is that you aren't wasting a lot of time trying to get support. Two big problems solved.



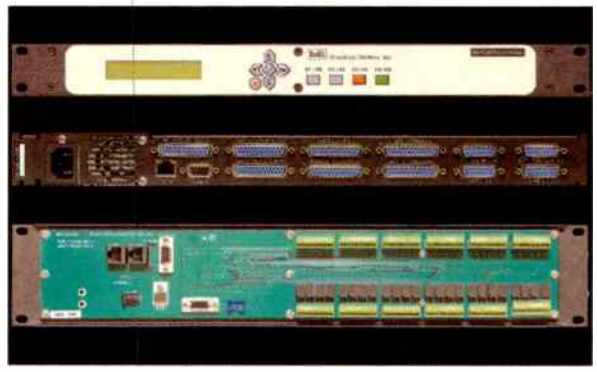
DPS-100D Power Meter

Building on the investment is another theme that BDI has built its reputation on. We have developed one of the most comprehensive families of products that can work together to create even more value and time saved for the station engineer, while insuring on-air readiness. We developed a motorized RF switch controller series – the SWP-200. Again we looked around the marketplace and saw that there was room for improvement. We introduced the first model in 2008 and have continuously improved the product by adding capability built on existing products. A DPS-100D power meter can be connected directly to an SWP-200 and create a totally automated transmitter switchover system in addition to providing accurate power measurement and transmission system protection. We added even more capability with the introduction of SNMP – Simple Network Management Protocol. We were the first company in the industry to do this in this product class. So, where's the value? An integrated system that can be built upon. Power meter plus switch controller is already more powerful and solves a problem – automatic changeover in the event of a failure and protection from hot switching.

No Soldering Iron Needed

Another problem solved is time at installation. Because all BDI web enabled products are SNMP, interfacing to a remote control is easier now than ever. A CAT5 cable is all that is needed for connection to modern remote controls and software. No soldering iron needed for a typical installation. More time is saved during installation because we offer premade cables for virtually every interface, from RF switches to transmitter interface cables. Another problem at sites where RF switches are involved is interlocks. This is handled by our interlock steering system which takes the guess work out of figuring out interlock paths. Time saved and problem solved so that the station guy who is already stretched thin can do something else.

I have just described how we created two products that work together. We have built on this idea with yet another innovation. The above system is fine for power measurement and interactive control of RF switches but what about other remote control functions that are needed? We added another accessory to the SWP-200 series which provides 24 channels of control and status, plus we even added analog inputs. Our model **IOX-24 Panel** is a direct plug in addition to all new SWP-200/300 systems.



Model IOX-24 Panel

Antenna monitor systems are something we have been doing for a long time. We recognized that there were indeed many antenna monitor "systems" that were custom made by some really smart people but they were all one of a kind. Often these were put together with customer fixtures and expensive, exotic components. Within a few years those systems would need attention, and trying to find the guys in a garage that put the original system together was tough. Then, the parts they used are no longer available even if you try a do it yourself repair. That's a big problem if you're the guy who has to explain why you paid those guys in a garage all that money in the first place.

SWP-206D Digi Monitor

We recognized that what was needed is a reputable manufacturer that used components with a model number and a technical manual and, most importantly, ongoing support long after the warranty has expired. We offer the **SWP-206D** antenna monitor product which has facility to accept up to 8 of our DPS-100D series power meters to form a really powerful calibrated power measurement system along with antenna and combiner protection. All of this is done with standard model number DPS-100D series power meters and the SWP-206D chassis. It's SNMP and seamlessly interfaces to all modern SNMP based remote control systems and third party SNMP software. Standards are a good thing that make this product, along with our other web enabled products, easily compatible with other manufacturer's equipment and software.

Part no longer available? The reputable manufacturer has a migration path for getting that system running with a compatible solution of replacement parts and/or software. The next time you consider an antenna monitor system where millions of dollars' worth of advertising revenue will be at stake, ask yourself this question: Do I really think the guys in a garage are the ones I should depend on to keep us on the air and, just as importantly, protect my investment?

I hope I've let you see some problems that you face, in a different light and that the choice of who you reach out to solve those problems really matters. Look at the big picture, and ask yourself – what am I trying to accomplish? Then look at the details – what products and services make the most sense for what I am trying to do? Assemble a budget and then be prepared to justify it, stressing that protection of the employer's investment is key. Even in this time of difficult budgets and uncertainty you will more often than not succeed in your goals. – *Radio Guide*

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Studio Site

Improve Your Look and Sound

Can Your Zoom, Broadcast, or Podcast Presence Improve?

by George Zahn

We continue our look and listen to how the Covid 19 pandemic is affecting our broadcast studio operations. Stations across the country are doing more with increasingly limited resources, and discovering creative ways to utilize talent and create interaction with new (and sometimes, as in our last article, older) technologies and devices.

This time around, let's discuss the aesthetics of the sound, and even the look, of what our talent may be doing from home or remote studios. This trend continues in both TV and radio, and may be changed forever as we find new ways to do what would have been unthinkable a year ago. A year ago, we could ask any manager in any organization if they could have a significant number of employees working from home in a productive and efficient manner, and most might have rolled their eyes and said, "Yeah, right."

The tips in this article are for a variety of users. Broadcasters utilizing their regular or possibly a makeshift home studio, those who are creating podcast material, those holding web meetings, and even those who are interviewees connecting to broadcasters and podcasters via Zoom, Microsoft Teams, Webex, Google Hangout or the like. My goal is to give you something to improve the Internet connection experience.

Listen Up!

As a lifelong radio person, I'm keenly aware of sound, and one of the worst aspects of the pandemic is the interconnection via collaborative Internet sites. While these are fine for off-air listener conversations, basic meetings, and general discussions, the variety of audio quality you get from one participant to another is striking. If you're recording the audio or video for broadcast, the programming is only as good as the weakest audio source.

How can we work on this? Some of it may seem like common sense from a sound and audio perspective, but I've seen and heard so many truly deficient quality connections that it really should be addressed. Many of us have gotten sloppy as we just tried to make things happen in an "any port in a storm" mentality.

The easy part of sound is choosing the right location in which to originate your content. Listen to the basic acoustics of the room in which you intend to work. If you project well, a small room can be a real problem. There are simple ways to do some sound "deadening" around you to create a warmer and less reverberant or even "boxy" sound.

Starting with a good reliable microphone is step one. Too many trust the microphone pickup from their tablet or laptop for their audio and for broadcast or recording, most of those basic built-in microphones just won't cut it. We've discussed the microphone issue a few articles ago, but many companies are marketing hybrid microphones similar to one I've tried: the Audio Technica ATR 2100X-USB which has USB C connection and can also be used with an XLR cable. More marketing is being pushed to sell slightly less expensive USB/XLR hybrid mics designed to come close to the performance of our studio microphones while working to eliminate the "boxiness" of less ideal surroundings.

Shure Thing?

One example is Shure offering a relatively new hybrid microphone. The MV7 is based on the design of Shure's classic SM7B. The MV7 is about $250 compared to the $400-$500 price tag of the dynamic SM7B. The MV7 does have USB and XLR connectivity, built-in USB automatic volume control (a feature that may already be found in your Zoom or other software. It also come with the Shure software package to tailor sound or let the microphone circuitry handle everything. The MV7 claims Voice Isolated Technology helps it better focus on voices, and less on reverberation. It has near or far speech setting.

Shure MV7

A last consideration on microphone choice is the pickup pattern. As we've talked about the MV7, it has a basic cardioid pickup pattern. Another option would be to choose a switchable pattern microphone or simply choose one with a supercardioid (more narrow) pattern. helping to reject sound from the sides.

Throw in the Towel

On a recent Steven Colbert show, Julie Andrews was his guest and talked about a podcast she was producing from her home. She turned her webcam around to show a closet someone had helped her transfer into a studio. It was filled with blankets and towels around the walls and behind the microphone. That works well for audio only – not so aesthetic from a video perspective.

We may not always have many choices of where we can broadcast from, when not in the studio. Having some soft surfaces around you for an audio setting can help absorb much of the reverberant sound in a live room. You can guy panels of sound diffusion or absorption material or just experiment with carpet remnants or other fabric. You can also buy or create your own reflection filter, which is mounted behind the microphone to keep close sound reflections from bouncing off computer screens or other nearby objects.

Among the commercially available reflection filters are the Aston Halo Shadow Box or the sE Reflection Filter, or Sterling Audio's VSM which are sometimes easier to find at music instrument stores. The size of each can be rather large and the cost between $100 and $400 for many, and they may not be good aesthetically if you're doing video as well, or if you need to see a screen for visual cues. These are primarily designed for music studio recording, but some have successfully tried them for tight voice work spaces. You can experiment with some smaller foam creations of your own before deciding if some form of reflection filter will be a good addition for you.

Green With Envy

I promised mention of visual aesthetics. For under $20 on places such as Amazon, you can buy a six-foot by nine-foot green screen – basically a big piece of green cloth. Not only will the fact that it's material will help at least a bit in preventing reverberation, but it allows easy use of a custom background in applications such as Zoom.

I have to admit, I wasn't a believer until a business Zoom meeting a few months ago. The person I was speaking with looked great with the corporate office behind them. Only when they moved at the very end of the meeting could I tell it was green screen, but it was impressive and beats the standard background so many use which is a bookshelf in their den or family room.

For many of my home Zoom meetings, I have a green screen push-pinned to the wall behind me, and I can customize what is "behind" me from a business logo to whatever image might facilitate conversation. For the logo, I often use a checkered design with the logo spaced around like those behind sports figures sitting at a table post-game, instead of one gigantic logo behind me.

Remember, the image you choose for the green screen should not be so distracting that it detracts from your conversation. That's why I like the checkered background – the logo is there but not overbearing. Many applications such as Zoom allow you to store multiple backgrounds so you can choose your background based on your meeting. This is a really nice touch for business meetings or for those being interviewed who want an image of their organization behind them.

I mentioned that the person I was speaking with moved a bit and gave away the fact that they were using green screen. This happens when there is uneven lighting on you and the screen. Often a shadow on the screen changes the shade of green enough that you'll get a fuzzy black spot where the shadow is. To avoid that you can invest is some inexpensive LED lighting. I actually use a little (two by three inch) LED bar that has maybe twenty LED lights and fills in where I might have a shadow. I sit it on the table beside me in the appropriate place depending on my lighting and it fills nicely. There are larger LED rings and even photography lights that some have used.

One last visual aesthetic is the camera on your laptop or tablet. Many of the cameras are not built for high definition video and can actually look pretty blurry. Many aftermarket USB HD webcams are inexpensive but many are very wide angle, so you might want to shop around for the right definition and angle for you.

Do you have any other tips on improving sound and appearance for on-air web connections? Share some with me and we can share them in a future article.

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

Fool Me Once, Shame on Me. Fool Me Twice ... We Won't Get Fooled Again

by Scott Schmeling

Thank you to George W Bush for the title. I could have titled it, "If it's not one thing it's *three!* That is my motto in the Engineering Department.

I try not to focus on specific equipment here. While this example is from one particular transmitter, the lesson is more universal.

As we care for equipment, we learn its idiosyncrasies and we mentally file a history or "medical record" of sorts for that equipment. When "this" happens, it was because of "that." This is information that can be very valuable the next time "this" happens.

In this transmitter, wiring for high power is fairly standard. A contactor applies each side of 220 VAC to the two primary terminals of the high voltage transformer. For low power, a different contactor applies *one* side of the 220 to one primary terminal and ground to the other, providing roughly half the normal plate voltage.

By design, when this transmitter starts up (after a 120 second delay for the tubes to warm up) the low power contactor energizes, bringing the transmitter up at half power. After another delay, the low power contactor releases and the high power contactor energizes, bringing the transmitter up to full power. Auxiliary contacts are wired as interlocks so only one of the contactors can be energized at a time.

I had a problem a few years ago where the transmitter came up on low power just fine, but when the high power contactor energized, it would trip the "wall breaker." What I found was the low power contactor was not releasing when the high power contactor energized ... which put a ground directly on one side of the 220 – tripping the breaker instantly.

Fool me once – same symptom, wall breaker trips when full power contactor energized. I assumed it was that same contactor issue because symptoms were the same. Nope. A resistor to ground through a capacitor (forming a surge suppressor) had changed value.

Fool me twice – same symptom, wall breaker trips when full power contactor energized. Again, I assumed it was the contactor. I ordered a replacement, but when I actually *opened* the door and got ready to install the replacement contactor I noticed some "debris" on the floor. A closer look revealed a damaged high voltage filter capacitor.

In low power, plate voltage is about 3000 Volts. Apparently, the capacitor could handle that, but in *high* power the 6000 Volts was just too much. A replacement capacitor was ordered.

The replacement was the same value (12 uf / 8 kV) from the same manufacturer. The width and depth were the same as the original, but it was a couple inches shorter – that meant the original mounting brackets would not work. No problem, the new caps came with mounting brackets – but these were narrower and the hole spacing was different! I guess one screw per side will do for now

Transmitter output had been dropping so we replaced the tube, too. When we were done, the transmitter was running nice and happy at full power. That was on a Thursday.

The following Tuesday evening the SINE system called me with an alarm on channel 0-3. The transmitter was off and would not come back up by remote.

Travis (remember him from the last article ... tall kid – long last name?) was about a half-hour closer than I, so he drove to the site and called me. He said a couple things that were alarming to me. First, it was very warm inside. And second, when he reset the wall breaker he heard the contactors energize as they should, but the box was totally quiet – the blower should have been running ... *and* the Air Interlock LED was *green* – with no blower running!

I put my jacket on and headed south.

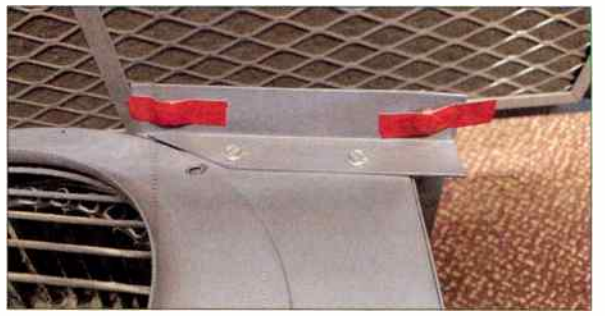
When I got there, we reset the breakers and tried it again. After a few seconds, the breaker would trip. We reset the breaker and pushed the Filament OFF button. With no blower running, the Air Interlock LED should have been red. It was still *green!*

Apparently, five days after replacing the filter cap and installing a fresh PA tube, the blower motor failed (it happens). Had everything worked properly, the Air Interlock would have shut the transmitter down immediately, but it didn't. And of course, I had already shipped my old tube to Econco for rebuilding (the *one* time I didn't hold on to it for a few days – or *months!*).

I manually moved the little paddle on the air switch. It had been stuck in the up position (falsely indicating air flow).

After putting a low-power backup transmitter on line, we removed the blower and the tube and sent them off for repair. Later, Econco verified my fear that we had "cooked" the new tube. Fortunately, they had one in inventory and had it shipped to me right away.

The problem with the blower was a bad capacitor. It was repaired and ready to go the next day. I decided to take the blower down and put it back in by myself. That solo project is easier with some blowers, but not with this one. When we work alone we discover little tricks. Since I only have two hands and both would be needed to get the blower in place, I held two of the bolts into their holes (upside down ... with the threads pointing up) using some tape and carefully got the blower in place where I could hold it with one hand while starting the nuts with the other hand. Then I was able to put all of the bolts, nuts and washers in properly.



Since the transmitter would be down for a few days, I pulled the exciter and took it back to the shop. The exciter has a 4-inch fan inside the cabinet that had failed several years ago. At that time, I had a 4-inch fan in the van, but it was 120 VAC (the fan in the exciter was 24 VDC). I installed the 120 Volt fan and ran the power wires through a couple vent holes in the back. I wasn't proud of my work, but it got us back on the air. And after all, isn't that our main objective?

In addition to blowing the dust out of the exciter, I did a little modification so the next time this happens repairs will be quicker and much less frustrating. I did two things – I used a connectorized power cable so no soldering next time. And I cut out part of the enclosure where the fan is, so it can be pulled up and out by just removing the top and the four screws that hold the little filter screen in place. Oh, and I ordered *two* of the fans and put one of them on the shelf at the site.

When the replacement tube arrived, I met Travis at the site. We gave the transmitter a fairly thorough dusting and installed the tube. Then we mounted the exciter back in the rack and connected its cables.

We reset the circuit breaker and let the tube warm up for about 10 minutes. Pressing the Low Power switch brought the transmitter up to the proper low power level. Again, we let it run that way for a while before we pressed High Power. Watching that meter come up was a thing of beauty, and after a little tuning and loading we were at 100%.

What I learned here was *not* to assume the same symptom indicates the same problem. In all three instances, the wall breaker tripped, but in each case the cause was something different. Every day is a new adventure!

If my calendar serves me correctly, you're probably reading this sometime in December. I wish you all a very Merry Christmas and send the hope of a wonderful 2021. Stay positive – *test negative!*

And until next time ... Keep it between 90 and 105!

Scott Schmeling is the Chief Engineer for Minnesota Valley Broadcasting He can be reached via email at scottschmeling@radiomankato.com

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FCC Focus

All-Digital AM: The Time Has Come

by Gregg P. Skall, Member – Telecommunications Law Professionals PLLC

It may seem that it has taken forever to get here, but the Commission has finally adopted rules that allow an AM station's voluntary conversion to all-digital broadcasting. Just released at the end of October, it is a cause to rejoice for many. Research on the potential for a voluntary conversion to all-digital AM has spanned the better part of a decade. At the 2014 Radio Show, a panel of broadcasters and radio engineers presented the results of their tests indicating that AM all-digital could be a long-term solution to the decline of AM radio due to increased noise and the quality of FM.

The panel showed that AM all-digital was significantly more immune to noise and interference than either analog or AM hybrid digital. Their recordings demonstrated that AM all-digital offers improved audio – quality they characterized as good or better than analog FM. Importantly, it also offers the potential for new data services and multicasting. Test results showed that the daytime and nighttime signals provided solid coverage well beyond the 0.5 mV/m analog contour on most of the test routes. Indoor performance, as well, was good within the 0.5 mV/m analog contour.

Six years later, an important key to this new Commission decision is its recognition that AM has proven to still be a vital force in many American communities despite many predictions of AM radio's imminent demise – this in especially rural areas. In 2011, the consequences of a devastating tornado disaster in Joplin MO were significantly mitigated by an AM station that remained on the air to provide critical, accurate, life-saving information.

Comments in the docket clearly demonstrate that 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. In many communities, minority-oriented stations provide the only voice for their ethnic populations. This local focus and community service was recently emphasized in an article from POLITICO Magazine titled, *"The Lo-Fi Voices That Speak for America."*

POLITICO reported that as recently as 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 noted 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 with specific station examples of AM radio programming that serve diverse populations, including a minority oriented Baltimore, Maryland station serving the city's neighborhoods with community based 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.

So the need is there. But what are the drawbacks to all-digital AM radio? As detailed by the Commission, the principal one is that all-digital signals are not receivable on analog only radios, creating issues around costs of conversion. However, new data from Xperi shows that the receivers are now out there. Its data reveals that the number of HD radio-equipped cars in the U.S. is growing almost exponentially, to a total of over 50 million HD receivers-equipped cars in 2018. Over 9 million are being added annually. Xperi has also provided data demonstrating 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.

The New Rules

Persuaded by the comments and passion of many of the commenters, the Commission adopted a rule that allows voluntary conversion to MA-3 all-digital AM operation. After numerous tests, the Commission agreed that digital broadcasting has the potential to significantly improve the AM service, particularly since digital modulation can operate with a much lower signal-to-noise ratio than analog, recognizing that in high noise environments, digital radio eliminates the tradeoff between receiver audio bandwidth and noise performance. These benefits were demonstrated by field and laboratory testing carried out by NAB labs (now Pilot) and the experimental operation of all-digital station WWFD, Frederick, Maryland, operating on special temporary authorization. Together with other NAB lab field testing, the Commission concluded that all-digital transmission results in a clearer, more robust signal, with greater daytime coverage than hybrid digital AM.

Accordingly, the Commission adopted its proposed rule to allow AM broadcasters to voluntarily broadcast using HD radio all-digital MA-3 mode. It was persuasive that even where the digital signal is relatively weak, it can still be received and decoded by digital receivers, placing an undistorted listenable signal over a slightly greater area than either analog or hybrid transmission. The Report and Order also concludes that better signal quality will give AM broadcasters access to greater format choices to serve their communities.

Some broadcasters did voice concern over the cost of conversion. However, since the conversion will be voluntary, stations can make their own decisions based on their own financial and technical situation, the interest of their audience and the number of receivers in the market. As stated above, Xperi claims the conversion cost is coming down, reporting that prices for HD-radio specific transmission equipment have dropped by approximately 80% in the last 10 years. It stated that it offers AM a perpetual license to use HD radio technology with no initial or recurring cost to the broadcaster.

In addition to allowing voluntary conversion, the Commission adopted several technical and procedural rules. Initially, the Commission had proposed to apply its existing nominal power limits to the unmodulated analog carrier at the center of the MA-3 waveform. However, NAUTEL persuaded it to use the average power of the all-digital signal, including the unmodulated analog carrier power and all the digital sidebands to determine compliance with the nominal power limits of §73.21. Significantly, the Commission believes that using average power to calculate compliance will enable more stations to use existing transmitters for all-digital operations.

Recognizing that digital operation offers many new forms of information delivery, including some non-broadcast data services, with the ability to charge end-users, the new rules require any broadcaster converting to all-digital to provide at least one free over the air digital programming stream that is comparable to or better in audio quality than the standard analog broadcast. After that, the all-digital licensee can use its digital bitrate capacity for broadcast or non-broadcast services consistent with the Commission's technical rules. Thus, new revenue opportunities are made available to the AM broadcaster.

The Commission adopted other technical rules to prevent interference and substandard service. Should an incumbent station believe that prohibited interference is nonetheless occurring, the new rules provide a streamlined resolution procedure based on that currently applicable to hybrid stations. Essentially, the Commission expects AM all-digital operators and complaining stations to work together to identify whether interference exists and to resolve complaints in a mutually acceptable fashion, including voluntary power reduction. To facilitate this, §73.404 was amended to allow up to 6 dB reduction of all-digital secondary and tertiary sidebands to avoid or resolve prohibited interference.

Issues have also attended nighttime AM operations for many years. The Commission agreed with many commenters that all-digital operations should be permitted both day and night, believing that restricting all-digital operations to daytime would effectively doom all-digital AM. Xperi claimed that Skywave behavior of a digitally modulated signal will be comparable to that of an analog signal. NAB and others pointed out that WWFD had been broadcasting all-digital night time service for 20 months without any problems. The Commission recognized that if signal degradation is not masked by the noise floor, there could be degradation. However, in view of the larger public interest, it decided to risk that possibility. In the unlikely event that prohibited interference occurs, the interfering station must follow the remediation procedures set out in the Order.

Switching to all-digital operation will not affect a station's obligation to participate in the national emergency alert system (EAS). Stating that digital broadcast stations, like analog broadcast stations, play an integral part in the distribution of EAS alerts, the obligation extends to ensuring that any "downstream" EAS participant stations are capable of receiving and decoding EAS alerts from the all-digital station or can adjust their monitoring assignments to receive EAS alerts from another nearby station.

Stations electing to convert to all-digital operation, must electronically file a notification using the FCC form 335-AM digital notification (or any successor form) to notify the Commission of the following changes: (1) the commencement of new all-digital operations; (2) an increase in nominal power of an all-digital AM station or (3) a transition from core-only to enhanced operating mode. Thereafter, the notification will be placed on a Commission public notice and new operation may begin no sooner than 30 calendar days from the date of the public notice.

During the 30 day public notice, a broadcaster commencing new all-digital operation must also provide reasonable notice to its listeners that the station will be converting and will no longer be available on analog receivers.

So, it took a while, but the challenge is now here. This order presents a great opportunity for AM broadcasters. Many are hoping they will rise to meet it.

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 member of the law firm of Telecommunications Law Professionals PLLC. He frequently lectures on FCC rules and regulations, represents several state broadcaster associations and individual broadcasters and other parties before the FCC.

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Radio Stories

More Trips Down Memory Lane

by Michael Bradford

Before anything else, I'd like to acknowledge a nice email from Dave Dintenfass of Full Track Productions out in Seattle, Washington. Dave read my article in the July/August edition of *Radio Guide* about my experience with the Collins 212G series audio console back in the 1960s and sent along a nice picture of the Collins 212G-1 console he rebuilt. Dave features all sorts of Ampex repair parts at his website, along with turn-table idler pucks and other goodies. Check everything out at www.fulltrackproductions.com.

I was listening to some of my favorite records recently and came across a Sheffield-Labs "direct to disc" recording of Amanda McBroom. In my opinion, nothing sounds as good as an analog recording from a vinyl record or magnetic tape source. The first time I heard this particular recording was when Electro Voice salesman Greg Silsby brought the new Sentry 100 speakers to the Park Place in Traverse City, back in the 70's to demonstrate their power capability and wide-band frequency response. As I recall, Greg had set up a turntable, pre-amp, Crown amplifier and two EV Sentry 100 speakers on a table in a room at the Park Place and invited numerous engineers, program directors and other interested Radio/TV folks from around northern Michigan to hear the demonstration.

Greg had some snacks for the attendees and had placed a bowl of popcorn in front of one of the Sentry 100 speakers. After the introduction comments and hand-shakes all around, Greg put the Amanda McBroom record on the turntable and got the demo underway. The first few seconds of the record were a capella ... then a strong bass guitar note began the song. As that note hit the Sentry 100 speakers, the sound pressure blew the popcorn out of the bowl. The overall sound was very impressive from the relatively small enclosures and filled the whole room. The Sentry speakers utilized an 8-inch bass speaker and a separate high frequency driver with cross-over control and were mounted in an enclosure that fit nicely into a standard 19-inch rack width. You could also mount them on the wall or sit them on top of a cabinet as the need required. I know that Greg took orders for several of the speakers at the end of the presentation, while many engineers tried to get him to sell them the display models right on the spot.

Greg also used to carry one of the field-famous EV 635A microphones with him that had been run over by a truck in a parking lot at one of the recent NAB shows. The mic was squished almost flat after being jammed into the asphalt, but when he plugged it into an amplifier it still produced sound. Not perfect sound mind you, but it pointed out how robust and durable the EV 635s were.

Speaking of Electro Voice, Dave Veldsma of Audio Distributors in Grand Rapids, Michigan, arranged for several Michigan/Ohio/Indiana/Illinois engineers to ride the Audio Distributor's demo buss to Buchannon, Michigan to experience the EV anechoic room they had just built. This was circa 1988 and the EV anechoic room was the largest anywhere in the US. EV had built their first anechoic room back in 1946 after moving their production facilities to Buchanan. The room was utilized for testing and designing microphones and speakers. I recall the wire-grid "floor" in that room actually suspended you in the middle of the enclosure. We were asked to be as quiet as possible and after a moment, you could hear a watch ticking from anywhere in the room or your own heart beating if you held your breath.

If you have ever wondered how Electro Voice came upon their brand name? I discovered the credit might belong to Notre Dame's football coach, Knute Rockne. It seems that back in 1930, Knute was recovering from an illness that kept him from walking around easily between the four practice fields at Notre Dame. He asked Al Kahn and Lou Burroughs of "Radio Engineers" to design a PA system that would allow him to "speak" to any of the four practice fields from a central location. Al and Lou put their heads together and designed a four-speaker PA system with a microphone/amplifier mounted on a tall central platform with a switch configuration to allow Knute to send instructions to any or all of the fields from that control point. Knute is said to have referred to the system as his "Electric Voice" and lead to the change in name for the company to "Electro Voice."

Electro Voice began life in 1927 as "Radio Engineers" in the basement of a tire company in South Bend, Indiana. The company was an industry leader in dynamic microphone design and construction, and obtained numerous patents for their microphones and speakers. EV perfected a special transformer design for their dynamic mics that reduced interference from nearby AC electric fields. This was in 1934 and was called their "humbucking coil." This coil made EV microphones the first choice for PA, Stage and Radio production around the globe.

Electro Voice moved their production facility to Buchanan, Michigan in 1946 and I later in the 40s, Al Kahn was instrumental in setting up the Heath Kit Company in nearby Benton Harbor, Michigan. I dare say that many of us older engineers are very familiar with Heath Kits and used many of their "kits" to solve station needs on a budget. Heath kit made power supplies, amplifiers, telephone hybrids, oscilloscopes and many other devices that found places in radio stations across the nation. Plus, we got the fun of building a piece of top-quality equipment from scratch.

How many of you have heard the Altec Lansing "Voice of the Theater" speakers in your lifetime? WTCM Radio in Traverse City used to have one in their lobby back in the 60s. The sound was impressive and easily filled the whole room with just a small radio output as the source. I haven't been back there in several years and wonder if they still use that speaker. Altec Lansing began its life as an offshoot of Western Electric, building huge speaker systems, especially for the new "talkies" in theaters around the world. From that initial design, their enclosures were customized for home use and radio station sound reproduction.

I ran across an Altec Lansing telephone line equalizer in my stock-o-parts cabinet recently. A small, passive equalizer used to produce a flat frequency response from a standard unloaded telephone line for sending audio to the transmitter site from the studio or to/from a remote location. I first used the Altec Lansing passive equalizer coils when WCCW added their FM service. We had two equal-length phone lines to the transmitter and I was able to obtain flat response up to 20 kHz with the little equalizer units mounted on a piece of plywood under the telephone interface enclosure. Engineers from Western Electric who began work on theater sound systems back in 1927 progressed to audio equipment of all descriptions for sound reproduction and telephone line long-distance repeating amplifiers and line equalizers. I used to see the Altec Lansing equalizers at radio station transmitter sites across the country as recent as 1988, some of which were still in use. Many of the Western Electric engineers would move to the Bell Labs and work on designing transistors, telephone repeaters and the famous "touch tone" telephones.

I had a nice conversation recently with John Abdnour, now retired from Nautel and previously a salesman for Continental Electronics and ITC in Bloomington, Illinois. I've known John for over 30 years and we share an interest in all things Radio.

I recall joining a group of engineers for a tour of the ITC production facilities back in the 70s. At the invitation of John, we boarded the Audio Distributor's demo bus and headed to Bloomington. The ITC production facility was very impressive and watching the employees put the various cart machines together gave us a first-hand look at the quality and care that went into every machine. The milled, solid aluminum decks, the air-damped solenoids, the tiny "bicycle chain" pinch roller drive systems and the external rotor capstan motor design all made for a reliable tape cart machine.

"Jack" Jenkins was our official tour guide at ITC and showed us a huge cart automation unit that held 1,000 carts; this was a proto-type unit that used several of their single-play cart machines which rode up and down in the middle of the structure while the vertical trays that held the carts rotated around the base structure, placing the selected cart in position to be fed into one of the cart machines. The cart machines rode up and down on a slide mechanism driven by bicycle chains and electric motors. The whole "system" must have weighed at least 1,000 pounds and covered several square feet of floor space. I don't think the machine ever made it into full production and John Abdnour told me he thought it was shown at just one NAB show.

During the tour at ITC, I recall Jack Jenkins telling the gathered engineers that he believed there were only three types of Project Management that made any sense: (1) Plan it, do it, I don't ever want to hear about it again; (2) Plan it, report to me on it, then do it; (3) Plan it, do it, then report to me on it. After lunch, Jack asked our group if we could remember the three forms of Project Management he had told us earlier. As my memory actually worked well back then, I was the only one able to repeat the three forms verbatim. I didn't get an award or anything, but two weeks after returning to Michigan I received a job offer from ITC. Coincidence? Perhaps. I choose not to accept the offer as I was having too much fun "in Radio" and didn't want to change gears.

While our group of engineers was in Bloomington, we all were also treated to a tour of the SMC plant. Sono Mag Corporation was known industry-wide as the builder of the famous "Carousel" multi-cart player. We strolled through the production area and watched the crew build the Carousels from the ground up. I had a lot of experience with the Carousels in our automation system at WCCW in Traverse City. I preferred the open-frame motor design used to rotate the cart holder and draw the carts into the "play" position in the original Carousels. The later Carousels used DC drive motors with a pencil lead/spring brake system. I never had any trouble with the original design but recall numerous "issues" with the pencil lead brakes failing in the newer designs. I do recall getting a finger pinched when I tried to insert a new cart into a tray while the system was in motion. I can't blame SMC for that injury but I take a certain solace in knowing I wasn't the only one getting pinched while trying to out-pace the machine and load new carts into place while a record or a commercial was ending in another studio.

Well, I've only had 7 cups of coffee in the last 6 hours so I'm going to sign off for now and try to catch up. Hope you are all staying safe during the Covid-19 pandemic but continuing conversation with your family, friends and fellow engineers on a regular basis.

Michael Bradford began his career at WCCW in 1962, A CPBE since 1984, and currently a contract engineer. You may reach him at: mbradford@triton.net

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Documentation

by Sam Wallington

We walked into the station for the first time as contract engineers, taking over after the previous engineer left. The place had a nice lobby with receptionist and prominent station logo, air studios visible off the lobby, and a hallway to the production rooms. The GM's office was straight ahead, with Sales and Engineering upstairs.

After a few minutes discussing terms, we were given a verbal list of broken things, and we set out to fix what we could. Step one ... explore. We found the wiring closet hiding behind the on-air studios and the production rooms. Oh boy, lots of wire, plus apparently active components balanced atop stacks of boxes and junk. Not wanting to cause new problems, we moved into the space cautiously and saw what appeared to be original wiring plus a lot of wiring which was apparently hurriedly added later.

Going upstairs to the unfinished room acting as the Engineering shop, we found a couple shelves with manuals and parts, a desk piled with papers and various trade magazines, a rack with STL and processing gear, and a pieced-together bench with a few tools and partially completed repairs.

Digging through the piles brought the reward of a documentation binder. The pages outlined the intended design of wiring from each studio to the wiring closet, and from the wiring closet to the processing and STL rack. Happy with the results of the treasure hunt, work could begin in earnest!

The next bit of time was spent deciphering the intent of the person who assembled the binder. Eventually, using headphones and a cable toning set, we were able to determine which wiring section corresponded to which page of the binder. A few areas had received attention from a Dymo label maker, which helped the deciphering process.

While figuring out the layout, it became apparent the documentation was older, likely dating to the most recent remodel of the facility. The original wiring was neatly routed and attached to the wall and followed obvious logic. Unfortunately, the newer wiring was increasingly messy and drifted significantly from the logic behind the documentation. The worst parts were wiring which attached to a barrier strip, ran to a component balanced on a box "over there," and then ran to a different spot on a different barrier strip. Oh, and the power cords for these ad hoc bits of equipment were a tripping hazard at best.

We were able to resolve the station's immediate problems, and thanks to those successes, we were invited back repeatedly. Over time, with some significant wiring cleanup, we were able to get the station sounding much better (those pieces of equipment added in haste were not doing the audio any favors).

Does this story sound familiar? I suspect any broadcast engineer who has taken over when an engineer left has had similar experiences. Whenever I have, I have always vowed I will "never again" neglect to document things. But as schedules become overbooked and too many things become urgent, documentation can fall by the wayside.

With the realization none of us are perfect, I intend no judgement (especially since I am just as guilty as most). I thought I would share some documentation tips I have picked up over the years.

Most of us are pretty good at documentation when we take the time to do it. My problem is finding the time (and sometimes, the willingness). Like the station I described at the beginning, documentation is important (and relatively easy) when the facility is first built or remodeled. Documentation at that time is more planning than recording, and once planning is complete, the plan becomes a guide to construction. Often, we will even keep a pencil with us during construction to adjust the documentation when we realize an oversight or error.

Ethernet and Audio over IP (AoIP)have dramatically changed documentation requirements. IP simplifies a lot of things, but it also means documentation needs to be extended well beyond physical wiring and equipment placement. There is the need to document IP addresses, subnets, audio and data routing configurations, switch settings (such as quality of service), login names and passwords, software versions, and a host of other non-physical things.

If you are like me, your documentation gets weaker as we finish up the physical connections and installation. and move into the virtual world. Some things we will likely plan out in advance, such as the configuration for an audio crosspoint switch. At best, other things such as the password for the managed switch end up scribbled on the back of a handy scrap of paper (most recently, I scrawled passwords on the back of my punch list of things to finish up). Those scraps are easy to lose – not a big deal at installation, since you can simply reset the box and start over – but a much bigger problem six months later when the entire air chain depends on the box with the missing password. We need to have a permanent, easy-to-access, and organized place to put this information (such as password management software or a secure document in the cloud).

One of the tricks I learned while doing contract engineering was documenting for invoicing. Our contract allowed billing for time and mileage, along with a reimbursement for parts expenditures. We used small audio recorders which we kept in our trucks. Every time we got in or out of the truck, we would record the time and mileage, then describe what we had been doing since the last entry. An entry might say, "It is 3:57 PM on November 18, and the mileage is 52,345. I just finished fixing the first fader on the main control room console at KXXX, and before that I replaced the springs on the mic boom in Production A. I am now headed to KYYY." When we arrived at KYYY, we would capture the time and mileage, then set off to work.

When it came time to invoice the clients each month, we would sit down at a computer with the recordings and start playback, transcribing mileage, times, the work done, and who did the work (important if the work took two or three people). Once the invoicing was done, we would delete the recordings and start over for the next billing cycle. Most months, it only took a couple hours to invoice all clients because the information was all in one place.

The same idea can be used in other areas, whether you use your phone or a small MP3 recorder you carry with you. Why not record, "I connected wire X between points Y and Z" or, "I installed box A, with inputs coming from B and outputs going to C?" Since it only takes a few seconds and is easier than writing legibly while you are on your back under the console, it increases the likelihood of capturing the data. If you keep the station's documentation in the cloud, such as on Google Drive, you can do your updates during down times such as waiting at the parts counter or doctor's office (probably with earbuds).

Use a voice recorder as your "notebook."

Another tool is wire markers. There are a number on the market with various designs. I am particularly fond of ones which are computer printed and sealed so they do not smudge (rather than those gooey and non-informative pre-printed labels with just numbers or letters). I have seen a bunch of different schemes for clear wire labelling, but design something for your system and implement it during installation or during a major focus on wiring cleanup. Then. when you have a bit of time every month or two, print new labels based on the audio or video recordings of changes you have made. Next time you are back at that gear, a couple minutes will get the wires labeled and the documentation is up to date.

One other trick used during my contracting days was carrying a notebook with everything about every client. By everything, I mean everything! Gate codes, addresses, directions, station-specific vendors (such as a plumber or HVAC repair person), frequencies (including the STL), DJ birthdays, IP addresses, circuit numbers, etc. Obviously, this needs to be kept secure, and with nearly ubiquitous Internet access, storing it in the cloud is a reasonable option (though to fix failed Internet access, you may need a phone backup of some data). With a paper notebook, simply update it in pen or pencil, then every month or two, correct the computerized copy and re-print that station's page(s). With a digital version, just update it in real time – or use the audio recorder to capture something when you are in a hurry (better to catch up later than miss it).

In my opinion, the hardest part of documentation is the discipline. Good intentions and good practices do not help at all if we do not take the time to put the information somewhere safe. For contract engineers, the need to be paid incentivizes preparing invoices, so updating documentation when doing invoicing makes sense. For others, I recommend setting two "unbreakable" calendar events on your calendar every month. Use the time to update documentation (the second appointment is in case you have an emergency during the first one).

Like the documentation binder we found at the station, you should give yourself and the next engineer the gift of good documentation (incidentally, do not stress about moving on! It does not have to be a bad thing, as it could be your dream job offer next month). Accurate documentation will make your job easier now and is a blessing to whoever comes next.

Sam Wallington is VP of Operations and Engineering for Educational Media Foundation, and has 36 years of experience in broadcast engineering. He can be reached at swallington@kloveair1.com

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Tower Topics

Tower Grounding Improvement

by Dave Dunsmoor

I've been involved in grounding buildings and towers, occasionally for about 40 years now. And it's generally dirty work, with the work generally hidden from casual view. No glamor here, lots of ditch digging, gravel shoveling, and ground rod pounding using either a post driver, large hammer, or if quite fortunate, an electric power hammer, such as a Hilti with the proper driving adapter.

Yeah, it's dirty work but when done right, it's a work of art – positively beautiful. And even better yet, if done right, it'll go a long way toward protecting the equipment inside the building from lightning induced damage. And you notice I said "lightning induced," not lightning damage? Now, I've seen evidence of direct hits to a VHF antenna: the RF cable was hanging down from the tower hardware, separated from the antenna connector when I arrived. However, inside the building, no damage was evident, but this isn't really the normal outcome.

Most often, a direct lightning strike will cause significant physical and/or electronic damage, usually to the point of making repairs a useless endeavor. Early in my career, I worked at a small two-way radio shop, and the first time I attempted to repair a lightning damaged radio was (eventually) my last. A few times I felt that I had found and replaced all necessary components, only to have the radio returned a few days later with new failures. After this experience, replacement was the only choice I offered.

Lightning induced, in general, means that the lightning bolt can be considered the primary winding of an air core transformer, and your tower, coax, or power lines (either buried or on poles) is the secondary. A ka-jillion volts through very low Ohms (the ionized air path) produces a ka-jillion Amps in this primary winding, and the associated magnetic/electric fields then produce high electric fields in nearby metallic objects. This is a very simplistic explanation of the phenomena, but illustrates it well enough for my purpose in describing what I'm doing – and why – as I relate a story.

Original Ground Strap With No Ground Rods

For some time now, I've acted as the local "on call" guy for EMF (K-LOVE) radio in my area. Their FM transmitter is located in a building owned by a TV station, and has recently been bought by a local owner. It used to be quite the mess, inside and out, but following the ownership change, the building and tower site has been nicely cleaned up, and many long overdue "deferred maintenance" list items have been neatly dealt with. The site has been mowed and graveled, the diesel engine/generator has been serviced and actually works now when needed, and what was an open sided shed housing the generator has been enclosed with metal siding and good quality doors. All around, nicely done.

Earlier this year I did a walk around the site, admiring the work, and when I took a closer look at the base of the 700 foot tower, I was a bit surprised to see that the tower's "grounding" was what appeared to be an afterthought by the original tower crew. Some 2" copper strap screwed to the tower base faces with 1/4" bolts. Although they did use stainless steel, they certainly didn't torque the nuts, as they were all loose. And at least one of the copper straps had been cut.

Strap Termination Unknown

Further, as I dug down to determine just where the 2" copper was actually terminated, I found no ground rods, just the copper going down into the earth. I supposed it was just laid into the foundation excavation. No ground rods were found anywhere.

I contacted the facility manager, asking if the owners would like to have the tower grounding cleaned up and done correctly. Initially, I recommended, as a minimum until the owners decided to go ahead with a small project and until they secured funding, that the copper straps and associated steel be cleaned up and re-tightened prior to the summer thunderstorm season. This was done in one afternoon, then I waited to hear that either my suggestion had been approved or not.

It was eventually approved and I contacted an electrical contractor that I've used many times in the past, supplied them with my scope of work, and they went to work. By now the ground had frozen, and the trenching was much more difficult, but they did good work, despite the conditions. I had specified six, 10-foot ground rods, spaced approximately 10 feet apart, with a ring of 4/0 bare connecting all ground rods, and a run of 4/0 from each back to the tower. All connections were thermo welded, resulting in a solid mechanical connection – a significant improvement over what I had initially discovered!

4/0 Cable Thermo Welded to Ground Rod

A couple tools that they used warrant mention here, I believe. First was the Toro "Dingo." It's a small version of a "skid steer." It was very useful in tight spaces, and having a machine moving gravel saves a lot of time.

Second was a soil compactor. This might be overlooked by inexperienced contractors, but putting the soil back as it was found, tightly compacted, does a couple of things. First it helps prevent sagging of the soil in years to come, and it also helps prevent gophers from tunneling into the trenches excavated for the electrical cables. In this case, it's not much of a problem, but buried cable insulation can be attractive to the little rodents.

A Toro "Dingo" Exceptionally Useful in Tight Quarters

A few things to mention now that the project is completed. First is that, even though I drew a diagram for the foreman when I first requested a bid, the specifics of this project didn't get *exactly* transferred to the crew. Close, but not as I would have done it. This means that even though I thought what I wanted was clearly understood, what was finally transmitted to the crew was slightly different. The work was done well, but the geometry wasn't exactly as I had envisioned.

A Ground Compactor – Very Necessary!

So next time, I'll not only make a drawing, but I will also layout dimensions, and locations on the drawing. Perhaps I'll even use surveyor's paint on the ground, prior to the start, to further illustrate. Second, I've discovered that electrical contractors understand "grounding" to mean doing it for single- or 3-phase safety grounding, which is a bit different than grounding, when considering the high frequency and exceptionally high currents associated with lightning. For example, the 4/0 cables from the tower down over the concrete were run with more "curvature" than I would have done. Again, a drawing would have been easier to follow (and remember) than verbal instructions only.

Completed Job Significant Improvement

However, I am satisfied with the end product. And another one next spring is in the works.

Dave is mostly retired, and does backup engineering for Air-1 and I-heart Media as requested. He can be reached at: mrfixit@min.midco.net

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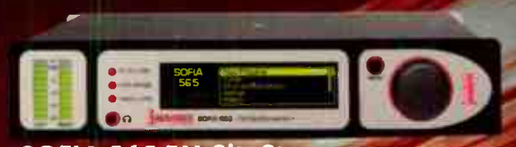

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Links and Lines

Have You Hugged Your STL Today?

by Steve Callahan

It's the Rodney Dangerfield of your radio station because it just doesn't get any respect.

Your STL works 365 days a year and 24 hours a day performing a vital service. However, do you walk past your racks in the morning and even notice that they are there or, at the very least, see that the meters are moving?

When you first installed it you were in a little way amazed and in a very big way thankful that it worked and what you put in at the studio side came out the transmitter end. However, have you checked lately to see if your 950 path is still clear and no one has put up a big building in the aperture, or that little tree in the Fresnel zone is now a very large tree?

Back in the previous century, STL's were often one or two phone lines running from the studio to the transmitter. You usually had one for mono or an AM and two phased lines for FM stereo. You called upon the friendly folks at the telephone company to send their Special Services techs to build or maintain the lines. The Special Services crews were two man teams who knew how to adjust the Bell Labs amps and equalizers to get flat frequency response all the way up to 15 kHz.

Although the old timers in the telephone company were very smart, sometimes they weren't. A friend once told me of a story of when he worked at a station in Tampa, Florida in the pre-satellite days, which was a Paul Harvey affiliate. Remember "Hello Americans, This is Paul Harvey ... stand by for news?" It seems that one day he potted up the Paul Harvey noon feed and there was nothing there. A quick call to the telephone company and they said that it was leaving them OK. and later the 1:00 p.m. newscast feed was OK. The next day, the same thing happened – no Paul Harvey. However, a quick look around showed a telephone tech sitting by the board eating lunch with a pair of headphones plugged into the ABC feed to the station. It seems that he liked to listen to Paul Harvey as he ate lunch.

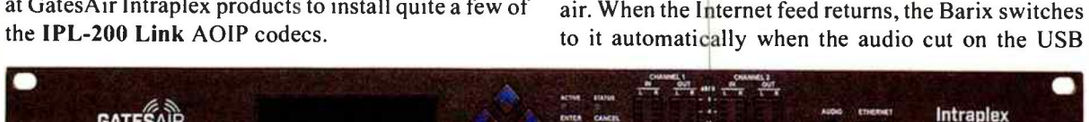
Fast forward a couple of decades and I was listening to the major market FM station that I was chief engineer for. We used telephones lines as an STL. I was driving into work one morning when one channel dropped out. A quick call to the studio revealed that everything was as it should be. I was just pulling into the parking garage, where the telco demarc board was located, and I saw a diligent telephone company employee, sitting on a bucket waiting for his co-worker, with his butt set clipped across one channel of my STL line. It seems he was a big fan of our morning show so I tried to contain my anger but I'm afraid I didn't do a very good job.

A big step up was the proliferation of 950 composite microwave STLs. The stereo generator could live at the studio and you could preserve the composite signal all the way to the exciter. Some folks elected to split the STL channel and run left channel on one frequency and the right frequency on the other frequency. Common practice was, if one STL link died, you could switch to the other working one and be on the air in mono which was better than not being on at all.

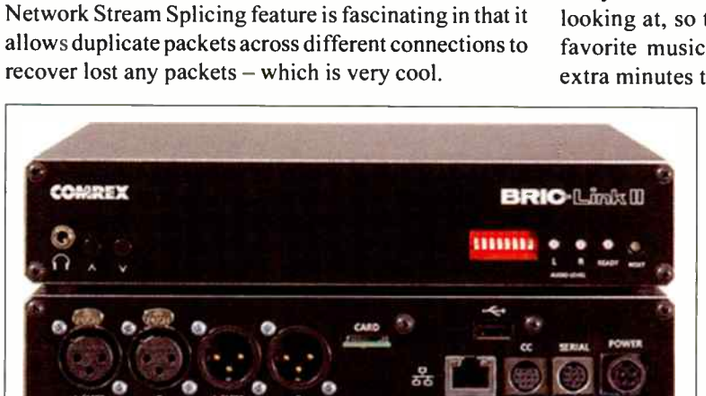
The allocated 950 frequencies, especially in congested cities, filled up fast so some creative folks out there went with unlicensed STL frequencies and frequencies in other bands. Weather conditions were the weakness of some of those other frequencies which often relegated them to "fair weather spare" duty.

Enter the all mighty Internet. The first Internet-based STL's were not too robust and were not ready for full-time STL duty. However, several of the big STL companies made great strides in developing some very robust and multi-directional STL's which were Internet based. Today's Internet based STL is a work of art, which is a good thing, because the wire-line telephone companies around the country have detariffed, or discontinued, the old analog copper service and many digital services which were copper-based.

I've had the pleasure of working with Tony Gervasi at GatesAir Intraplex products to install quite a few of the **IPL-200 Link** AOIP codecs.



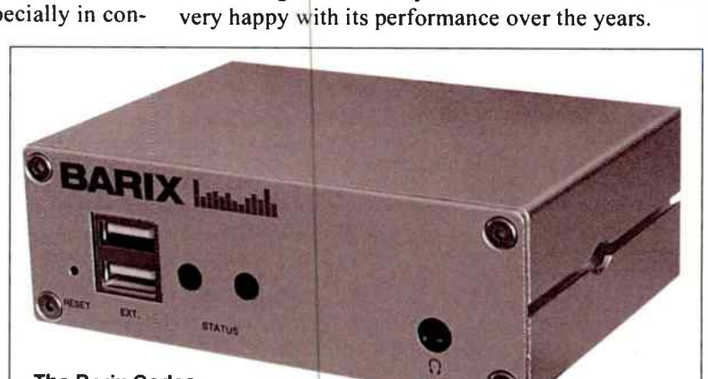
The single rack unit boxes are packed with features like redundant power supplies, three network ports with automatic fallover, the ability to send a stream to more than one location at a time and so much more. Their Network Stream Splicing feature is fascinating in that it allows duplicate packets across different connections to recover lost any packets – which is very cool.



The Comrex Bric Link

The very neat thing is that you have bidirectional audio which is crucial in an application where the station is a long distance from the studio. You just can't, and you really don't want to, run a multi-hop 950 STL when you can go with this box. Like everything Internet, you want the best Internet pipe you can, to get all of the available features and reliability from the IPL-200. Fiber at both ends is how I've been installing them and I must say I haven't been disappointed.

If you want to examine other options, my friends at Comrex would love to sell you a **Bric Link**. The first time I saw a Bric Link, I was at a local broadcasting trade show and Comrex's Tom Hartnett called out across the room for me to come over and see his latest creation which was the Bric Link. I was so impressed that I bought one for my own station and have been very happy with its performance over the years.



The Barix Codec

The **Barix Codec** has found its way into many radio stations as an STL. It's amazingly simple to set up and it's extremely gratifying to have audio pop out after one minute of set up. I have used the three source fall back many times and it's a very handy feature. If you lose one Internet feed, it goes to a second IP and then to a USB stick so that you have something on the air. When the Internet feed returns, the Barix switches to it automatically when the audio cut on the USB sticks ends. One caution I have is don't get carried away with how simple it is to make a Barix work. Remember, the little Swiss man inside the codec will tell your audience what the IP address is, that he's looking at, so they can also hack into it to play their favorite music over your radio station. Take a few extra minutes to go into the security part of the Barix advanced setup and lock it down with a password.

A tip of the Clevite headset to Jeff Montgomery down in Texas who filled me in on the Texas Broadcast Museum down in Kilgore, Texas. I took a look at their webpage and it's a very good looking radio and television museum. They have a mighty fine collection of old radio and television equipment. I was especially impressed with their fully restored Dumont Telecaster remote broadcast bus. I wish I lived closer so I could visit it but it's on my "to do" list when this whole virus thing is over.

Steve Callahan, CBRE, AMD, is a member of the engineering staff at Entercom Boston. Email at: wvbf1530@yahoo.com

The astonishing new Bluetooth Audio Gadget.
So much better than taping your phone to the mic.

There are plenty of ways a smartphone could be useful on air. Playing recorded audio, voice clips or music, for instance. How about using a SIP client as a codec? Or Skype or Zoom or social media sound? And of course, putting callers on the air. If only there was a professional bidirectional audio interface for cell phones...

Problem solved. The Bluetooth Audio Gadget makes it easy to put a smartphone on the air. Just pair your phone, and the Bluetooth Audio Gadget automatically negotiates the optimal codec algorithm (usually APT-X for Android, AAC for iPhone). Balanced aud o I/O connects the Gadget to your console. The sound quality is amazing. And the Bluetooth Audio Gadget is bi-directional, so you can even send mix-minus to your caller.

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Practical Engineering

Good Questions Improve Station Maintenance

by Daniel Carcopo

Things are often overlooked while the pressures at the studio keep you busy all winter long. Now is a good time to get your Springtime maintenance plans in order – Spring will be here before you know it.

Springtime is a perfect time to evaluate your plant. But do not just write down a whole bunch of issues and leave them on the "To Do" list. Take advantage of the good weather and make plans to really get something done; this could be the start of a new beginning that will ensure reliability of your total plant operations and better prepare you for when unforeseen things happens.

Getting an Overview

So grab the nearest pad of paper and a pen full of ink and we will get started. Please note that a proper maintenance inspection, whether routine or a "yearly checkout," will highlight both technical and safety concerns. Ask a lot of questions as you go; The more you ask, the better your inspection will be.

We start by pulling up to the front of the transmitter site, and from the outside of the front gate or roadside of the entrance to the site take a look from the outside – the "total picture" as you might say. Is the fencing in good condition around the property? How about around the tower and anchor points? If your AM tower is surrounded by wooden fencing, are all the slats in place? For stations with guyed towers, are the guy anchors fenced in?

Are the proper warning signs (RF warning signs) in place? Is the Tower Registration (ASRN) number visible? Are the signs clearly legible to visitors?

While you are thinking about the tower, take a moment and look at the tower's condition. Is all of the metal covered by paint, and are the paint bands the proper color? Do the tower lamps appear to be in working order and evenly lit when on? Does there appear to be anything out of order on the tower; for example, are any of the transmission lines unsecured? Are the radomes in place on the FM antenna? (If you have deicers on the antenna, do not forget to check their operation when you get into the transmitter building.)

If you notice any of these items out of place or inoperable, it may be time to invite your local tower climber to the site and set things straight.

Inside the Fence

As you open the main gate to enter the property, does the lock open properly, or does it need some oil? If there are multiple locks, do all the users understand the concept of how to put their locks together to create links in the chain, or has one person effectively locked everyone else out? Does the gate open without undue effort?

Once inside, is the driveway in good condition? Or has it become washed out, filled with potholes or otherwise requires a monster truck with mud bog tires to get to the transmitter building? Hiking in during an emergency can be time consuming and annoying.

After parking, walk around the perimeter of the building, checking its condition. Are there any problems with vandals leaving graffiti or causing other damage? Are the gutters in good condition, or are they rusted out or clogged with debris and serving no purpose? Is the outdoor light working? Better to catch it now than find it non-functional in the middle of some night.

More External Checks

At the transmission line entrance point, are the lines properly secured, and grounded? Or is there damage from ice having fallen off the tower and knocked the lines ajar?

Following the lines out to the tower, are they secured properly? Are they grounded to the tower properly? And are the tower grounds properly secured? If an AM station, is the ATU in good condition, free of rust and properly bonded to the ground system? Does the ATU door lock (and is the key available)? At the tower for AM stations are the lightning balls in good shape, and gapped properly? Does the base insulator look to be in good shape? Be sure to make your notes accordingly.

Looking Inside

Moving back to the transmitter building, is the door properly secured, or did a tenant unwittingly leave the door unlocked for the entire world to get into the building? As you look around inside the building, when was the last time the floor was swept? Are there cobwebs hanging all over the place? Are there "critters" in there? Or has it become a dumping ground for all the old equipment that is no longer used at the studio? (Often, old equipment has to be stored at the site but does it have to be lying all over the place?)

By the way, this might be an advantageous time to inventory any excess items, and give the list to the company bean counters to find out when the items can come off the books. Then, when it is permitted to remove these items from the records, a small dumpster can be procured from the local waste collector. If the items are still serviceable and in working order, generate some of your own "non-traditional income" by selling the stuff. Use the funds to purchase new equipment or put the proceeds into a station party fund.

In the long run, a clean building is a happy place for transmitters, support equipment, HVAC and, more importantly, you! Clean air filters ensure the equipment has proper airflow and you will not run the risk of getting a dreaded emergency call due to a clogged filter. Something as simple as sweeping the floor and taking out the garbage can help to boost your morale and also show others with whom you work, including management, that you take pride in what you do.

How is the HVAC (heating, ventilation, and air conditioning)? Has the return air filter been replaced lately? Is the room temperature within specifications for your particular equipment? When was the last time the HVAC system was serviced and the condensing coils cleaned?

Technical Checks

These next things probably ought to be noted on a separate sheet of paper. I suppose the first question to ask is: "Is there a transmitter log, and if so, how up to date and detailed is it?" Such a log is the key to being on top of your transmitter's condition, and in the long run will help better diagnose any potential problems as they arise.

Start with a record of the forward and reverse power; then check the plate voltage and current, screen voltages and any other readings that your transmitter may offer. For AM stations, check your base/common point current. And if your station is directional add spaces for the monitor point readings. Other things to make note of include the remote control readings. How accurate is the calibration compared to the actual readings? Leave space on your sheet to add notes about the modulation, transmission line pressures, STL receiver readings, etc.

If you have a backup transmitter, open it up and look inside; does it need cleaning in there? Are there any capacitors leaking? Are the interlocks working – are they working properly? Filters clean? Are all of the cooling fans working? And most importantly, if for some reason the main transmitter gives up the ghost, are there means of easily and quickly taking the backup to air? Did you test those means? (That also gives you the chance to look inside the Main.)

For those stations unable to put the backup on-air due to programming requirements, run the backup into the dummy load (you do have one, right?) and check for normal parameters and log the readings. Do not forget to note other general but important information including generator fuel and oil levels. When was the generator last exercised? When was it serviced?

Using the Information

All this data should go back to the office with you, so you can do two important things. First, make a list of priorities; the ones at the top of the list are those problems that could result in forfeiture if you happen to get a surprise inspection. The list continues with each thing that could potentially put the station off the air, if not looked after promptly.

The other important use of the data from your inspection is to produce a printout so that whomever goes to the site (hopefully on a regular basis) now has something more to do than just look at the forward power and run out of the building. A three ring binder will help keep track of these sheets, and effectively create a transmitter log that will demonstrate to anyone the plant is being run cleanly and things are getting done to ensure it stays that way.

Use the information you gathered. With your list in hand and a maintenance plan, you will be able to make your site visits more productive, promote site safety, and keep everything well maintained. – *Radio Guide* –

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The Linux Connection, Etc!

Getting Around the "Windows Frustration Syndrome" – continued

by Tommy Gray CPBE CBNE

Back at It!

Since last time, we have had to deal with two hurricanes in our area. I missed my last article due to a lot of damage in our area form Hurricane Laura. We were without power for quite a while. All of our stations, other than those with generators, were off for many days while while power crews rebuilt the infrastructure. In the last article I discussed upgrading your Linux Mint Cinnamon installation to the latest version which is version 20. Due to space limitations I could not go through the entire process but left you a link to follow to finish the upgrade. At this point I hope you have completed it and are running v.20. If not, 19.3 is still a great OS and is supported for a few more years. In my opinion, of all the Linux distros, Linux Mint cinnamon is the most user friendly, and for those transitioning from Windows, the easiest to adjust to. This is of course for workstations that I am mentioning it. If you want a server there is another great OS that is especially designed for servers and is running on thousands, if not millions of systems worldwide. That would be a Linux Server. A great majority of the world's web servers are running it these days.

A quick search for information on the Internet will show you that 96.3% of the world's top 1 million servers run on Linux. Only 1.9% use Windows, and 1.8% FreeBSD. As of 2019, 100% of the world's supercomputers were running Linux I am told. 90% of all cloud infrastructure operates on Linux, and practically all the best cloud hosts use it. Of those top servers the most popular one, based on Internet statistics, is Ubuntu Server. I personally use it and have found it to be rock solid and easy to setup and maintain. The most recent version is 20.04 LTS. The LTS stands for "long term support." The great thing about Ubuntu server, as it also is with Linux Mint Cinnamon, is that it is totally free!

Virtual Computing

A few weeks ago, while I was in the middle of dealing with all the aftermath of Hurricane Laura, I received a phone call from the Society of Broadcast Engineers (SBE) asking if I could do a presentation on virtualization. I was honored to be asked but at that time, as I stated, the hurricane had us in a mess, working round the clock recovering, so I had to decline. I recommended a capable young man who used to work for me in my department at a network, and he is going to do it, as I understand. However, ironically enough, I had already been working on putting something together along these lines for these articles. I have also seen others writing on it recently, so it is a hot topic right now.

Getting Started With "Virtual"

Now before you go into "Virtualization," you might want to take an old computer you are not using and install Ubuntu Server on it for experimentation. The great thing about it is that it does not require a lot of resources for a basic installation, and can be run on just about any old computer. To run 20.04 LTS, however it *must* be a 64-bit machine as Linux Mint 20 also requires. The good news is that there are still older versions available that will run on 32-bit machines. A quick web search on "Installing Ubuntu Server 20.02 LTS" will get you some very easy-to-follow instructions. You can easily have an Ubuntu Server up and running in a couple of hours or less ... usually. Once you have Ubuntu server running I would suggest that you look into things you can do with it and "play with it" a bit to familiarize yourself with it.

When you have a working system, before you start modifying it, I suggest you make a snapshot (backup) of the system, so if you mess things up you can easily go back to your clean install and try it again. The easiest thing to use is a native utility called "Timeshift." You can create a backup of your entire system and if the need were to ever arise, you can completely restore it back to where it was at the time of the snapshot. In your Linux Mint Cinnamon install, it is found in the main menu and easy to use. In Ubuntu server, it can easily be installed from a terminal (which you will find is your best friend in Ubuntu Server).

Door #2

If you don't have another spare computer all is not lost. If you have your Linux Mint Cinnamon computer working well you can still run Ubuntu Server on it and not at all mess things up. You can still keep your LMC install intact and run Ubuntu server on it "Virtually." "How can I do that?", you may ask? Well, it is very simple. In your LMC Software Manager (in the main menu) you will find a program named "VirtualBox." It is a platform that will allow you to install a complete operating system and create another complete computer inside a file on your host computer. The Computer that is running VirtualBox (in this case your LMC machine) is called the "Host." The virtual machines are called "Guest" machines. I am about to tell you something that you might find hard to believe, but it is true.

(Continued on Page 28)

– Continued from Page 26 –

I took an old Dell Inspiron laptop and installed LMC on it. I then installed VirtualBox™ along with the guest extensions (which you will need), and finally created three (3) Ubuntu Server virtual machines on it, all running at the same time. One of these Virtual Machines (VM's for short) is running Apache Webserver and is hosting three (yes three!) different websites on a single VM! The other two are doing other chores. All of this is running on that one old laptop, and is connected to my network through nothing but the internal Network interface built in to the machine. The great thing about Virtualbox (VB) is that it can create virtual Windows, Linux, and yes even MAC computers. You can have several computers to use on a single physical machine. Can you see why virtual computing is such a powerful and useful tool for engineers and IT professionals?

Figure 1 is a screen shot of the host screen of my VirtualBox machine showing the desktop of the LMC machine with VirtualBox running, and also showing the three servers running alongside it. The limitations of the system are only your hardware complement. I would suggest a lot of RAM and plenty of drive space.

Now if you are familiar with Servers, you will notice that I am not showing a typical Terminal screen in the VM's. I have installed Ubuntu Mate on the VM's simply because I prefer to have something visible. The terminal is readily available when needed but in the meantime I have something to look at. This is simply personal preference, and is just fine as long as your machine has enough RAM and a fast enough processor. This machine has a meager 4 GB RAM and a 500 GB HD, along with a 2.2 GB Intel Core2 Duo processor. I would recommend a faster machine with more processing power and RAM for a service machine. Running here is the Linux Mint Cinnamon 20 host computer with Virtualbox (showing in the upper right corner), and 3 Ubuntu Server 20.04 LTS VMs. What you do not see is that the 3rd one has three websites running on it!

Figure 1: Main Screen of the Host Computer (taken remotely from another computer)

By the way, the screen you are seeing was actually captured from another machine on the network by way of RDP (Remote Desktop Protocol viewing). I like a program called "Remmina" **(Figure 2)** to manage RDP and SSH (Secure Shell) and VNC sessions. It is a great program and can be found in the Linux Mint Cinnamon software manager.

Did I mention that everything you see and everything I have described is totally free? It does not cost anything, as it is all "OpenSource" and readily available for free on the Internet.

By the way, you can save on host machine resources by running the VBox VMs in what is called "Headless" mode whereby on the host computer, the VMs are not seen and are totally "virtual" even with regard to visibility. You do not see them running but in the Virtualbox screen their status will show running. When you access them from a remote computer however they look normal right down to the desktop screen or the terminal screen, depending on which method you used to connect to them. I rarely ever even open up the host machine or VMs, as I do everything using either SSH, RDP, or VNC from my favorite computer on the in-house network.

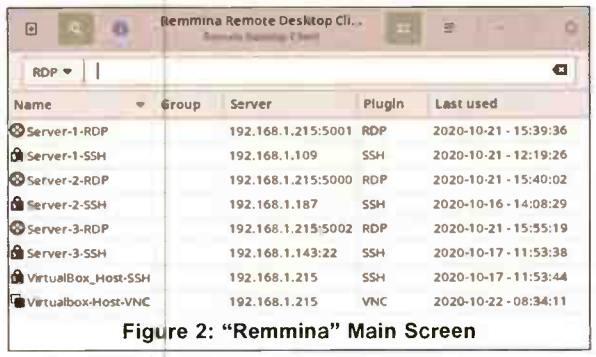

Figure 2: "Remmina" Main Screen

I am running very short of space for now, so I will wrap this up. Next time we will get into setting up a computer with everything I have shown you here. In the meantime, go ahead and download the ISO file for the Ubuntu Server 20.04 LTS (https://ubuntu.com/download/server). Choose "Option 3," and have it handy on your computer. If you have not already installed Linux Mint Cinnamon 20, get that ISO and make a bootable flash drive or DVD of Linux Mint Cinnamon (https://blog.linuxmint.com/?p=3928). We will setup Ubuntu server next time as well as VirtualBox. Keep in mind that the instructions for doing everything I have shown you are readily available from an Internet search.

Until next time ...

Tommy Gray is a semi-retired veteran broadcast engineer currently staying busy doing engineering and IT 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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Customer Service in 2020

by Wiely Boswell

It is a new normal in a lot of ways. The impact of Covid 19 has been apparent in the broadcast industry. A large new facility to support a local TV station has recently been constructed and moved. The new location is pristine and exhibits the latest technology, yet no visitors and very few staff members are even coming in. They are doing so much remotely and all is still going as well as could be expected. Tech support has had its place with this project.

Not only broadcasters are in a remote way of doing things but so are broadcast equipment vendors. Fewer people are around at the factory floor because some people are working from home, which can impact lead times on equipment and customer interaction. Many customer technical support operations are also working from home and it does pose its challenges. I am going to try to look at both sides, having worked for years in technical support, and now quite a few years as a customer involving broadcast electronic equipment, tower work, and other facility support items. So now I approach this subject as a customer but I know how hard it can be on the other end. I must admit I do expect quality to be evident in all aspects of interaction with vendors.

What is reasonable to expect from a company that makes "widgets?" To start with, there needs to be someone answering the phone and not a voicemail. A lot of companies do answer and may ask if it is an off air situation. At this point you may be handed off in a transfer and hopefully it will be answered or be given a voice mail opportunity to leave a message. A timely returned call should be expected and *answered* by you, otherwise phone tag may ensue. If it is a low priority issue you should indicate that on voice mail, and offer your email as a response to a question. This takes the stress off tech support and will show you do respect they are some times overloaded with requests for help. I don't remember calls coming in very often just saying your equipment works great and we appreciate your always being there to help! Once you get the support person on the line you need to have all the pertinent information at your fingertips. So here is my main thought– it is a two way street. As a customer needing help, there really *are* expectations of you, the customer, to make the process go smooth.

There are several great people that have left the service position that I really miss a lot. A great place to make contact is during a new installation and turnup phase. It is important to be able to build a relationship as you are able. We had a great "in the know" specialist turn up our new automation with short training. He now knows our layout and staff. Unfortunately, we can not reach him directly anymore. Even with a service contract, this can be a long term response with automation bugs that can take months to prove and even longer to fix.

Customer service organizations should take efforts to have a customer database that has easy access to you and your station's call history – it's off to a good start when they know you. This is when they pull up your call sign from the database, "OK you are with KXYZ in Houston." It gives you a good sense of the support being efficient and providing credible service when you call. Salesmen take this a step further and have birthdays and number of kids and how much you like golf in their customer database. We don't necessarily need all that relationship but we do need to be known, where we are located, and what stations we work for. I hate to admit it, but a major account, the big customer, gets more service. That's just a fact, but the smaller customer matters too.

Customer service is expensive for the vendor so you need to remember that, if you are calling for free help, not all help is free. As a vendor you really need to be on the ball if you sell support contracts. When we have to pay we expect more from your support. The cost of the equipment also enters as a factor. No surprise, large equipment manufactures have more resources to put towards customer service. If a product never failed there would be less need for support contact.

Excellent support can help shore up a company's reputation, if a product is less than dependable or perhaps in an early stage of deployment.

(Continued on Page 32)

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Customer Service in 2020

– Continued from Page 30 –

We have to do our part to make all this support go smoothly and be productive. We can first read the equipment manual. I always showed the customer where the answer was in the documentation to help them help themselves in the future. Good documentation is a big part of support. Most can be found in the company's website including older discontinued legacy equipment. As a customer service representative, if I got lots of calls about a certain feature that might be confusing, I would suggest edits to documentation in efforts to better explain what we must have missed. I also suggest giving reason for cautions. If you say, "don't pull board under power," *explain* that pulling under power will damage interface ICs for example. If you make a power divider that located up at the bays on a tower, caution installers not to stop up weep holes at the bottom! A red arrow sticker pointing at the hole for instance and dark print caution in documentation would go a long way. First, it would save time on phone with customer service and protect your company reputation. Pump water seals are amazing ceramic things and they caution you to not touch the seal surface, using a screwdriver to push it into place. There must be a good reason?

You need details of what you are asking about. Things such as model number, serial number, software/hardware releases, and date codes are good to have when you call. A description of what happened and what happens (LED boot sequence for example), as detailed as possible, can save diagnostic time.

Any specific needs from support can be spelled out in documentation with the customer service number and email. That is the new factor – email support and even online videos. You have to explain the issue well to avoid "mail" tag. A combination of email and phone can be an effective tool.

Customer service will have you try different things to narrow down a problem. Again, a good description/observation of what happened before when it went down, and what happens following any procedure, as requested from support. You have to watch for any clues that might even point to another piece of equipment in the chain. Things have changed in electronics with fewer repairs in the field – it's a "swap out the card" nowadays. Schematics can be rare and sometimes a tease with parts blurred out. So you send the module back. In this case it is also very important to completely describe problem in writing, with the module, that does not get lost in the box. A lot of companies have a form requiring details to get an RMA number. A note back as to what was done to repair equipment helps us understand the breakdown much better with feedback from the actual person who fixes it. We have to help them help us. After all, they are the wizards! We need them more than ever.

As a customer who tries to do all the right stuff we have expectations. We expect help from a support individual who is knowledgeable in the subject. They need to be up to date on hardware revisions and/or factory modifications. They need to quickly ascertain a problem related to old software or required hardware mods and be ready to provide return info or what you can do on site.

No one can be an expert on everything and new people will come up in the ranks. Here is where senior support should be available in training new support. Working at home prevents them from going down a couple of cubicles to get advice on a problem. The slow down occurs as the younger wait on the experienced help now via email. When you go out of your way helping customers they will ask for you. We should be ready to give support some grace and be sensitive to their support load. If not critical, give them some slack. Remember, when service as a norm goes out of its way to help a customer, it builds grace so when you have a serious outage, and it takes a while to respond, they have earned some slack by paying the service forward.

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

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Shop Talk

by Steve Tuzeneu, CBT

Misc. Tech-Tips and Thoughts

I always enjoy getting emails from my readers. Some of you have made some very interesting and helpful comments. If you have something positive to contribute, I would love to hear from you. If you have some helpful technical advice or words of wisdom, please contact me at stuzeneu@sbe.org. Your help will be appreciated by the readers, and I would appreciate it as well.

Letters From Readers

A while ago I wrote an article about EAS. Jimmie Rushing read it and had a comment about it:

I have intended to reply to your article in Radio Guide (May-June 19) for a good while. Arkansas is one of the few, if only, states that has TV as its primary on EAS.

I have used everything from an old VCR to a Zenith digital converter as a receiver for EAS. Most of the time it has required a DA or some kind of amp for the EAS box to have a good level. As you mentioned, I still have one of the old RS radios on the shelf for future use. I am always careful to have all my EAS stuff on a UPS.

I have retired twice and am now still on call for four TV transmitter sites. I served as Operations Manager and engineer for KVTJ (Victory Television Network-religious broadcaster) for seven years. I was a CBT but there is no SBE chapter near me now.

God Speed – Jimmie A. Rushing

TECS Television Electronics Consulting Services

Planning for the New Year

By the time you read this article it will be just a few weeks until Christmas. I hope you had a great Thanksgiving, and I wish you a Merry Christmas.

Along with the holidays, some of us are thinking about the New Year, and I am not talking about what party you are planning to attend. I am thinking more about what you will be doing in the new year to improve or maintain your transmitter site(s). A number of companies, large and small, work on their capital expenditure budgets in December; the budget is also commonly referred to as "capex." If you don't work for one of the heavily leveraged companies, you probably have funds you can spend on repairs or improvements in your capex.

Now is the time to prepare and submit your budget to the owner, or in some cases to the director of engineering. Let's start with the generator.

I was curious about how often other engineers maintain their generators. On one of the Facebook engineering pages, I asked, "How often do you bring in a company to maintain your generator?" Some said once a year, others said twice a year and some even said every three months. If you want to chime in on how often you service your generator, or how often you have it serviced, I would enjoy reading your email.

Whatever the schedule you choose to maintain your generator, make sure you have the funds to keep yours in excellent condition. Cutting the budget here could cost you revenue later when you're off the air. If you had your generator serviced before the cold weather came, then you are prepared for a power failure. If you haven't serviced your generator recently, now is a good time to make sure it is in your budget and on your "to do" list for the new year.

One of the budget items you may wish to consider is the cost of a tower crew and some transmission line parts. It's not a matter of if, but *when* you have a transmission line leak. About fifty percent of the tower sites I have been to have a slow leak of some kind. Eventually the problem will become worse without attention.

On the lighter side of the story, here is a somewhat amusing photo of a transmission line with an interesting connection for the nitrogen gas. Would you connect your nitrogen to your transmission line like this?

(Continued on Page 36)

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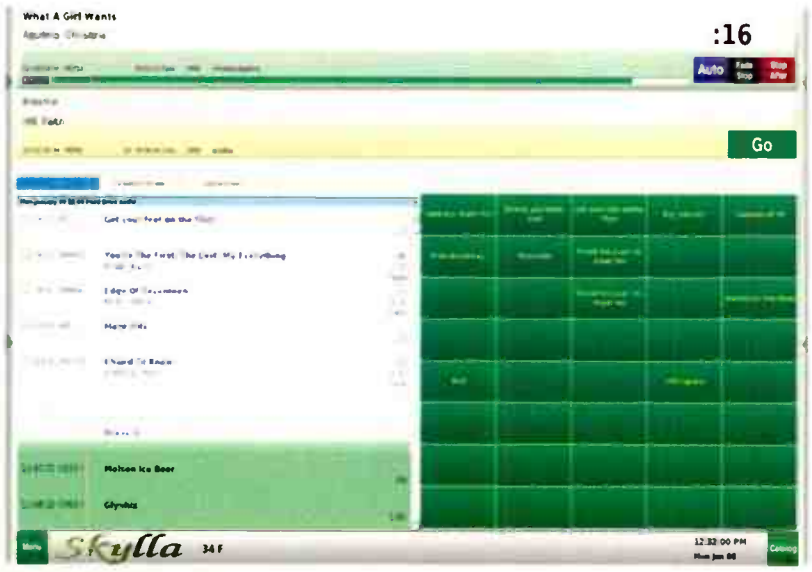

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Shop Talk

Misc. Tech-Tips and Thoughts

– Continued from Page 34 –

Ground Systems

While you are working on your budget for next year, here are some areas to consider. How's your ground system doing? Both AM and FM stations need a thoughtfully and carefully installed ground system. It also needs to be inspected on a regular basis. I have watched webinars where the author shows poorly constructed ground systems. The engineer showed photos of equipment grounded to every possible location in the transmitter building. He also pointed out that a single ground location is the best choice. A poorly maintained antenna ground system on an AM station will obviously degrade your signal. For an FM plant, you increase the likelihood that a lightning strike will destroy some, or all of your equipment. There are a number of resources to show you how to properly ground your tower and transmitter building. While working for a radio network, I was told you need to have six copper ground rods driven eight feet into the soil: two rods at each corner and two more about halfway between the corners of the building. After watching a webinar from an engineer who installs and evaluates ground systems for a living, I discovered that ground rods driven eight feet into the ground is not deep enough. I also learned that proper grounding is a bit more complicated than just driving rods into the ground and connecting copper wires.

Properly grounding your tower and transmitter building is both an art and a science. The impedance of the ground needs to be taken into consideration. I thought that was odd, that you need to measure the impedance of the ground into which you will drive the grounding rods. But it makes sense when you consider that lightning will take the path of least resistance. For more information, the SBE offers an excellent on-demand webinar on the subject.

Backup Systems

When planning your budget, look at what your station needs to stay on the air. Along with the usual spare parts, like an RF module or a spare tube, as mentioned earlier in this article, maybe you need a backup generator to keep your transmitter going during a power failure. How about a backup audio delivery system? That could mean a redundant over-the-air STL, or a digital land line of some sort for when your STL system goes down.

While this may not be a budget item, here is something you want to think about. You probably know what normal readings on your main or standby transmitter look like, but what about your STL transmitter and receiver? Having records of what readings are normal could save you some time trouble-shooting.

You may also want to include some tools in your budget that could make your life easier. I'm not talking about the kind you will find in your toolbox, but rather the kind that will save you a trip to the transmitter. If your router is acting up and you can't get into the network in your shack, a power reboot switch could make your life easier. A dial-up remote control could power down your router for a second or two and bring your network back to life. An IP switch could reboot a piece of equipment that has locked up, providing your Internet is working properly.

Maybe you should include some security cameras in your budget for the outside of your transmitter building, or one inside to show you what's going on with your transmitter or the equipment in your rack. Small cameras are available for very little money, and as long as your Internet is operating properly, you could save time and money locating a malfunctioning piece of equipment just by looking at it with your newly acquired remote camera.

When working up that budget, don't forget things like air filters for your transmitters or other equipment in the building. Your air conditioning also needs an annual cleaning and checkup, so include a maintenance agreement with your local HVAC company.

Make a little time to visit a fellow engineer's transmitter building. You might spot some great ideas you can take with you to your facility. Good engineers don't mind sharing great ideas with fellow engineers. Have a great new year and I hope your budget includes some new "toys" to make your life easier.

Got some great ideas to share? Please write and let me know.

The thoughts, ideas, and opinions in this column are my own, and do not necessarily reflect the views of Radio Guide or its publisher.

Steve Tuzeneu, CBT, is the general manager and chief engineer for WIHS 104.9 FM in Middletown, Connecticut. He is a member of the SBE, and an extra class radio amateur.

Small Market Guide

Good Engineering Practices Can Save Your Tower Site a Lot of Problems

by Roger Paskvan

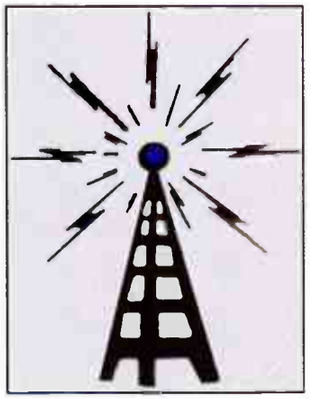
Most stations want to rent out tower space since it brings in constant monthly income and helps the NTR bottom line. This story begins in 1990 when the station first went on the air. They were the only antenna on the tower and all was well. First came the local sheriff department that put up a two-way antenna on the tower. Several more two-way radio customers came and went over the years as they usually do. In the process to sell the features of the tower site, some of the basics of good engineering practices are not always followed.

Next, this station was asked by a local competitor if they would rent antenna space to another 100 KW FM on their tower. Well, that was big money and, of course, they jumped on it. After all, the station was in the market and wanted a better tower site. If you're going to have competition, at least have them paying you each month. So the second FM goes on the tower below the first antenna. The station consulting engineer insisted that the new station invest in a band pass filter just to keep the signal clean, which they obliged.

Well, all was well and a few months went by. Two-way rental customers began to complain to their local radio dealer that their range seemed to be less and small portables could not get into the local system like they used to. Of course the standard answer was check your antenna and have the radio service people verify that nothing has changed in the radio, etc. So they did, but the systems seemed to be degraded. Finally, this station lost one of its long term customers from these complaints.

The station management, not knowing a lot about RF tower sites, hired a consultant to look into the complaints and recommend a solution. After all, they were now losing rental income but didn't know how or why.

Well, as the story goes, this consultant spent time doing test and measurements at their site. After the initial engineering was completed, the findings indicated that there was a lot of garbage being generated at their tower site. It was also noted that this interference was intermittent and a function of who was transmitting at what time. Now the consultant determined that they definitely had a problem but came up short as to how to fix it.



Further investigation revealed that there were intermod products being generated at the site combined with wideband sidebands from the FM stations getting into the two-way radio receivers. To make the situation more difficult, these mixes were occurring at a signal level below the FCC broadcast limits. The mixes at -80 dB were actually receivable on the two-way equipment, since they have very sensitive receiver front ends.

So, they had a classic situation of adding transmitters at this tower site with little engineering being done to check for intermod interference – which should have been done for each new tower customer. Trying, after the fact, to isolate each intermittent case was a healthy task to say the least. To get control of the situation, the consultant recommended that each two-way tower customer purchase a band pass filter on their frequency to isolate interaction between transmitters.

So, in summary, the tower site basically became a haven for harmonic and intermod combinations that stretched a long way into the spectrum above the standard, 2A-B mixes. Signals from one transmitter would enter down through another antenna, mix in that transmitter output circuit, and re-radiate back out that antenna to bother other users on the site. To make matters worse, this occurred intermittently combined with sideband interference from two high power FM stations.

Adding a filter to each user's antenna cleaned up a lot of the problems and it is standard good engineering practice to require a filter from each new tower add-on customer. They still were not out of the woods; a stubborn mix was noticed very close to one of the two-way customer frequencies. Shutting off each FM station separately, revealed the culprit – the original FM station that owned the tower never had a filter. Well, $12,000 later, a band pass filter was installed on the original FM and all interference went away. Other signals were coming down the FM antenna into their big transmitter and reradiating back out to cause problems.

The final recommendation to all small market tower owners, if you're going to share your tower site, make sure every transmitter has a filter installed at your site and you will have happy campers in small marketville.

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

Switch Mode Power Supply in Solid State Transmitters

by John L. Marcon, CBRE CBTE 8VSB Specialist

Back in the day, whenever there was work on a transmitter, we knew what we were getting if the problem was with a power supply. Be it the high voltage or the low-level ones, there were just three basic components: transformer, diode, and filter capacitor. The filter could also be a combination of capacitors and inductors. For voltage sensitive circuits, a regulator was added. This could be a zener diode or a combination of zener and a series pass transistor for high current loads. Regulators made the linear power supply even less efficient because of transistor heat dissipation. If you needed multiple outputs, the transformer could also have multiple taps.

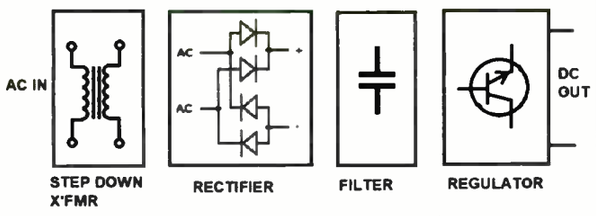


Figure 1: Simplified block diagram of a linear AC to DC power supply. The AC voltage is stepped up or down with a transformer. The output from the secondary is rectified, filtered and regulated. It is a simple circuit, but heavy and not very efficient.

Then came the Switch Mode Power Supply or SMPS and the parts number increased dramatically. It became more complicated as well. In the beginning, it did not seem to make sense because it was more expensive than the linear type.

Who invented the switching power supply, you might ask. The development happened in stages, like that of the television. It was also long and complicated. Even Steve Jobs claimed that one of his engineers invented the switching power supply of their early Apple computer in the late 70s.

However, the technique of switching high voltage DC to obtain AC, and converting it back to DC, was developed much earlier than the computer era. It was in 1959 that General Motors applied for a patent of a circuit using switching transistors at the input windings of a transformer, hence an actual switch mode system. Before 1959, many circuits used vacuum tubes or electromechanical switching devices to transform a DC voltage from one level to another. It was not until the development of transistors (especially the MOSFET) and integrated circuits, that the SMPS became what we know today as the small, compact, lightweight and highly efficient machine. It is in just about every piece of electronic equipment today and billions are being used throughout the world.

The Basic Circuit

Although there are many types and categories of SMPS, we will focus on the AC to DC buck converter, which transmitters today use for the various sub systems inside the transmitter. A buck converter simply means a step down from a high voltage to a low voltage.

In FM, it can be 240/120 VAC to 50 VDC for the power modules. AM solid-state transmitters, on the other hand, usually have higher DC supply than 50V because of the FET type used in the RF modules. For a low power 1 kW AM transmitter, the DC can be as high as 180 Volts and an SMPS is used at this level. For higher power AM, the DC can be as high as 380 Volts and the usual linear power supply is used instead.

Switching supply circuits look daunting at first but, like the old linear, we can divide the whole circuit into two – the AC and DC side. The AC side begins with an EMI filter and MOVs. The incoming AC is converted to DC with a bridge rectifier and the capacitor then filters the voltage to produce a clean DC. As you may realize, the 120 VAC voltage will be rectified to the peak of the wave and the DC equivalent is 170 Volts! The AC side components have their own ground reference and when energized, all of them, including the reference ground, are at 120 VAC referenced to *chassis* ground. At this state, extra precaution is needed when checking the AC side to avoid electrical shock or busting your test equipment. Make sure that the two reference grounds do not touch each other.

From the filters, the DC is applied to the coupled inductor (transformer) and switching FET series circuit.

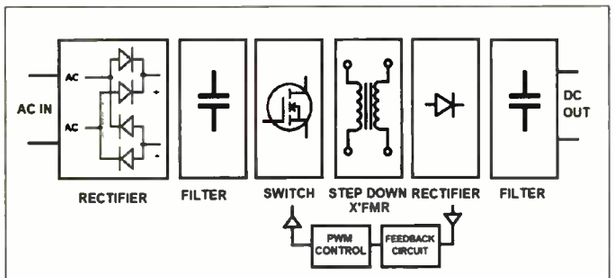


Figure 2: Block diagram of a typical AC to DC switch-mode power supply. The incoming AC voltage is converted to DC and then converted to high frequency AC. The voltage is then stepped down with a transformer, and finally converted back to DC.

The on and off action of the FET forms the square-wave pulses at the primary of the transformer. A PWM IC is used to control the switching duration. The longer the duration, the higher the average voltage of the pulse waveforms. The switching frequency can be as high as 100 kHz. The AC energy from the primary will be transferred to the transformer secondary.

This is where the AC side ends and the DC side begins. The AC from the secondary is then rectified and filtered to produce the desired DC output. The transformer isolates the AC side from the DC side also, much like its function in a linear power supply.

Using opto-isolators, a feedback signal from the output is fed to the PWM controller IC which will then control the pulse width of the FET drive in order to regulate the voltage and current required by the load. Because of the switching action on the transistors, harmonics and ringing on the waveforms can cause interference to other equipment plugged into the AC source. The EMI filter at the front of the rectifier reduces this outgoing interference and also filters the incoming high frequency noise from the source.

The high efficiency in a switching supply is achieved because the switching action leaves little energy stored in the circuit. It also results into smaller and lighter transformers and capacitors.

This type of supply also prevents the inrush currents during power-on, a feature that is especially important with transmitter amplifiers. Remember that the tube type transmitters use the step-start relays to reduce the inrush currents on the plate voltage of the PA vacuum tubes. A protection circuit prevents the start if the circuit senses higher than usual amps in the "step" resistors.

The SMPS does not use a step-start relay but the current delay is done electronically. This is accomplished in a variety of ways but the simplest way is using a resistor capacitor combination as a delay circuit in the input of the PWM generator op-amp.

Troubleshooting

Knowledge of doing static test of transistors, Triacs, diodes and all other electronic components is necessary before one can really fix any circuit. Keen observation is necessary in any troubleshooting. Do not skip the simple problems like blown fuse, loose wire or a burnt component. We sometimes ignore the simple things because our mind is already imagining complex issues.

We need to isolate the specific cause of the problem and determine the circumstances leading to the problem at hand. The equipment may have failed because of improper use, or lightning surge or other external factors. It may also have failed because of internal components. A component may fail because of a variety of reasons: it came from a bad batch, factory defect, end of life, etc. When checking the components, we may be dealing with hazardous voltage or RF level. It is better to de-energize the board before checking any components. There are many things to consider when you want to check a live circuit. Safety is the first priority in doing so. Familiarity with the circuit is also important.

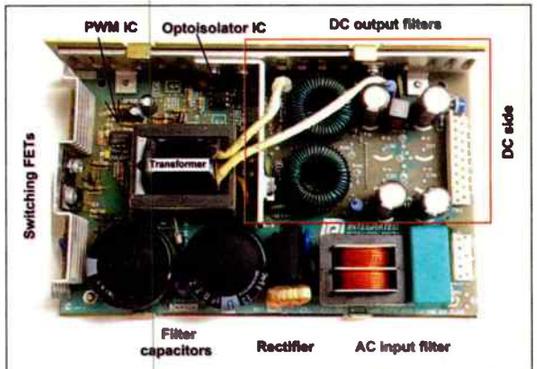


Figure 3: A +12V, -12V 100 Watt SMPS from the control circuit of a 1 kW solid state AM transmitter. The AC side fuse would always blow up. I found out that one of the switching FETs had shorted. I replaced the FET and that fixed the problem.

When you look at a SMPS board to be repaired, the first thing to do is to identify which parts belong to the AC side and which ones are on the DC side. Usually, a power supply data sheet contains most of the informa-

(Continued on Page 42)

Switch Mode Power Supply in Solid State Transmitters

– Continued from Page 40 –

tion you need. This is the next best thing if a schematic diagram is not available.

You may start to check for blown or burned item like the MOV or fuse – replace the blown MOV as necessary. Blown fuses are caused by something else, so do not replace the fuse just yet. Check for bad power FETs or a Triac that may have caused the fuse to blow. The FETs and PWM controller IC are all on the AC side so they are likely to fail more often than those parts on the DC side.

Beside the PWM IC, there maybe 2 to 3 more ICs that need to be identified and by checking their data sheet, you will determine the function of all of the active devices in the circuit. For example, there can be a PFC control and optocoupler IC. PFC stands for power factor correction. This can be either passive capacitors or an active switching transistor. As you may guess, this also acts as a filter. Its main function is to reduce the reactive power loss and thereby making the power supply more efficient. An active PFC also makes possible a wide range of input voltage.

On the DC side, there are capacitors, diodes, inductors and the terminal connectors. Sometimes, you can also find a fuse. Check the capacitors on both sides. These usually dry up and fail. Bulging capacitors are a sure sign of failure – inductors and transformers rarely fail. The capacitor can also be suspect if there is an output voltage not holding up under load. Do a static check on all the transistors, FETs, and diodes. This will take only a few minutes, especially if you are used to checking transistors with your DMM.

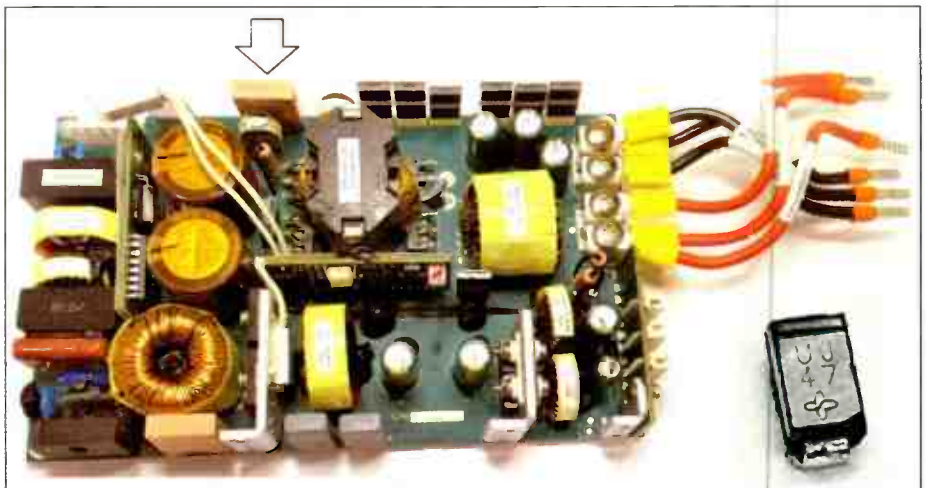


Figure 4: A 3.3V, 5V, 12V Encoder power supply. The symptom is also a blown fuse on the AC side.

If it will still not work, the PWM controller ICs could be the problem. You may check the output of the controller IC with an oscilloscope but this is a little tricky because, as I mentioned before, if it is energized, everything on the AC side is at 120 Volts referenced to ground, even the ICs! So, be aware of this fact before proceeding further.

For my last example, the power supply on **Figure 4** has no make and model written on the board and it looks like it is especially made for an encoder. From the way the fuse blew up, I suspected that the problem could be a FET or diode. It turned out to be both. The switching FET 2SK3878 and a diode were both shorted. The FET is shrouded by a pink silicone insulator (arrow). As you can see on the right side, the surface mount diode is very small. The way they mark surface mount components like this diode is a whole story by itself. The "47" on the diode is actually the date of manufacture, not the diode type. Anyway, I found out later that it is a 600V 1A fast acting diode.

For station engineers and electronics enthusiasts, it is exciting to learn about SMPS. Successfully fixing one is indeed a fulfilling experience. It sure adds another dimension in your technical skills and knowledge.

Sources:

- https://www.electronics-tutorials.ws/connectivity/ac-dc-converters.html
- http://www.industrial-electronics.com/switching-power-supply_1-9.html
- https://en.wikipedia.org/wiki/Switched-mode_power_supply

John L. Marcon, CBTE CBRE 8VSB Specialist, is the Chief Engineer for Victory Television Network (VTN) in Arkansas, with international experience in both Radio and Television Broadcast, and has an Electronics Teaching background.

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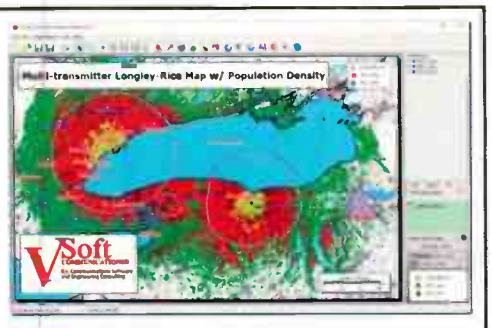

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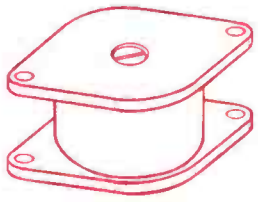

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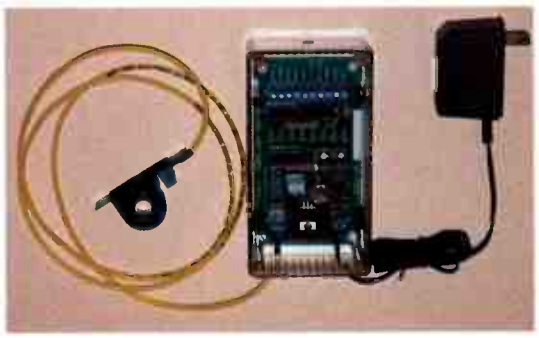

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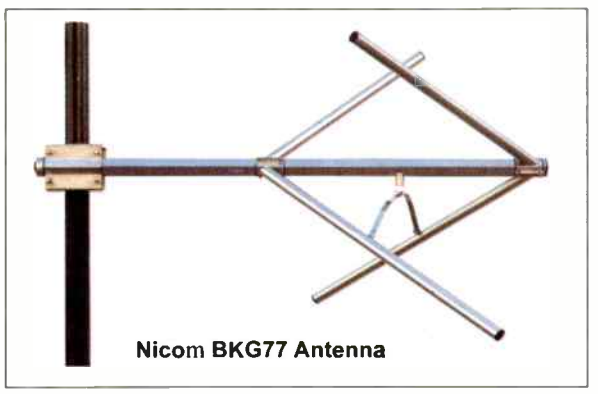
Dear Reader: I think we agree, it's hard to even breathe these days with a mask over your face. We're being told to stay away from others when we really need hugs and handshakes. This Covid 19 virus that we're all trying to avoid has turned the entire world upside down. 2020 has been a year without any recreation, county fairs, movies, bowling leagues, sporting events and a big one for me – no NAB show last April. Heck, we can't even attend the church of our choice, a fundamental right granted by our founding fathers. Seems like "you can't do that" is the answer from the state if you want to gather with others. As we approach 2021, I hope "normal" will soon return and I wish for you the very best in this new year. May you stay safe and well.

As you know, transmitters operate best with an impedance match to their 50 Ohm output. Antennas work best when they are resonant at the frequency that is being transmitted. When an antenna mis-match occurs, the RF signal encounters resistance and reacts by sending reflected power back to the transmitter. To quote Homer Simpson, Doh! Not good. The reflected power can then generate unwanted heat that will damage antennas and coax, not to mention the transmitter itself. Of course, today's well built FM transmitters rachet down the output power (TPO) to compensate for high reflected power.

FM antennas are built to match to 50 Ohms and are designed to best operate at one specific frequency. A number of years ago my company sold a multi-antenna array to a broadcaster in Africa. They ordered the antenna at 94.0 MHz to match the frequency of the 10 kilowatt transmitter. Shortly thereafter, the government told them to change to a new frequency, 102.0 MHz. They didn't understand why they were seeing so much reflected power and had trouble staying on the air at all. When they contacted me I told them that they most likely, not only ruined the antenna, but would probably need new transmission line as well. When I saw the photos they sent of the damage, I was actually surprised at how burnt the connections were. The heat must have been intense. I would love to show you the photos of the damage, but that was years ago and I no longer have them. Trust me, it wasn't pretty.

In the past several years I have reviewed items from many companies. Rarely would I consider taking a second look at a product already discussed, however, NiCom has created something that is worth talking about again. Did you see the Gear Guide where NiCom was highlighted? It was published in August 2018. I re-read what I wrote about NiCom. This is a truly amazing success story of how someone can immigrate from a foreign country, work hard and create a new business opportunity in the land of the free. Franco Piagentini came from Italy where he had success working in the broadcast industry but he had a dream to start his own company in America. Franco brought his son Dario to San Diego California and started a little company, NiCom USA. Against the odds, NiCom was able to not only compete with giant transmitter companies, but find success. With a line of FM transmitters and some audio products along with antennas, NiCom continues to succeed with good products at reasonable prices and if you should need it, customer service is fast, efficient and in a word, excellent.

I personally have a lot of experience using NiCom Antennas. The BKG77 is by far my favorite. The '77 I installed years ago, and still operating at KKHP in Oroville California, has turned the 39 Watt ERP into a powerhouse serving the entire area with a great signal, even providing great reception driving down the steep roads from the top of Kelly Ridge into downtown. It has always been sold as a "broadband antenna," but, as I've recently discovered, there is really no such thing as a truly broadband antenna – until now.


Nicom BKG77 Antenna

The newly designed model of the BKG77 is Patent Pending, with good reason. By using some "Antenna Magic," Franco and Dario Piagentini have created the world's first, true broadband antenna. The redesign of the antenna seems to achieve a "perfect match." A tweak in the angles of the elements, some modifications on the internal lines, and use of different conductive materials with stainless steel used as the primary metal is how they achieved the match.


Figure 2: VSWR Chart

Seeing is believing: **Figure 2** is the VSWR Chart showing excellent ratio throughout the whole FM band.

As someone who has been a dealer of broadcast equipment, I've had many opportunities to suggest brands and work with customers to match price and performance of everything needed to build new stations or retrofit existing facilities. Stations that have transmitter sites high enough to expect snow and ice to affect performance have always inquired about heated elements or radomes. Traditional radomes that cover the entire antenna are used by most companies, but NiCom has a different, much more affordable answer. Presenting the Mini-Radome! A covering of the connection is all that is needed to keep the station operating even with ice build-up. Here is a close-up photo of the BKG77 with a mini-radome installed.


The BKG77 with a mini-radome

I feel it is important to mention that NiCom products proudly proclaim, "Built In The USA."

Also, in this time of Covid temperature monitoring, NiCom's website quietly proclaims a non-broadcast product. Forgive me as I simply borrow direct;y from the description on the NiCom webpage, (nicomusa.com/thermologger) as they describe it better than I could.

*"**Thermologger** is an infrared thermometer that is able to capture the body temperature of a person, without contact, by scanning the wrist. Combine it with an NFC Chip, so every employee is scanned at the beginning, during and at the end of each shift. It gives a green light and a voice greeting if the temperature is healthy, and it can be programmed to open or close relays such as doors or external lighting."*

Any size company can now more easily meet or even exceed employee health monitoring requirements with this product. Call NiCom direct for information and pricing.

Ron Erickson is an engineer, on air talent, and consultant. He may be reached at 541-460-0249 or ronerickson@gmx.com.

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