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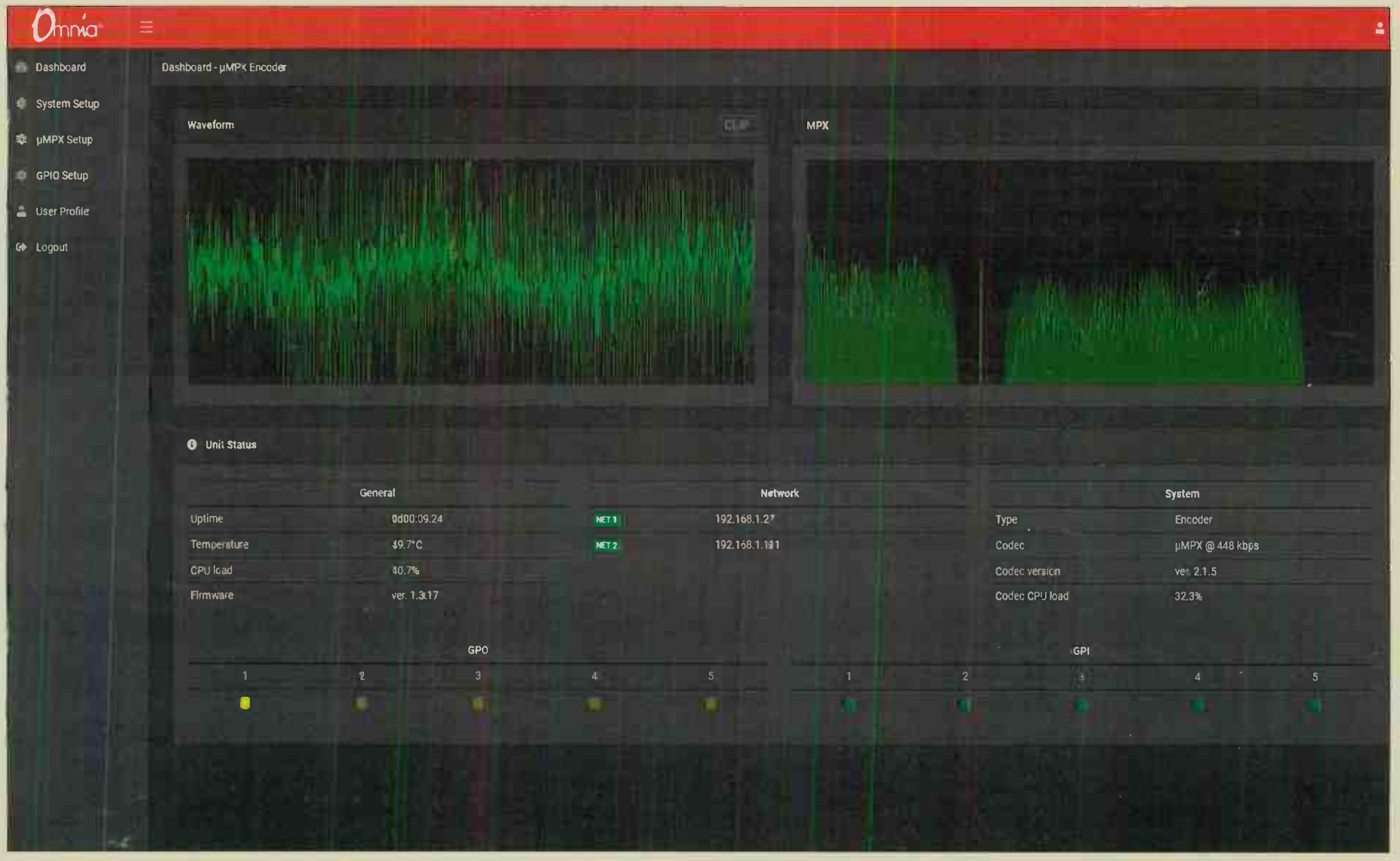
FM Composite Over IP: Omnia MPX Node Brings Joy to a Boston Public Radio Network



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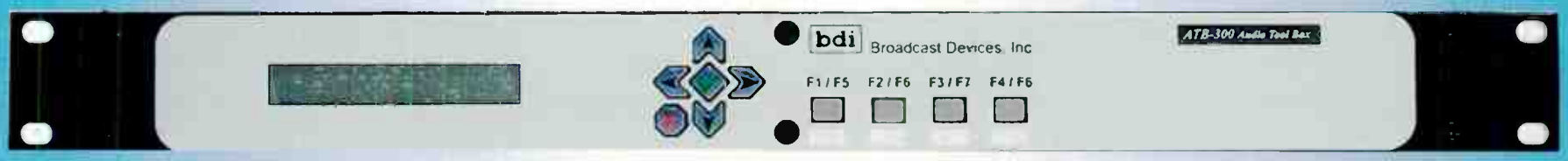

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Reminder: You Have a Tower! *"This January, the FCC sent the sharp reminder to broadcasters that, as licensees, they must never forget their first and foremost method of communication, the broadcast tower. An antenna structure can pose a hazard to air traffic, and without daily monitoring, it can become a danger to safety of life. Daily monitoring is a potential life-saving measure, critical to public safety."*

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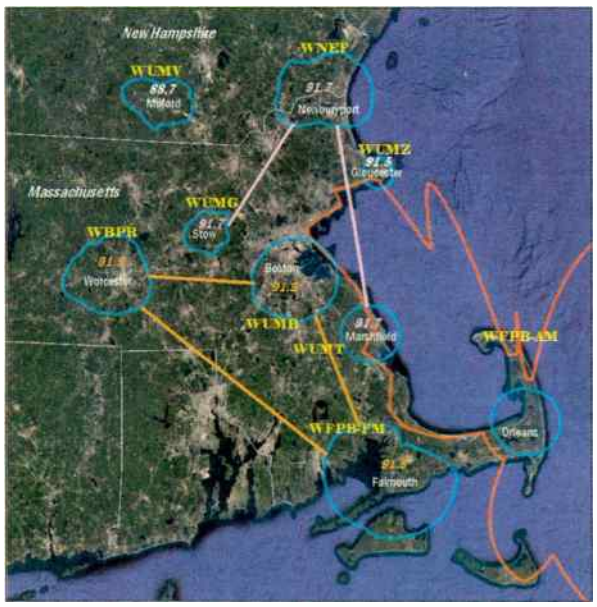
Cover Story

FM Composite Over IP: Omnia MPX Node Brings Joy to a Boston Public Radio Network

by Grady Moates, Owner, LOUD & Clean Broadcast Science – grady@loudandclean.com

I am celebrating three-score years in radio broadcast engineering this year. Starting with a Knight-Kit Radio Broadcaster Amplifier at 12 years old, and after three years of operating a pirate station in my bedroom, I got my first commercial station job at 15. In these six decades of fun and excitement, I've worked with all kinds of gear and have become an avowed early adopter. This article describes my latest foray into the realm of solving unusual problems with new technology.

WUMB-FM is a state owned and operated public station and was the last, new, full-service FM station licensed by the FCC to Boston back in 1981. However, it is a "minimum facility" shoe-horned into an already full #10 market. After three upgrade moves it now operates with maximized facilities at 166 Watts ERP from 500 feet above average terrain. In order to protect the service area of this small signal, the founding station manager aggressively pursued co-channel licenses in nearby cities and towns, and today the WUMB Public Radio Network includes two, three-station, Single Frequency Networks among its eight FM sites. As you might imagine, in the overlap areas between the sites in the SFNs, there is significant self-interference and time alignment is of critical importance.



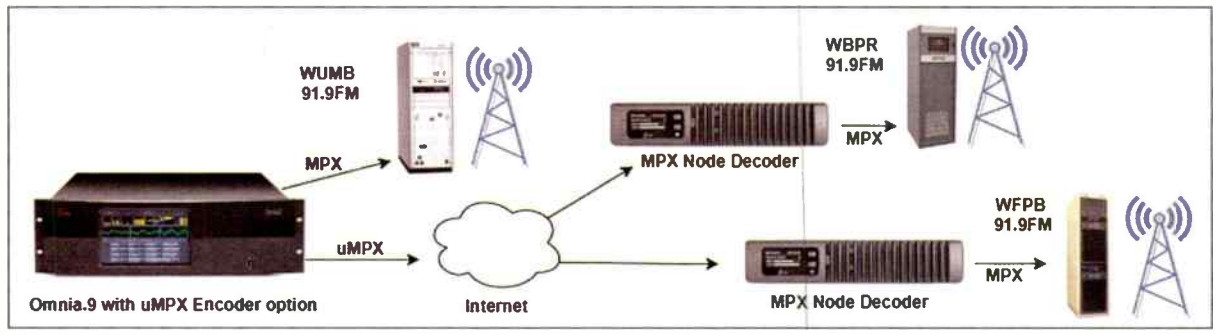
WUMB-FM Public Radio Network 60 dBu Contours

The Telos Alliance Omnia MPX Node system is now installed for the three 91.9 sites. More sites will be upgraded using µMPX in the near future.

Over the years, I've tried numerous ways to mitigate this challenging problem, but have always dreamed of the ability to deliver the exact same composite baseband signal directly to the FM exciter modulators and to have fine incremental control over timing. Today, Telos Alliance's Omnia MPX Node provides these capabilities, and the new technology makes it easy.

With careful advance planning, the installation of the initial system for two sites took less than five hours, including travel time between the sites. Years ago, after several episodes of limited campus access, I moved the network distribution point from campus to the Boston transmitter site, allowing the station to continue to operate on an emergency basis from anywhere. This came in handy for these tests, because I have 5 Megabits-Per-Second of Internet Service from Towerstream, fed from their rack only eight feet from mine. My connection goes right into their system with no radio at all!

One of the announced features of the MPX Node is its "processor agnostic" design. Because of the need to operate eight stations with identical sound signatures on a state-owned, public-radio budget, I had standardized on the inexpensive, yet surprisingly clean and competitive Inovonics David IV processor at all of our sites. For the first test, I left the entire legacy STL/processing system in place at the Falmouth site and put the new µMPX system up in parallel, fed from the second output of the David IV audio processor. Once the modulation levels from the two STLs were matched, switching between the two was not noticeable.



A/B/X listening tests were interesting: semi-technical listeners actually preferred the sound of the µMPX STL, commenting that the low end seemed tighter and the upper midrange seemed to have more definition. This makes sense when one realizes that the legacy STL system operates with E2 HE-AAC at 64 kb/s on the discrete left and right audio channels; while the µMPX system is operating for this test at a bit rate of 570 kbs. Station management noticed the improvement in sound quality within a day of installation.

You'll notice, on the front cover GUI image, that the composite baseband spectrum shows the 57 kHz RBDS subcarrier at the right-hand end of the display. Another benefit of the MPX Node approach is simplified, centralized RBDS distribution. It is no longer necessary for us to maintain a separate data path to each site, or maintain RBDS encoders at each site. MPX Node does that job for us, too.

This "Dashboard" screen, easily accessed using a tablet or smartphone, reveals a number of other very interesting things. The MPX Node offers five GPIO inputs and five GPIO outputs, all programmable as the user desires. In this unit, GPO #1 is seen to be "ON." This unit is programmed to close that contact when valid composite audio is being decoded and delivered on the output BNC connector. Should there be a failure of any kind, this contact will open, allowing an external device, such as a composite audio relay, to revert to a backup system. The Statistics screen shows zero errors in the last 1024 data packets received, and the Transport Status screen reports how long the unit has been connected and receiving audio. I've found the composite waveform window very educational, as it appears to allow the user to see how well the clipped waveform has been delivered through the system when a low-frequency, high-amplitude event occurs. I have not yet observed the output waveform on an oscilloscope, but the lack of pre- or post-peak overshoots and the lack of tilt on this screen is impressive.

Another challenge at WUMB has been attempting to provide a consistent listening experience for our audience with eight similar-but-not-identical air chains. Omnia also provided me with a new solution to this problem when they integrated a µMPX encoder directly into their venerable Omnia.9 audio processor. When I added the third station to the µMPX setup, it made sense to try this out. Once again, installation was simple, there were no "gotchas," and the third site was integrated into the system in about four hours (including travel).. Time alignment of the system was very easy, because the Omnia.9 has several adjustable delay buffers, including three that affect only the analog composite outputs. We measured the Internet latency using ping tests and chose an analog composite delay of 4.04 seconds in the Omnia .9, set stream delay buffers in the decoders for 4.000 seconds and went for a ride. There was no "echo" effect at all in the overlap areas, and as we drove through the entire four-mile interference zone in the Natick/Framingham area on the Mass Pike, every word spoken by the announcer or in recorded underwriting announcements was clearly understandable. I am still amazed at how easy it was to achieve this level of performance without sitting in the overlap zone for an hour with a laptop on a wireless hotspot manually trimming the delay by ear.

I hasten to add that the WUMB Network's array of fully-spaced, full-service facilities is not at all like an on-frequency booster within a station's city-grade coverage area. There are state-of-the-art technologies available from other broadcast equipment manufacturers that very elegantly address the different challenges of on-frequency booster service. But in our case, the signals of the stations in the overlap areas are below 50 dBu, and an attempt to synchronize the RF carrier and modulation envelope is, in my opinion, pointless. The signal from each transmitter is experiencing regular, severe dropouts in these overlap areas, and frequently, when one signal is missing, the other signal is present. It has been my experience that using the FM radio's "capture effect" to deal with this is a better approach. As a listener drives through the overlap area, our properly time-aligned µMPX system provides a listening experience very much like multipath dropouts from a single site in the extreme fringe area, except that the radio now has two different signals to which it can lock, so it actually plays audio more of the time!

Speaking of "ear," I'm very pleased to finally be able to try out the famous-but-not-cheap Omnia.9 sound on WUMB's Adult Alternative music format. Comprising Folk, Blues, and crossover music that hasn't been through the mill of pop-music-CD overprocessing, the WUMB source material gives the 9 a great playground to show off its sonic capabilities. Omnia's recently introduced "embedded pilot" technology is in this processor, and the technique has also been applied to the internally generated RBDS carriers, so the three WUMB sites fed with MPX Nodes are a dB louder than before, with less-aggressive peak processing. The station has never sounded better.

Because the MPX Node device is a gender-neutral design-field-configurable to be either an encoder or a decoder without the need to load new firmware-our investment in spare nodes is negligible.

Station management wrote the checks and we own the system now. Active listeners who never hesitate telling us when they are unhappy have taken the time to tell us how much better our signal sounds in their suburban towns. Omnia's MPX Node is truly a winner. We've now had multiple MPX Nodes running solidly for 5 months and counting. As time and budgets permit, we plan to expand the system to the rest of the WUMB network, further leveraging the processing power of the Omnia.9 and transporting a "carbon copy" MPX signal to all eight FM transmitters. Our legacy systems will stay in place as backup. – *Radio Guide*

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Chief Engineer

Transmitter Surprises

by Scott Schmeling

If I may paraphrase Forest Gump: "*Transmitters can be like a box of chocolates – you never know what you're going to get.*"

Great Old Box

A While back, I was asked to help a company that had purchased a small group of stations, and was in the transfer process. One of the transmitters was a Continental 816-3 (there was no R on the name plate). Judging by the grey, rather than tan paint, it's probably fair to presume this was a model from early in the Collins-to-Continental transition. That being said, the transmitter design is rock solid, as evidenced by the fact there are so many in use today around the world!

From the Top

Ted Mahn, an engineer and one of the partners, reported the initial symptom that started all of this was that the main PA breaker would trip and then show a PA screen overload. Resetting the breaker would restore the transmitter to air. The staff dropped the power to 80 percent, which kept it on until someone could look at it. When Ted arrived he found the screen current to be running at nearly 600 mA (too high) at about 90% power. Ted's first step was to retune the final. In doing this, he found the tuning control was sluggish or stuck. It didn't even seem to be moving. However, the loading control allowed him to bring the power up by 3 kW and get the screen current down. He thought, perhaps, that fixed it. Then came Friday afternoon when he and John Daniels (another one of the partners) were standing and visitng in front of it, when they heard a high voltage crack, and saw a flash of light which seemed to come from the PA cavity. John jumped at the sound, but I think we've all been there – and done that! It was still making the licensed 18,500 Watts, but it didn't seem very stable.

More Problems Found

We found the drivers were no longer balanced and the manual power control was choppy. In fact, if we tapped the front panel, the forward power would fluctuate. Ted had also found the PA Plate breaker would trip when the plates were turned off or when control was switched from Local to Remote. And, we found that the Plate Voltage dropped very slowly when plates were turned off.

Ted had been in contact with Continental Tech Support earlier. They told him the plate breaker tripping (when plates turned off) was probably caused by a bad C1 on the A8 board. He also had a fresh pair of balanced Eimac 4CX250Bs for the drivers. Auto power adjustment was nice and smooth, so the choppy manual control was probably a bad R43 motorized pot – but we knew the motor worked!

The slow high voltage drop was most likely an open high voltage supply bleeder resistor. Granted, leaving it wouldn't have any effect of the normal operation of the transmitter, but as a safety factor we decided we should check into that, too. But, the first order of business – PIZZA! (Engineers do not run on caffeine alone.) While eating, we discussed our plan of attack for the night.

Working the Plan

At our prescribed time, we shut the transmitter down, opened it up and went to work. The first thing we found was lots of dust, but that's not all that unusual. We could see R7, one of the bleeder resistors, was discolored near the top. Most likely that was our bleeder problem. No real surprises yet.

A look inside the PA – not a pretty sight.

Inside the PA cavity was a different story. We found the plate blocker clamped at the very top of the tube instead of just above the air guide as prescribed by Continental. There were signs of over heating and arching on the blocker and the bottom stainless steel clamp and on the PA tube.

The bottom of R75, on the left side of the cavity, was literally burned up and melted. R75, along with a metal strap (L14), form a suppressor that dampens third harmonic resonances. We didn't have a spectrum analyzer, so we couldn't verify any harmonic radiations.

Given the cavity "surprises," we reassessed our work plan. It was Friday night and we didn't want to start any repair that might keep us off the air on Saturday. After a bit of discussion, we decided not to touch anything in the cavity until we had parts in hand.

We started to make a parts order list. If we could get the parts next day, we could work on the cavity repairs that night. Ted called Richard, the Continental tech on call, and he verified the parts were in stock, then drove to the plant and boxed up the parts – shipping for Saturday delivery.

Meanwhile, we went to work. First we removed as much of the dust as possible with a duster and vacuum. One area that's usually ignored is the honeycomb piece that passes the air from the blower into the IPA and PA areas. Ours didn't have a serious buildup, but it was surprising how much dust we were able to get out of it by tapping it on the floor.

Remember that one of the original symptoms was the plate breaker tripping when the plates were turned off. Tech support had told us that it was most likely caused by C1 on the Power Control Regulator card. We had one on hand, so we replaced it.

Next, we replaced both driver tubes and set the static bias level. But we found that, for some reason, as we were adjusting, the tubes seemed to "take off" and cathode current would jump up. We decided to put the original drivers back in and set the bias a little low – after all, we were coming back again tomorrow night.

As we were driving away, Ted heard a hi-pitched tone between songs. He went back and found that adjusting the driver plate tuning took care of that.

Another Saturday Night of Work

On Saturday, I arrived on site at 7:00 p.m. that evening. Ted already had the burned R75 out of the cavity and was cleaning the top mounting clamp (half of the bottom clamp had literally fallen apart because of overheating). We planned to move the top clamp to the bottom.

We were able to use the damaged clamp at the top, since all it had to do was hold the top of the resistor in place. Using a drill with a wire brush, I carefully cleaned the bottom contact area of the plate blocker. Meanwhile, Ted used a wire brush to buff the high voltage contact area of the tube.

Blowing Off Some Dust

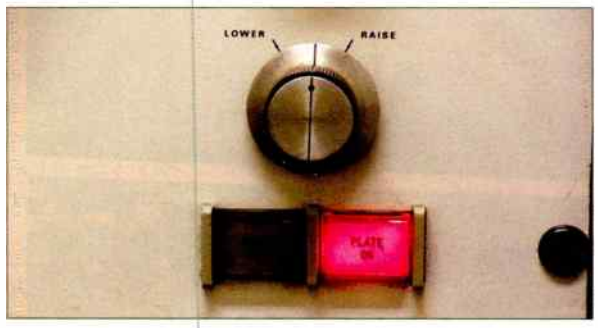
We had located an air compressor that we used to blow out even more dust. There was also a lot of "black stuff" (we called it caramelized dust) coating areas of the driver and PA. We were able to peel off a lot of that with the compressed air. We did find one good thing – the motor that drives the paddle of PA tune capacitor was only stuck. With a little "exercising," we were able to get it to move smoothly and consistently.

Ted was able to replace the bleeder resistors fairly easily. I pulled the Card Cage Assembly (A20) out enough to gain access to the motorized pot R43 (5K, 10-turn). This is the pot that controls the manual power setting. It's located behind the Local/Remote switch on the right end of the A20 assembly.

At this point, we had done all we were going to do. We gave it a quick once-over, to be sure everything was tight and in place, closed up the doors, and put the panels back on and got ready to check our work.

Gentlemen – Fire Up the Box and Hope

This is the best part of the story. After the half-hour warm-up, Ted pushed the Plates ON button and we watched the transmitter output power raise to something over 100 percent. We brought it down to normal and went through the tuning adjustments. Manual power control was nice and smooth, and tapping on the front panel had no effect. And when we turned plates off, the breaker held and the voltage dropped like it should. We now made full licensed power with plenty of headroom. And the transmitter seemed nice and stable. It was a very successful two nights' work.



Scott's LED fix for the push button switches.

One more thing I'd like to add. The push button switches use either a #327 or #387, 28 Volt lamp. I have found an LED replacement that works beautifully. The Dialight 585 series is a non-polarized lamp.

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

Important Broadcaster Reminder: You Have a Tower!

By Gregg P. Skall, Womble Bond Dickinson (US) LLP

With the emphasis many broadcasters, particularly large corporate mega-corporate broadcasters, are placing on new media distribution to appeal to millennials as well as older adaptors of new technology, it's becoming painfully clear that some broadcasters are losing sight of the fact that they are, indeed "broadcasters." As the U.S. 3rd Circuit Court of Appeals once made clear, Broadcasters distribute content the old fashioned way; from a transmitter and tower. Diverted attention from towers has also been compounded by the elimination of the main studio rule and increased automation, resulting in a tremendous reduction in local station staff, as witnessed by the mass firings at some large corporate broadcaster stations we've seen in the last month. The consequence is that for many stations, there really aren't any live local staff left at a radio station. As these enormous staffing changes have come along, and with less and less dependence upon an audience that listens to an over-the-air radio, it has become alarmingly clear that some broadcasters are actually forgetting, or neglecting, to take care of their towers.

This January, the FCC sent the sharp reminder to broadcasters that, as licensees, they must never forget their first and foremost method of communication, the broadcast tower. An antenna structure can pose a hazard to air traffic, and without daily monitoring, it can become a danger to safety of life. Daily monitoring is a potential life-saving measure, critical to public safety. The reminder came in the form of an Enforcement Bureau investigation into Cordillera Communications, LLC tower practices, the predecessor in interest to Scripts Broadcasting Holdings. The investigation came after a small aircraft collided with a tower located in Kaplan, Louisiana, and registered to KATC Communications, LLC (KATC), a subsidiary of Cordillera. Although the Bureau found no evidence connecting the collision to a violation of the FCC's rules by Cordillera, it found compliance irregularities related to Cordillera's communications towers.

To acquire the Cordillera stations, Scripts accepted responsibility for any enforcement action arising out of the investigation. That investigation included 11 towers in five states stretching across much of the country. The investigation concluded that Cordillera violated Section 303(q) of the Communications Act and the Commission's rules by (a) failing to conduct a required daily inspection of lighting systems for 10 antenna structures, (b) by failing to completely log twelve lighting failures at seven antenna structures and, (c) by failing to timely notify the Commission of its acquisition of 2 antenna structures.

The result was costly! It was obviously designed to send a message. Scripts was fined $1,130,000 and must implement an agreed upon compliance plan. By its order, the Enforcement Bureau made clear its concern that many broadcasters may be paying insufficient attention to tower maintenance and the need to promote aviation safety near antenna structures.

The consent decree makes clear that each broadcaster is required to engage in regular, consistent monitoring of their antenna structure lighting systems. Neglecting this responsibility creates a potential hazard to safety of life. Regular consistent monitoring insures that owners will learn quickly of malfunctioning obstruction lighting. FCC rules require daily inspections of the lighting systems. Broadcasters are required to maintain a complete record of lighting failures and timely notify the Commission when they acquire an antenna structure.

Section 303(q) of the Communications Act states that "The permittee or licensee, and the tower owner in any case in which the owner is not the permittee or licensee, shall maintain the painting and/or illumination of the tower as prescribed by the Commission." Part 17 [http://bit.ly/FCCPart17] of the Commission's rules require the structure owners to monitor the status of the structure's lighting system by either (1) making "an observation of the antenna structure's lights **at least once each 24 hours** either visually or by observing an automatic properly maintained indicator designed to register any failure of such lights" or (2) by "provid[ing] and properly maintain[ing] an automatic alarm system designed to detect any failure of such lights and to provide indication of such failures to the owner." The owner of the antenna structure is required "... to [maintain a record of any observed or otherwise known extinguishment or improper functioning of a structure light" and that "... the [antenna structure] owner must also notify the Commission within 5 days of any change in structure height or change in ownership information."

The investigation of the Cordillera towers resulted from a small aircraft collision with one of its structures. While the Bureau found no evidence connecting the collision to a violation of Part 17 of its Rules, it did find significant irregularities that warranted an expansion of the investigation. As a result of the violations, in addition to the significant financial penalty, Scripts agreed to a compliance plan that should be followed by all broadcasters without the need of a push from the FCC. A compliance plan has 3 significant parts.

1. Operating Procedures: All employees who have any connection to the licensee's responsibility for compliance with communications laws, including those relating to antenna structures, must be educated on and accept responsibility for following internal procedures to ensure compliance with the lighting system of each tower by (a) visually inspecting the structure once every 24 hours, or (b) providing and properly maintaining an automatic alarm system designed to detect any failure of the lighting system and notification to the licensee. Scripps was required to develop a step-by-step compliance checklist to ensure compliance with Part 17 rules.

2. Compliance Manual: Vest a senior employee or manager with responsibility for knowledge of Part 17 and for development of a plan that will ensure compliance with required tower inspection and maintenance. The compliance officer should develop and distribute a compliance manual to all station employees that explains Part 17 rules and assure that specific employees are designated to follow the procedures regarding inspection and reporting for each antenna structure. The compliance manual should be reviewed and updated on a periodic basis.

3. Training Program: Implement a training program on compliance with Part 17 rules and operating procedures. Part 17 rules can be found here: [http://bit.ly/FCCPart17].

Multi-User Towers

My Womble Bond Dickinson colleague, Marjorie Spivak, recently penned an article addressing the confusion where there are many users on a common communications tower. This article, *Tower Rule Compliance: Whose Responsibility Is It*, published in *Radio World* in August 2019, warns licensees to be careful: while the tower owner is primarily responsible for compliance, FCC licensee-tenants can also have significant responsibility!

Any observed or known improper functioning of the top steady burning light or any flashing obstruction light on the tower, if not corrected within 30 minutes, must be reported immediately to the FAA. A further notification to the FAA must be given immediately upon resumption of normal operations. While a tower owner is primarily responsible for maintaining the painting and lighting of the tower, should an FCC licensee-tenant become aware that the structure is not being properly maintained, including improper or failed lighting, the licensee-tenant must take immediate steps to ensure that the tower is brought into and remains in compliance. Specifically, the FCC licensee-tenant must: (1) immediately notify the tower owner; (2) immediately notify the site management company (if applicable); (3) immediately notify the FCC; and (4) make a diligent effort to immediately bring the structure into compliance.

If upon notification the tower owner does not comply with the FCC's rules, each licensee authorized on the tower could be required to maintain the structure in accordance with FCC rules.

This article has dealt primarily with the duty to monitor and maintain tower lighting, emphasizing the responsibility that all station employees should have to monitor and observe lighting failures. Failed tower lighting presents a tremendous hazard to air traffic and safety of life. However, tower responsibilities do not end there. Tower owners, and licensee-tenants also have responsibility to assure that radio frequency radiation levels are maintained according to the stations authorized licensed parameters and that towers are properly fenced. With AM, fencing responsibility does not shift to the tower owner. FCC rules make AM broadcasters responsible for compliance with AM fencing rules, including assuring that they are enclosed with an effective locked fence, since AM towers are "hot" towers. AM licensees are also responsible to periodically measure and correct disturbances to the AM radiation pattern in compliance with the AM detuning rule.

Clearly there are significant changes underway in the way broadcasters seek to, and are reaching their audiences. As more emphasis is placed on streaming media and its various iterations, and as some broadcasters seek to centralize or even nationalize their staff, it becomes an even more pressing and important requirement not to overlook the basic broadcaster *raison d'etre*, the reason for being a broadcaster over the airways. That requires even more vigilant emphasis and special attention on tower maintenance by every broadcaster.

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

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

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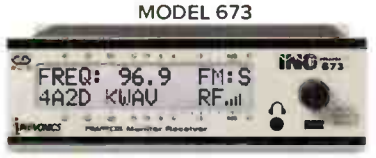

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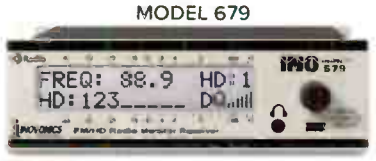

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Practical Tech

Connections

by Dave Dunsmoor

A few thoughts regarding resolving equipment problems. Where to start, I wonder? Not just in reference to this article, but also in dealing with failed, (or worse, intermittently misbehaving) equipment. I've made mention previously the importance of "clean and tight" in electrical connections, and this seems to be as good a starting place as any.

Consider this then – reliable electronic operation is (almost always) based on secure mechanical connections. This means, in general, that when I place a new piece of equipment into service, I check the mechanical integrity of all reasonably accessible electrical connections. A new transmitter, be it high powered AM/FM, LPFM, or STL, or a new antenna, coax, new PC for the front office, or even new/replacement network cable from the server room to the studio, gets an inspection. No, I don't take the PC all apart to re-seat all connectors, but opening the case to see that the cards, power and HDD connectors are all properly in place might be warranted, depending on it's source. Shipped directly from an out of town vendor, yeah probably a good idea. If purchased from a local shop with whom you've developed trust, probably not.

However, I do inspect closely a heavy item to be certain that all connections from the incoming AC to the little control/metering connections are tight. This even extends to the AC connections inside the breaker panel, and all the way back to the disconnect or power meter. Those connections rarely see the light of day once the initial installation is completed. The installation of new equipment is a perfect time to re-inspect. And to do so, I just ever so slightly loosen, then re-tighten all screws, etc. The reason behind all this fuss is that solid connections don't cause failures – loose ones can, and do. And it's better to do it now than at 3:00 a.m. Management and staff are much more impressed if any down time is related to uncontrollable failures (lightning, vandalism, etc.) than if you tell them that "it was loose and I tightened it again." See where we're going with this?

Even something so simple as installing or replacing an ethernet cable, switch, router, etc., warrants a physical inspection. Not to disassemble the box in question, but just take a look at the port which is to receive the cable end. Is it clear of debris, are all the little gold wires even and clean, and do they look "normal," like the adjacent port's pins such that they apply proper pressure on the cable's connector pins? Yes, I have had newly installed switching equipment fail, or operate intermittently, due to "not quite tight enough" ethernet port pins. So, yes you could just replace the entire box (whatever that may be), and that may end up being the best option, but first, if you're extremely careful, and you still have very good dexterity (and eyesight), inspect the pins and if you find one that isn't lined up with the rest, just pull it outward slightly just enough so that it lines up with the rest of the pins using a small hook. I've done this too, and it's worked. Weigh your options and this might be a consideration.

Now that the basics have been discussed, next to consider might be, what is "it" supposed to do instead of what is it actually doing (or not)? This is where things can get tricky, and taking the time to think carefully is really helpful. In the purely analog domain, audio (or control) may be simpler to follow, and therefore easier to find the point of failure. Often a listening device (or a scope) may be all that is needed to see where the problem is. Audio out of the SAT receiver sounds clean, but out of one channel of the distribution amplifier it does not. That type of discovery is often relatively easy.

However, in the digital domain, the audio or control signals are not discreet, but a few bits of data in a stream of bits which are told where to go, and when to go there, by yet more bits of data. How do you sort that out? After determining that the power to the device is correct (and digital equipment generally is a bit more susceptible to poor input power than equivalent analog), a lot of your troubleshooting procedure may be more "thinking than doing." Swapping positions of modules or cards can reveal whether the problem is in the card or the *position* of the card. A schematic, or perhaps a logic diagram of the card, might be useful here, but not in the way one might think. Actual repair of the card is unlikely to be practical due to the availability of parts, the (probable) population of the card by surface mount components, and so on. But, by applying a bit of, "if I wanted to cause this exact problem, how might I go about it" thought to the situation, may lead you to some useful conclusions. Then, if these ideas don't lead you to the solution of the problem, a call to the manufacturer's support line should. A 'scope here would be useful to "watch" the audio in/out, the control signals, the digital bus(s) and so on. True, you may not be able to see the exact change in, or loss of, digital bits in the string, when you operate whichever control is not working correctly, but you should be able to see *some* change in the display. A consistent, or intermittent display change would be what you're looking for. Consistent meaning it works the same every time, as opposed to an occasional intermittent display which would (should?) indicate the problem's location.

I have not yet have had the opportunity to use one the cheap little "pocket scopes," and while one isn't likely to be very useful to do accurate measurements, I would think it should be quite sufficient to "see" what's going on in this use. I have a conventional analog scope and a newer Tektronix digital scope, and while each have their place on the bench, they are not all that handy for carrying in a tool box for quick observations of various signals, or levels. This is an item that I may explore later.

How many times have you been tracking down a seemingly "obscure" problem, only to find, eventually, that it was "just the power supply/source" which was at fault? Yeah, me neither. OK, now here are a few thoughts on that.

First, fuses and circuit breakers can quit without direct evidence of the failure. Meaning that, from outward appearances, they look OK. Fuse element appears fine, not blown, and the inside of the glass tube is clean. Or the breaker operates smoothly (and is not tripped) when you first inspect it. So, quickly onto the next most likely source of a problem, and then down the rabbit hole we go, eventually finding nothing wrong and then wondering if there *is* something weird about the power source(s).

To be completely certain of the correct operation of a circuit breaker, remove the load side wire and check the line/load continuity of the breaker, several times, looking for *any* intermittent indication. This one has caught me a time or two. If you have *any* question, just replace it. Breakers are (generally) not expensive.

I have more than once found a glass fuse to be open at the end of the fuse element, inside the cupped metal endcap – not at all visible from the outside, and found only by use of metering the in/out of the fuse – either with a voltmeter, or perhaps (better yet) with a Ohmmeter on the fuse itself when the in/out voltages are there, but maybe not quite right. This often is the case when checking non-visible fuse bodies on a 3-phase system. Even though the fuse may be completely open, there will be voltage at the load side of the fuse coming from the internal windings of the transformer primary, or the motor windings. To be certain, you pull the fuse and check it alone with an Ohmmeter.

Back to the glass bodied fuse which appears to be good, but is not. Why would that occur? Knowing this is useful information which may well prevent you from just replacing the fuse only to be called back later for a repeat failure. It's been my experience that fuses open for two reasons. First is over-current which is indicative of a circuit failure "downstream" (which is a correct fused circuit operation). The evidence of this is the inside of the fuse body being blackened and often splattered with blobs of the fuse element material.

Next is over-heating, which is generally a failure of the fuse holder itself by becoming loose. This comes from the holder being slightly "not tight," which allows heat buildup due to increased resistance at the fuse/holder mechanical connection, then eventually the metal fatigues to the point of becoming loose, which then heats up more and the solder within the fuse itself opens. There are couple of "quick fixes" to deal with this. Either pinch the fuseholder wings together slightly and re-install a new fuse, or wrap a bit of wire around the fuseholder with the new fuse installed.

However, both of these are only meant to be temporary until you can do a proper repair. I've seen a few temporary repairs remain intact for years, and yeah, they may still be OK, but that isn't the standard to which we ought to aspire. The real, correct, professional fix is to replace the fuseholder.

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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StudioHub

Maintenance Guide

Weak Spots in Reliable Equipment

by Wiely Boswell

When you have circuit boards and related assemblies, the inner-connections should not be a reliability issue, but they can be. If you can get connections to a minimum, reliability will increase. Even IC sockets lower reliability. Within a circuit board itself, the quality of the solder wave is critical. The wave has to be able to heat large metal protrusions in the board associated with connection pins or tabs, terminal strips, wire conductors through board, or power jacks. Anything mounted on a board that extends from the board, such as a directly soldered wire that is subject to movement, can break a poor solder joint. Vibration moves parts, especially if they hit resonance. Large capacitors will move, as well as any large part that is on the circuit board. You will often see capacitors connected together with some type of glue to keep them from moving. Parts will resonate at different frequencies, depending on size and shape.

There is a time to "bang" on equipment and lightly push on boards, when looking for intermittent problems. (Repair 101) A high current connection that arcs, while delivering power from a supply to circuitry, can send intense pulses into delicate circuits. The protection at the input or output of the supply would not protect the circuit.

Connections within well made connector assemblies have standards. The metals in connections need to resist corrosion and not have any sort of dissimilar metal reaction once connected. When a connection is made there is a small contact area that may not ever be disturbed. A connection that is moved occasionally will scrub the contact surface and clean the surfaces where they come into contact. A 1/4-inch guitar cable is an example. The tip on the cable will have small area that comes into contact with the jack. If it just sits there as a patch cable it may end up with a poor or no connection at all. Plugging the cable in and out or spinning the cable end in the jack socket will clean the connection. A double 310 type connector (two plugs together) will not spin in a patch panel. The plugs must be manually burnished when they tarnish.This is a large example of what can happen, even in much smaller connections.

Another example is relay contacts. A relay that never operates, while in a de-energized NC state, can develop a poor connection. A loopback test, done and released in a circuit, can clear a trouble. Equipment, when powered up, may very well do loopbacks as part of a diagnostic routine. The contact surfaces in a relay, depending on the application, are made of expensive type exotic metals such as silver cadmium. Burnishing with any type of file is not recommended, since the thin metal layer that is deposited on the contacts will be filed off. A mechanical relay will clean contacts every time it's operated – the contacts actually wipe across each other when they move. Toggle and rotary switches are also cleaned every time they are operated. You can see the contact traces in a rotary switch section, so operating switches actually can clear a trouble. You can spray switches with contact cleaner to remove corrosion and add lubricant to the moving parts and surfaces. If you restore really old equipment, a switch might have to be operated 20-30 times, or more, to get reliable operation along with a cleaner.

On a much smaller scale than a relay, high density ribbon cables with lots of pins can certainly be an issue. Plastic in and around the small holes can interfere with a solid connection. I have reseated ribbon cables or just rocked them by pulling up one side a little with the eject lever, pushing back to normal, then pulling up other end of connector and then pushing it back in. This has fixed a lot of issues for me in the past. A ribbon cable can become ajar and cause a problem, so securing them is necessary in a lot of applications. If you reseat the entire cable connector in a socket you have to be careful not to bend pins – get used to inspecting for bent pins as well.

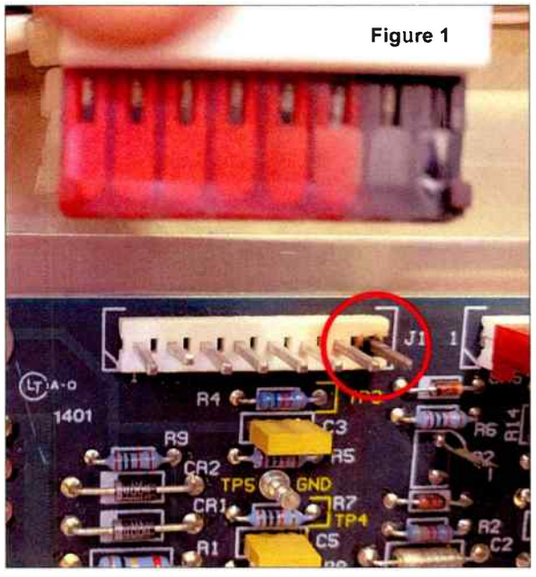

Figure 1

Pins in a Molex type circuit board connector can be of various pin sizes/spacing, are much larger than ribbon cable socket pins and can carry much more current. **Figure 1** shows where a connector experienced a poor connection that got hot in a Nautel FM 8 power board. The pin (which was, fortunately, on the connector edge for this fix) had burnt the connector bad enough to crumble away and the wire was then directly "soldered" to the pin. This type has a punch down design with a white slide-on cap and wire catches to keep wire from being pulled loose. I was trying to slide the cap off to check a voltage. I was surprised that I did not see the burn right at first, but I got to the trouble with the schematic road map. The punch down insulation piercing connection could have contributed to this problem too. A connection can get so hot it will transmit the heat through the board to the pin solder joint on the board and even burn the board or trace.

There is another style which is crimped on the wire. The actual contact can be released and pulled out if needed. It may even slip and back out when it is not supposed to, as a result of reseating the connector at some point. (Repair 102). **Figure 2** shows the crimp style with one female "pin" removed. Note the toroid on the feed with a color coded fuse in the background.

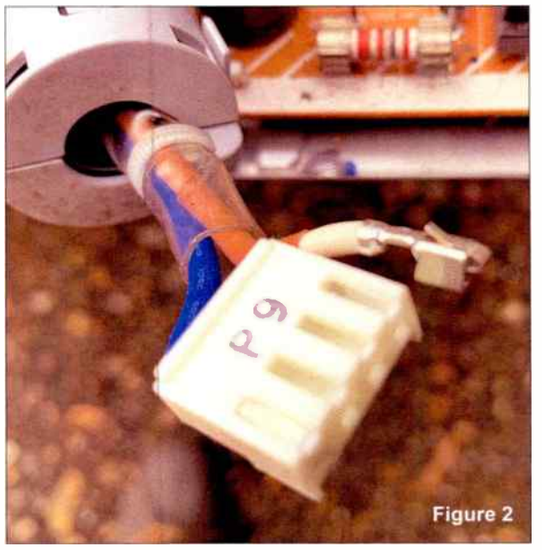
Figure 2

Another pesky issue was when our uplink amp started glitching. I determined it dropped for a second when the cooling fan automatically kicked on. It was a poor power connection inside at the power supply. The supply is a single voltage with multiple pins to be able to take full load out of the supply. They had two pins paralleled but, as **Figure 3** shows, it got hot. You may even be able to see where it melted around the pins. It did not show any heating at the other end plugged on the RF board. I doubled up on the pins at the power supply and went ahead and soldered the wires directly to the pins on the board. This AnaSat uplink I always considered as high quality equipment but had a weak connector. Main reason I went into the amp was that last time it got sent back the report said burnt connection and was expensive. It can be a challenge to keep old equipment going.

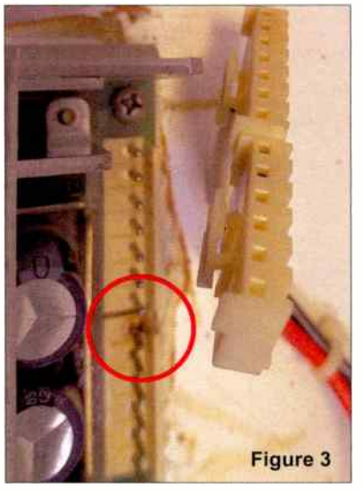
Figure 3

Edge card connections can be another issue. First was the standard single or double sided gold contacts on a circuit board direct edge card connection. They are quite reliable in my opinion. Then as number of connections to boards went up by five times or more a dense connector with multiple rows of pins came about. Typically modules contain the pins but the back plane can also. Bending pins in the back plane is bad so the module may have the pins on it. Whichever design they always need to be carefully checked when replacing modules. One more noteworthy fact is the ground pins tend to be a tad longer grounding the module and circuitry before power gets applied. They usually are first to bend.

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

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Radio Report

Life After Station Ownership
Museum of Broadcast Technology

by Steve Callahan

Well, it has been six months since I sold my radio station, and what a six months it's been. I keep getting asked it I miss the day-to-day responsibilities of radio station ownership and I always say no. The time was right to pass the baton of media ownership on to the next sprinter. I did, however, sign a short-term consulting agreement because the new owner has never owned a broadcast property, has never worked at a radio station and was totally confused by EAS, PPM, PSA, TPO and other lingo that we use everyday.

I have to give the new owner credit for jumping in with both feet into a business he's always wanted to be in. It is a bit frustrating to have to go back-to-basics repeatedly, to school him in the foundations of running a business, especially a radio station. Admittedly, he has some good ideas like moving the studio to a more visible location downtown. One day I got a call on a Wednesday that went like this, "Are you ready to move the studio on Saturday?" I reminded him that a radio station needed working telephone lines and an Internet connection at the new location, before we even begin to set a date for a studio move. I also reminded him that moving a radio studio was not like moving an office in that an office has desks, chairs and file cabinets, while a radio station has specialized furniture and lots of equipment that has to be considered.

For a pre-planned studio move with no special frills, I can utilize Studio Hub hardware to put it together in two long days. This was not a pre-planned move and it was not going to take two days. I suggested that, to minimize downtime, this might be the perfect time to put new equipment in the new studio and move the existing studio over and utilize it as a production or backup studio. That suggestion drew a blank stare from the new owner.

One aspect of station ownership that I do miss is the interaction with our very loyal radio audience. For the past few years we've covered live, the local Christmas tree lighting parade to the town common and on Christmas morning I take to the board to play holiday shows from old time radio stars like Jack Benny, Bob Hope and Bing Crosby. I also dig up some lesser-played and unique Christmas music and play a recording of the previous evening's Christmas Eve church service from a local pastor. I used to get many appreciative calls from listeners thanking me for our very special holiday programming. The new owner didn't think that it was necessary to continue with this tradition because it seemed a little bit hokey to him. Never mind that we sold it as a Holiday Advertising Package that didn't require a lot effort to sell out in less than one day to local businesses.

One thing that I tried to impress upon the new owner is that radio stations are more than commercials and recorded music. It's the people who sit behind the microphone hour after hour, day after day, week after week, and year after year, to share their talent, knowledge and information with the faceless but always appreciative audience. The new owner listened politely and then asked how we could get a network in to save on payroll, like he had heard other stations had done.

You can probably guess by now that the technical side of radio is foreign to this new owner. He asked it we could put some solar panels on the roof of the transmitter building to run the 5 kW main AM transmitter to save money. It was time for a lesson in the electrical consumption of AM broadcast transmitters at 100% modulation and how many acres of solar panels it would take to achieve his desired goal. Once again, a blank stare of amazement was all I got when I finished my explanation.

It took some explaining and some coverage maps to show the new owner that the coverage of the station's FM translator was not, and would never be, equivalent to the parent AM station's 5 kW daytime coverage. He truly thought that his translator was the only station in New England on that particular FM frequency.

Despite what seems to us some rather naïve and, in some cases, just plain foolish questions, the new owner does have some good ideas and just needs some help in planning and executing them properly. I'll keep listening to his questions and suggestions and I'll keep advising him on the right way to be a better local broadcaster.

The Museum of Broadcast Technology, Inc.

I've been on the road again and this time it's to the Museum of Broadcast Technology in Woonsocket, Rhode Island. I've heard of this amazing little museum from other area broadcast engineers, so I made an appointment to meet with Paul Beck, who is the president of the non-profit group behind the museum.

Paul Beck (left) and Tom Sprague (right)

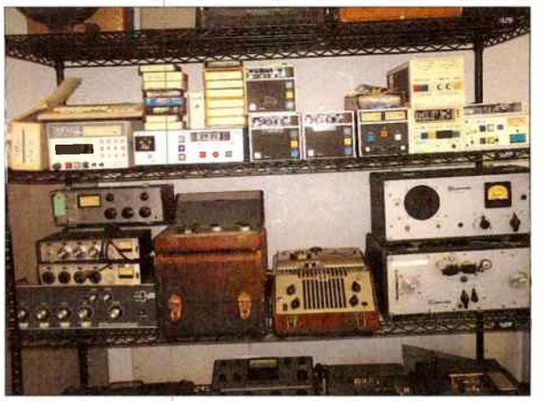
When I entered the first floor of the museum, in an old bank building in Woonsocket, I was blown away by the large amount of working quad helical video tape machines that the museum owns. The first floor was practically covered with these beautiful machines. Just behind the quad machines is an equally impressive collection of working 1-inch tape machines and cassette-based VTR machines. Paul told me that the mission of the museum is to Restore-Preserve-Educate in the ways of the golden days of Broadcast Technology.

Utilizing a small but dedicated staff: Paul Beck, Tom Sprague, Jay Ballard, Peter Fasciano, Marc Burman, George Leamaster, Cheryl Lustenberger and Henry Burman work together to keep this technology alive in this very impressive setting.

When we came out of the elevator on the museum's second floor, I was greeted by dozens of classic television cameras – many of which have been restored and are operational. The genesis of the Museum of Broadcast Technology was back in 1981 when Paul, then a broadcast equipment salesperson, came to call on Emerson College in Boston.

One of many classic TV cameras.

Emerson's broadcasting studios were in sad shape and the school's new equipment budget was minuscule. Paul knew all of the local Boston area TV engineers from his days as a salesperson so he knocked on doors and asked if the stations had any usable, but soon-to-be-replaced broadcast gear. It didn't take too long to get some working TV studios at Emerson College, thanks to Paul and his connections.



Remember cart machines?

When Emerson got some money for new TV equipment, rather than send the old equipment to the landfill, Paul started the museum and displayed it. He's been very successful renting some of the classic cameras and other broadcast equipment to movie companies as authentic props. If you saw the movie "The Quiz Show," by Robert Redford, you saw some of Paul's equipment.

Unfortunately, the people who know how to feed and care for this equipment are not getting any younger and there is classic TV equipment still in the hands of private collectors in barns and storage units across the country. The museum is always interested in pre-1950 television equipment and especially any Dumont equipment that is still out there somewhere.

The Museum of Broadcast Technology, Inc. is located at 144 Main Street in Woonsocket RI and is open by appointment. 401-388-5764 or main.desk@wmbt.org

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

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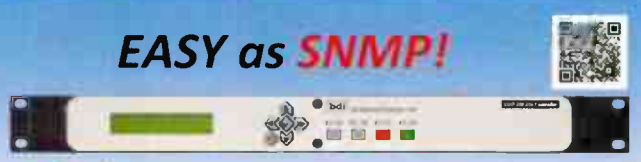

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Tower Topics

Tower Light Monitoring

by Bob Reite CBT

Daily Observation

Way back, perhaps not so long ago, when radio studios were staffed 24/7, monitoring tower lights consisted of the swing shift DJ looking out the window, noting if the tower lights were working and making a notation every night in the station log. If the beacon was out, he would call the FAA flight service center to file a NOTAM, then call the engineer and let him know that a tower climb needed to be scheduled. If the tower could not be seen from one of the studio windows, a current sample from the feed to the beacon was wired into the transmitter remote control and that channel was read while taking the transmitter readings. The FCC rules still allow confirmation of proper operation of tower lights by daily observation, either visually or by checking an indicator as described above.

Tower Light Alarm Systems

The other approach is to install a tower light alarm system that will continuously monitor the condition of the lights and call the engineer or other responsible party when a fault is detected. While daily observation meets the FCC rules, it doesn't cover the case of a lighting failure a half hour after the tower was looked at. In theory, at least, a good automatic monitoring system will inform responsible parties minutes after a failure occurs no matter what time of the night it happened.

TLM-1 Tower Light Monitor

TLM-1 System

The TLM-1 Tower Light Monitor is a complete one box solution from **FM Services [towermonitor.com]** that is able to monitor up to eight 116 Watt steady burning side bulbs and eight 620 Watt or six 700 Watt beacon bulbs. In addition, if the photocell has not changed state within 20 hours, a photocell alarm will be generated. A "Flasher Failure" alarm will be generated if the beacon gets stuck on all the time or the flash rate and /or duty cycle fall out of FAA tolerance. While originally designed for traditional incandescent lights, it can be configured to work with red LED lighting. Installation consists of running the wire from the tower light circuit breaker inside the building, through the supplied current transformer. The current transformer output must be connected to the main alarm unit before turning the AC Power back on, otherwise damage to the current transformer will occur. Alarm outputs go to the transmitter remote control unit. Finally, the wall wart for the TLM-1 should be plugged into an outlet that is on the same breaker as the tower lights. This way, if there is a tower light breaker trip, the system will alarm.

Alarm outputs are opto-isolated for photocell failure, flasher failure, beacon lamp failure, side light failure, and master alarm, which activates upon any of the above alarms. The first four alarms will reset to normal if the condition is corrected, but the master alarm must be manually reset, either by the reset button on the TLM-1, or from the associated transmitter remote control system. In addition, there are two status outputs. One for lights, which will be on at night, and one for beacon. The beacon status indicator goes on and off in cadence with the beacon.

Yes, wiring up the full complement will use up seven status channels on the remote control unit plus one control channel for the reset. One could get by with just using the master alarm and the two light status outputs. Upon receiving the master alarm call, the beacon status could be checked to see if it was still going on and off. If so, it can be assumed that the beacon is OK and one of the side lights burned out, which does not require FAA notification.

A way to share status inputs on sites with multiple towers, such as an AM directional array, is to configure each TLM-1 unit for "active low" to allow the paralleling of the first four alarm outputs from the TLM-1 for each tower. Each tower would have its own master alarm output connected to an individual status channel. Upon receiving an alarm, the master alarm will tell you which tower has the problem while the other alarm outputs will tell you exactly what is wrong with that tower.

After having one system in use, I noted that it will generate a photocell alarm if the photocell relay fails shorted as well as open. This is why the TLM-1 includes the option of "no photocell" for installations where the lights are left on all the time. While it is permissible to leave red tower lights on 24 hours a day doing so runs up the electric bill and shortens useful lamp life.

For the most part, a tower light monitor system such as the TLM-1 needs to be tested every three months. To make the test easier, I added two switches to simulate a beacon lamp failure and a flasher failure to the tower lighting system. The beacon lamp test switch is wired in series with the feed to the beacon and is left closed or "on" for normal operation. Don't skimp on this switch, I used a 20 Amp industrial grade switch so as not to have the test switch be the cause of a beacon outage. The flasher test switch is wired in parallel with the flasher and is normally left in the open or "off" position. Make sure that the switches are clearly labeled as shown in the photo.

I test during the day by covering the photocell with a small box to turn on the lights, then open the beacon lamp test switch to confirm that a burned out bulb will activate the beacon alarm about one minute after the test switch is operated. Once that is tested, I close the lamp test switch, wait until the beacon out alarm status is back to normal, then close the flasher test switch to confirm that the flasher alarm is working – bearing in mind that it may take up to four minutes for the flasher alarm to register.

TowerSentry

Finally, if cost is no object, there are systems that have been certified as having enough redundancy as to not require a quarterly test and that have central station monitoring, similar to that of a central station burglar alarm system. One example are the offerings from **TowerSentry [www.towersentry.com]**. TowerSentry has a wide range of products for every possible FAA approved tower lighting and marking scheme, such as daytime strobes and nighttime red lighting. The unit most similar in functionality to the TLM-1 is the TowerSentry SBMS unit, for incandescent lighting without built in alarm outputs. Unlike the TLM-1, the SBMS unit must be located next to the flasher as the conductors going to the beacon and side lights must be opened and electrically routed through the TowerSentry Unit.

However, connection to the outside world is made by a built in 4G GSM radio – no connection to the station remote control or land line is needed. Cost of the equipment is nine hundred to twelve hundred dollars per tower. While the hardware may seem expensive, if it fails for any reason, other than fire or vandalism, TowerSentry will send a replacement at no charge, even if it was killed by a lightning hit, while you are under contract.

The wireless airtime is included in the monthly monitoring fee. The TowerSentry central station will take the responsibility of notifying the FAA as well as the owner of the tower. Monthly Tower Light Logs are generated and emailed each month to system subscribers. The cost of monitoring is fifty dollars per site on a month-to-month basis. A one year contract drops the price to forty dollars a month while a three year commitment drops the price to thirty five dollars per month. Bear in mind that having an FCC approved system that does not require quarterly testing will save the labor costs of such tests, offsetting the monthly monitoring fee.

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

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Station Stories

Changes

by Sam Wallington

The station had been a somewhat typical college station. Despite building new studios, tough financial times caused the organization to be restructured and a new corporation created. While the college still had some influence through a board position or two, they no longer owned the station. Meanwhile, I had just finished my degree and was wondering what to do next. The news and rumors about the station's changes piqued my interest and I went to see if they were looking for any employees.

My first encounter with the Chief Engineer was brief. He said, while carrying a turntable from the old studios to the new, he did not need any help ... thanks. OK, my first venture in radio was short! But, on a whim, I went and talked with the General Manager, who thought I could be helpful (or perhaps he felt sorry for me) and encouraged the Chief to give me a chance. Thus, I became ... (drumroll please) a volunteer!

The Chief's first job for me was to sit in the new talk studio while he finished wiring the mics. He went to the control room and scared me to death by turning on one of the mics – which illuminated the "On Air" sign in front of me! I was so new to radio, I thought for sure he had made a mistake and put me on the air. Being an introverted electronics guy, this "opportunity" did not create joy. I pointed at the sign and mumbled, "Is that true?" I must have mumbled so quietly he never heard me, and next thing I know he's back in the talk studio asking if I can hear him through the headphones (yes) and then telling me to talk so he can set the level of the microphone. He was talking pretty loudly, so I figured the "On Air" sign must not be accurate, and I settled into helping him set up the mics and studio – and start my education in radio and engineering.

Six months later, the station hired me (for a wee bit of money). A year or two later, they promoted the Chief to Operations Manager, and I slid in behind him to become Chief Engineer. Maybe you can relate to a nightmare I had one night shortly after my promotion: I dreamt a disgruntled employee had snuck into the station overnight and ripped out all the wiring from the automation system, leaving me to put it back together! I had *no idea* what all those wires did or where they went, or why they were there! How would I ever put it back together?!

For you who have only worked in radio, since automation systems have been all contained within a computer (audio and all), an explanation might be in order. This automation system used an ancient computer. (It used magnetic-core memory – Google it!) and was programmed by a dedicated button/LED display terminal, or if all else failed, via octal switches on the back along with paper punch tape. That computer controlled a half-dozen reel-to-reel tape machines, a triple-stack cart machine, and a cart carousel. Besides routing the audio, all that wiring routed the control signals from the computer and 25 Hz tone detectors. Though it was a lot of wire, I eventually realized it was relatively simple.

After such auspicious beginnings, my delight in some of the changes in radio may not be a surprise. Advances in computers have made radio very much easier than it used to be – and that's just from the technical viewpoint. Right now, I am sitting on my couch writing this on my iPad. Sure beats an IBM Selectric typewriter and a bottle of Wite-Out!® We went from Selectric to WordStar (on a CP/M computer), to WordStar (on an MS-DOS computer), to Word Perfect and Windows 3.1 to Word, and (eventually) Windows 10, not to mention MacBooks. Printers have gone from dot-matrix, to daisy-wheel, to ink-jet and laser and – glorious, wireless, color! Computer networks have gone from Novell and Token Ring to 10BASE-T Ethernet to Gigabit Plus. ISPs from AOL and a 2400 baud dial-up modems have moved on – now my kids complain about our WiFi being only 50 Mbps.

We Made Do

Those computer changes have improved radio automation systems immensely. When the automation died at my first station, it took the OM (former CE) and I something like 14 hours just to reboot it, so we could start entering the program schedule. Now one can kill the power to an automation computer without any on-air glitch because of real-time redundancies. That is a miraculous and very welcome change!

Transmitter technology has also become vastly better. I still have a soft spot (but not a soft tube ... sorry, engineer joke) for old transmitters, but solid state transmitters are so much better. Being able to hot-swap modules, avoiding death even without using a high-voltage shorting stick, better efficiencies, longer life, quieter operation, no tuning required across the entire band – there are a lot of things to love about improvements in transmitter technology.

How about remote control systems? Though we had an STL/TSL radio system at my first station, I later worked at a station with miles of actual copper wire between the studio and transmitter to pass remote control information, which was created via a rotary-dial on the front panel. Now I can take the remote control with me anywhere I have Internet access. I can also change audio processor settings from anywhere (much easier to do from the car instead of driving back to the studio, tweaking something, then driving around some more). In fact, it is now possible to access and adjust just about every component at a transmitter site (excluding towers and antennas – though I could see them using a drone!) from pretty much anywhere. Talk about convenience!

But, honestly, I wish some things in radio had not changed. First and foremost on my list is audio quality. In general, I do not think radio is solely to blame here. Somewhere along the way, too many record labels misplaced the art of great recordings. Maybe the innovations around digital audio and non-linear editing (many of which could/should have improved the sound) made it too easy. Or maybe it was a style thing, or a generational thing, or something. But sometimes I put on an SACD of a fabulous recording and it makes me sad to think what we have misplaced. However, I am not saying "lost" since there are studios, producers, and artists who still turn out great recordings, and movie production audio is still mostly healthy. Audio quality is not lost but needs to be (re)learned by some. Naturally, radio needs to avoid sample-rate changes and move toward quality instead of loudness (side note to many of you classical, jazz, and smooth jazz folks: Thank you for carrying the torch!)

Next, but also critically important: spending time and money to really resolve problems correctly. I used to have a boss who was surprised – maybe even shocked – when I asked whether I should fix something correctly (for a higher cost) or put on a Band-Aid for little or nothing. "What's the question?" he asked. "Fix it right!"

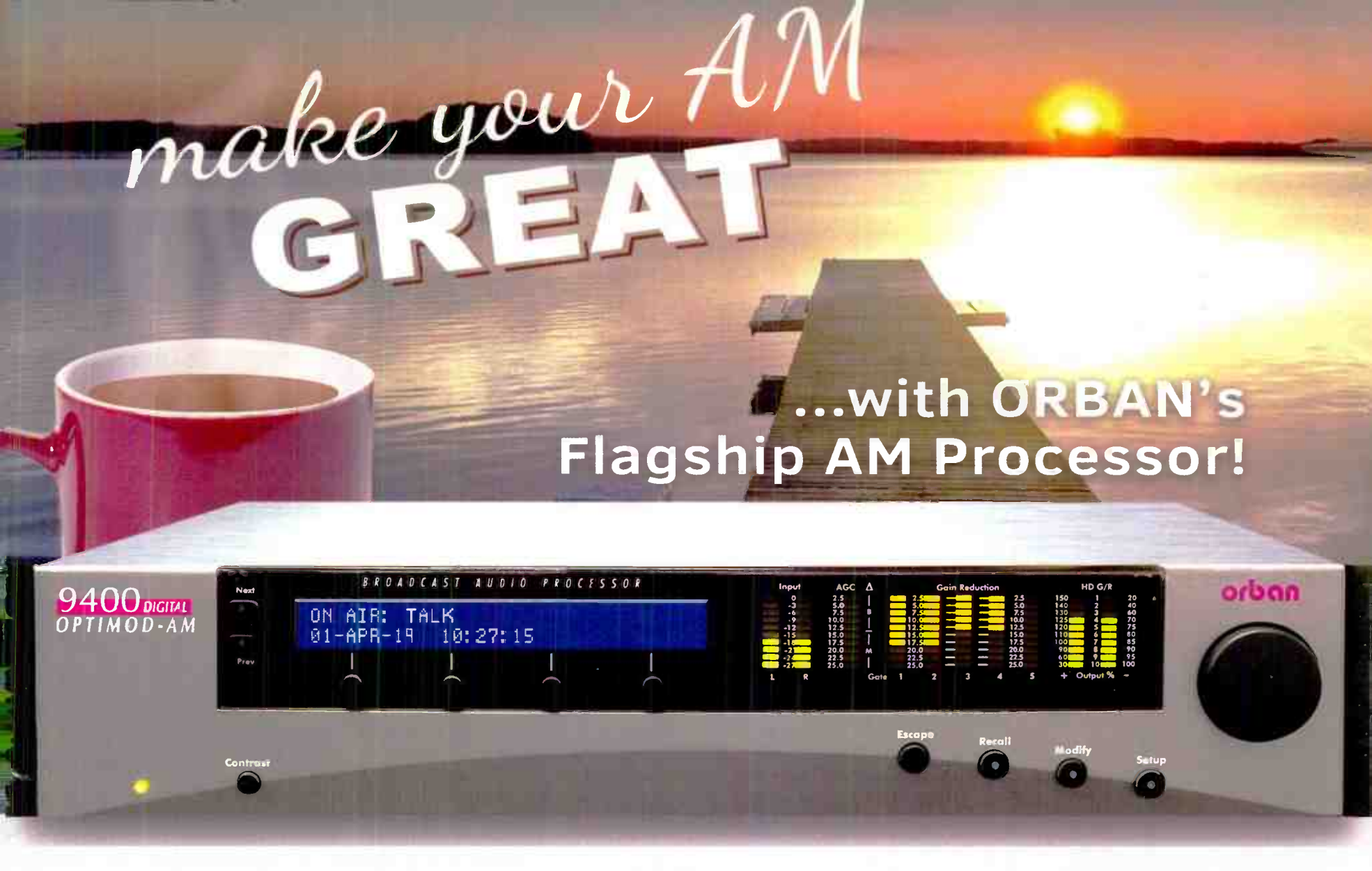
When a signal is off, the urgency and concern are more around whether a spot plays than around what the audience needs. As a result, repairs are often half-baked kludges which end up making the overall facility less reliable. Once the station is back on the air (perhaps barely), Engineering moves back to being seen as a "cost center," which makes it hard to fix things correctly because it would "cost too much." But such an approach is short-sighted. Engineering is a vital piece of a station's product-delivery system, of keeping the Morning Zoo in the listener's car. If all stations would treat their Engineers with fair pay, reasonable hours, and enough budget to do the job right, the outcome would be more reliable signals (and station income) and a larger engineering talent pool.

On a related note, I have noticed a trend toward cutting air talent. Think of a product which used to be great, but then the company changed the thing that made it great (New Coke maybe? Or perhaps Kodak not understanding their product was photographs, not film). Yes, great air talent can be expensive. But there is a reason they are expensive – they bring audiences in larger numbers than ones who are less expensive, and a larger audience means larger revenues. But someone looks at payroll and assumes income will stay the same by replacing expensive air talent with newbies.

We must not fire experienced and appropriate air talent simply because syndicated content or a college student is cheaper. There is nothing wrong with syndicated radio programs – it is a way of distributing great talent to a larger audience. But if we hang on to and develop excellent talent, we can make sure radio creates truly compelling and creative content instead of the "same old stuff." As audiences grow because of unique and innovative talent, revenue grows, allowing us to grow even more talent.

One of the reasons I love radio is because it is constantly changing. I enjoy seeing the new ideas and challenges each day brings. Though we have occasionally mis-stepped or missed opportunities, there are so many possibilities ahead! Radio has a tremendous reach, and tremendous cultural influence. I, for one, will continue to work toward an even better tomorrow by creating and embracing change. When mistakes are made, I will work to change those mistakes into successes and innovation. Will you join me?

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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Linux for the Uninitiated
Breathing New Life Into Old Computers!

Getting around "Windows Frustration Syndrome" – continued

by Tommy Gray – CPBE, CBNE

Recap

In case you have missed some or all of the previous "Episodes" here is a brief recap of the Linux Project. The goal was to save some older computer that had been running obsolete versions of Windows, and for which there was no free upgrade path available. This all had to be done for free or "cheap." Also these machines, after years of Windows updates (which yours has done too if you are running Windows), the machines had gotten so slow that they were very frustrating to use. With all the needed security updates, the antivirus programs, and the firmware updates, to keep hackers at bay, the machines were slow as molasses and were sidelined and destined to never be used again.

Having been a software developer, as well as a long time engineer, I always sloved to try new things. I had used Unix in college, and had gone through all the various distros of Linux years ago, trying to find something that I would be comfortable with running on a day to day basis as a personal workstation. Though some showed promise, none were never what I would consider viable Windows replacements. Now my definition is this: They had to be something that I would use – and either forget it was not running Windows, or maybe even like better. After a year or two of trying various Linux distributions (operating systems) I finally just said, "Oh Well" and put the project aside. Fast forward to 2016.

Having dealt with the mandatory Windows 10 thing and after having seen perfectly great machines rendered boat anchors from the associated updates and new versions, I once again said to myself, "There *has* to be something out there to replace this mess!" Admittedly, down through the years, there have been some pretty good versions of Windows. A couple come to mind, from having done development for them. There was Windows 2000 which was heads and shoulders above its predecessor, and then Windows XP Pro SP3. Actually Windows 7 was not bad and we eventually used it for a good while. When 10 came on the scene the computer world was turned upside down and it has now started to settle a little – but after so many machine replacements and updates that it sometimes makes one want to go back to a calculator and pocket PC!

I started looking at Linux again, when I got tired of Windows 10 updates that took hours to install and then half worked or failed, after tying up your machine for hours and burning through most of your Internet data allowance for the whole month!

I looked for something that would make me and the folks in the office feel comfortable in their day-to-day computer use, and would not require me, or someone, to constantly have to use a terminal to do everything. The great thing about most Linux distros is that you can install them onto a bootable flash drive and run them for testing, without having to actually install them on your computer. Plug in a flash drive, reboot, and viola, you are running Linux. Of course this type of operation has its limitations and is slower than actually installing it, but nonetheless you can run it and "kick the tires," to see if you like it. If not, plug in another one and do it again. After testing numerous versions, I settled on Linux Mint Cinnamon, and have been using it ever since.

Recently, I convinced a friend who is a software tester and a tech support person for one of the largest broadcast software companies around to try it. He had a very nice personal machine in his office that had gotten so slow running Windows 10 that he was no longer using it. He created a bootable flash drive, ran Linux Mint Cinnamon for about 30 minutes, and then did a real install and has been running it ever since. He performed what is called an "Alongside" installation, where he kept Windows on the machine and installed Linux alongside. However, he stated that, after using it for a few weeks, he rarely if ever runs Windows anymore. I cannot tell you the last time I have run it here in my office!

(Continued on Page 28)

– *Continued from Page 26* –

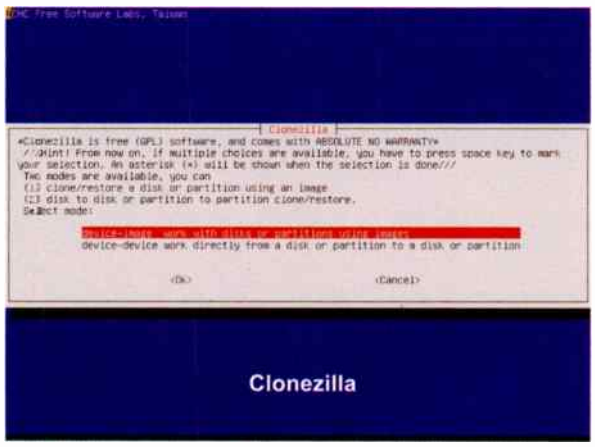
The great thing about Linux is that it is totally free, and when a new version with more bells and whistles comes out, it too is a free upgrade. There is another plus in that regard. When you upgrade, you can upgrade without losing your data, and the new version installs many times without rebooting! The only time, as I recall, I had to reboot was when I installed a kernel upgrade.

Lockups and program freezes are very rare, and if it ever happens, you can recover almost every time without having to reboot the computer. You can kill a frozen app through a simple process. Oh, and another great thing that I like is that "Plug and Play," which we used to call "Plug and Pray" on Windows, actually *works* on Linux. My friend had a piece of audio hardware that stopped working on Windows 10 after an upgrade.

When he installed Linux Mint Cinnamon on the same machine, with everything still connected, the OS actually found the previously non-working hardware, and installed the necessary drivers all on its own with him having to do anything. And lo and behold ... it came up working! A couple of weeks after he installed Linux Mint Cinnamon, we were chatting and he said that the machine that was so slow running Windows was now faster than it was when it was brand new running Windows.

My Hard Drive is Too Small!

Eventually your older machine that came with maybe a 100 GB hard drive, or something like that, will become so popular with you that you will fill up your hard drive. This will especially become a problem if you did a dual boot install of Linux and Windows. So what is the answer?

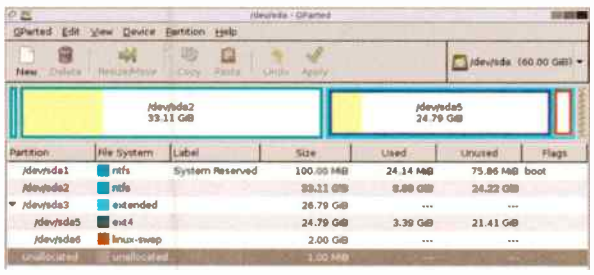


First, if you are simply wanting to clone the hard drive for backup purposes, in case your drive happens to fail, then you can simply install from the Software Manager, a utility called "Clonezilla," which works great. "Clonezilla" is a program without a fancy GUI. It looks more like an old DOS program but works very well. I put the new drive in an external USB drive case and plugged it in. I make the drive a working drive, and then boot from my USB drive.

Once Linux is running on the USB drive, I install Clonezilla on it and run it. *Don't* install it on the hard drive, as the machine needs to be able to not have the drives tied up as the active drive. Once Clonezilla is running, just clone the drive, shut down,, and put the new drive in the machine and go. There are simple instructions all over the Internet, and the program is easy to use.

If however you *do* need a larger drive and want to create it without losing what is on the current drive, there are a couple of ways I do it. The easiest one is a program called "EASEus." It is *not* a free program, but it is a great program and will clone and resize all at the same time.

There is another option, and that is the program that is included with your Linux mint Install in the software Manager and that is a program called "Gparted," standing for (Gnome, Partition Editor).



Gparted

It will do what you need, as long as the partition you want to resize is adjacent to the free space on the new drive. As I recall (and I apologize for any uncertainty, as it has been a while since I did this), what I did was to clone the new drive from the old drive using Clonezilla and, then using Gparted, I simply went in and resized the Linux partition to fill the remaining drive space. Maybe in the next issue I can walk you through the process (if I can find a spare drive or two around here to play with).

I will give you details on using these two next time.

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

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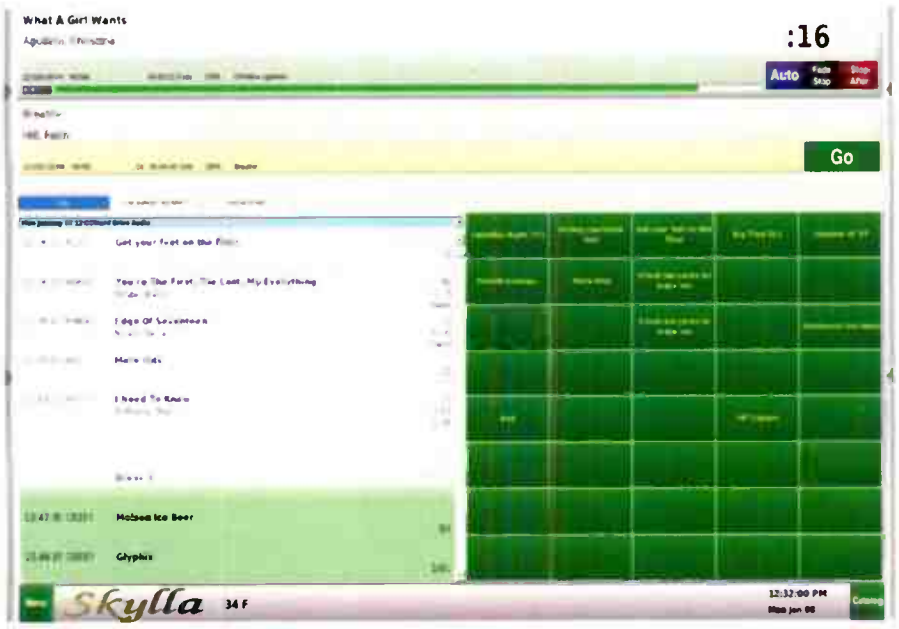

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SMARTS Broadcast Systems

Engineering Perspective

Influence of Adages

by Jim Turvaville

It's not just the turning of the decade or the New Year that can make one stop to ponder deeper thoughts. Nor is it the fact that my own body odometer keeps turning those miles higher and higher each year. However, as an avid reader I have recently been exposed to many common adages which caused reflection on how they have influenced my career. Perhaps these musings will also inspire you.

Two heads are better than one.
No man is an Island.

This is a pair of adages that I recently was reminded that have played a large role in my life. I had made a long day trip to far West Texas to a station, and stopped in on my way back to see an old friend and have dinner. He and I pretty much "grew up" in this radio engineering business together – him being a few years ahead of me and with a bit better education and opportunities than I. We now live four hours apart, and both have retired from corporate careers and settled down in small towns, owning local radio stations. We became acquaintances nearly 40 years ago, when he was brought in to help me on my very first station build – a 3 kW FM on an AM tower, using scrapped together pieces and parts.

Once again, we had a chance to reminisce about that, and other projects we have shared through the years, and I was keenly reminded how much he meant to me both professionally and personally. And the follow up thought was that none of us should try to be a "lone ranger" out in this business – besides not being safe, it's not smart.

Not only are two heads better than one, third or fourth are often a great asset as well. If you do not have a network of peers that you can lean on and learn from, then you are less the person than you can be. It's not always easy to build and cultivate that peer group, but even if it's by phone and email instead of in person, I implore you to make the effort and do what is necessary to build and keep good professional associates to help, and by which to be helped yourself.

Actions speak louder than words.
Well done is better than well said.

Here is another pair of adages that were very important to me, and have been an underlying principal of most of my career. I cannot tell you how many "engineers" that I have ran across in my 40+ years which were a whole lot more talk than action, and most of them were simply lazy when it came to getting things accomplished. It's not just my Christian upbringing that has made me leery of those types of people – I'd rather people see what I can do than me have to constantly tell them about it. My observation of most engineering types is that we tend to be selectively social, rather introverted, and more the fly on the wall than the life of the party. I'm not saying the other swing of that pendulum is not out there, but generalizing based on my own personality type, that would tend to be true more often than not.

I have spent many an hour on a project to get it done on time and in a proper manner, and then stepped back and waited to see just who would be the one to notice it was done and working. Of course I rarely violated the proper respect to my supervisor to report on work accomplished, but as far as the rest of the staff, I have always preferred to let them find out what I had done by the results, rather than me reminding them of it. Now that I'm back in full time contract work for income, I actually have the luxury to go and do things for my clients and never tell them that it was accomplished – I can just tune the dial and check that all the "children" are behaving properly and have the immense satisfaction of knowing a job has been well done. After all, I get paid the same.

A chain is only as strong as its weakest link.

This adage took a few years to sink in, and only in recent years have I really paid close attention to fragility and reliability in its light. The first time I realized this was about 15 years ago when I was visiting a fellow engineer at his Network Operations Center. They programmed three nationally distributed pro-

(Continued on Page 32)

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...the Bluetooth phone interfaces work with BOTH cell phones and Bluetooth headset enabled land lines.

Engineering Perspective

– Continued from Page 30 –

gram networks from that location, and he was the sole engineer on staff responsible for all of it. I was a "stand by" for him, along with a couple other engineers in the area, and he was always keeping us up to date on how things worked in the facility should we be the one to come help in an emergency. This was back in the Point-To-Point T1 days, and that multiplexed signal was the network's connection to the uplink facility cross country. As a backup, they had a bank of ISDN (Wow, anyone thought of *that* in a while?) codecs which could serve as a backup feed if the T1 was lost. It was that day when I realized that all 300 or so radio stations they were feeding had one thing in common – that single RJ45 plug on the back of the T1 box. In fact, it was just 1 pair of 24 AWG wires that connected to the local CO that carried the entirety of those three programming networks.

It was then that I began to examine all of my own facilities and seek to isolate the one most central and most vulnerable point of failure. Have all the UPS units and secondary or tertiary pieces of gear on standby, but if that one audio connection is missing you're still dead in the water. Or maybe you have all the spare equipment, but no backup power source – you might as well have nothing at all. Whatever it is at your facility, think about it and be aware of what you might do to protect it and have a working alternative in place. That might be where another old adage comes along which says, "Necessity is the Mother of Invention." Not sure I need to elaborate on that one except to implore you to do whatever is needed to minimize that weak link in your chain.

Work harder, not smarter.

I've written in detail on this principle on more than one occasion, so not much needs to be added on this old adage and how it drives our lives. I will add that, as the miles and years roll along, we tend to get better at this principle, if only out of necessity. During my corporate career, in discussing time or project management, some people would argue that, "We need to be more efficient with our time!" Other people would claim, "Let's not worry so much about efficiency; let's be more effective!" Efficiency means doing things right; effectiveness means doing the right things. Working efficiently is doing things with the least amount of wasted effort; efficiency gets you from point A to point B via a straight line. Inefficiency goes in circles, zigzags, and gets fewer mpg. Effectiveness means doing the things that yield results. This is applicable in not only our engineering world, but as a general rule for every area of our workplace and life.

A picture is worth a thousand words.

With the advent of the Smartphone, we have no excuse for not taking pictures of things in our work. Yes, it requires the dedication to actually download those pictures, and then the ambitious task of organizing them; but you got to take them first. For those of us with visual acuities, that camera is also really useful for reading serial numbers on equipment, or seeing the labels on that wiring strip – just snap a photo and blow it up on your screen to see the tiny writing. I have two clients currently which have on-line organized systems (both based on Google Docs) where I can go and actually upload those pictures to specified folders for each of their facilities. That has really helped me be a bit more organized in my picture collection, and is a huge help to the client who may not have the luxury of seeing those sites as often as I do. I do not need to remind you to either label those pictures as to their location, or put them in a folder designated for that location; before we forget what they are!

There's no time like the present. Don't put off till tomorrow what you can do today.

I close with these two adages which are probably the most difficult to accomplish. We most often have our days organized in the "Crisis – Immediate – Important" order of getting things done, and the bulk of what we should get done falls into that third category which gets the last of our energies and attention. I can only say, do your best to not let those crisis or immediate situations keep you from getting the most important things done. My former manager used to tell us to plan only 30% of your day, because the rest of it will be taken over by what he called "the tyranny of the urgent." I think his wisdom has been a great inspiration to me in being all that I can be on a daily basis – may you be inspired as well.

Jim "Turbo" Turvaville is semi- retired from 41 years in full-time Radio Engineering and lives in Rural Wheeler County Texas in a "tiny house" where he maintains a small clientele of stations under his Turbo Technical Services (www.jimturbo.net) operation providing FCC application preparation and field work.

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Shop Talk

by Steve Tuzeneu, CBT

Misc. Tech-Tips and Thoughts

Here we are, already a few weeks into the New Year. It never ceases to amaze me just how fast time goes by. As engineers, we know that feeling every year. You have so many things to take care of, that the weeks rush by. Now that we are into another new year, it's time to think about what you plan to do over the months ahead.

Operating Systems

By the time you read this column, Windows 7 support will have expired. If you are running a radio station or group of stations on this operating system, you really should plan to migrate to Windows 10. Or you could transition to an alternative to Windows: Linux.

Linux does not require you to pay hundreds, or if you work for a big company, thousands of dollars to upgrade or purchase new software. Some versions of Linux look a lot like Windows, and are just as user-friendly.

I have Linux "Mint" on one of my computers at home, and it looks and feels like Windows to me. Mint has almost everything its Windows cousin has. There's a browser, an email client, a media player, a word processing program and other programs that are a lot like Windows. While it's true you can't use any off-the-shelf (or downloaded) software designed for Windows on a Linux machine, there is a module that will emulate Windows and allow you to use many programs you will use at your station.

Whatever operating system you have, or plan to transition to, take steps to keep your computers secure. I have read in a national radio publication where a big radio group had to deal with some ransomware that landed on one of their computers. I once worked for a group that had to deal with that kind of nuisance. Trust me, it's no fun, so make plans so you are ready should it happen at your station or group.

Documentation – It's Important.

Some of the equipment around your station comes with a software utility that enables you to save settings to your laptop. That's very handy to have, should you need to configure another piece of identical equipment at another location. Then there are the times something happens to cause that piece of equipment to lose its settings. It's very convenient to have those settings where you can upload them. Uploading the settings to your box saves a lot of time. Keep a copy of your settings on a thumb drive and somewhere in the cloud. If you have a copy in the cloud, you can retrieve the file from almost anywhere.

Sometimes a piece of equipment does not allow you to save your settings to a file on your laptop, like the Gates Air IP 100. In that case, it's a good idea to take screen shots of all the places where you entered configuration parameters. You can save the screen shots in your photo library, amd it will save you time if, for any reason, you need to do it all over again – you'll have the information and can just manually input the settings.

While I'm talking about documentation, keep copies of your documentation where you will need to use them. In the transmitter shack, keep hard copies and digital copies in a dry, temperature-controlled place where you can find them. Some remote locations have poor, or no, access to the Internet, so downloading what you need may not be possible. In some cases, the company that produced your manuals and schematics is no longer in business, and getting replacements will not be possible.

Once again, if it's possible and practical, keep your documents in the cloud for easy access from anywhere that has good Internet access.

When you make repairs or carry out scheduled maintenance, record those details in a book at your shack, and some place on the web, like in a document in Google Docs, or in a file on Drop Box. Should you need to have someone else do work at your site, details can be shared through Google or Drop Box, and that person can record any additional work in the same document.

Back-Up Plans

As soon as you possibly can, spend time working up some back-up plans. Preparing your back-up plans now, when everything is running smoothly, will save you time and frustration later.

Loss of Power

What will you do when the power goes out? Does your generator have enough ready fuel to last until the power is restored? What will you do if your tank runs out of fuel? Do you have the name and number of a business that will be

(Continued on Page 36)

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Shop Talk

Misc. Tech-Tips and Thoughts

– Continued from Page 34 –

ready to fill your tank with fuel? Has your generator been on a routine maintenance and test schedule? What will you do if your generator fails? Can you locate the name and number of a technician who will come and repair yours at a moment's notice?

Transmitter Failure

In your transmitter shack, do you have a back-up transmitter that's ready to go when you need it? If no back-up exists, do you have a spare tube or parts, should the need arise? Placing spare tubes or parts in your new budget will save a lot of down time once they have been purchased and placed where you need them. It is obviously faster to get your transmitter back on the air if you have the parts in the shack then if you have to order them delivered overnight.

Studio Failure

Are your studios ready in the event of a disaster? What will you do if a lightning hit or power surge takes out your on-air console? Have you placed surge protection ahead of your studio equipment? How old are the batteries in your UPS? Will your equipment operate once the power goes out and your generator needs a minute to start up?

If the on-air studio suddenly goes silent because lightning took out the console, do you have a plan in place to get back on the air? Will you switch to a production studio or secondary studio until repairs can be made?

Is there a plan in place should you discover ransomware on your hard drive? What will you do if one of your hard drives or solid state drives containing your music or commercials fails?

STL Failure

How will you get your audio to the transmitter site if your aural STL dies? What about your Internet-based STL; what will you do if that goes out?

These are the kinds of thought processes which will help you greatly in the event of an emergency. While you're documenting these plans, you will want to have at least one other person who will fill in for you when you go away on vacation or attend a convention.

That substitute engineer should know where to find your plans and contact numbers so he can be in touch with people or companies that will need to do their job to get you back on the air.

If you don't have a generator, what is the name and number of your power company? Is there a special phone number you need to call for commercial customers? Do you have your account number and location ready should they ask for it?

38 kW Standby Generator

Do you have your remote control and monitoring equipment on back-up power, like a UPS, for times when the power goes out? It can't call you or your substitute without some kind of power. Some engineers listen to their stations all the time, and there are times when that is not practical, so your remote control needs power to call out during a power failure.

Everything I have mentioned in this column is likely something you have read elsewhere and is nothing new, but we need these reminders now and then to encourage us to get the work done. It's an investment in time and money that will pay us back later when an emergency arises.

Self-Inspection

Another area where we need to invest time is in inspecting our station's transmitter site and studios for legal compliance. Many state broadcasters' associations have an engineer on contract that will offer the Alternative Broadcast Inspection Program, or ABIP for short. Yes, it costs money, but the ABIP could save you a fine and embarrassment later should the FCC come for an unexpected visit. It's a good idea to have an ABIP engineer check things over to make sure you didn't miss anything.

If utilizing the ABIP is not in your budget, download the FCC check list for your AM or FM station, and ask a fellow engineer to help you after you have done the process yourself. You could always reward him by taking him out to lunch or dinner.

If no other engineer is willing or available, you could at least go over the check list yourself and see if there is anything that needs attention.

What Can You Share?

Is there something that you have learned last year, or this year that would help solve a problem for another engineer? If you have some technical news or advice, please let me know. If so, please feel free to contact me at: stuzeneu@sbe.org

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

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Small Market Guide

An Interfering Situation

by Roger Paskvan

It was a warm November afternoon in Small Marketville. The station phone rang. The receptionist said, some guy from Verizon wants to talk to an engineer about interference. The words came to my mind, Oh goody, isn't this going to be fun.

Yes, their engineer from out of town, with his extremely expensive Rhode and Swartz spectrum analyzer, was at our tower site eagerly wanting to show us something. I agreed to meet him at the tower in 30 minutes.

Well, he was polite and basically showed me that there was a huge spike in the center of his screen. He informed me that this was our 9th harmonic and it was very strong, landing right in the middle of their cellular band. I asked, "Is it radiated or coming out of this box?" Well, about 300 feet in front of the tower, the harmonic was gone. It was actually coming out of the transmitter cabinet.

He explained that the signal is making it to their panel antennas and causing havoc on 828 MHz. To make matters worse, being deviated FM times nine, makes a big bandwidth imprint on their channel. He walked around the transmitter – there were definite areas that were, more or less, radiating harmonics out of the case. We parted company and told the gentlemen we would work on the issue to try and reduce the emission.

The next week, all the small holes and knockouts in the transmitter were plugged with copper and sheet metal screws. One of the biggest areas was where the three inch line comes out of the back of the transmitter. Our efforts made some difference and the harmonic was reduced by 10 dB. A receive standard was set up, utilizing a tuned dipole antenna on a stick, cut for 828 MHz. This became a wand that could sniff out leaks, as well as a standard for the interference level.

Continental 816R

Since it was an older 816R transmitter, I called Continental and asked them for advice. They said, in the 1980's, the word cellular was not even thought of. In any case, they told me to check the cavity and door finger stock. In doing so, I learned the harmonic would drop by 15 dB, just by pushing on the cavity door. An internal inspection revealed that the finger stock at the bottom of the cavity door had burned off over a period of time and was not making a good connection. Continental still sells the finger stock but, hope you're sitting down, at the price of $250 for 15 inches. After all, it is silver plated.

That night, I took the beast off the air and removed the finger stock. Yes, it was burnt from a long period of arcing. The new shiny shims fit-in perfectly. I took a copper Brillo pad and cleaned up the remaining finger stock as well as the door that surrounds the cavity. This helped a lot and the door no longer responds to physical pressure, with the harmonic level now dropping another 12 dB. Sniffing around the cavity, it became apparent that the 816R generates the harmonics in the cavity section. The driver was clean but there was some 9th harmonic content on the coax coming in from the external exciter. A quarter wave trap for 828 MHz was installed on the exciter line that reduced that harmonic down 30 dB. This trap looked good on the spectrum analyzer but had no effect on the harmonic level from the 816R cavity. It was concluded that the ninth harmonic was not riding through the driver chain but being self-generated within the cavity.

Next, we learned that cavity tuning and loading had a big effect on the harmonic content of the 828 MHz signal. It was possible to tune the transmitter for minimum harmonic content and maximum output. All other functions in the transmitter had little or no effect on this problem.

Overall, the mods brought the harmonic content down some 30 dB. The transmitter exceeds the -60 dB FCC requirement but the harmonic is still there at a much reduced level. I guess those cell sites have a real hot receive front end. To add to the situation, the cell site is on the same tower as our FM station.

Our next option is to build a screen frame that will fit over the front of the transmitter box. A lot of harmonic energy is finding a way out through the meter squares since they are plastic. If any readers have encountered a similar problem, I would welcome any email input that may help reduce or solve this case radiation problem.

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

Links and Lines

Nitrogen vs Dry Air

by Gary Minker

If you are in the Broadcast Engineering business as an employee or contracting member of the Gainfully Self Unemployed, you are probably over the age of majority and are not too crazy about folks shaking their finger at you bellowing ... Don't Do That!!

Get over it. It is these well meaning folks that are either trying to save you from killing yourself, your apprentice, or the station cat, and in this well meaning insubordination, you ought to listen to what they have to say and not just write it off as their childish folly. Those older, and some younger, may have been to the goat roping that you missed and my articles, I will be that thorn in your side and welcome your thoughts by email or voice toward the same content.

In keeping with provocative topics, the war rages on between the followers of Nitrogen pressurized systems and the Dry Air Dehydrator bunch. Just like Ford and Chevy fans, there is always a Dodge fan out there also who believes that a pancake compressor is just fine for his 1200 feet of 3-1/8" rigid, but we won't go there.

The introduction of inert dry gasses is nothing new to industry and food preparation. Noble and other flammable gasses have long been pumped into bags and cans of crispy and chewy snack foods to keep Oxidation at bay and to keep the snacks crispy and free from the effects of moisture. Notice the word "Oxidation." No, your snacks don't rust or corrode but they do age, rot and discolor, in the presence of Oxygen, and the idea of moisture in your pretzel bag is just unthinkable. Argon, Nitrogen, Propane, and other combinants of Butanes, and a host of other smells, have been used to preserve everything from Twinkies to Tostito's for ages.

The same principals apply to your tidy little environment of dissimilar metals from the galvanic table, that make a great battery when wet – especially so, when excited by electricity. While electrically useful, Beryllium and Silver are pretty diametric, as far as the creation of voltages are concerned. This disparity, and elementally high voltage, cries out for a super dry environment. With the simple list including Silver, Beryllium, Stainless Steel (of some grade or another), Copper, Spring (carbon)Steel, Brass, and Bronze, you add carbon, silicon grease, other forms of dirt, and who know what – then add water and excite with RF ... yummy! You can see the picture is complex and continues to unfold.

This is a long running war and dates back pretty much to the beginning of electrical technologies. One of the first recorded uses for purging was telephone cables. These lead, oil, and paper buried and aerial cables had valves installed on them so that Nitrogen could be pumped through the cables to keep the moisture out. It is true that the purveyors of the round conductor equally vacillate on the use of Nitrogen and Dehydrated Air, but when it gets down to it, tarnish, oxidation, corrosion and just plain rot can not happen in a Nitrogen environment. This notion was the lead thought with the paper, oil and lead cables. Fungus, tarnish, rot, water intrusion, and corrosion were factors here. Unfortunately the conundrum does not stop with green fuzzy rot.

During a burn out, other than the thought of molten metals dripping down from the sustained arc inside the line, the Teflon insulators are the main culprit. Like any useful petrochemical, PTFE, and all of the derivatives used in transmission line, nasty chemical compounds are released during the early stages of severe heating, all the way through to the point of self sustaining combustion. (OK, the arcing helps out a lot.)

There is even a Patent for a Line Safety Monitoring Device that includes the purity of a Nitrogen atmosphere inside the transmission line system as one of the criteria for detecting a fire in the making.

Fuel for the Fire

I have spent days looking for the article published by a chemist that proves beyond a doubt that, under certain and *ideal* conditions, burning Teflon can create soot while in a pure Nitrogen atmosphere. I admit that I am not a chemist and while I followed the article with great interest, the chemist admits that precise conditions must exist in order for this chemical breakdown to happen. If I find the article, or anyone has it, I will include it in a followup article. While these precise conditions are a bit scarce, I give kudos to the author who ever he was.

The practical side of the matter, after nearly 30 years of working with Transmission Line fires, is that the ones that have Nitrogen pressurization are greatly limited in collateral damage from smoke, soot, and other gaseous damages. The Dry Air systems just flame away and soot up the system with dramatic consequences. I don't know if it was the 50th or the 100th burn out that I worked that convinced me of this but I just state my case and have photos.

As if this is not enough, there are other consequences. Severely heated PTFE products also release root base gasses. This is a highly corrosive and toxic gas that has been seen to corrode the metals inside of the line systems when present and remain unpurged from a super heat incident that may not have resulted in a line fire – such as a high VSWR that was caught and supposedly cured. This illustrates the notion that purging is a good thing and popper valves can be your friend. Then there are various oils and other semi solids that ooze about and can irritate the technicians if contacted or ingested. This gas is sometimes known as Oxygen Difluoride or Fluorine Monoxide, and according to the one document, shares a top spot with another unrelated chemical for the king of respirator selection criteria.

Saving the World

In this battle the question then becomes, what is practical for your use? Many years ago, Litton Medical introduced a Nitrogen Generator called the InstaGas. This was a fantastic creation because it extracted and stored pure membrane sieve Nitrogen gas from ambient atmosphere at 35 psi and vended it to you at any pressure below that level. Unfortunately it came with a cheap compressor that did not live very long and the sieve device required periodic trips back to the company for care and adjustment. The unit was only on the market for a decade or so and then left many of us with them to sit in the corner sad and neglected. I have two units, one large and one small, that I will cheerfully sell the sieves to someone who needs them (I'm keeping the tanks).

Bottled high pressure gas is always a good choice, and for those with active leaks or wild desires to purge their lines often. High and Low pressure Liquid tanks are cheap and plentiful. Caution, liquid tanks do not have a shelf life of much longer than three weeks. You gotta use the gas or it boils off and vents to the room which can cause an inhalation or suffocation hazard.

Dehydrator manufacturers have been having some issues lately with who will stay and play in the market place and who will abandon ship after years of dominating the market. All of these product images are borrowed and have no claim for use or advertisement.

The decision to use air or gas is a personal one and should be made with many factors brought in to consideration. Tight systems, remote locations, transportation problems, line size and type, all play in to the decision process. What should *not* influence your decision is what the neighbors do or how "it" has always been done for years. Make this important decision wisely, and for those in doubt, chat about it at a local watering hole or SBE meeting.

Fire is inspirational but should not be taken lightly. Soot can destroy a line and render it a total loss, if not a candidate for a total strip out and component replacement, with the potential of future fires from the missed carbon that remains from a poor cleaning job.

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

Tech Tips

by Richard Rudman

Quick RF Plumbing Solution

When you are making emergency AM RF repairs involving transmission lines, would it not be great to be able to go to Home Depot, Lowes, or any good full service hardware store, and buy the parts to make almost any flange type coax connector you need?

Consider the benefits. No floor pacing while waiting for FedEx or UPS to show up. Even better, you are not paying for emergency connectors as if they were made of gold.

A Need Arises

A situation came up with one of my clients where we had to build a pass/notch filter for a new solid-state transmitter that refused to work into the existing two-tower DA phasor. A new phasor network was already on order, but delivery was months away.

The mission: Get the new transmitter on the air so the site power bill would not no longer go into heating a bank of resistors every night.

Building the temporary filter design involved providing new terminations of 7/8" and 1/2" foam-filled line. I have often looked at the bright copper and brass fittings in hardware stores and mused that they might be used in some way to make coax connectors. The time had come to find out.

Shopping for Hardware

With some short pieces of transmission line in hand, I surveyed the available hardware at my local outlets. I found out that there were some copper and brass fittings that might work.

For the 7/8" line, I bought copper tubing to 3/4" pipe thread adapters and a section of copper tubing to fit inside the tubing end of the connector. This provided a snug fit for the copper jacketed coax. For the 1/2" line, I found a 1/2" hose connector to 1/2" pipe thread connector that looked promising.

How do you adapt 3/4" pipe to a flange that could be solidly bolted and grounded to the filter network? I had to leave the world of brass and copper for that. But, as I reminded myself, this is temporary, and everything would be indoors.

Suitable Substitute

Pipe floor flanges found in hardware store electrical departments were the answer I chose. They come in a variety of pipe thread sizes including 3/4" and larger. I bought the cast iron variety, but they are available in brass at specialty home or office decorator supply houses that are not always open in the middle of the night.

If you have a little time, I found a source on-line called the Hardware Hut:
www.thehardwarehut.com/catalog-product.php?p_ref=6739

The smallest size they offer is one inch, so some added copper fitting creativity would be involved to adapt from the copper tubing or hose connectors that actually secure the copper coax jacket.

Putting it Together

Some details: for the 1/2" adapter to the flange, I had to use an iron 1/2" to 3/4" adapter. I know these are available in brass, but even full service hardware stores run out of stock.

Back at the site, I cut slots in the copper tubing adapter, the copper tubing section for the 7/8" adapter, and the 1/2" brass hose adapter so I could mechanically secure and provide a good RF ground to the copper coax jacket. I used standard automotive stainless steel hose clamps for my makeshift connector. All grounding surfaces were filed and deburred.

The flanges were bolted to a section of pre-drilled angle bracket. I drilled mating holes in wide copper strap for bolts.

A usable 1/2" adapter from the hardware store.

Problem Solved

After assembly and tuning, we checked the effectiveness the new connectors and their grounding by using heavy clip leads to look for any changes to the filter's tuning. We saw no changes.

This emergency work-around could well apply to larger coax sizes up to three inches for AM service. I will let you know if the future takes me back to hardware land with a section of larger line.

A custom-built 7/8" adapter.

This project brought back a lot of memories of Ham radio Field Day activity, including not having all the right connectors on hand and the strange but effective things we came up with to get on the air. – Radio Guide –

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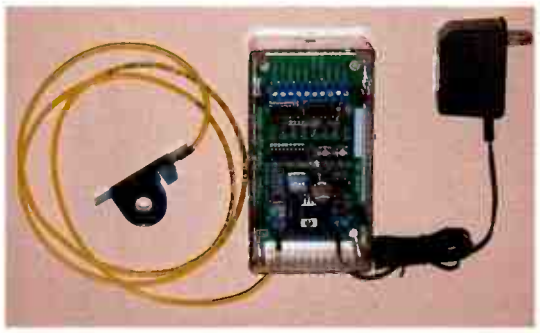

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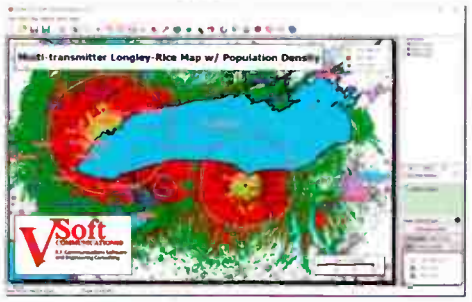

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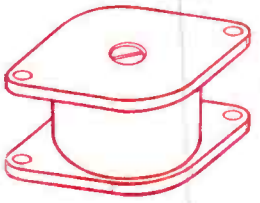

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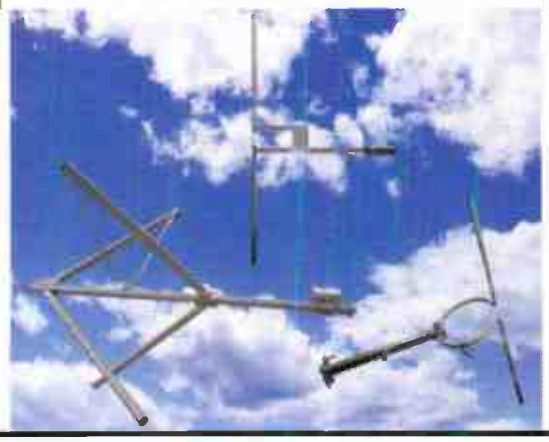
Three New Products Available From Progressive Concepts

Progressive Concepts announces a new line of FM broadcast Antennas. There are three new models to choose from: The CIRPA, the PCP, and the LB1. The CIRPA antenna is a Broadband Circular model that handles up to 2KW and can be stacked for higher power levels and to provide more gain. The CIRPA antenna uses a 7/16" DIN connector on 2KW models and a 7/8" EIA on higher power models. The PCP is a Tuneable Circular model that handles up to 800 Watts and can be stacked to handle more power and to provide higher gain. The PCP antenna uses an "N" type connector for 800 Watt models and a 7/16" DIN for higher power models. And finally there is the LB1 Vertical Broadband antenna that handles up to 2KW and can also be stacked to handle more power and provide higher gain. The LB1 uses a 7/16" DIN connector for 2KW models and a 7/8" EIA on higher power models. All models are currently available from stock.

Progressive Concepts has been supplying its customers with high quality FM Broadcasting Equipment for 30 years! The company announced today that they are now an Authorized Dealer and Complete Service Center for Italian Mfg. RVR Electronica. Progressive Concepts now offers seven new models of RVR FM Transmitters that are all FCC Certified AND Industry Canada Approved. They are: TEX30, TEX100, TEX150, TEX300, TEX502, TEX702, and TEX1002 ranging in output power from 30 watts to 1KW. All of these Stereo FM Transmitters are suitable for both Class A and LPFM stations and include remote control via a built-in Ethernet port. Options such as RDS, AES/EBU, TOSLINK, CW & FSK ID, etc. are available upon request. Most of these models are currently available from stock.



Progressive Concepts announces that it is the Master USA Distributor and Service Center for Dutch Co. D&R Electronica. Progressive Concepts carries their complete line of Radio Production and ON-AIR mixing boards and mixing consoles. There are many models to choose from such as the Airlab, Airlite, Airmate, Airence, Lyra, Axum, Axite, and the WebStation. All of these mixers incorporate digital control over the analog signal. VCA circuitry insures ultra-clean audio. The entire line of mixers and consoles can be programmed to fit the users needs and connect via USB to any computer for use with automation software. D&R also manufactures a line of ON-AIR warning lights, VU meters, Telephone Hybrids, and their own "Aircast" automation Software. All of these are available from Progressive Concepts.

ALL THEY WANTED WAS A STUDIO

By Ron Erickson

It was May of 2014 when KKHP-LP, Oroville California received their license from the Federal Communications Commission. I was the consulting engineer on the project and have stayed involved over the years. The thing is, they had a great transmitter site way up on Kelly Ridge near the Oroville Dam. In fact, the site was high enough the FCC granted only 35 Watts ERP. Height is everything in FM and this small amount of power, pushed into a NiCom BKG77 circular antenna, performed very well, producing an excellent car radio signal all the way down the road into town. The station was well received by the folks around Oroville. It was programmed with "Five Decades Of Radio Hits" – as their slogan said. The thing was, they had an automation computer, a NiCom transmitter, an excellent Inovonics FM processor, the required EAS gear ... but no *real* studio. About a year later a location for the studio was found but the building needed a complete renovation. The plans to build at this location seemed so solid that they moved on buying equipment, purchasing furniture from Graham Studios, and waited for the building remodel to be completed. Almost a year later the studio location vanished as the owners changed their minds. Several subsequent sites were looked at, but nothing really worked out. Everything went into storage.

Fast forward to 2018. Finally a location deal was agreed upon, where a studio could be built inside a downtown building. This location was occupied by an organization that the station management was really familiar with. *What could go wrong?* I pulled our 38 foot motorhome into an Oroville RV park and started working with the carpenter. The remodeling was going well when, in July 2018, a small fire outside of Redding California started but quickly gained ground. This was the Carr Fire and smoke filtered down into the Oroville area to the level of, *"we should drive elsewhere,"* and so we put the studio build on hold and left town.

In late October 2018 we travelled back to Oroville. The weather was perfect with no smoke in sight. By the first week in November, the studio walls were up and I was ready to start moving in the broadcast furniture. Then in the early morning hours of November 8th, 2018, a real disaster struck. The fire began near the community of Pulga and quickly destroyed over 20,000 acres as well as the town of Paradise. Residents awoke to smoke and before very long the people knew they had to get out. Evacuation was tough with only one main route down to Chico. Cell sites were burned, hampering phone communication. Comcast lost signals as the fire spread, the power went off and then there was concern that the fire might jump Lake Oroville and spread to Berry Creek Ridge, very close to the RV park we were in. Our carpenter left our job to hand out food and water to evacuees. Our RV park dog run had become a haven for rescued horses. Once again we decided it was time to go ... but where?

Photo Courtesy of express.co.uk

The smoke we wanted to escape from was covering Sacramento and spreading south. We choose to get above it by going East on Interstate 80 to Reno. The worst part in my mind to this day, is the loss of 86 lives and the devistation of homes, businesses and 100,000 acres.

Photo Courtesy of Capitol Public Radio

Later I read on the Internet: "After a very meticulous and thorough investigation, Cal Fire has determined that the Camp Fire was caused by sparks from electrical transmission lines owned and operated by Pacific Gas and Electricity."

Back to Oroville in the spring of 2019 to complete the studio wiring. Two days into the project the station manager notified me that the building had been sold and the new owner wanted to double the rent. Once again I packed up the gear and it went back into storage. Fortunately, before I drove away again, a deal was made for another and better location, but the studio walls needed to be constructed, so again we left town.

Returning again to Oroville September 30th, 2019, I discovered the carpenter had completed a very nice studio room, nearly ready for the furniture and gear. I was able to start work by the 5th of November when PG&E announced that there would be power outages because of "high winds" (which never occurred) and they were doing this because they didn't want to be responsible for starting another fire. So, on November 7th, the station went off the air and the wiring of the studio was stopped. Honestly it felt like someone was trying to tell me not to build it. Darn weird that so many things had delayed this studio build. Around November 10th I was able to get back to work on the studio, installing the Graham-Studios furniture, Dynamax Console from Sandies, RODE Microphones, Automation, CD Decks and Barix boxes linking the new studio with the transmitter site. Ooma is an excellent choice of studio telephone unless you need a talk show system.

The Completed Studio

By the way, Dynamax consoles are built like a brick house. If you're still good with a solid analog console, I think you should browse the website at sandiesusa.com. Dave Strode is quick to respond to any questions but engineers who have been around for a while will find the layout and wiring to be "old school."

Ron Erickson is a writer, Voice Talent, Engineer and a Radio Consultant. He may be reached at 541-460-0249 or at ericksonradiosales@gmail.com

Final Stage

RADIO ROUNDUP

The Radio Guide Event Register

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https://natehome.com/annual-conference/nate-unite-2020

Great Lakes Media Show
March 3-4, 2020
Lansing Center – Lansing, Michigan
https://michmab.com/programs-events/great-lakes-media-show/

2020 NRB Convention
March 25-28, 2020
Gaylord Opryland Resort – Nashville, Tennesee
www.nrbconvention.org

NAB 2020 Spring Convention
Convention Center – Las Vegas, Nevada
April 19-22, 2020
www.nabshow.com

Texas Association of Broadcsters (TAB)
July 29-30, 2020
JW Marriot Downtown – Austin, Texas
www.tab.org/convention-and-trade-show

NAB Radio Show
September 13-16, 2020
Omni Nashville – Nashville, Tennessee
www.radioshowweb.com

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