Radio Guide

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Digital Issue Now On-Line

January-February 2013 – Vol. 21, No. 1

OMB Systems – A Fascinating Journey Continues

WHEN YOU NEED SOLUTIONS FOR BROADCAST AND PRO AUDIO, HENRY ENGINEERING MAKES ALL THE DIFFERENCE...

POWER, LOGIC CONTROL

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An interface for control of "On The Air" warning lights and utility switching from tally circuit of a broadcast console or switcher.

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DISTRIBUTION, ANALOG & DIGITAL

DIGIMATCH 2X6
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THE MATCHBOX HD
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"Considering the LX-24's attractive good looks, modularity, traditional console layout and functionality, I can't wait to get my hands on one!"

Greg Landgraf, Senior Engineering Manager, Corus Radio Western Canada

"A high performance, reasonably priced, great looking console integrating common sense features such as overload indicators for meters and ergonomic controls. Very impressive and well thought out."

Benjamin Brinitzer, Regional VP Engineering Clear Channel Media & Entertainment

"By far the most elegant and feature rich control surface on the market. The attention to detail and functionality is remarkable. Its architecture, such as "hot swappable" modular design, is a winner. A traditional meter bridge is appreciated by users and your millwork guy will appreciate the fact that it's a table-top design."

Kris Rodts, Director of Engineering, IT & Facilities, CKUA Radio Network

"Wheatstone's innovation continues to make AoIP a viable product for professional broadcasting facilities. Just a few things that make the LX-24 stand out to me are the clear and decisive metering, individual fader modules, and "out of the box" thinking with faders for the headphone and monitor volume controls instead of rotary knobs."

Phillip Vaughan, Chief Engineer KFROG, CBS Radio

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Tim Schwieger, President / CEO, BSW - Broadcast Supply Worldwide

"I didn't think Wheatstone could improve upon the E-Series of consoles, but they have done it with the new LX-24. This is a beautiful, well designed console and the individual faders, integrated meters with overload indicators and low profile table-top design make this a must have for our facilities."

Michael Cooney, Vice President of Engineering & CTO, Beasley Broadcast Group, Inc.

"Cool and sexy (I sound like Bruno from Dancing with the Stars). A great addition to the WheatNet-IP family."

Norman Philips, Vice President of Engineering, Townsquare Media

"I am very impressed with the sleek new design that incorporates single channel-strip architecture, integrated metering and stereo cue speakers in a thin, sloping chassis that needs no cabinetry cut out. Well done."

Erik Kuhlmann, Senior Vice President of Engineering, Clear Channel Media + Entertainment

"Wheatstone continues to hit balls out of the park and this year they did so again with the LX-24 control surface. This new product marries the best of the old (modular design architecture) with the new (Audio-over-IP). Continuing in that theme was a Wheatstone module that marries their bridge router system to the new "BLADE" audio-over-IP system. This has the potential to extend the life of bridge router facilities indefinitely."

W.C. Alexander, CPBE, AMD, DRB, Director of Engineering, Crawford Broadcasting Company

"The LX caught my attention on the NAB Show floor. The look, form and function are unlike any other IP console available today. The easy-to-read buttons and displays are just second to none, not to mention the most bang for the buck. I can't wait 'til I have the opportunity to deploy my first LX."

Anthony A. Gervasi, Jr., Sr. Vice President Engineering & Technology, Nassau Broadcasting

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Radio Guide

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PO Box 20975, Sedona, AZ 86341
Phone: 928-284-3700 • Fax: 866-728-5764
Ray Topp *(publisher)* – radio@rconnect.com
Ernie Belanger *(editor)* – editorial@radio-guide.com

Radio Waves

by Ray Topp – Publisher

In This Issue

• In *Studio Site,* George Zahn explains the importance of keeping audio levels in check.

• In our *Transmitter Site* column, Mike Callaghan shows us how to set up remote control systems for the best metering and control flexibility.

• Peter Gutmann updates us on the FCC Rule changes and filing windows that will be coming for LPFM and translators, in *FCC Focus.*

• *Safety and Security* addresses the "dirty" job we all face when cleaning equipment after a spill – and Jeff Johnson answers the question: which is worse, vomit or coke?

• In *Operations Guide* Chris Tarr explains the features of the Google ChromeBook, and helps us learn if this $249 laptop can replace its bigger brothers at your radio station.

• Scott Schmeling tells us what he didn't know, he didn't know. If you don't know, what you don't know, then read about it in *Chief Engineer.*

• In *Test and Measurement,* we learn how to find cable breaks using a simple combination of readily available test equipment.

• Leo Ashcraft explains the variety of codecs that are available for us to get our signal from point A to point B, in *Links and Lines.*

• In *Small Market Guide*, Roger Paskvan details the construction of a coaxial phasing harness, to combine two UHF antennas, for increased RPU range.

– Ray Topp, Publisher

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Dan Jackson, engineer for 92.9 FM in Perth, Australia was faced with a unique challenge. Breakfast hosts Paul Hogan and Lisa Fernandez would be cycling for hours in strong winds and pouring rain as part of the 92.9 Kids Appeal for Telethon.

The unique solution was to equip Dan's bike as a mobile production facility. The talent wore wireless mics AND in-the-ear monitors which communicated with receivers and transmitters in a rack bag on Dan's bike.

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Cover Story

OMB Systems

A Fascinating Journey Continues

by Ernie Belanger

In the 28 years since its inception in Zaragoza, in the northeastern region of Spain, OMB Sistemas Electrónicos S.A. (OMB) has reached an important position in the international broadcasting market.

During those nearly three decades, more than 12,000 antenna systems, over 9,000 FM stations, and nearly 2,000 TV transmitters have been sold and installed globally by OMB.

OMB has not only accomplished its initial goal of servicing Spain and Europe's increasing needs of high quality broadcasting equipment, but it also has played an important role in Spain's recent transition to digital TV.

A Little Bit of History

What is today known as OMB Spain was established July 23rd 1985, over 25 years ago, as a continuation of Electrónicos Ormad, a company created to both manufacture TV translators, and to offer customer service and equipment repair. Founder and owner, Mr. Antonio Ormad, later became co-founder and co-owner of OMB Sistemas Electrónicos S.A., with Mr. Julian Muro, then one of his customers and himself a broadcaster in his native Zaragoza.

A combination of the founder's initials form the company's main name "OMB"– Ormad and Muro broadcasting. The passion these well-known Zaragoza residents and entrepreneurs shared for broadcasting was the driving force behind their decision to start manufacturing and servicing transmitters for other FM broadcasters in Spain and Europe.

OMB USA technician Victor Cabrera, changing frequency on a transmitter in test.

OMB USA

Five years in later in 1990, Mr. Muro's son, Julian Muro Jr., moved to the United States with one goal in mind: set up an OMB American subsidiary in Miami that would serve markets in the United States the Caribbean and Latin America. In 1991 Transamerica International Broadcast was founded, better known as OMB America.

"We were the first European company in the broadcasting industry to set roots in the United States," said Ormad, 67, CEO of OMB Spain and President of OMB America. "We are about to complete 22 years in the United States and our business continues to grow," he told ***Radio Guide***. "Our business model allows us to respond quickly to our customers' needs, not only with the equipment they ask for, but also with a complete stock of parts and prompt technical support," he concluded.

A Team for the Customer

OMB Sistemas Electrónicos is a one hundred percent Spanish company that places great value in international markets. Its products, TV and radio transmitters, and STL and antenna systems, are manufactured using the most advanced technology. The venture that started almost 30 years ago has gone far beyond its Spanish frontiers, to build a brand that is now recognized world wide for high quality equipment and excellent technical support and customer service.

"My first experience with OMB was on July, 1999," says Michael Glinter, owner and president of Satellite Radio Network, in Florida. "I was granted a permit to construct a new C3 FM in Navarre, FL, and I had a construction window of less than 5 weeks. Finding a transmitter was no problem. However, finding a medium power 6-bay antenna system was another story – none of the U.S. manufactures could deliver. I saw an ad for OMB in Miami, called them, and got connected with their International Marketing and Sales Manager, Rafael Arreaza. When I told him what I needed, he said, "Of course we have it. We can deliver in two to three weeks, and if needed I will drive it up from Miami myself."

More Customer Satisfaction

OMB America is an asset for the headquarters in Spain and for those it serves, like Eagle Radio, a radio network with several stations in the state of Michigan. "I have used OMB products for 14 years and they have proven to be very reliable," said Kent Smith, president of Eagle Radio. "We have eight stations and products from all the manufacturers. The quality and reliability of the OMB product measures up with all of them, and surpasses many of them. If we need to order something in a hurry, OMB has been very responsive and helpful." Smith continues, "If we need to order something in a hurry, Rafael and OMB have been very responsive and helpful," says Smith. "The OMB STL systems are very good. They sound good and best of all, we put them in and forget about them. They work day in and day out." he concludes.

Arreaza is to be credited for that; he is responsible for both new sales and customer satisfaction for OMB America since 1997. The Miami based operation gives OMB a large part of it's international market share, serving customers in the United States, the Caribbean Islands and many other countries including Indonesia, Malaysia, Asia, East Africa, the Far East and the South Pacific.

And in the original target market of Europe, OMB Spain's Europe Sales Manager, German Gutierrez, has secured the early legacy intended by the founders, Ormad and Muro. Gutierrez, who is also an engineer, has been with OMB Spain for over 10 years. During his watch, OMB has extended its market reach to Africa and the Middle East.

Commitment to Quality

OMB Sistemas Electrónicos S.A. was one of the first European companies in the broadcasting industry to obtain and maintain ISO 9001:2008 and ISO 14001:2004 certifications. Both OMB Spain, and its subsidiary here in the United States, have made a commitment to quality equipment and a clean environment, that is supported by their highly qualified staff and R&D department in Zaragoza.

Through the years, OMB has become a familiar presence in the broadcasting landscape in America, and it is always present at events such as NAB in Las Vegas, NV and NRB in Nashville, TN. They have a profound commitment to be in contact with customers that attend international broadcasting meetings such as IBC, and Broadcast Asia.

Transmitter testing at OMB headquarters.

Customer Training

Understanding the need for on-sight, trained engineers at their customer's stations, more than 15 years ago OMB Sistemas Electrónicos S.A. began free equipment maintenance training for station engineers and technicians. "When something fails in the radio station, the first reaction is to blame the transmission equipment: 'the transmitter is not working,' or 'the antenna does not work,' 'the signal is not going far enough' and so on," said Ormad. "The training we give has reduced the complaints and the time radio stations are off the air due to a technical failure. The training has also saved stations the cost of shipping and repairs performed at our Zaragoza or Miami locations," explained Ormad. The training is led by Manuel Sancho, OMB's chief engineer and production manager.

Market Expansion and a Bright Future

But let's not forget the initial goal Julian Muro Jr. had set in Miami for Ormad and his father's company. The Latin American and the Caribbean markets have provided continuous growth for OMB America. From Mexico to Chile, and from the Dominican Republic to the Virgin Islands and Haiti, the name of OMB America resonates through the many transmitters that have taken music, local news and religious services to the radio waves in Spanish, Creole, and English languages throughout the western hemisphere.

OMB continues to expand its product lines, keeping a keen eye on future market needs. But even as their market continues to expand, they will never loose sight of their goal to provide the best possible quality products and product support available. These are two of the key ingredients that help them with their continued success.

For more information, contact OMB America in Miami at 305-477-0973, or via email at: usa@omb.com. OMB headquarters in Spain can be reach by calling +34 976 141 717 or via email at europa@omb.com. Their web site is: www.omb.com

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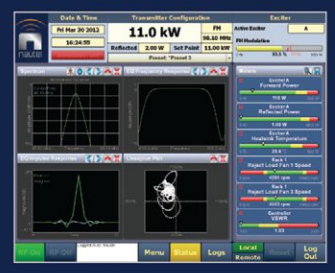

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Studio Site

Using Your Head About Headroom

George Zahn

There are times that we become so entranced with new technologies and devices for studio use, that we skim over some of the true radio basics. Even in this digital age when we have less "noise floor" concerns than ever before, we still need to consider calibrating our studio equipment for proper broadcast and recording levels. It's been easy to let calibration run wild out of the corral, and I'd put even money that many stations face a battle with moderately to grossly out-of-kilter audio levels from song sets, to spots, to news actualities.

First a quick bit of history for new engineers and those in management who may not have encountered the "C" word before. On a larger scale, it has been critical to calibrate, or match, audio levels throughout the broadcast chain, to ensure that a station is operating legally and at its optimum performance. In short, we want to make sure that what our peak or average meters on the console show are accurate, and "in calibration" throughout the broadcast chain.

I can see some engineers already rolling their eyes because we all have hosts/producers at our stations that don't even pay attention to the broadcast console's VU meters. There are those who push the meters so far to the right that they barely move, using every dB of console headroom and then some! On the other end of the dynamic range spectrum are the folks that run "in the mud" or way too low on the meter.

In the old days, the habit of over-driving the meters was somewhat reinforced by the fact that many stations used dedicated equalized phone lines for their STL. "Those early phone lines had noise only about 60 dB below the signal going through the line," says long time radio engineer Jay Crawford. "That meant the hosts were pushing the meters and the engineers set the reference point at +8dB (instead of 0dB) to make sure everything was well above the noise floor."

In those earlier days, running the VU meters on the console too low resulted in a far noisier broadcast, since any noise from the phone line was picked up by the station's processing and exaggerated in the on-air signal.

As phone lines improved, and more stations went to alternative STL methods (microwave, DSL, Internet, etc.), Crawford says that the standard for many stations dropped to +4 and many are now running 0dB as a true VU meter reference point. That means that the standard VU meter (a meter showing the average audio level going through the console) should be hitting near 0dB most of the time. Please remember that standard "average audio level" VU meters do not show peaks in audio, the transients that happen on certain sounds that far exceed the average audio level.

If you're using an average meter, it's very important to understand the meter and what it's telling, or not telling, you. It *is* telling you the average audio level passing through the console's circuit. It *cannot* show you peaks in spoken language or music that spike anywhere from 8 dB to 12 dB above the average. Some sibilant "S" and "T" sounds, or sharp attacks on drums and cymbals are just a few great examples of sounds with sudden sharp transients that can drive your audio level much higher than an average meter will ever indicate.

The console manufacturer has your back on this, but only to a limited extent. In fact, most broadcast consoles have enough "headroom" – the point beyond the 0 dB reference point at which audio clipping (unwanted, irreparable distortion) will occur – that you can have peaks as high as 20 to 26 decibels higher than the average. That should be almost immune from clipping. If average levels hit close to 0 dB, for the most part, there should be virtually nothing that should drive the console to clipping. But if average readings are consistently at the upper end of the VU meter scale, higher than +3 dB, you won't know what your true level is, and you may become dangerously close to clipping.

An average level VU meter will not show the audio peaks.

Now if your console has a peak meter (as opposed to the average meter mentioned above), the scale looks a bit different. In this case, 0dB is the last point *before* clipping occurs. It's important for station staffers to understand the difference in the meters and shoot for consistency. What most engineers consider 0 dB on a VU meter would be calibrated to -15 dB on a peak program meter. The reason for the -15 dB setting is that average audio will appear at roughly -15 dB, but the meter will then have enough headroom to handle the peaks we discussed earlier, allowing enough headroom for those 8 dB to 12 dB peaks, with still some room for error.

I'll be among the first to admit that I've become lazy about running good recording levels on digital recorders because there's virtually no noise on a digital medium, so I tend to ride "in the mud," or too low, simply to avoid the risk of an irreparable digital clip. I've made recordings that were *peaking* as low as -20 dB to be "uber-cautious" and keep things from clipping. That means somewhere before the finished product hits the air, I need to bring the levels back up or the spot will be far too low a level for air. My New Year's resolution is to record at a higher level, and not be so skittish about the peaks, while still leaving a reasonable amount of headroom.

In speaking with Jay Crawford about the issue of calibration, he says he hears the problem at too many stations. You must calibrate your meters and urge consistency to avoid the problem that is found in far too in many stations: wildly inconsistent levels on-air, and even more in streaming. The same happens on many channel feeds on satellite TV where normal program content is fine, then the commercial set is blaring at 10 or even 20 dB hotter than the normal level.

"Even the on-air processing for a station can only help so much," says Crawford. "As professionals we should be able to keep things in a fairly wide +/- 5dB swing so the audio compression can handle it, but that's not what's happening." Keep in mind that for many stations providing Internet streaming feeds, there may be no compression at all on that audio, and level problems are significantly magnified for those listening on-line.

Some good tips from Crawford are that stations need to re-visit the importance of audio levels with staff announcers and producers. "The key is that if your peak meter is calibrated to -12 dB, then everyone should be near that," says this long-time engineer. Crawford adds "Even the big boys, the key talent at the station, need to be reminded or have a correction when they're so far out of level range."

You can be pretty "far out" ... but not with your audio levels.

Other tips: First, if you're trying to calibrate mixed meters – for example, an average VU meter on a console, to a recording device such as a CD recorder with a peak meter – run a tone at 0 dB VU on the console, then set the input meter on the recording device at -15 dB. Second, if you notice wildly different levels during on-air or streamed programming, jot down the spot, song, or program element, and see if there's not a common culprit recording or running the board significantly low or way too hot.

Seeking a good answer, I brought up the idea of setting levels on recording devices in a studio and somehow "locking them down" or disabling the level adjustments so that 0 dB VU on the console would be the same for all users. Jay Crawford brought up a very good point, in that since all voices are slightly different and each announcer has a "fingerprint" dynamic range, locking down levels may not be the best way. Also some multi-format stations may need a bit more recording flexibility.

In my opinion, the best way to get on top of this burgeoning problem for broadcasters is to make it a priority in 2013. A joint effort on behalf of management and engineers can "rope in this dogie," helping our on-air sound, streaming quality, and making us all better broadcasters – putting more listeners, and better audio, in the corral! It's on my New Year's list ... how about you?

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

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David Trudrung, General Manager & Co-owner

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Transmitter Site

Creatively Setting Up a Remote Control

by Mike Callaghan

One opportunity to enjoy being creative is when you configure a new remote control system. You get to combine the number of metering, status, and control channels there are – with the specifics of the transmitters and peripherals – to provide the greatest control and metering flexibility. We've all seen stations where just two or three of over a dozen metering channels get used. There are a lot more parameters that could be metered, but just the basic three (Volts, Amps, and Watts) seem to suffice for some of us.

Meanwhile, if the air conditioning gave out, who would know the transmitter room was over 100 degrees, until the equipment failed because it was too hot? Or maybe sagging line voltage on a hot summer day made it look as if the plate supply was dying, when just waiting until the utility got things fixed would bring things back to normal?

Many transmitters we bought in the past had just minimal intentions of working with a remote control. You could turn them on and off, and adjust the power. Some even offered a reset function, but that was unexpected. By contrast, the transmitters supplied now have numerous parameters, power adjustments, status signals, and other provisions to reveal almost as many values to the remote operator as he could observe if he were standing in front of the transmitter itself.

Along with the transmitter readings, there are room temperature, AC line voltages on one or three phases, outside temperature to know if its freezing, coaxial line pressure, and the generator and control supply voltages.

Status channels were originally meant to show things such as the status of antenna switches, or transmitter interlocks, but now we can use extra contacts in selector panels to show which processor is on the air, or which program line is being used.

The illustrations show the status and remote control layout for a 50 kW plant with two transmitters, two directional patterns, and two non-directional options. Each transmitter has three power levels, and a local/remote flag to show when it's being maintained or if the power is adjusting up or down. Finally, there are indicators to show when the auxiliary transmitter or the backup processor is on the air, the telco line is on rather than the STL, or if the tower lights are on or off. Other uses could include dummy load fan operation, or even whether the building security alarm is activated. All these are valuable to know. Once the operators get used to what LEDs are normally on, any change is easy to spot and report, so corrections can begin.

In laying out the Raise and Lower functions for each channel, there are some unwritten conventions. The most important control functions (Transmitter On and Off) are usually on the first channels. This is a carryover from the days when phone relays were at the heart of remote control systems, and the first channels were the fastest to access. Since restarting the transmitter is probably the most important function of all, it makes sense to make it the easiest as well.

If the transmitter has multiple power settings, and you have enough control channels, you can use different channel's raise functions to start it at different output levels. The lower for each of these channels can turn it off. This allows an easy shutdown if starting up a transmitter produces amazing and undesired effects. After the channels controlling the first (and likely the main) transmitter are addressed, the next few channels can be used for antenna switching, processor and program source changes, and other utilitarian functions. The on-off and power control functions for an auxiliary transmitter are typically on channels higher than the utility controls.

Try to make the steps involved in getting the station back on the air as simple and intuitive as possible. This means avoiding switching between a lot of different control channels to get the antenna switches moved and the auxiliary transmitter on the air. And after you have the station back on, you'll want to go back and turn off the transmitter that had stopped running.

KTLK 1150AM - Burk ARC-16 Remote Control

Channel (Site 41)	RAISE	LOWER	METERING	STATUS
A-1	TX 1 On High Power	TX 1 Off	TX 1 Supply Volts	TX 1 - 50 KW
A-2	TX 1 On Medium Power	TX 1 Off	TX 1 Supply Amps	TX 1 - 44 KW
A-3	TX 1 On Low Power	TX 1 Off	TX 1 Supply Volts	TX 1 - 12.5 KW
A-4	TX 1 Power Raise	TX 1 Power Lower	TX 1 Power Out Fwd.	Power Adjust
A-5	TX 1 Reset		TX 1 Power Out Ref.	TX 1 Local Mode
A-6	TX 2 On High Power	TX 2 Off	TX 2 Supply Volts	TX 2 - 50 KW
A-7	TX 2 On Medium Power	TX 2 Off	TX 2 Supply Amps	TX 2 - 44 KW
A-8	TX 2 On Low Power	TX 2 Off	TX 2 Supply Volts	TX 2 - 12.5 KW
A-9	TX 2 Power Raise	TX 2 Power Lower	TX 2 Power Out Fwd.	Power Adjust
A-10	TX 2 Reset		TX 2 Power Out Ref.	TX 2 Local Mode
A-11	TX 1 On Air	TX 2 On Air	Room Temp.	TX 2 On Air
A-12	Day Pattern		Day Icp	Day Pattern
A-13	Night Pattern		Night Icp	Night Pattern
A-14	STL On Air	T1 On Air	N.D. #1 Antenna Amps	Telco On Air
A-15	Main Processing	Backup Processing	N.D. #3 Antenna Amps	Backup Processor On
A-16			Coax Line Pressure	T-1 Ckt. Synced

It's *imperative* that all the possible positions and options for the antenna switches be indicated on status lights or with some other method. A remote user will always need to know what position the switches are in. Over the years, a lot of damage has been caused by unsure engineers and operators "shooting in the dark" when trying to get a station back on the air.

Antenna switches come with interlocks meant to be wired into the control system, so transmitter won't light up unless the switches are fully seated and in the correct position. Please don't yield to the temptation to avoid using them.

It's bad enough having a transmitter fail, but even worse to have the backup transmitter not get connected to the antenna while you're trying to put it on the air.

While we're talking about interlocks, be sure you use the ones in the dummy load. These are wired to shut down the transmitter feeding the load if it overheats. Ignore using these at you own peril. A station in Santa Monica, CA, had a power bump at the transmitter located on top of an office building. The board op turned on the backup transmitter, and the station came back on. Mission accomplished, right? He'd actually fired up the auxiliary transmitter into the dummy load at the same time the main came back up on its own. The interlocks weren't connected, the dummy load caught fire and it burned down the transmitter site before help arrived.

While most readings on a remote control are read from the front panel, there are many logging options and other features that do everything from calling for help, to switching the day/night patterns on AM stations. With some of them, you can log in with a computer for a graphic representation of the different metering values. This is much easier than trying to remember what the voltages and currents were, as you hop from one channel to another on the phone or while dialing channels at the studio.

If the computer that offers these screens and displays is at the station, you can VPN into it and take control of the transmitter site from home. This has turned out to be the preferable method of checking out and correcting transmitter issues on weekends and when the studio has no engineers available.

If bravery is your strong point, you can even configure the remote control to try and put an auxiliary transmitter on the air when the main fails. After you've written the macros and installed them, pick a late night with few listeners to switch off the main and test that your efforts work correctly.

The status indicators provide an easy and meaningful way to check on the transmitter with just a glance. The status panel shown is for a 50 kW plant, and is laid out to display the two transmitters with three power levels for each. Indicators for the two directional patterns are shown, as well as indicators to show the status of the auxiliary transmitter. Backup processor, telco line, STL, and tower lights status is also displayed. Once the operators get used to what LEDs are normally on, any change is easy to spot and report, so corrections can be made.

As you lay out your plans, you might remember that the best coax switch is no coax switch at all. If you have an FM with the tower space and the money, connect one antenna to each transmitter directly. If you want a dummy load, use a coaxial patch bay to connect it manually at the transmitter site. You'll know it's seated and in the right position when you turn on the transmitter. But there's no reassurance as great as knowing each transmitter had its own antenna. This also has another advantage; you can segue between transmitters when you want to work on one. Just turn the power on one down while you turn the other up. Listeners will never know, and there are real advantages to cleaning transmitters at 10 AM on a weekday morning.

As you ponder the metering and status channels you have to work with, remember — there's never been a remote control system that showed too many things about a transmitter plant. Making the maximum use of the metering and status channels you have will never be a mistake.

Mike Callaghan is the Chief Engineer at KIIS-FM in Los Angeles, CA. His email is: mc@amandfm.com

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Facility Focus

STL Options at 18 GHz

by Steve Callahan

There have been many changes in broadcast station operation in the past few years, but the need for change has been the greatest in the area of studio to transmitter link or STL. For many years, the humble telephone line would connect a studio and a remote transmitter site. It worked well enough for a single, unidirectional link but there was the ongoing cost from the phone company which never decreased. It was always vulnerable to a driver hitting a telephone pole or an inattentive phone company employee pulling a patch at the central office.

Then along came the discrete 950 MHz STL RF link which solved the problem of ongoing phone line costs – as long as you had a line-of-sight and Fresnel zone clearance between your studio and transmitter locations. You had to make an initial investment in the equipment, but it was under your control except for the occasional interference from a new uncoordinated link on the same frequency. For stereo you needed two frequencies and twice the receivers and transmitters of a mono link, so then came the 950 MHz composite link. However, you still basically had only one channel of composite stereo audio going in just one direction.

Today the needs we have for STL links have gotten much more complex – stations need multiple channels to feed co-owned stations at consolidated tower sites. Has your station owner ever told you he just bought another station in the market and now you have to get still another programming stream to the tower site? The 950 MHz STL band is quite full in most metropolitan areas, especially if there is a dominant tower location where it seems everyone needs to get to – like a tall tower, building or mountaintop.

And then you have the need for IP connectivity. Internet access at the tower site is not a luxury, but it's a necessity these days as it seems like every piece of equipment at the tower site has an IP address. Remote mirrored servers, IP-based equipment and transmitter control, and security and surveillance, are just some of the ways stations can protect valuable assets and save time and money through IP connectivity at transmitter sites.

Engineers Leery of Unlicensed STLs

Unlicensed ISM band technology seemed to be a good solution to gain higher capacity and bidirectionality. They require no coordination and sport bandwidths wide enough to carry multiple stations' audio and Ethernet traffic. There are many of these systems operating in the 5.8 GHz ISM band today, and have been for years. High gain antennas and directional paths allow these systems to coexist in many markets. But some station engineers are leery of unlicensed STLs. There is no guarantee from future interference and there is no stopping an unfriendly ISP operator from blanketing the ISM band in a market.

I've always been a big fan of Moseley Broadcast and their ground breaking advances in STL technology. My old friend Bill Gould at Moseley suggested I talk with Nolan Stephany at WXXI in Rochester, NY to see how he solved his STL challenge with the help of Moseley.

Nolan had the need to send multiple channels of audio from his studio to his transmitter site two miles away, on Pinacle Hill in Rochester, NY. His consultant gave him a "thumbs down" on any additional 950 MHz frequencies in the area. However, he still needed to send his stereo classical music format to WXXI, a stereo NPR news format to his HD-2 and to a co-owned AM, a AAA stereo music format to a co-owned 88.5 FM, a radio reading service to his SCA, and a program stream for a Regional Radio Network. Add in the need for a bi-directional remote control and telemetry return, and the future need to relay video programming to a co-owned TV station, and you'll see his need for a very creative and high capacity STL solution. Enter the Moseley's Event 18G.

Nolan contacted Bill Gould, Moseley Sales Engineer. They discussed the alternatives, including an unlicensed 5.8 GHz solution, but Nolan felt more comfortable with a licensed system. Bill laid out the 18 GHz Event system for WXXI and explained the true potential of the system for aural, Ethernet and video transport. Jim Peck of SCMS northeast office was the responsible Moseley dealer who assisted in the process.

Moseley Event 18G System

The Event 18G operates in the 18 GHz licensed band which is available to radio and TV STL use. Since it is licensed, and must be coordinated, no problems will be encountered from other interfering signals as would be the case in the unlicensed ISM band. The Event 18G radio features a robust, carrier-class transport with powerful Reed-Solomon error correction, trellis coded error correction and an interleaver to overcome any multipath and channel impairments.

It is the same radio that Moseley sells in the public safety and telecom markets where five- nines performance is a must; but it is customized for the broadcast industry. Event comes in a variety of capacity options: Video DVB-ASI up to 100 Mbps full duplex, Ethernet up to 100 Mbps full duplex plus 2 E1/T1 wayside channels, or 16 E1/T1 with up to 40Mbps Ethernet. It includes an additional 2Mbps full duplex for network management traffic. It is controlled by web browser or SNMP.

The Event 18G provides a bi-directional scalable link with integrated T1, E1 and Ethernet interfaces allowing for a combination of T1/E1 and IP packet data payloads. You combine it with the Moseley Starlink T1 or Rincon to create a high capacity aural STL/TSL system. Moseley also outfitted Nolan's system with a DVB-ASI video card capable of 4 ASI feeds for future video transport for the collocated TV station.

The Event 18G topology employs a separate indoor unit (IDU) and outdoor unit (ODU) which permits running IF up the tower using low cost LMR400 foam coax cable. At WXXI the ODU is direct connected to the 3-foot, 42 dB gain dish antenna so the ODU delivers maximum power to the link without having the losses associated with a long ground-to-antenna coax run. At 18 GHz even modest size dish antennas give tremendous gain factors.

Nolan wisely considered backup protection in his initial purchase, so his system includes (1+1) redundancy. This provides dual ODUs mounted on a "Y" configuration directional coupler and dual coax runs. The IDU boasts dual modems with automatic switchover and dual power supplies.

Nolan selected the Moseley Rincon Digital Audio Transporter option to be the audio engine of his installation interfacing with his Event 18G. Rincon is a multi channel, multi network, multi algorithm, multi codec. Nolan's system has multiple linear uncompressed audio channel capacity and the all important IP capacity extends his station's LAN/WAN to his transmitter site. Each Rincon is capable of four Stereo channels over IP or T1 network connections. It operates linear uncompressed or utilizes popular compression formats like AAC and MPEG. Rincon even has dual IP connections so it can be configured to back itself up over a second IP link such as DSL or cable modem.

Nolan Stephany and his Moseley Event system.

So far the Event 18 G system sounded pretty good to me, but here's the really interesting part. While I was talking to Nolan on the phone, I asked him if the system had been up and running for a Rochester, NY winter. He answered yes, with no weather-related problems even when Superstorm Sandy came through, and he said that the system automatically adjusts its RF output depending on weather conditions. I had to know more, so he logged into the Event 18G to report that it was taking only 20 milliwatts or +2db to transport all of his STL data to his tower site. I was impressed.

According to Bill, "When I asked Nolan after a year of operation what he thought about his Event 18G, he answered in a word,'Wonderful.' I believe this is a great product for guys like Nolan, with high STL/TSL transport needs who think outside of the box of traditional STL."

If you are in the market for a state-of-the art STL solution, you should start as you normally would if you were planning for a classic RF link. Have your consultant analyze your path realistically and make sure you have the best Fresnel zone clearance possible. You do not want to build a new STL system and be disappointed with performance that falls far under your expectations. Make sure your consultant knows that this technology might take a little additional time and work to notify, coordinate and license it. After all, it is new technology, but it's a time and money saver if your consultant has been exposed to it before.

If your station requirements exceed that of a traditional STL, consider the high capacity aural/video/IP options available as Nolan Stephany did at WXXI.

Steve Callahan is the owner of WVBF, 1530 AM, Middleboro, Mass. and may be reached at wvbf1530@yahoo.com

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FCC Focus

New Opportunities for LPFM

by Peter Gutmann

As is well known by now, the FCC at last has finalized its plan to address the backlog of about 6,500 FM translator applications that still linger from a March 2003 filing window and to open a new filing opportunity for Low Power FM ("LPFM") stations.

The FCC's task was both prodded and complicated by the Local Community Radio Act of 2010 (the "LCRA"), which required that it balance translator grants against the need for preserving filing opportunities for new LPFMs. In resolving the choice between the two media, the five commissioners made it clear that the FCC overwhelmingly favors LPFM as holding a promise to expand locally-originated service to narrow constituencies.

Broadcasters have long considered the LPFM service as their enemy. The NAB, in particular, has fought LPFM as a mortal threat as a source of both competition and interference. But let's put the matter in perspective. Contrary to established wisdom, development of the LPFM service just might prove to benefit a wide variety of radio licensees.

Broadcaster fears of lax technical oversight of LPFM and the consequent potential for creating pockets of interference may prove to be justified. Yet, broadcasters just might welcome the relief that LPFM can provide to satisfy public and Congressional pressure to devote commercially-impractical levels of service to niche markets. Indeed, many radio licensees may come to openly support LPFM entrants in recognition of the local orientation they are chartered to create, the creation of a much-needed training ground for radio professionals, and the positive publicity that such support is apt to generate.

A Reversed Provision

Broadcasters should be relieved that, citing spectrum efficiency, the FCC has reversed the prior provision of its LPFM rules that would have licensed ten-watt stations in the interstices among other facilities and which, broadcasters contended, would have caused preclusion well beyond their negligible service areas. The FCC further rebuffed (for now, at least) calls for 250 Watt LPFM stations that would have signaled a first step toward regional, rather than strictly neighborhood, service and that might have posed a meaningful challenge to local full-service stations.

To better encourage LPFMs to focus on needs of their listeners, the FCC has adjusted the selection criteria it will apply using its point system. Thus, it added a new point for applicants proposing a publicly-accessible local main studio staffed at least 20 hours per week. The importance of this factor will be enhanced by awarding a further point for applicants qualifying both for the new main studio point and the existing localism point (which continues to require nearby headquarters or board residences). Even so, the FCC rejected proposals to award a further point for greater amounts of local programming than the eight hours currently required to obtain the existing point for local origination.

Broadcasters also can take a certain degree of comfort in the awarding of a new comparative point to LPFM applicants that have no attributable interest in any other broadcast station. That new entrant credit, together with the point for local program origination, may serve to promote a genuine commitment to serving unmet needs while discouraging chain operation that could meaningfully encroach upon full-service broadcasters' programming.

Thus in many if not most respects, these revisions to the LPFM rules may prove beneficial to radio. Now let's consider some of the other specific rule changes.

Translators

Prompted in part by the debate over whether FM translator carriage of AM primary stations will prove the salvation of the AM band or will only accelerate public perceptions of its inferiority, broadcasters understandably take greater interest in local translators than in the fate of LPFMs. Here, the FCC faced two problems – how to clear up the backlog of applications that remain from the 2003 window, while discouraging speculative future filings.

The Commission's concern with speculation stemmed from its concern that most of the 2003 window applications had been filed by a handful of parties, that a significant number of previously-granted translator permits had never been built, and that many of the grants to mass-filers had been sold to others. Yet, as many had observed, it's rather late in the game to change the rules and penalize entrepreneurs who had fully complied with all then-applicable requirements and merely had seized upon fully legal opportunities. Indeed it seems disingenuous for the FCC to profess shock at the number of filings it had received in response to a long-delayed, wide-open window which it did nothing to limit. And it seems rather unfair to further punish those who have already endured a decade of delay rather than focus on taking steps to deter speculation in future windows.

Rather than apply a holding period that would require a permit holder to build and operate its facility for, say, four years before being able to sell it, or limit sale prices to the recovery of actual expenses, the FCC decided to impose two market caps. The first is a national limit of 70 applications in a single filing window, only 50 of which can be in 156 specified larger radio markets. The second is a regional limit of three filings per market.

Even then, two conditions will have to be met for multiple filings in any market. First, there can be no 60 dBu contour overlap among the filings nor with the 60 dBu contour of an applicant's existing translator authorizations. Second, each application must demonstrate that its grant would not preclude a future LPFM application within the same population grid. The preclusion showing must follow a detailed methodology which the Commission had outlined in its previous March 2012 LPFM report in which a variant of the current rules had been proposed.

In arriving at the new standard, the Commission largely dismissed concerns of parties with multiple pending applications within a single large market, who had pointed out that small translator service contours required many such facilities to achieve meaningful market-wide coverage. It also seems significant that the LCRA said nothing of market-based restrictions, but spoke only in terms of communities. Even so, the Commission claimed that it would be administratively impractical to apply its limits on a per-community basis (even though it would seem easier to identify the community already specified in an application than to figure out to which radio market it might belong).

To implement the new rules, the Commission is requiring parties affected by either cap to declare which applications they wish to pursue. At the same time, all commonly-owned multiple applications within a market are to be amended to demonstrate compliance with the overlap and preclusion conditions. Unless dismissed or grantable through a voluntary settlement, applications that remain viable but mutually-exclusive will go to auction.

LPFM

Admittedly, not all the changes to the LPFM rules bode well for broadcasters. Chief among these are new standards for waivers of the second- and third-adjacent channel spacing requirements. While these are designed to protect established facilities, they will facilitate locating LPFMs in urban areas.

Second-adjacent channel waivers are to be permitted only upon a showing that no actual interference would occur. This can be done by documenting an absence of population in affected areas, or through terrain-sensitive propagation models, lowering power, directionalizing or using different polarization. Upon a complaint of actual interference to a second adjacent channel, an LPFM will have to shut down until it can show that the interference is either eliminated or due to factors other than its emissions.

Although the LCRA eliminated third-adjacent spacing requirements, third-adjacent channel interference protection remains. The applicable procedure will depend upon whether an LPFM would have been short-spaced under the prior separations. LPFMs that would have been short-spaced will have to cease operation until they can remedy interference to the reception of any regularly-received third-adjacent channel full-service station, regardless of signal quality. LPFMs that would have been fully-spaced will be able to continue to operate during a reasonable opportunity to resolve complaints, and even during a proceeding to consider a formal complaint. Alternatively, the LPFM may seek modification of its authorization, including relocating near the third-adjacent channel station.

The new rules enable LPFMs to extend their service through translators, but only somewhat. Up to two translators are to be permitted, but their 60 dBu contours must overlap that of the LPFM, they must receive their input signals directly over the air, they must be within 20 miles of the LPFM's transmitter or city reference coordinates (10 miles in the top 50 markets), and they must synchronously transmit the LPFM's primary analog or HD-1 digital signal.

To move ahead with LPFM, the FCC plans to open a filing window in October 2013. Presumably by then it will have resolved all pending FM translator applications, since they will be entitled to protection against the new LPFMs.

To meet its goal, the FCC staff will need to process LPFM filings at a far more rapid pace than it took to resolve the last window for full-service noncommercial educational applicants. They, too, were subject to a lottery system based on comparative points, but the FCC took many years for the seemingly simple process of aggregating them into mutually-exclusive groups, providing settlement windows, and then comparing the arithmetic sums of their respective points and on that basis declaring "winners." One indication of a greater commitment is a harsh new time-sharing procedure to be imposed on LPFM applicants that remain comparatively equal but refuse to settle. (How would you want to be able to operate only from 2:00 am to 9:59 am daily?)

In any event, despite the delays and remaining challenges, broadcasters hopefully will tend to view the new LPFM regimen more as an opportunity than a threat.

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

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Safety and Security

A regular column on protecting property and persons.

The Big Spill

By Jeff Johnson, CPBE

We've discussed scary things – spiders, snakes, arcs and sparks. The most frightening of all? Look below ...

Certain Disaster!

Yes, Coke on a console! A recipe for certain disaster! But why?

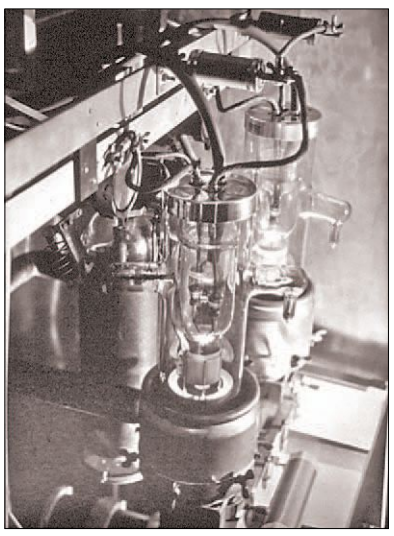
Conductivity of Liquids

Sticky factor aside, what is the problem? Coca Cola, as well as any other carbonated beverage, is electrically conductive. Carbonation "fizz" in soda pop is due to the presence of dissolved carbon dioxide, forming carbonic acid. For a substance to conduct electricity it must have charged particles that are free to move. Carbonic acid disassociates in water forming "counter" ions, a preponderance of which will conduct electrical current.

An ion is an atom or molecule in which the total number of electrons is not equal to the total number of protons, giving the atom a net positive or negative electrical charge. A counterion is the ion that accompanies an ionic 'species' in order to maintain electric neutrality. A counter ion is a mobile ion, the presence of which allows the formation of an overall neutrally charged 'species' – ***Wikipedia.com***

The electrical conductivity of a solution is the measurement of all ions present. A high concentration of ions will correspond to high conductivity.

Let us discuss water as an insulator. "What?" you might say, "Insulating water?" Yes, consider the cooling of high power transmitting tubes with plates directly submerged in water.

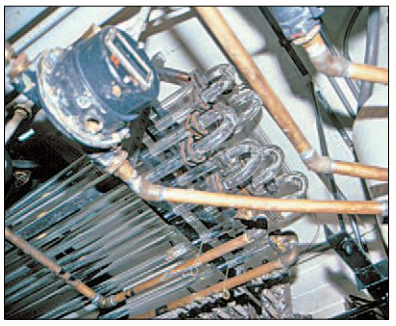


WLW power tubes in cooling cylinders.

The famous WLW 500 kW transmitter was water-cooled. Its power tubes' anodes were immersed in cylinders filled with water – deionized water.

The deionized water was circulated through Pyrex glass tubes, connecting a heat exchanger with the power tubes' cooling cylinders. The water and glass insulated the high voltage of the anodes. The water had no ions, therefore it could not conduct electricity.

"The actual amount of electricity that a given water solution will conduct changes with how far apart the electrodes are and what temperature the water is. This quantity is expressed in units called mhos (the unit of resistivity is the ohm; mho is ohm spelled backwards). The meter has a probe with two electrodes, usually 1 centimeter apart. Most of the modern ones sense the temperature as well and electronically correct for its effects. Since the meter gives a reading which is corrected for temperature and electrode separating distance, the number is called "specific conductance," expressed in mhos per centimeter at 25° C. Laboratory pure water has a specific conductance of about one millionth of a mho/cm." – ***http://environmentalet.hypermart.net***



Pyrex glass tubes containing deionized water.

In more familiar terms, absolutely pure water is considered to have a resistance of 18.2 million Ohms per cm at 25° C. Water is a darn good insulator in its purest state!

Deionized water is not the same as distilled water. Distillation, if accomplished in a sterile environment, produces sterile, ion-free water. Deionization is accomplished by a chemical process, which uses specially manufactured ion-exchange resins. *However, deionization does not significantly remove uncharged organic molecules, viruses or bacteria. –* ***Wikipedia.com***

Deionized water, which will be useful in cleaning up that Coke spill, is available from many laboratory sources such as: www.sciencecompany.com or www.chemworld.com

pH, Electrolysis and Corrosion

The pH of a liquid is the measure of its degree of acidity or alkalinity. 7.0 is neutral. Below 7.0 is acidic and liquid becomes progressively conductive. *"However, the more alkaline (above 7) the water is, the more likely it will be to have a lime scale build-up –* ***cranmerengineeringinc.com***

Both cases are bad for electronic components. Knowing the pH of the fluid can help give you an idea of how severe the damage may be.

As can be seen, becoming "ill" on the console is, by far, the worst of all.

- Pure water neutral pH = 7.0
- Blood = 7.4
- ***Gastric Juice = 0.7***
- Urine = 6.0
- Saliva = 7.0
- Beer = 3.3 to 5.5
- Lemon Juice = 2.3
- Bleach = 12 to 12.6
- Sea Water (i.e. Saltwater) = about 8.2
- Regulated Pool Water = 7.2 to 7.8

Coffee

Coffee is relatively low in acid. Its pH averages around 5.0 - 5.1, which is more neutral than most beer or any fruit juice and similar to carbonated water.

The Damages

After a spill, damage occurs immediately as currents flow through the conductive fluid to places *not* safe. Consider 120 VAC attacking the balanced mic inputs! Consider 120 VAC attacking *you* when you attempt to cleanup or even grab the can.

Electrolytic effects can cause molecule migration and etch circuit board traces even after the power is off.

Corrosion and accretion due to impurities – sugar, salt, chocolate, tomato juice, judiciously enumerated post consumer materials – everything we carry into a studio can do damage. Let's get busy quickly!

The first thing to do after a spill is to turn the equipment *off!* Many contemporary electronic devices do not have an actual "off" switch, but only a software off – *unplug the gear!*

Cleanup

What next? Removal of the offending substance and restoring operation will differ greatly depending on what happened. Is the gear critical? Is the station off the air? Some techniques are quicker than others. Larger components may not be immersible. In any instance, never hurry the process.

Obviously, quickly disassemble the equipment to the degree possible. As we've discussed, deionized water is safe for electrical components. If that is not available, distilled water will suffice as the equipment will be off. Once the offending substance has been removed by washing, brushing and scrubbing, proper drying is very important.

"To displace any remaining liquid around or under any components of the logic board submerge it completely in a suitably sized container filled with isopropyl alcohol. Ideally use a 99% concentration available from a pharmacist or drug store."– ***iFIXIT.com*** The author has used 99% isopropyl alcohol extensively for cleaning and maintenance of DAT mechanisms, including rubber components, with success.

The alcohol will displace the water and subsequently evaporate. If the final rinse was deionized or distilled water, drying will take longer. If there is any hesitation with the use of alcohol due to its solvent action, stick with deionized or distilled water.

Another product the author has successfully used repeatedly over the years is "Original" Windex. It has a surface wetting detergent action and leaves little residue. It should not be used on sensitive gear where liquid penetration is possible, such as unsealed switches or pots. Of course an alcohol or water final rinse, as discussed, should be used subsequently.

Drying

An afternoon on a sunny, warm and breezy beach is ideal for drying. It is also good for our nerves after the 'Big Spill.' Absent a beach, employ a long session on a radiator or under a heat lamp.

Thorough, thorough drying is critical. Even though deionized water is an insulator, it can become easily ionized by contaminants found on the surfaces of the components involved and must be evaporated completely.

Now would be a good time to apply DeoxIT to contact surfaces, and then DeoxIT Gold preservative, if appropriate.

If the cleaned equipment is modular, it would be smart to put it back together and power it up in stages – power supply, main board, then daughter boards one-by-one.

Hooray! Back on the air! Good job!

Jeff Johnson can be reached at: jeff@rfproof.com

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Operations Guide

Is the Chromebook Ready for Prime Time?

by Chris Tarr

For many years, there was a theory that the "network" could be the computer. Every now and then, a company would make a run at creating a "network appliance" – a low-cost computer that required a connection via the network to something with much more horsepower. Of course, that was a familiar paradigm; in the early days that is exactly how computers worked. There was the "Mainframe" that did all of the computing, while the terminals were simple machines providing the input and output. There was very little computing going on in the terminals, in fact if the terminal wasn't connected to the mainframe it became nothing more than a paperweight.

After those early years, the push was on to create the desktop computer. These computers were meant to be in places where there was little-to-no network connectivity, therefore they were designed to do all of the computing locally. Thanks to Moore's Law and other factors, that worked out nicely, and continues today. However, is that really necessary?

Like them or hate them, Google is a big proponent of cloud computing. It makes sense – if they wish to collect and parse data (and use that aggregate data to make money) it's worth it to them to move people towards cloud computing.

As a company, Google is interesting. They tend to create means to their ends. For example, if they want to lead in the cloud computing effort, they figure that in addition to hosting the cloud services, they should come up with a product that makes using those services easy.

At the 2011 Google I/O conference, Google announced the release of the Chromebook CR-48. The laptop ran a stripped down version of Linux called ChromeOS. Essentially the browser became the operating system. There was very little storage on the device itself. You booted up to a browser, and that was your interface. All of your email, documents, calandars, etc. lived on-line. It didn't seem to take off – the interface seemed clunky and thanks to slow hardware, it just didn't match the performance of typical computers.

The idea was pretty sound, however. If there was very little in terms of OS on the device, it would be very easy to lock down configurations and prevent viruses. Plus, since there is no user data on the device that isn't backed up on the cloud, you never have the risk of losing data.

It looks like Google is finally getting the problem solved. A few months ago, they introduced a new line of Chromebooks, partnering with Samsung and Acer to make the hardware. They also overhauled the ChromeOS interface to make it more friendly.

Being the tech geek that I am, I couldn't resist trying out the new Samsung Chromebook. I bought the 11.6" WiFi version, which retails for $249. It's got 2 GB of RAM, and a 16 GB solid-state drive, and includes a USB 2.0, USB 3.0, and HDMI port as well as an SD slot. The processor is the new Samsung Exynos dual core processor that uses very little power and requires no fan. The unit is made of plastic, but is very good looking with a nice solid feel to it – and the keyboard and mouse are fantastic.

The first thing you need to know about the Chromebook is that you need to have a Google account to use one (if you have a Gmail address, you have a Google account). The reason you need one? Everything you're working with is stored online in that account. Without it – just like the old terminals – you basically have a nice looking paperweight.

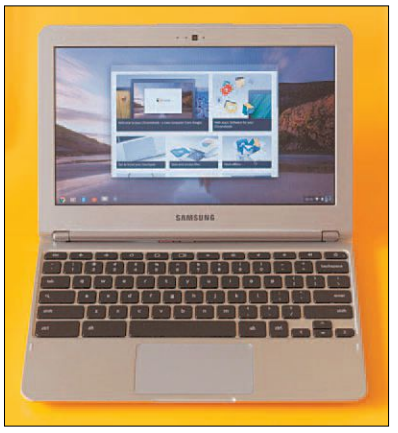
Once you get logged in, you're presented with a fairly familiar looking desktop. To the left you have launch icons for the Chrome browser, Gmail, Youtube and other Apps. To the right is a clock, and battery and connection information. It looks very much like a typical desktop. Once you start poking around however, you'll notice that everything runs in a browser window. It's a little odd at first, but I got used to it pretty quick.

The other thing you immediately notice is that you usually need to be on-line to use it. There is a "file" application that allows you to download Google Drive files locally, and you can use Gmail and Docs (the word processor and spreadsheet program) in off-line mode, but other than that, you really need to have an Internet connection. For those of us in metropolitan areas, that's not much of a problem since there's WiFi just about everywhere. If you're out in the country? It will likely be a dealbreaker.

So, how does this relate to radio? Well it doesn't directly, but I'm always on the lookout for new tech that can deployed at the station. One of the reasons I picked one up (aside from my gadget habit) is that there's something appealing about a nice looking $250 laptop that requires very little in the way of maintenance and can simply be "reset" if things go south. It would be great to buy a fleet of these for employees' everyday use, instead of machines running two to three times the price.

Google does offer a deployment dashboard that allows you to push configuration changes and other features to all of your machines en-masse, making enterprise management pretty simple. Of course, the rub is that you can't install "typical" software directly to the machine. I believe that is going to be less and less of an issue as more services move to the cloud. For example, at my facility, things like file serving, email, and traffic are all handled in browser sessions. They would work just fine on a Chromebook.

You can, by the way, read things like USB drives and print to network printers – even those in other buildings using the Chrome Print service. There are also many apps available for the computer in the Chrome Store online.



I'm thinking that the biggest difficulty in moving to a platform such as this will be adjusting to the new paradigm. For many of us, we grew up having complete control of our computers. We install and reinstall operating systems, add and remove software, and generally are responsible for the care and maintenance of the machine. We also, of course, have total control of the information on the machine. All of that gets thrown on it's ear in this brave new world.

First, we trust that our data is secure out in the cloud. We don't hold the physical copy of our data anymore. Whether or not you choose to trust the company holding that data is a discussion for another time. However it is something to think about. Second, you no longer deal with the operating system. That's good or bad depending on how you see it. With a Chromebook, the OS is automatically kept up to date. Any upgrades are pushed to the device automatically, and you're prompted to install them when ready. So if the developers come up with a new version of ChromeOS, you get the upgrade for free. You do have the ability to sign up to get pushed development and beta releases if you like to be on the bleeding edge.

So what happens if the machine breaks or the operating system gets corrupted? The way the system works is that there is always a clean system image stored on the machine, so if anything goes bad, hitting the reset button gives you a fresh install. Because everything is stored on-line, logging to the fresh install (or any Chromebook for that matter) immediately gives you access to all of your information again. Remember though – the price you pay for that is that the machine has limited functionality without an Internet connection.

This is the kind of device that I really recommend doing some research on before diving in. It's certainly not for everyone. For example, you may not want a machine like this as your main computer, but it's great for a second machine. In my case, I really didn't like toting around my expensive MacBook Air for fear of dropping it or having it stolen – and in reality, 99% of the time I use it to check email and a few websites when I'm out of the office. I can easily justify carrying around a $250 computer for that.

Pros: Lightweight, attractive, easy to use, simple management.

Cons: Totally reliant on an Internet connection, most of your data is stored by Google, not very customizable, still a bit rough around the edges.

Bottom Line: If you're looking for a light, well built, easy to use machine that's great for email, writing, and surfing the 'net, give the Chromebook a look. You may be surprised at how functional it really is.

Christopher Tarr CSRE, CBNE, DRB is the Director of Radio Operations/Engineering for 88Nine, Radio Milwaukee. He can be reached at chris@radiomilwaukee.org

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Tech Management

Labor Saving Ideas – by the Numbers

by Mike Callaghan

1. For temporary labels on wires, take a Post-It note and cut off the part without adhesive on the back. Then write on the sticky part and use that as a label. It stays for a long time, and is easily removed when you want to attach something more permanent.

2. When you buy spare computer monitors, keyboards, and mice, unpack them and have them on a shelf, ready to go. When you need to do a swap, you'll save some valuable time getting the studio back up and running. Do the same thing with spare network switches and routers. Remember to replace your spares as soon as they get used.

3. If you've inherited different brands and models of headphone and monitor speaker amplifiers, adapt the input and output connectors to a common standard. Then when you need to swap out a bad unit, you won't have to change connectors while someone's trying to do a show. I prefer the dual banana plugs for the speakers and XLR's for the inputs.

4. Install cupholders in the studios, and put them far enough away from the console and other equipment, that a simple spill won't become a disaster.

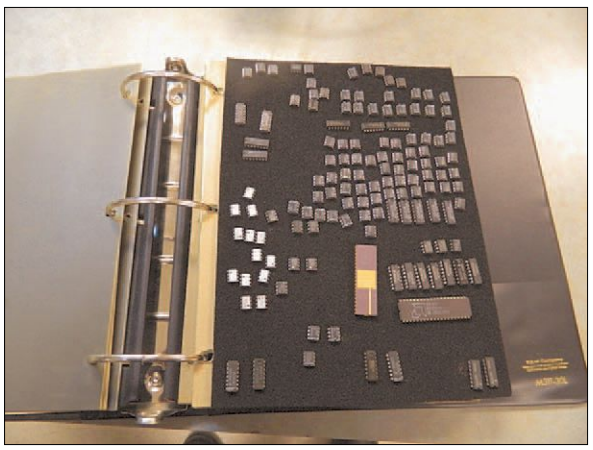
5. Since the Commission stopped requiring transmitter maintenance logs, they've become way too scarce. Writing down what happened, and what you did, while visiting the transmitter provides valuable feedback when things drift and change. Oftentimes, a log of what readings used to be will provide your only way to track something down. Take the time to make a detailed record: filters changed, parts that look different, changes in tuning – all these are important to have down the road.

6. Get a good infra-red thermometer, and jot down the temperature of all the active parts in a transmitter. Measure the transmission line, harmonic filter, phasor panels and everything else you can get at. If a transmitter has eight output modules, and one is 20 degrees hotter than the others, that's important to know.

7. If your board ops or talent has trouble getting the weekly EAS tests on the air, wait until just before you leave for the weekend. Stop by the studio, and if the RWT hasn't run yet, wait until it does get aired and logged. Then, when you do leave, you'll know for sure that the station is legal.

8. Building a new workshop? Make the bottom of the workcounter 33 inches off the floor. Then an industrial wastebasket will just slide under it, so sweeping wire ends and debris off the counter and into the trash will be a breeze.

9. Keep the spare I.C.'s and opamps for your equipment in a 3-ring binder. Glue anti-static sponge sheets onto cardboard and keep the sheets in the binder. Push the parts into the pages and they'll be easy to find, and you'll know when you need to order more. *(see photo)*



10. Keep a project book on your desk. When you talk with a vendor on the phone, jot down notes of everything you say, and even things you don't say. If you need information from the project book to go somewhere else, copy it onto separate sheets. The project book should *never* leave your desk. When you have information from somewhere else, that relates to a project in the book, jot it down as well. This way you'll always have the phone numbers and contact info available, even weeks after a project is closed.

11. Set up a master oscillator somewhere, producing a 1,000 Hz tone at "0" VU – make it a source on your routing switcher. It will be useful when you're setting up outgoing lines and are asked to send a test tone to the other end. It's also useful for setting levels into CD burners, consoles, and analog recording devices.

12. If you have a large plant, make up an Excel spreadsheet showing all the jack numbers in the Ethernet wall plates in one column, and where they terminate in

(Continued on Page 22)

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Tech Management

– Continued from Page 20 –

the equipment racks in a second column. Include the rack number, row number, and jack number. Number each rack and provide a floor plan to show where they are. This will save a lot of time when you need to locate both ends of a cable drop quickly, using the Search function in the spreadsheet.

13. When new equipment is added, send an email or note to the other engineers telling what's new, what it does, and which rack it's in. This will save time when someone else has to reboot or adjust it.

14. Give each air personality his or her own mike muff. This will avoid head colds spreading through the air staff like wildfire. Make them different colors to avoid "borrowing" and confusion.

15. If computer monitor space is tight in the air studio, consider a combination monitor and TV set. This will allow keeping up with the news (and soap operas) while still being able to show the call screener or Internet browser.

16. If your AM station uses a T-1 circuit for an STL, consider bringing back the audio output of the modulation monitor or a radio at the transmitter site on the T-1's return path. This is the ideal source for a silence sensor or the off-air monitor to play in the studio. Oftentimes at night, "monkey chatter" from other stations will fool a silence sensor when your station goes quiet. Having a clean audio sample right out of the transmitter cures this issue.

17. Use a "notebook" app on your smartphone to keep a list of parts you need from the parts store. Having it with you all the time will eliminate the slips of paper and forgotten needs when you go shopping.

18. Keep a "universal" laptop power supply on hand for the guests that show up with a laptop and forget the power cord. Make the host responsible for getting the parts of it back from the guest and delivering them to you.

19. Set up a "guest" Wi-Fi access point so your laptop-toting visitors needn't "plug in" to your network for Internet access. Feed it separately from your network so guests can't leave viruses behind when they exit the station.

20. If there is the slightest chance a new piece of gear won't fit in a doorway or into a room, make a wooden frame out of 1" x 1" lumber, the same size as the outside dimensions, and move it in first. This will avoid having to "modify" walls and doors while the moving crew stands waiting – and the meter is running.

21. Consider having a rep from the moving outfit walk the job with you before the equipment arrives. There are steps, doorways, walls, and access hatches you might not consider that will be real issues when moving heavy equipment in and out.

22. When replacing heavy gear like transmitters, that consume a lot of power, insure your breaker panel has room and/or capacity for the new load. You don't want the new equipment to be useless while the electrician orders a panel or goes looking for some obscure part to make it work.

23. For any major installation, have the electrician, plumber, and/or contractor walk the job with you as far in advance as practical. Detailed planning will save you large amounts of grief when a deadline looms.

24. This may seem pretty basic, but make sure the new equipment will work with the power you have available. Is your three-phase power open delta? Is the grounding compatible? It's better to know this now, than after the transmitter's in place and won't work.

25. Does the new transmitter use external bandpass or harmonic filters? Do you have room for them?

26. While making the "scope of work" list for the electrician, consider including outlets for test equipment, the workbench and hanging trouble lights. Remember to provide a circuit for the fan in the dummy load and conduits for the interlock circuitry it uses.

27. When handing out keys, use a xerox copy to make charts of which key fits which lock. Lay the keys on the copy glass and make a copy of their size and shape.

28. Instead of a list of steps to follow to get back on the air after a transmitter failure, make up a flowchart. It will be easier for the operator to follow while under stress.

29. While installing the equipment at a transmitter site, try to keep the audio levels in and out of the processors close to the same. This way, when a processor fails, you can tie the output to the input and stay on the air, as opposed to overmodulation, or audio so weak it's hard to understand.

30. When you find a bad patch cable, cut it in half before you throw it away. The same for alligator clip leads, power cords, or computer cables. Bad cords have a nasty habit of finding their way from the trash back to the test bench or cord holder, only to cause additional anguish when they get reused.

31. Finally, rack-mounted UPS systems have become a way of life for us. Unfortunately, when the batteries get old and swell up, it becomes an exercise in frustration to get them out of the cabinet. Make it easy on yourself and mount a separate rack shelf above the UPS to hold them. A few feet of 6 gauge stranded wire will connect them into the UPS, and then they'll be easy to replace even while the UPS is running.

Mike Callaghan is the Chief Engineer at KIIS-FM in Los Angeles, CA. His email is: mc@amandfm.com

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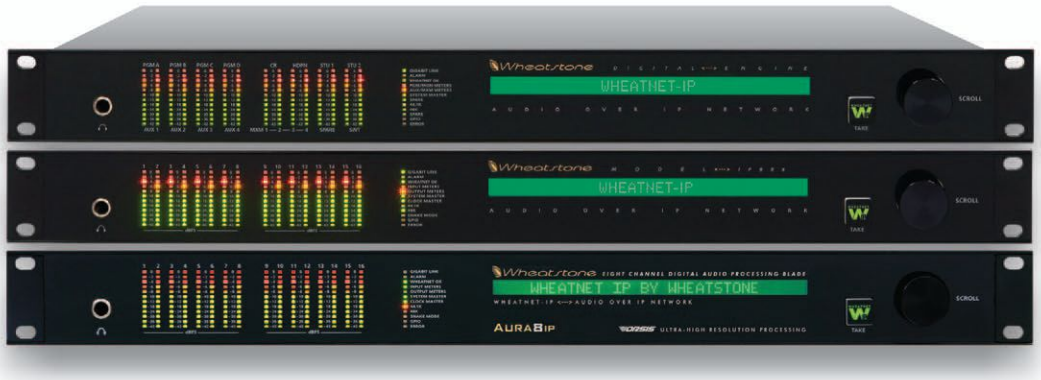

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Chief Engineer

Learn What You Didn't Know, You Didn't Know

by Scott Schmeling

I learned something I didn't know, I didn't know. More about that in a bit.

I hope you all had a wonderful Holiday season. We now have a brand new year ahead of us – a new year full of promise and possibilities.

Before we get into this issue's column, let's take a quick look back. Last month I told you about two early New Year's Resolutions. First, I resolved to throw something away every day, and second, I resolved to take a set of meter readings every time I visit a transmitter site. So far, I have missed a couple days of throwing something away, but I made up for it by throwing away multiple things on other days (I *think* that makes up for it!). I *have*, however, been taking my readings as resolved. And in the interest of full disclosure, yes, those photos were of two areas where I have "stuff."

I got an e-mail from J.P. Ferraro, from WHVW in Hyde Park, New York. The mere thought of throwing away an analog reel-to-reel deck made him shudder. He included a nine-point, "Why do I love reel-to-reels? Let me count the ways," that summarizes some of the differences. If any of you have a reel-to-reel deck looking for a home I'm sure J. P. would take very good care of it.

Last month I also admitted to you that I was not perfect and I don't know everything. Not much has changed there, so let's continue with that thought. There are a couple characteristics that we probably all share. As broadcast engineers, we like to know how things work, and we try to make them work better.

Like many of you, I have had no formal training for this job. I started in radio in 1964, when I was in 9th grade, as a part-timer at KSDR, a daytime AM in Watertown, South Dakota. (I played "She Loves You" as a current!) The station had a contract engineer who was called when something broke, so not everything was running as well as it could. Since I showed an interest, the owner allowed me to take equipment manuals home to study, and eventually I was allowed to make minor adjustments to the studio equipment. I couldn't touch the transmitter because you needed a "1st Class Ticket" (remember those?) to make transmitter adjustments. I could do things like align cart machine heads and adjust levels. I could even test and replace tubes from the console. (As I re-read this paragraph, I must sound *ancient!*) My point is everything I knew, I learned either reading the manuals or digging into the equipment to troubleshoot and solve the problem.

Jump ahead to the present. I love to read and I love to make things better. As in the past, most of my reading is equipment manuals. Sometimes I'm reading a manual for new equipment being installed ... sometimes I'm reading through the manual for something we've had running for several years. You know how, when you watch a movie for the second or third time, you pick up things you missed the first time or two? The same can be true when it comes to reading – or re-reading – your equipment manuals. And it's surprising what you can learn. Case in point ...

Some time ago I downloaded a training manual for the Continental 816R series transmitter from the Continental web site. I've been taking care of this model, or its predecessor the 831G, off and on since 1983, but as I have stated, "I don't know everything." I was reading through the training manual to see if I'd missed anything the previous times I'd read it. There was a section on improving the intake air filter that I wanted to look at – again. But as I went farther down the document, something else caught my eye ... more on that in a minute.

Let me ask you this. When you get a new transmitter, do you read through the manual? Usually toward the back, the manufacturer includes an Eimac publication titled *Extending Transmitter Tube Life* – it's Eimac Application Bulletin #18. It presents much information on the physics of the tube, checking for hot spots on tubes being replaced, which would indicate questionable contact, possible socket issues, and a discussion on "Filament Voltage Management." I'll admit it, I had read through the bulletin several years ago, so I usually skip reading it again.

Like I said before, while reading through the training manual, something caught my eye. As I skimmed down, I read the following: *"EIMAC has learned more about the best way to operate these tubes in regard to filament management. These revised operating instructions conflict with the advice given in the original EIMAC Application Bulletin AB-18, "Extending Transmitter Tube Life."*

(Continued on Page 28)

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COOL STUFF AWARD
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Chief Engineer

by Scott Schmeling

– Continued from Page 26 –

The procedure I had always used when installing a new tube was to increase filament voltage to "a couple tenths" above nominal voltage for about a week to burn off any contaminants. After a week I would lower the voltage to not less than 95% of nominal. Then as output droped, over time, I would increase the filament voltage to maintain proper output. As I read on, the next paragraph was equally intriguing ...

"The following instructions supersede all previous suggestions and instructions. Specifically, you should lower the filament voltage after the first 200 hours of operation. There is no longer a lower limit of 95% of full filament voltage. This is the principal change in Eimac Product Bulletin AB-18. After operating a new tube for 200 hours, the filament voltage should be reduced to the power emission knee required for your output power."

OK – you had me at "supersede!" Now I *had* to read the whole thing. The bulletin continued and outlined the updated procedure as follows:

The New Procedure:

"First stabilize the new tube emission by operating it at rated filament voltage for a minimum of 200 hours. Raise the transmitter output power to approximately 105% of normal power. (Note: a later revision says to set the power at 100%.)

Carefully lower the filament voltage in 0.2 Volt steps, pausing for about 30 seconds after each decrement, until you see a significant (greater than 2%) change in power output or plate current. This is the filament emission knee.

Now raise the filament voltage 0.2 Volts above the knee voltage. This is the correct filament operating voltage for your power output. Operation at this reduced filament voltage insures maximum possible tube life.

Check for a change in the filament voltage knee one week after you lower the filament voltage. Keep the operating voltage 0.2 Volts above the knee. Repeat this check monthly throughout the life of the tube."

This is so different from the procedure I had always used, that I contacted Eimac to double-check and to see if this only applied to the 4CX15,000 mentioned at the heading of the page, or if it was valid for other tubes as well. I heard from Debbie Storz of Econco, who had done some research, found the original document, and checked with Eimac engineers and verified. Yes, this updated procedure is valid for all the power tubes I use.

I found this "new" information just in time for a tube change, so I put it to use. Everything went as expected. The only issue I had was I couldn't lower my filament voltage to a point where my transmitter output dropped by 2%. On the same maintenance trip I had re-installed the motor control for the filament Variac. The motor had been removed by a previous engineer who suspected it was faulty, but I tested it on the bench and the motor worked fine in both directions so I reinstalled it. I'll just have to readjust the coupling so I can lower the voltage more. The tube has only been in for a month so I can't report on the evdntual tube life, but the procedure does makes perfect sense.

Once more thing, this Eimac bulletin was dated – are you ready for this – March 23, 1990! That's over 23 years ago! How could I have missed this? Just for giggles and grins, I checked the manual for a newer transmitter. As expected, I found the "Extending Transmitter Tube Life" insert at the back of the manual. Upon closer inspection I saw a revision date at the bottom of the front page of March 1990 and yes, it outlines the newer procedure.

We got that transmitter back in 1993. That means I've been doing it wrong, but had the correct information for 20 years! Now I want to check my other transmitter manuals to see how long I've actually *had* this information, but didn't know about it. The things you can learn when you just read the manual!

I have since found two newer revisions, the latest dated September, 2010. The only difference I could see from the original is that after the first 200 hours, rather than raising the power to 105% it was kept at 100%.

Debbie Storz of Econco also told me there is a *Tube Topics* document available for download at www.Econco.com that also addresses filament management as well as other tube care subjects. You can spend time with your favorite browser I'm sure, and find all this and so much more. I searched for *Eimac Application Bulletin #18* and found the 2010 revision as well as a number of other documents (some valid, some not). You can also find a wealth of information on transmitter manufacturers' websites.

If you'd rather not take the time searching, I have all of the documents mentioned and would be happy to e-mail them to you. But as this article has indicated, it's amazing what a wealth of very useful information you can find when you're not even looking for it. So go searching – and read your manuals again. You might be surprised to learn something you didn't know ... you didn't know!

Happy New Year Everybody, and keep it between 90 and 105!

Scott Schmeling is the Chief Engineer for Minnesota Valley Broadcasting. Email him scottschmeling@radiomankato.com

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Tips From the Field

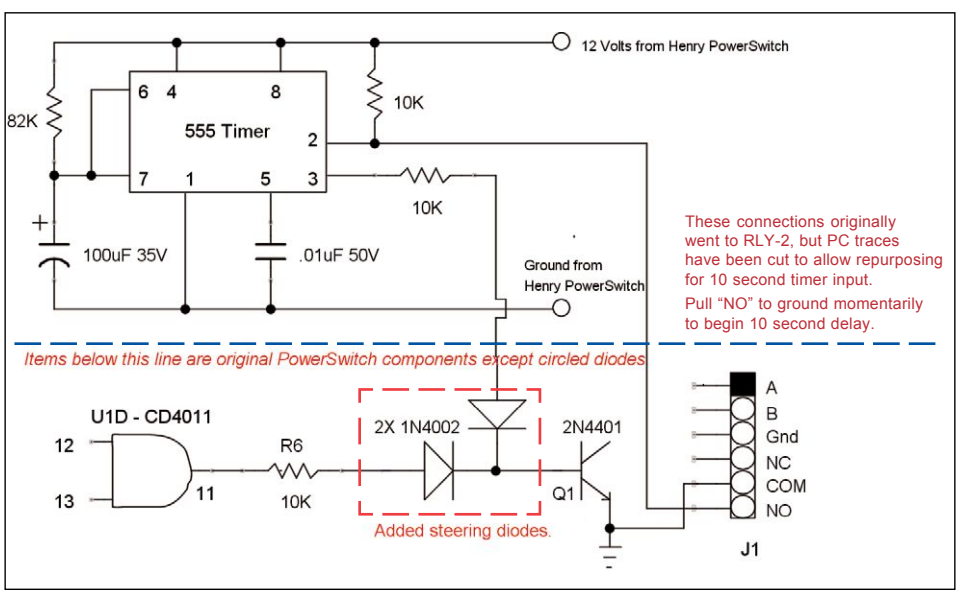
Henry PowerSwitch™ Mod & DTMF STL Re-Boot

by John Bredesen

Anybody who's worked in broadcast engineering recently knows that microprocessors are creeping into that landscape like crab grass. Everything from transmitters to audio processors, from audio boards to telephone systems, use these powerful chips to do jobs that were unimaginable just a few years ago. When they do what they're supposed to do, they can make the station sound better and our jobs easier.

But lives an engineer who hasn't had one of these devices lock up for some reason? Rebooting microprocessor equipment at a remote site can usually be accomplished only by shutting power off to the offending piece of equipment for a few seconds, then reapplying power. At a few of our remote sites we've been using the Henry Engineering PowerSwitch, controlled by the R/C. That arrangement requires the operator to issue a "lower" command followed by a "raise" command a few seconds later – a process that has, on occasion, left a site with a power-off situation, when the busy jock forgets to issue the raise command 5 or 10 seconds later..

This was easily solved by building a tiny 555 timer board into the PowerSwitch. To initiate the timing cycle, the R/C issues a momentary ground closure, which is connected into the PowerSwitch via a repurposed connection on the back of the unit. The beauty of this scheme is that the studio needs only to issue a single command to the modified unit. Power is then removed from the offending piece of equipment and automatically restored after a suitable delay. We rather arbitrarily chose 10 seconds, but you can chose whatever interval you wish simply by changing the value of one component. Here's the schematic for the timer board and the modification needed to the PowerSwitch. The components shown result in an approximate 10 second interval. If you wish to change the interval, it's probably easiest to change the resistor with the value of 82K in the schematic, according to the formula T = 1.1 x R x C, where R is expressed in Megohms (82K is 0.082 megohm) and C is expressed in Microfarads.



The timer circuit is built on a small perf board (1" x 1") with a total of six components, including the 555 timer chip, held in place on the main board with double sided foam tape. Two steering diodes are added near R6 on the main board. Unsolder the end of R6 connected to Q1, then tack solder one of the diodes between the loose end of R6 and the through-hole vacated by R6. The second added diode is also connected to the base of Q1. Note the polarity of the two diodes on the schematic.

Connections to the R/C is via the terminal plug on the back of the unit. We used the two screw terminals labeled "COM" and "NO." To be able to use them requires removal of the main board and severing the two traces on the PC board connected to them, then soldering two wires that bring the screw connection to the timer board. Power for the timer is 12 VDC from the main board.

At one site with bad power line transient problems, the timer concept was used, but it was built into a small project box containing not only the timer circuit, but also a small power supply and the switching relay. This was mounted on a 2-RU blank panel along with a surge protection outlet strip. This approach was taken because the current capacity of the PowerSwitch was not high enough for the load we needed to switch. The output of the 555 timer is rated for 200 mA so it can switch a 12 Volt relay directly, but don't forget to include a snubbing diode across the relay coil to protect the 555 – we used a 1N4002.

(Continued on Page 32)

Tips From the Field

– Continued from Page 30 –

The power supply was very simple, using a 12 VAC transformer, some filtering and a 7812 three-terminal regulator.

DTMF to the Rescue

Shortly after this problem was solved, another challenge presented itself. We have a two hop, 5.8 GHz microwave link from Eugene (Oregon) to Florence on the coast, with the repeater site on a mountain between the two cities. Soon after the system was installed, the station began receiving occasional calls that Florence was off the air. A 45 minute drive later, it was determined that the microwave system at this site needed rebooting. Total time to take care of problem: about an hour and a half. It happened several times and the drive was a pain and a real time waster.

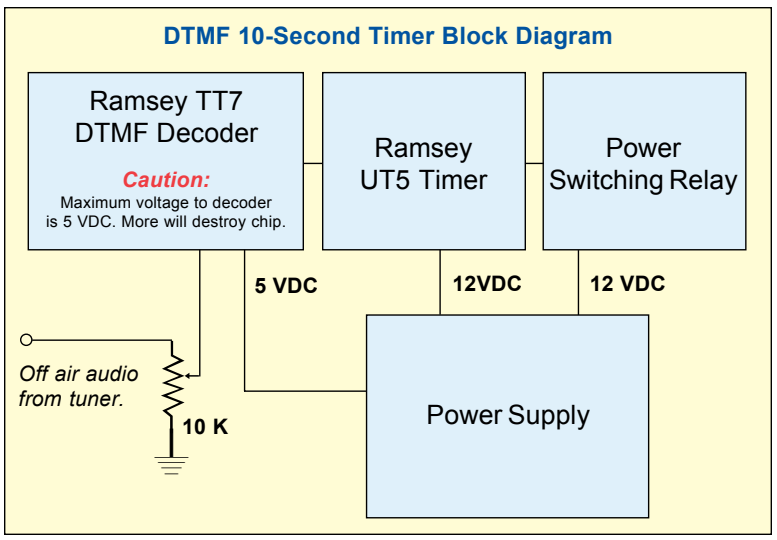
OK, why not use the remote control to do that job? Nice thought, except for two reasons:

One, there was not a remote control terminal at the site, and two, even if there had been, if the link from the end studio was the culprit, it wouldn't work anyway.

Searching for a solution, good 'ole DTMF (Dual tone, multi-frequency – aka, TouchTone) came to mind. Why not send a DTMF tone over the air when this reset need arose?

Commercial DTMF decoders are available. There's just one problem with those I've seen. To accomplish what is needed, we simply need to remove power for perhaps 10 seconds, and available decoders don't provide for that timed function. You could set it up so a relay was energized for as long as the tone was being sent, but nobody wants a multi-second tone interrupting programming.

We decided to design and build our own unit to both decode the tone and provide the 10 second delay. The finished device uses three little modules, two of which are from Ramsey Electronics – a DTMF decoder and a timer board based on the 555 timer chip. The third module was a home brew and incorporated both the power supply components and the power relay. All was built into a project box.



The Touch Tone concept was developed by Western Electric in the early 1960s. The tone frequencies are selected so their harmonics and intermodulation products will not cause an unreliable signal. No frequency is a multiple of another, the difference of any two frequencies does not equal any of the frequencies and the sum of any two does not equal a frequency. Each "touchtone" consists of two frequencies, one high and one low, and there are four of each which can therefore create 16 discrete tones. If you look at most available tone pads, including those on telephones, you'll see 12 including the "*" and the "#". So what about the remaining four tones? More on this later.

The first module uses the Ramsey TT7 decoder board. Audio in, one of 16 out. Each decoded tone is brought out to a separate header pin which, when a valid tone is detected, goes low. The pin representing the desired tone is connected to the trigger input of the 555 timer board, the Ramsey UT5.

The UT5 has components which can accept either a positive or a negative going trigger, so it's as simple as connecting the selected header pin of the TT7 board to the negative trigger input of the UT5 through a small capacitor. Components supplied with the UT5 allow selection of time intervals from microseconds to about half an hour. Again, we rather arbitrarily chose 10 seconds as being enough time to allow voltages within the equipment to fully decay. The UT5 kit allows you to chose any other reset time you desire, again by selecting a different value for the timing resistor.

The last four tones are designated A, B, C and D, and are not commonly used, which is why we chose to use one of those four. Occasionally a TouchTone signal will get on the air for any number of reasons. By choosing one of these four, the likelihood of an accidental trip is greatly minimized. Another way to minimize the possibility of an accidental trip would be to design the circuit so two (or more) sequential DTMF tones are required to initiate the reset. So far, however, we've not had any accidental trips with the single tone.

We originate the DTMF tones in the Cool Edit program at the studio, and store it as an audio file in the automation system. Other editing programs also have the ability to generate the needed tones. The DTMF decoder responds to very short bursts of tone. We use about 1/2-second.

These timer reset units have worked well for us and have saved many, many hours of engineering time. *– Radio Guide –*

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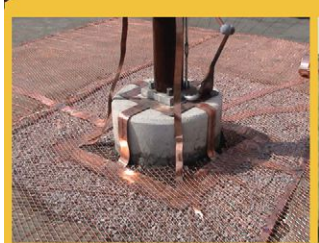

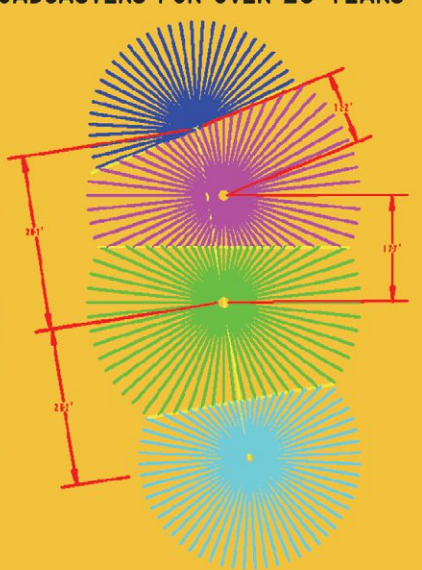

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Test & Measure

Finding Cable Breaks the Easy Way

by David Hershberger

While coming home from work one day, I found that my DirecTV receiver had quit working. Some investigation with a power supply and a voltmeter showed that both coaxes to the dish had continuity on the center conductors, but the shields were both open.

The 150 feet of coax was mostly inaccessible, and most of the coax was buried, and most of that was in conduit – some even was under concrete! Visual inspection revealed nothing wrong, so how was I going to find the breaks in the coax?

TDR In The Shop

What I needed was a time domain reflectometer (TDR), but I did not have one. After "reflecting" on the problem for a moment, I realized that I had the pieces to make one.

I started with my trusty Tektronix 465 100 MHz scope and added an old IG-4505 Heathkit oscilloscope calibrator that was on hand. The calibrator puts out fast-risetime square waves of varying frequencies from a crystal controlled reference. The signal source was a Schottky line driver.

To turn these pieces into a TDR, all I had to do is connect the vertical input to the scope, the square wave source, and the coax in question together, using a BNC Tee. **Figure 1** shows the test setup.

Coaxial cable is an energy storage device. What a TDR does in this case is to measure the "charge time" of a piece of un-terminated coax. The charge time is one "round trip" for the reflected rising edge of the square wave and it is proportional to cable length.

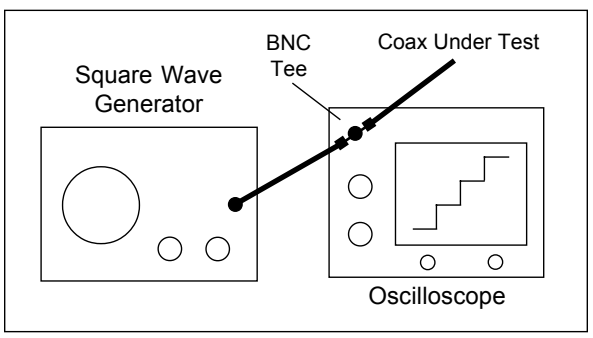

Fig. 1 – An improvised Time Delay Reflectometer.

After the coax charges up, it goes hi-Z, but until it finishes charging, it looks like a resistor (its surge impedance). The surge or characteristic impedance of coax is the apparent transient resistance of the cable when a voltage step is applied to it. This resistance persists until the wave returns to the driven end, after reflecting from the far end.

If you had an ohmmeter that responded fast enough (nanoseconds) and if you connected it to a piece of un-terminated, un-shorted 75 ohm coax, you would (for the first few nanoseconds) see a resistance – the characteristic impedance of the coax. Then, after the coax was fully charged by the ohmmeter, you would see an open circuit.

In other words, the 75 ohm coax will look like a 75 ohm resistor for a time period corresponding to twice its electrical length.

Measuring Constants

First, I needed to measure the velocity factor of RG-6 coax. Fortunately, I had a long length of coax that I had used to extend our in-house cable TV system to my sister's "Lumbago" (her RV) when she came out to visit a few years ago. I physically measured the coax and found that it was 140.5 feet long.

Then I put it on my ad-hoc TDR and observed its impedance as a function of time. The Heathkit scope calibrator has a low output impedance (less than 50 ohms) so the impedance "step" was higher than it would appear on a 50 ohm TDR. However, only the time duration of that first step is important – ignore everything else beyond that point. The scope display is shown in **Figure 2**.

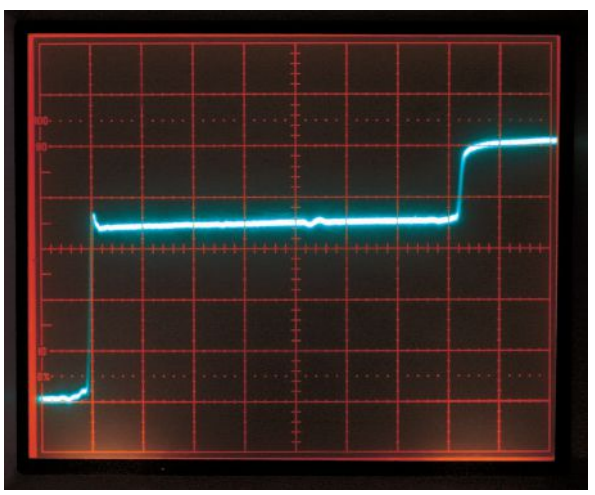

Fig. 2 – Measuring the velocity factor of RG/6.

The horizontal axis is 50 nanoseconds per division. The 140.5 foot piece of coax measured 365 nanoseconds. That corresponds to a velocity factor of about 78%, which is a reasonable number. So now I had a value for feet per nanosecond: about 0.385ft/nsec. *(Continued on Page 36)*

Test & Measure

– Continued from Page 34 –

For better accuracy, I recommend expanding out the horizontal display to make sure that the reflections all dampen out before the next square-wave edge occurs; otherwise you will see spurious voltage steps. At the same time, it is best to reduce the square-wave frequency until all reflections dampen out.

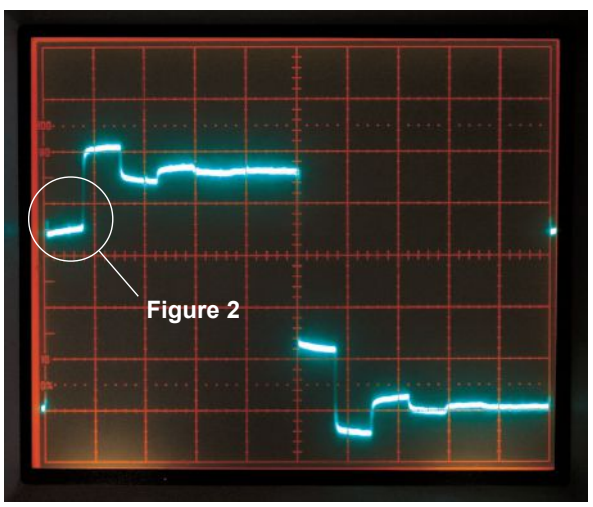

Fig. 3 – Allowing reflections to dampen out (0.5 microseconds/div).

Figure 3 shows what my setup looked like when measuring the 140.5 foot length of coax.

The horizontal axis is 0.5 microseconds per division. So you can see that I was using a 200 kHz square wave.

Next I connected the coaxes that went out to the dish. **Figure 4** shows the scope TDR display. One coax measured 62 nanoseconds and the other (which was a little bit longer in the TV room) measured 68 nanoseconds. Those times convert to distances of 23.9 and 26.2 feet.

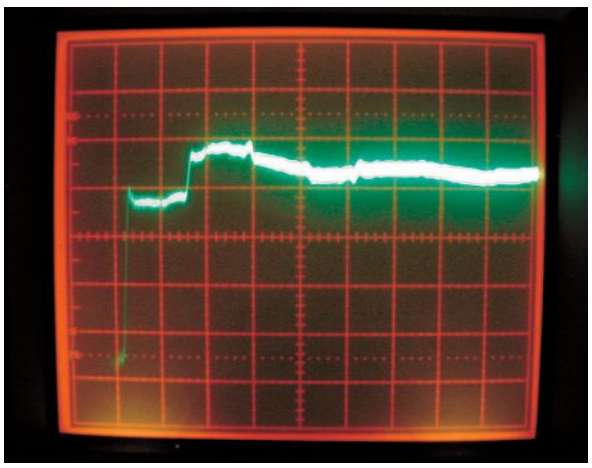

Fig. 4 – The display showing the distance to the DirecTV coax break (50 nsec/div).

That meant that the discontinuity was close to the TV room. I got out the tape measure and found that there is 19 feet of coax to the wall. So, the discontinuity was only a few feet outside the house!

With that information on hand, I started digging. Sure enough, I found two chewed places in the coax, right where they were supposed to be!

The chew marks did not go all the way around the coax rubber sheath, but apparently whatever critter did this chewed entirely through the shield on both coaxes. The chewed spots were a few inches apart. **Figure 5** shows the chewed coax.

At this point, all it took was a couple of connectors to properly splice the cable and I was back to watching my favorite programs.

The impedance discontinuity was not a simple open-circuit, since it was only the shield that was broken. That the center conductor continued on to the dish can be seen by the low frequency impedance oscillation visible in the scope display in **Figure 4** that the center conductor created.

Fig. 5 – Varmint-induced impedance discontinuities.

If your square-wave signal generator has an accurate 50 ohm source impedance, you can make impedance measurements too. But neither the generator impedance nor the cable impedance is very critical. You can certainly use a 50 ohm generator to measure 75 ohm coax or even audio cable where the impedance might be even higher. All you are looking for is the impedance variations as a function of time.

So if you ever find yourself with a broken buried cable, do not reach for the shovel first – reach for the TDR instead. But even if you do not have a TDR easily available, just go get a scope, a fast rise time square-wave source, and a BNC Tee ... and roll your own! *– Radio Guide –*

Links and Lines

From Here to There – A Sea of Codecs

by Leo Ashcraft

For such a simple job, there are many ways to accomplish the task. It's about getting your product – your audio – from point A to point B. It's about transferring your hard work from the studio to the transmitter for all to hear. You want it to get there in as close to the original form as possible, in the simplest most reliable method possible. Once in place, you need the system to simply work, day in, day out, 24/7.

This is a very important part of your audio distribution and chain. Without this very important, and mostly forgotten about system, your audio will never reach the listeners, or reaches them with non-optimum sound.

Let's dig into your options for setting up a high quality Studio to Transmitter Link – otherwise known as your "STL." It would be wonderful to simply wire directly from mixer, to processing, to transmitter, but that's not always an option. Many times the studio is better suited at a location far from the tower site. This is where the STL becomes very important to a radio station. But with so many options, what is the best solution?

The answer to that very common question involves a few things. A few to consider are: budget, length of hop (distance between studio and transmitter site), local regulations regarding shorter towers at the studio, and utility availability.

Budget is very important and will guide us through the selection process. The traditional solution is a microwave system. This is generally the most expensive, but is also very reliable. It requires additional site coordination, licensing and a tower at the studio location. Typical cost of such installations can approach $10,000. These systems can introduce problems if improperly installed, and can be a headache for smaller stations to maintain.

Unlicensed Part 15 Devices

If a tower at your studio location is an option, you may consider several devices on the market that utilize Part 15 of the FCC Rules. These devices operate in the 900 MHz, 2.4 GHz, and 5.4 GHz bands. They are fairly inexpensive compared to licensed microwave, and do not require prior coordination or licensing. If your link is a short distance of up to a few miles, these license-free devices may be your answer. They are line-of-sight, so you will need to keep that in mind when considering these as a solution. They are installed similarly to a licensed microwave system.

However, instead of running hard line up to the antennas, these generally use standard shielded network wire. The equipment is actually located outside, on the tower, and power and audio is sent up the network wire. Since the RF output of these units is limited, this makes use of every ounce of power available. Since this is a license-free service, you *are not* protected from interference. So your mileage here may vary – literally – but generally they are quite reliable.

Another solution is a dry pair, or equalized phone line from the local phone company. These can work quite well if the distance between your studio and transmitter site is not too great. A dry pair is good for a link of a block or two down the road. Beyond that, an equalized line would be required. Pricing on these varies and can range from $50 to several hundred dollars per month, and installation can cost $500 - $1,000. These solutions do not require additional equipment, though pre-processing of the audio at the studio is recommended.

ISDN is another older solution. This would require a special device on both ends, sometimes referred to as a codec. Additionally an ISDN circuit at both studio and transmitter site would be required. These are very reliable systems, but entry costs and ongoing monthly costs can be prohibitive to some stations.

The Internet has brought us many wonderful things. With the Internet we now have many STL options utilizing various codecs. ISDN was the first step in digital delivery of audio, and the Internet takes it a step further.

So Let's Talk Codecs

There are many flavors of codecs these days which will fit any budget. The first step is to establish a reliable Internet connection at both the studio and transmitter sites. While you'll only be sending a stream using about 128k of bandwidth, its best to go with a much higher Internet connection speed, which will ensure headroom as other traffic passes through the network in addition to your codecs' audio stream.

I recommend, at the very least, a 512k connection, but routinely select a higher plan when available, just to be sure. The extra bandwidth is also useful should you decide to install security cameras at the transmitter site. The Internet can also be useful to your engineer when working at the transmitter site. You can even ship telemetry data back to the studio via the Internet connection.

(Continued on Page 40)

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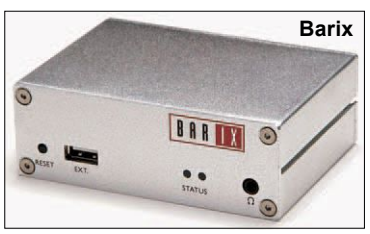
Links and Lines

– Continued from Page 38 –

Bring on the Codecs

If you've decided to go the Internet route, there are several options available, ranging from a few hundred dollars to several thousand dollars. In this article we'll briefly mention a few of these. In a future article we'll take a more detailed look at each device.

Common to all codecs are two parts: the encoder and the decoder – sometimes the devices operate in a duplex manner. My personal favorite, and the lowest cost codec, is from a company out of Switzerland. Barix entered the market several years ago with their low cost solution. For around $600 you can purchase a complete STL system from Barix. While there is a bit of a learning curve on the initial setup, these units operate very reliably once set up. Programming is handled through a standard web browser and can be adjusted from any Internet connected browser.



Barix

The Barix Instreamer/eEstreamer 100 is a great low cost solution. They do offer other models with additional features to fit your needs. While the lower cost unit offers only RCA input and output, the quality is quite good. It does have a s/pdif connection however. If you need balanced audio there are models which will accommodate your needs, but at a higher cost.

Another low cost system is Pyko. Similar to Barix in size and design, these units cost a bit more – around $1,200 for a system. These units offer balanced audio, and might be a bit lower cost than the Barix system with balanced audio.

I particularly like the 8 GB onboard RAM. The Pyko unit is also configured through a web interface.

Pyko

If you like German engineering you might be interested in the Mayah. At $4,000 per pair, this system is the "BMW" of the codec world. The C1191 dual IP codec utilizes FEC and AJC, minimizing the effects of changing bandwidth and packet loss. If you are on an "iffy" Internet connection, this unit may just save the day.

Mayah

The old favorite Comrex offers a few systems around $6,000 which offer balanced audio, and AES I/O on XLR. It can interface with a wireless Wi-Fi network, and even accommodates connections with 3G/4G/LTE cellular data networks using supported USB devices.

The Comrex "Access"

My first experience with a codec was with a Telos Zephyr. This was used on an ISDN circuit and produced unbelievably beautiful sound quality. While this was about ten years ago, the system is still being produced and can even be used on IP networks. A new version of the Zephyr comes with a built in mixer – great for remotes! The cost is usually around $10,000 for a pair.


The Telos Zephyr

I have heard great things about AEQ. This company offers the Phoenix-Mercury at a cost of around $1,800. These units offer balanced audio AES/EBU/I/O. APT offers the Horizon –Nextgen model for around $4,500 for the system. This offers balanced audio and unlike the previous systems it is contained within a 19" rack mount enclosure.

AEQ

As you can see, there are many options when choosing a codec for your station. We have only touched the surface in this article. The codec that is right for you may be decided by your budget. Each essentially does the same thing – they all deliver your audio from point A to point B. Each has their own unique way of doing this and how errors in the data stream are handled.

Leo Ashcraft is CEO of Nexus Broadcast – "Broadcast Outside The Box!" You may contact Leo at: Leo@NexusBroadcast.com or 888-672-4234.

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Two is Better Than One

by Roger Paskvan

There is a lot to say for that phrase, and in small marketville it proudly held its reputation. Our sales account executive came into the station all excited that she had sold football to a little town north of us. This was fine except the town was just outside of the useable range of our play-by-play Marti system. Here is what we did to make it all work.

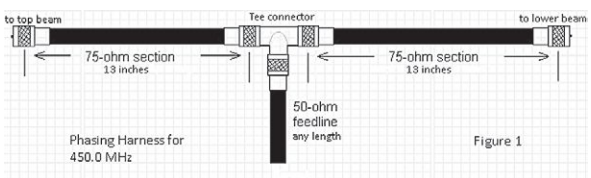
The thought occurred to me that "two is better than one." Two 10-element UHF beams were ordered for the job. Andrews wanted an outrages price for a combiner so we decided to construct one. Two UHF beams adding together will provide a three dB signal improvement. (that's two times)

First, we determined the stacking distance between the antennas on the tower. The experts say center-to-center between the beams should be close to 0.68 wavelengths. Since everything in antenna language is in wavelengths, we determined our wavelength at the Marti frequency. Our channel is 450.00 MHz, so we took 984/450 = 2.186 ft. Converting this to inches gave us 26.24 inches, which represented the physical distance of one cycle at 450 MHz. To determine 0.68 wavelengths, we multiplied 26.24 x 0.68 and got 17.84 inches (rounded to 18 inches). This was the vertical spacing between the two beam antennas on the tower, measured boom to boom.

The phasing harness was made up of coax cable and a handful of connectors. Since both beams were 50 Ohms, it was possible to utilize a matching device called a quarter wave transformer. This consisted of a piece of coax that was exactly one quarter wavelength (or multiples of a quarter wavelength) long. Its magic property is that it will double the 50 ohms at the opposite end. We utilized this property to match the two beam antennas by converting them both to 100 ohms and combining them together with a tee connector. Each piece of coax cable met in the center in parallel. (two 100 ohms in parallel will get us back to 50 ohms)

Next, we found the exact physical distance of a quarter wavelength of coax. Returning to our initial formula: a full wavelength is 26.24 inches. Dividing this number by four we found quarter wavelength distance of 6.56 inches. Since coaxial cable slows down radio waves, things get more complicated. You must now determine the velocity factor (VF) for your cable. Google the type number stamped on the cable and the cable specs should come up. In my case, our cable VF is 0.66. Multiply 6.56" times 0.66 (or your own cable's VP). My result was 4.32 inches. This was the physical distance of that quarter wavelength of coax.

The coaxial cable you are using must be 75 ohm type because it is midway between 100 and 50 ohms. We soon realized that 4.32 inches wa not long enough to connect the distance between the beams on the tower. Fortunately, the same laws that gave us this quarter wave theory say that any odd multiple (3, 5, 7 etc.) of this quarter wavelength will work the same way. We multiplied the basic quarter wavelength by three (4.32" x 3 = 12.96"), and we rounded up to use 13 inches as our magic number for a 3/4-wave of coax cable that will interconnect between the two beam antennas.



In part two, we will discuss how to fabricate this phasing harness out of these two 13 inch chunks of coax, and make it all work with testing.

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

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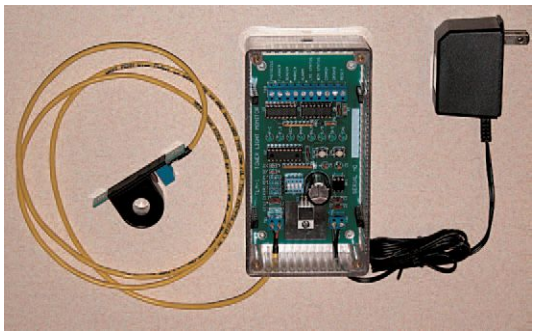

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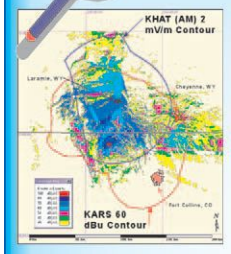

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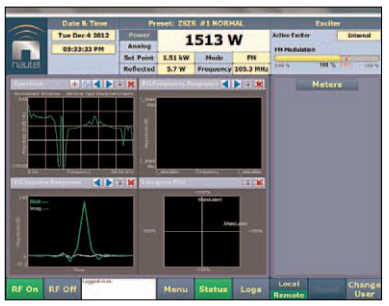

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