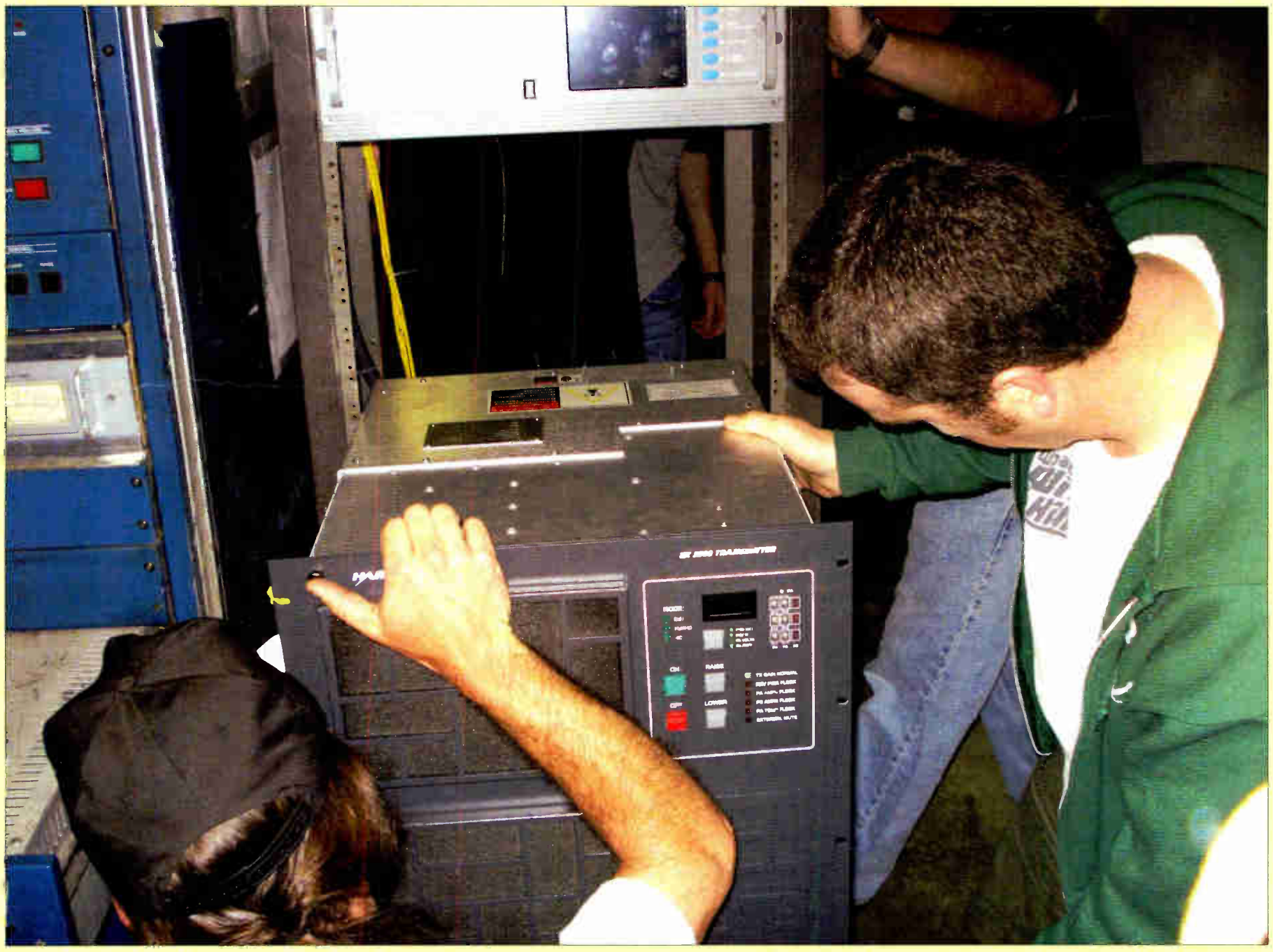
Radio Guide

Radio Technology for Engineers and Managers

July 2007

Broadcast Industry Volunteers Aid to Non-Comm College Station



Inside Radio Guide

Like the rest of the nation, I was shocked and saddened when I learned of the pointless bloodshed on the Virginia Tech Campus. I joined millions as we saw the brave face of Kevin Sterne, former Eagle Scout and current Electrical Engineering major – who, after being seriously wounded, fashioned a tourniquet from an electrical cord and tied it to himself, saving his life until he could be transported to the hospital.

What I did not know at the time was that Kevin was the Chief Engineer for the College radio station, WUVT-FM, nor did I know that his radio station had experienced a transmitter failure and was on significantly reduced power and operating under STA (Special Temporary Authority).

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Radio Guide

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Cover Photo

When you see more than one or two engineers in a transmitter room, something special must be going on. Here volunteers respond to help keep a college station on the air.

Provided by: Jeff Parker, DOE, Clear Channel Roanoke

Radio Guide

Volume 15 – Issue 7

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Radio Waves

by Barry Mishkind – Editor

Given the constant budget pressures in today's business climate, it is understandable if a broadcast engineer sometimes feels like he is a bit alone in the world.

Of course, if you are stuck up on a remote mountaintop with a broken transmitter and no cell service, yes, you are officially alone.

At the same time, we have an industry filled with folks willing to help whenever possible. It might be teaching an intern or new hire how to maintain a transmitter site or automation system. (Mentoring someone is one of the best ways "to give something back" to the industry you love.)

For those a bit more isolated in physical terms, perhaps answering a question or offering a helpful opinion on the Broadcasters' Internet mailing list (www.radiolists.net) at 3AM is another valid way to give something back.

And then there are those times where the engineering community-at-large comes together, volunteering time and effort to help a station or an engineer deal with emergencies or other major problems. Marketplace competition is forgotten quickly, as a helping hand is extended.

Steve Davis' account on Page 4 of how all sorts of radio people got together to help WUVT clearly shows that we are not alone in the field.

The other articles in this issue also come to you from people who want to help by sharing some of what they know. Dave Dunsmoor shows on Page 26 how Practical Engineering can prevent problems from getting started, and Chris Tarr's discussion on Page 8 gives advice on how to keep your station from being overcome by full closets.

You are invited to share in the process by giving something back – locally, via the Internet, or by sharing your knowledge and experience. That is our goal and the best legacy there is: making someone, somewhere, feel a little less alone. *– Radio Guide –*

Radio.edu

A Non-Comm View

by Steve Davis, CPBE
Clear Channel Radio

Broadcasters and Equipment Vendors Come Together to Help Virginia Tech Radio Station

Many college stations limp along with small budgets and older equipment. However, in the aftermath of the mass murders at Virginia Tech, the broadcast industry came together to help one struggling station, in a tribute to its selfless engineer.

Like the rest of the nation, I was shocked and saddened when I learned of the pointless bloodshed on the Virginia Tech Campus. I joined millions as we saw the brave face of Kevin Sterne – former Eagle Scout and current Electrical Engineering major – who, after being seriously wounded, fashioned a tourniquet from an electrical cord and tied it to himself, saving his life until he could be transported to the hospital.

BEYOND THE HEADLINES

What I did not know at the time was that Kevin was the Chief Engineer for the college radio station, WUVT-FM, nor did I know that his radio station had experienced a transmitter failure and was on significantly reduced power and operating under STA (Special Temporary Authority).

WUVT: On the air – barely.

Tex Meyer, General Manager of the Clear Channel radio stations in Roanoke, Virginia, contacted Clear Channel headquarters to let them know that the college station was in trouble, operating at low power, and that their Chief Engineer was in the hospital recovering. Other CC station employees in a number of markets had friends or relatives who attended, or were alumni of, Virginia Tech.

Soon, both Clear Channel President Mark Mays, and Radio President John Hogan were asking Jeff Littlejohn and me what we could do to help restore WUVT-FM to full power. We sent our Roanoke Chief Engineer, Jeff Parker, to the college transmitter site to investigate and to help acting WUVT Chief Engineer Josh Arritt, who was standing in for Kevin because of his injuries. The station had an aged BE transmitter which was in need of a part and some repairs.

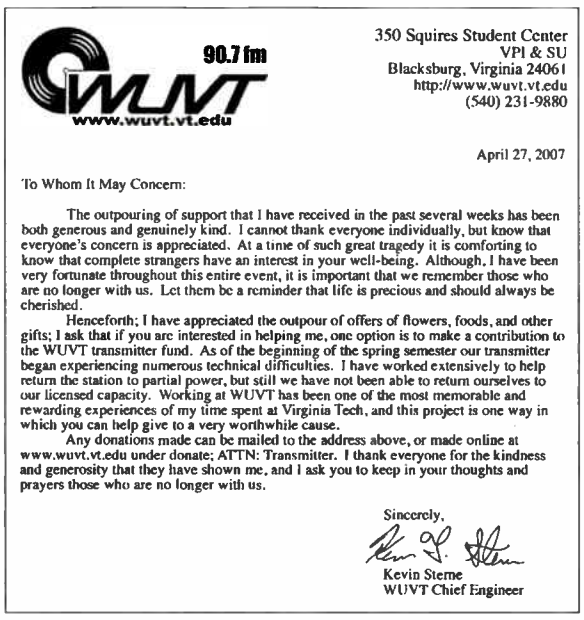
AN INDUSTRY MOVES INTO ACTION

Once BE was informed of the station's plight, they not only rushed the part via overnight delivery but offered to send a field tech if we could not solve the problem. Harris meantime offered to provide a small 3 kW ZX transmitter with an HD-capable Flexstar exciter in the event the BE could not be brought back to full power. Harris donated the exciter, Clear Channel paid for the transmitter.

When we saw the transmitter room, a non-air-conditioned room in an elevator penthouse atop a dorm building, we offered to help fix up the room and install an air conditioner. That is when we learned that the college and station had long-standing plans to move off of that site to a nearby site atop "Price Mountain," where the University owned land, thus enabling the station to increase power and coverage significantly.

Volunteers install a new transmitter.

In fact, we learned that one of Kevin Sterne's dreams was to be able to move the station to the mountaintop site. As part of that goal, Kevin selflessly wrote a letter asking any who might consider making donations to him personally to instead make donations to help facilitate WUVT's long planned move to this new site.



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April 27, 2007

To Whom It May Concern:

The outpouring of support that I have received in the past several weeks has been both generous and genuinely kind. I cannot thank everyone individually, but know that everyone's concern is appreciated. At a time of such great tragedy it is comforting to know that complete strangers have an interest in your well-being. Although, I have been very fortunate throughout this entire event, it is important that we remember those who are no longer with us. Let them be a reminder that life is precious and should always be cherished.

Henceforth; I have appreciated the outpour of offers of flowers, foods, and other gifts; I ask that if you are interested in helping me, one option is to make a contribution to the WUVT transmitter fund. As of the beginning of the spring semester our transmitter began experiencing numerous technical difficulties. I have worked extensively to help return the station to partial power, but still we have not been able to return ourselves to our licensed capacity. Working at WUVT has been one of the most memorable and rewarding experiences of my time spent at Virginia Tech, and this project is one way in which you can help give to a very worthwhile cause.

Any donations made can be mailed to the address above, or made online at www.wuvt.vt.edu under donate; ATTN: Transmitter. I thank everyone for the kindness and generosity that they have shown me, and I ask you to keep in your thoughts and prayers those who are no longer with us.

Sincerely,

Kevin Sterne
WUVT Chief Engineer

As word leaked out in the trade that BE, Harris and Clear Channel were providing help, soon the station and I were flooded with generous offers of help from all around!

GENEROSITY FLOWS FROM ALL OVER

This is when things *really* got exciting. I found myself in the role of coordinating offers from many generous patrons and working with WUVT General Manager Kim Foley, a student who was extremely responsive, organized and resourceful and deeply committed to making this happen.

First Chriss Scherer of the SBE called offering to help. The SBE offered to provide their own FCC counsel to handle the FCC legal work, and Dane Erickson of Hammet & Edison (an SBE Sustaining Member) offered to do work on the FCC Engineering studies and other engineering work.

Then Bob Orban donated a new 8500 processor and Burk donated a remote control. Mike Rhodes, an independent consultant, offered to handle STL licensing and frequency coordination. Clear Channel would provide a Harris Z5 transmitter, prefab transmitter building, and antenna. But our antenna had too many elements and was not on the non-commercial frequency of 90.7 MHz, so ERI offered to cut the antenna down and retune it to that frequency at no charge.

A Z5CD being retuned and donated to WUVT.

Telos-Omnia-Axia and Dielectric also offered equipment, TFT offered a digital STL. Lincoln Financial is donating a six-foot STL dish and has offered a Moseley STL system. Pittsburgh PA engineer John Johnson of WDUQ has offered hands-on engineering help. Contract engineer Josh Arritt is donating STL transmission line.

The outpouring of support has been very gratifying. The SBE is helping direct donations to the college to cover those things that the equipment donations cannot cover, such as foundation pouring costs.

MOVING AHEAD

It turned out that there was an existing tower on the university's mountaintop site, owned by Cumulus. Gary Kline has offered help as well, and not only is Cumulus working with ERI on supplying the information needed to complete the structural study, but Cumulus has offered to have their engineering firm do the FCC filing.

Recently, Cumulus Regional Engineer Dave Supplee joined us in-person for a meeting on the Virginia Tech campus to work with the University on antenna placement, given the existing Cumulus antennas and other appurtenances on the tower.

WUVT's future now includes a new transmitter building at this mountain site.

It is our fervent hope that now that Kevin has recovered from his serious wounds, he will have the opportunity, before he graduates, to oversee and participate in the move of WUVT-FM from its 3 kW ERP college dorm facility to a 10 kW ERP mountaintop site, fulfilling his long-time dream.

The broadcasters, broadcast suppliers, and the SBE have heard Kevin's plea and answered it, and I am thrilled to have the opportunity to help coordinate this extremely worthwhile project.

Steve Davis is the Senior Vice President, Engineering for Clear Channel Radio. He can be reached at stevedavis@clearchannel.com

Meet Some Real-World Super Heroes...

Mark Ericson and the WOKQ morning team, along with Steve Vanni from Technet, recently used ACCESS to deliver a three hour remote from the top of Mt. Washington. For mere mortals, this would have been an impossible task. The height, the weather, the distance – all conspired to prevent a successful remote. But because they carried ACCESS, they became real-world super heroes.

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Tech Tip

by Tom Taggert

Satellite TI Clinic

We were running programs from ABC Satellite for two years without a problem. Then the GM added Delilah from Premiere Radio.

A Starguide receiver arrived from Premiere and, after a simple installation, I had Delilah on the air. Having been used to the ABC receivers, I was suspicious of the front panel display on the Premiere Starguide. The "AG" number was near 120, but the "EB" number fluctuated, going from 10 down to 6, then back up to 8 in just a few minutes. However, Delilah aired without any problems for two months, so I stopped worrying.

Then one night the signal just vanished. The ABC receivers were happy so this must be a problem with the Premiere receiver, right?

Wrong. Welcome to the mysterious world of Terrestrial Interference (TI). The culprit in my little story proved to be a signal from an MCI tower some twenty miles away.

C-BAND, L-BAND, BAND ON THE RUN

Most satellite services for radio are on C-band satellites, using the spectrum between 3.7 and 4.2 GHz. Many of the satellite services are on AMC-8 (according to SES-Americom, over 6,000 stations use a service from AMC-8). If you look at the "frequency plan" for AMC-8 (found at www.ses-americom.com), the 24 transponders are 20 MHz apart, beginning at 3720 MHz for transponder 1 and ending at 4180 MHz for transponder 24.

When we added the Premiere feed, I could not find anywhere on the Premiere website which transponder they were using. The frequency display on the Starguide simply said 1023. But that does not look like a C-band channel. So tracing the interference required a bit of math.

Hanging on the front of the dish is an LNB (Low Noise Block) converter. C-band goes in, beats with an oscillator at 5150 MHz – and L-band audio comes out. If you take 5150 and subtract 1023, you get 4127 MHz, or just adjacent to Transponder 21 (4120 MHz).

Apparently, something in that frequency range was interfering with our Premiere signal.

TRACKING THE SIGNAL

To see what might be the problem, I used a search on the FCC site: http://svartifoss2.fcc.gov/reports7/ For this situation, I found the "Location/Range" query is the most useful.

To use the function, you put in your coordinates, select point radius and enter M3700 to M4200. In my case, a search found an MCI microwave site 23 miles away to the SW using 4130 MHz. From our site, AMC 8 is at 248° while the MCI tower was at 254°, aimed at another tower just a 1/2 mile east of us.

The much stronger telco signal just 3 MHz away was overwhelming the satellite feed.

OTHER POSSIBLE SOURCES

Not all interference is in-band. Coastal and navigational radars between 2.9 and 3.65 GHz can saturate the LNB, bothering the lower transponders. Airport altimeters between 4.25 and 4.40 may bug transponders 22-24 (ABC radio is on transponder 23). And Military radar ("AWACS") also operates in the range just above 4200; these signals usually appear as regular pulses as much as 30 seconds apart, fading in and out as the plane passes by.

When tracing interference, do not forget in-house sources can also cause problems: L-band signals can be as low as 950 MHz, or it might be a "dirty" STL causing your problems if everything is not buttoned up tight.

The best way to identify TI is with a spectrum analyzer. If you look at L-band, remember the spectrum is inverted – higher frequency C-band signals appear *below* your center frequency on the display. If you have a spare LNB, hook it up directly to the analyzer and wave it around. Any strong local signals will be obvious.

Some signals can only be identified with the spectrum analyzer. For example, "sweepers" – mysterious pulses that run up and down through the band. My local satellite guy tells me that renegade local oscillators from cellular equipment can cause this type of interference.

CURING TI

One of the easier cures, shielding the dish, can be very effective. In our case, we installed a hardware cloth screen, mounted behind our dish. That has eliminated much of the signal from the nearby MCI tower.

Filters can also be very effective. Microwave Filter in Syracuse (www.microwavefilter.com) makes a variety of useful filters. You might want to ask them about their "AWACS" filter that mounts directly in front of the LNB. It is a great tool for curing military radar interference.

Microwave Filter also sells several L-band filters, both fixed and tunable, which can be helpful for in-band interference. In our case, a three-section filter at 1020 MHz helped.

There is one more solution once you have identified the problem carrier and its source. It might take some effort, but it paid off for us. The real cure to our TI problem came when we were able to convince MCI to turn their carrier off.

Tom Taggart part owner of two FM stations in WV. He can be reached at tpt@eurekanet.com

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IT Guide

by Chris Tarr

Keeping Control of the Storage Closet

One of the highlights of the long-running NBC radio network show "Fibber McGee and Molly" was when Fibber went to open his closet and all manner of things fell out – at least it sounded that way on the radio. (The story was that Fibber McGee never threw anything out.) In a similar way, many an engineer has a closet full of out-of-service gear that he dreads to open. As you read Chris Tarr's discussion, feel free to imagine the sounds when the closet door is opened!

Declining prices along with the increased number of computers in service for all sorts of uses have created an explosion of waste that extends well past the capacity of our various storage spaces, and ends up in the environment, where it is causing problems.

We all have one: that "secret closet" full of old computers, monitors, motherboards, and a wide variety of PC cards of all sizes and shapes. Usually stacked floor to ceiling, it is where old computer parts go to live out their retirement.

LOOK, MA! IT'S GROWING!

Well, at least it *starts* in the closet. It seems as though in the dark of night these parts magically multiply and, before you know it, you have parts in the closet, transmitter building, office – anywhere you had some spare room. It only takes a little time and the whole thing can quickly get out of hand.

The "Pile 'o Cards" at the Bolack Electrical Museum in Farmington, NM.

Of course, for environmental reasons, you cannot just simply throw the stuff out. Circuit boards and old CRTs contain hazardous materials like lead and mercury. Even if your municipality does not have laws governing the disposal of these types of items (most do), just throwing them out is a dangerous thing to do.

So, what can a station do with the growing number of old computers piling up in the back?

REUSE OR RECYCLE

The system I use is a kind of "reuse or recycle" system. It provides for some valuable spare parts. And what I do not need does not pile up in the back.

First, take inventory of what you have. There is a very good chance that you have enough parts to make one or two capable backup computers. These backup machines are handy – anyone who has ever had a sales or on-air Internet computer go down knows what kind of an emergency that can create! While these machines may not be speed demons, they will get the job done in a pinch.

Next, go to your local dollar or hardware store. Pick up some plastic bins and start sorting. Look for newer power supplies, memory, hard drives, CD-ROM drives, network cards, etc. Pull them and put them into your bins.

Do not forget to include some of those back plane "filler" plates and screws. (If you are like me, you are always looking for one those guys.) Label the bins, and stack them in an out-of-the-way place. Now, the next time you have a computer that needs some TLC, there is a good chance you have what you need in stock.

MAKING THEM DISAPPEAR

What can you do with those older computers that do not have any usable parts? If the computer is still functional (but you have outgrown it) there are a couple of routes to take.

There are some non-profit agencies that will take the computer, refurbish it, and resell it. Do call ahead before you donate – many places will not take real old computers or computers without an operating system and license (in the case of Windows machines).

In addition, there are many organizations that specialize in collecting parts to build computers for schools and churches; if they cannot use the parts, they will recycle what is left. If you are patient, many of these organizations hold a free recycling event once or twice a year.

One more possibility is to turn that old machine into a brand new one. Several computer manufacturers will take old computers in as trade-ins for new machines. While you will not get a huge discount, you will save a few dollars – and help the environment at the same time.

There is an important security issue to note, however. Depending on your company's security policies, you may need to pull the hard drive out and keep it. At the very least, you will need to get a good drive erase tool (a good free tool is "Darik's Boot and Nuke" – you can get it at http://dban.sourceforge.net/) and wipe the drive clean.

A PLACE FOR UNWANTED PARTS

While not necessarily noted for their insulation qualities – nor a wife-pleaser – surplus circuit boards can serve as a rather special conversation starter.

A different kind of "wallpaper."

The other solution, if nobody wants what you have left, is to contact a computer recycling company. The computer recycling, or "e-cycling" industry is relatively new, but is quickly growing.

Usually for a small fee, the recycler will take in your old CRTs and other computer parts. They remove and reuse whatever parts they can, and dispose of what is left in an environmentally responsible manner.

ADDITIONAL INFORMATION

Finally, here are a few resources to help you out:

- Share the Technology, www.sharetechnology.org, is a clearing house for computer recycling information.
- E-Cycling Central, www.eiae.org, also has some great information on electronics recycling.
- The EPA's site on "e-cycling", www.epa.gov/epaoswer/hazwaste/recycle/ecycling/index.htm has information on the hazards of electronic waste.

Although it seems like the piles of computer parts just continue to grow faster than you can get rid of them, with a little bit of effort, you will find that it is indeed possible to give some of that old stuff some new life – while still keeping the rest out of our landfills.

Chris Tarr, CBRE, CBNT, is the Director of Engineering for Entercom in Milwaukee and Madison, WI. Contact Chris at: ctarr@entercom.com

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The RemoteMix 4 can be powered by batteries or the included AC adapter, so you'll never lose a connection – even during a loss in power!

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Digital Guide

by Philipp Schmid
Nautel Ltd.

Addressing Packet Loss in HD Transmission

As more stations move to digital transmissions, transporting the IBOC signal from the studio to the transmitter is proving to be more of a challenge than anticipated. The manufacturers have identified various problem areas, and solutions are starting to filter out to the field.

OVERCOMING THE STL BOTTLENECK

A studio-transmitter link must be able to carry Ethernet/IP based traffic along with traditional audio streams, making a digital STL mandatory. Many stations have already transitioned to digital STLs, and most STL vendors now provide upgrade paths to share the existing digital STL bandwidth between audio paths and Ethernet-based paths.

However, since most STLs have traditionally been unidirectional in nature, many digital STLs today only provide a unidirectional Ethernet path.

Digital signal paths are notoriously fragile. Signal fades, ducting, multipath, etc. are challenging enough with analog STLs, but digital streams are unforgiving. A single bit error on the STL can cause an entire data packet to be dropped, which translates to one to two seconds of dead air on all digital program channels (HD dropout).

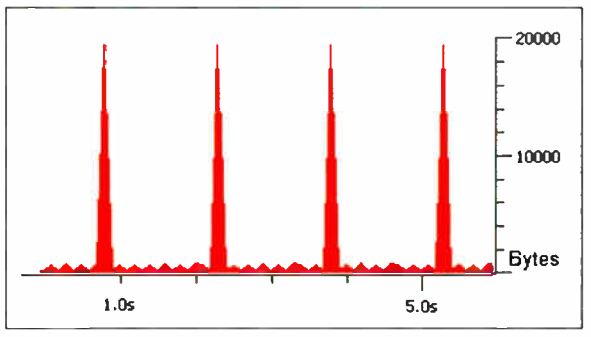
THE E2X PROTOCOL

An IBOC deployment today uses the iBiquity exporter to exciter (E2X) protocol, which requires IP transmission for the studio-transmitter link. It is frequently deployed using UDP, which is fast and has a reasonably low overhead in terms of bandwidth.

Service Mode	On Air Bandwidth	Average E2X Bandwidth	Required E2X Bandwidth
MP1	98.4 kbps	119.7 kbps	159.9 kbps
MP2	110.8 kbps	132.1 kbps	176.1 kbps
MP3	123.2 kbps	149.3 kbps	199.0 kbps

Table 1: E2X UDP Bandwidth Requirements
[taken from iBiquity Network Requirements]

The required bandwidth shown in Table 1 is sufficient to establish a data connection. However, peak throughput can be as much as 1.8 Mbps, causing transmission congestion, in turn requiring extensive buffering and breaking the studio to transmitter synchronization, which makes it necessary to use additional GPS synchronization at the transmitter.



The peak throughput can greatly exceed the typical STL bandwidth, causing problems.

Re-transmission of such HD data is problematic; the packets only convey meaningful information prior to the time that they are intended to be on the air. Retransmission requests beyond that time are useless and may unnecessarily congest the STL; late delivery of a packet results in the same effect as packet loss.

FROM UDP TO TCP/IP?

There is some talk in the industry of switching from a UDP transport layer to TCP/IP (something supported in the Nautel M50 for the past 14 months). This would enable better re-transmission of packets but creates a different set of problems.

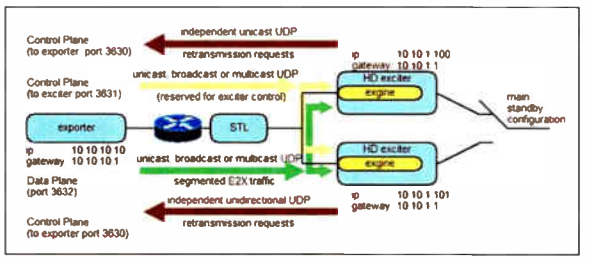
Here is why: TCP/IP is limited to point-to-point connections; it does not work on unidirectional STLs; it is not well suited for high latency links or links with even intermittent packet loss greater than 1%; and it re-transmits packets well past their usable transmission window or terminates the connection altogether.

In looking at the various options for transporting HD signals, Nautel engineers decided that neither traditional UDP nor TCP/IP was the solution. Instead, they wrote a new protocol that allows bidirectional communication for retransmission requests and can use multiple links for communication.

NAUTEL'S IMPLEMENTATION OF E2X

The Nautel protocol buffers the IBOC data by a user-configurable amount of time to allow for retransmission, reducing the chance of losing packets on the receive end. It also restructures the data stream so that instead of sending one large burst followed by several frames of almost no data, the data is repackaged into a continuous stream that occupies a constant bit rate.

This new method of transporting HD reduces the demanding reliability constraints placed on STLs, thereby reducing the chance of dead air.



Nautel's E2X signal flow.

The Nautel protocol is addressable; it can operate point-to-point or point-to-multipoint at the user's discretion. This allows an Exporter to address a specific exciter for a retransmission or to address several exciters for booster, translator, main/standby applications, or network broadcasting applications. Directed broadcast can be used to avoid flooding every other device on the net.

The Nautel protocol also allows for a dedicated unidirectional path for the HD data to the transmitter site, with retransmission requests being handled on a second path. An example would be the use of a Moseley Starlink for transmission of HD data and a Lanlink used for other data such as retransmission requests, site remote control/telemetry, and Internet/intranet/Ethernet connections at the transmitter site.

Although the Nautel HD Transport protocol was written originally for use with Nautel HD transmitters, it will operate with other manufacturers' HD transmitters that have been equipped with Nautel interface units.

A LAYER ON TOP OF UDP

The Nautel E2X transport protocol implementation is layered on top of UDP, since UDP allows broadcast and multicast communication. The preceding diagram shows one possible main/standby exciter configuration across a generic STL.

The protocol is broken into a control plane and data plane. The data plane carries the encapsulated and segmented E2X protocol to all exciters. With a bidirectional STL, the Exporter can directly communicate with a single exciter using unicast IP, which directly maps a single IP address to a unique MAC address. (In the case of a unidirectional STL, the intermediate router can be programmed with a static MAC entry.)

To address multiple exciters simultaneously the Exporter must resort to either the broadcast mode (without an intermediate router), directed broadcast (through the router), or multicast IP (scheduled for implementation soon by Nautel) to address only a subset of exciters.

The control plane communication from the Exporter to the exciters follows the same communication modes as the data plane, but the Exporter may choose to directly address only one of several exciters. For example, the Exporter may grant the ability to issue a retransmission request only to a subset of listening exciters, allowing for a highly scalable point-to-multipoint deployment of this protocol.

PASSING REQUESTS BACK TO THE EXCITER

The control plane communication from the exciters back to the Exporter is always unicast directly to the Exporter.

However, in the case of a unidirectional STL, this communication stream will not make it back to the Exporter, so the transport protocol cannot make the assumption that retransmission requests will in fact reach the Exporter. This will result in an HD dropout, but the E2X protocol will continue to operate correctly.

On the other hand, the Nautel exgine implementation is specifically designed to handle data loss by repeating known good content on air in the case of data loss. This ensures maintaining your analog diversity delay, as well as maintaining power levels and spectral compliance during and after the data loss.

Some packet types, such as the Exporter's control packet, require guaranteed delivery in order for the exciter to start modulation with correct operating parameters. Rather than relying on stored parameters, which could cause a configuration mismatch between the Exporter and the exciter, the reliable HD transport protocol maintains a copy of the most recent control packet and periodically retransmits the control packet to the exciter.

MEETING THE NEED

Using the configuration shown in the diagram, both HD exciters are always ready to transmit HD and the digital modulator is not aware whether it is active or in hot-standby mode. The Exporter also is not aware which exciter is currently active.

Both exciters independently issue retransmission requests back to the Exporter. If only a single exciter has lost a packet, it will issue a corresponding retransmission request. If both exciters lose a packet, both will issue a retransmission request but if the retransmission requests have been received close enough in time, the Exporter will only retransmit the same data packet once.

Retransmitted packets are delivered to both exciters just like a regular data transmission. An exciter knows, based on sequence numbers, whether it has already received a packet and will discard duplicate data packets. Retransmission requests are made continuously until the data packet arrives or until the operation times out.

This approach not only allows for redundancy in the exciters, it also allows the entire data path between Exporter and exciters to be split and made redundant. This is an option when employing two unlicensed STLs – when one STL link is lost due to interference the transmitter can switch over to the working link by switching exciters.

(Continued on Page 12)

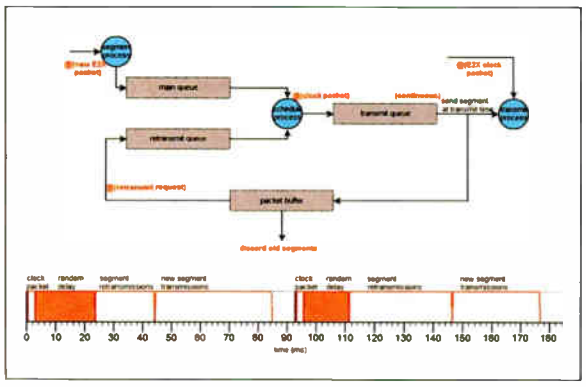
Continued From Page 10

Addressing Packet Loss in HD Transmission

SEGMENT SCHEDULING

In order to maximize transport bandwidth, the E2X data stream has been segmented. Standard UDP provides segmenting functions already; however, most STLs operate at a much lower network bandwidth compared to most LAN deployments.

Consequently, all UDP segmented packets will likely be placed on FIFO queues effectively negating the effect of segmentation unless the STL provides more sophisticated queuing. The following diagram presents a queuing structure that can effectively utilize the segments and compute packet dispatch times that match the reduced STL throughput rate.



A look at the segment scheduling.

On the Exporter, every new E2X packet is segmented right away and all resulting segments are placed on the main queue; each segment is treated independently from that point on. The reception of a clock packet triggers the scheduling process that is controlled by two parameters:

1. The main bandwidth parameter sets the bandwidth required to sustain the regular E2X data stream without retransmissions. It determines how many segments may be transmitted in one clock interval and causes any instantaneous bandwidth variations to smooth out over time;

2. Overall STL bandwidth dedicated to this E2X stream dictates the rate at which segments are dispatched from the Exporter. It also governs how much additional bandwidth is available for retransmissions.

The scheduling process places segments from both the main queue and the retransmit queue onto the transmit queue as shown on the diagram. However, clock packets bypass the transmit queue and are directly sent to the exciter with a flag set to disable retransmissions for clock packets.

KEEPING THE TIMING RIGHT

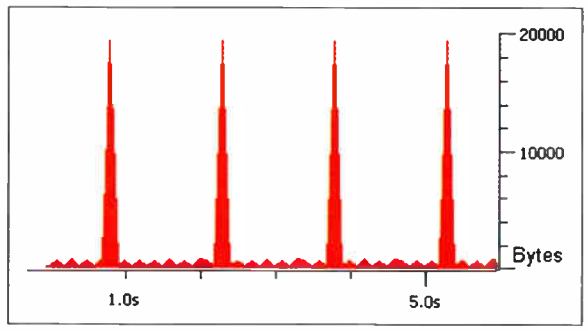
As each segment is placed on the transmit queue a dispatch time stamp is attached to it. The transmit process only dispatches segments after the given time stamp has elapsed.

The scheduler may first insert a random delay where no segments are scheduled. This minimizes the impact of one E2X stream onto another on the same STL, as it allows the two streams to interlock better while minimizing the synchronization impact. The scheduler first determines how much bandwidth is used up by new segments, but it schedules retransmissions prior to new segments, since retransmissions are more time critical.

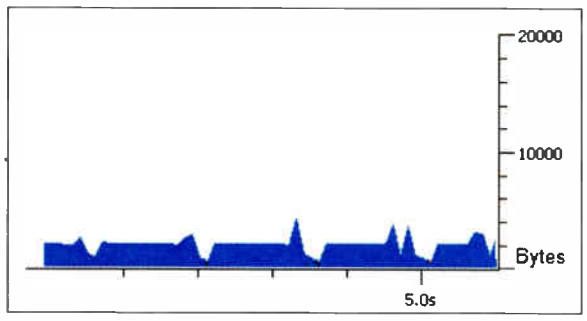
All dispatched segments are placed on the packet buffer until they get too old to be of interest (in other words, greater than the exciter receive buffer depth). A retransmission request from any destination searches the packet buffer for the given sequence number and places it on the retransmit queue. If two or more requests for the same sequence number from different exciters are received, only the first request is serviced since the same packet is delivered to both destinations.

BANDWIDTH BENEFITS

The following diagrams show the marked improvement in bandwidth utilization that is achieved, compared to standard E2X bandwidth utilization, and demonstrates how multiple E2X streams can coexist on the same STL much more easily.



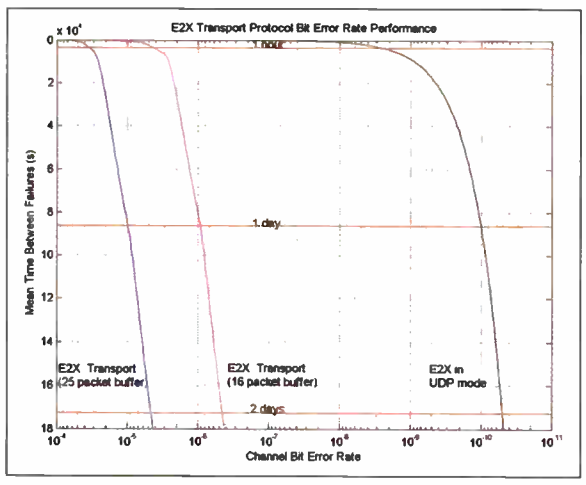
E2X Instantaneous Bandwidth



E2X Transport Protocol Bandwidth

BIT AND BURST ERROR PERFORMANCE

In order to evaluate the effectiveness of this retransmission scheme, random bit errors are intentionally introduced at the segment level rather than causing discards. That way bandwidth resources are still consumed while not conveying any useful information.



A comparison of Bit Error Rates shows the benefits of the Nautel E2X Transport Protocol.

In the above diagram, the data contrasts the transport protocol's bit error performance with the E2X protocol in UDP mode based on the relationships discussed earlier. The exciter has a configurable receive buffer depth that allows the station operator to choose between increased protocol performance and total signal propagation delay.

Two buffer levels of 16 packets (1.48 seconds) and 25 packets (2.32 seconds) are illustrated. Keep in mind that the E2X stream is spread almost over an entire L1 IBOC frame depending on how much bandwidth is allocated for it, reducing the effective buffer depth to a degree. This means that not every segment has the same chance of successful retransmission.

With a buffer depth of 16 packets some packets may only be retransmitted once or twice; a buffer depth of 25 packets provides increased reliability due to a greater chance of successful retransmission.

The number of retransmissions depends on the throughput delay across the STL. The presented data takes this delay into account as it has been collected using a Moseley Starlink / Lanlink combination in this instance.

MATCHING STL PERFORMANCE

Engineers should analyze the effective bit error performance of their STL equipment and select the desired quality of service. This identifies the operating point on this chart.

If necessary the exciter's buffer depth can be adjusted. High quality RF/T1 based STLs are available with bit error rates sufficient for good quality IBOC transmission. However, the STL itself is not the only source of data loss.

Intermediate network equipment can contribute to packet loss due to congestion conditions or other circumstances and most network equipment is not designed to provide extremely high reliability. These symptoms will manifest themselves as packet loss which can be lumped into an effective bit error rate when averaging over a long enough time period.

USING THE BIT ERROR INFORMATION

Bit errors are a good way of characterizing the effectiveness of this protocol, but uniform random bit errors are almost an ideal error distribution, if they happen infrequently enough.

In reality, bit errors are not uniformly distributed and usually occur due to an interference condition or fading. So it makes sense to investigate the maximum amount of time the exciter can maintain a steady data stream and replenish the data due to a complete STL interruption and associated packet loss. The following table outlines the burst tolerance of the protocol with respect to a configured receive buffer depth.

Buffer Depth (packets)	Buffer Depth (seconds)	Maximum Error Burst	Max Aggressor Traffic (300 kbps)
16	1.48 s	200 ms	7.3 kB
25	2.32 s	600 ms	22.0 kB
35	3.2 s	1300 ms	47.6 kB
50	4.64 s	2100 ms	76.9 kB
75	6.96 s	3700 ms	135.5 kB

With a greater packet depth, the stream is more resilient to errors or brief interruptions.

Of course, the leading reason for an STL interruption may not be the RF path at all. Instead the STL may experience a congestion condition due to other traffic, which could lead to packet loss or severe packet delay with the same consequences.

The last column shows how much aggressor traffic can cause a corresponding STL interruption given an effective throughput rate of 300 kbps. The speed differential caused by inadequate network design can easily allow these amounts of aggressor traffic to be injected into the STL if no precautions are taken.

The benefits of the Nautel E2X Transport Protocol are robust, drop-out free program stream and can be adapted to any manufacturer's digital transmission system.

There is a great deal of additional material describing this E2X transport system and its operation in a White Paper by the author that has been published by Nautel. Covering all aspects of the new HD transport system, the White Paper may be found on the Nautel website, www.nautel.com

Philipp Schmid is a Digital Design Engineer at Nautel Ltd. His email contact is philipp.schmid@nautel.com

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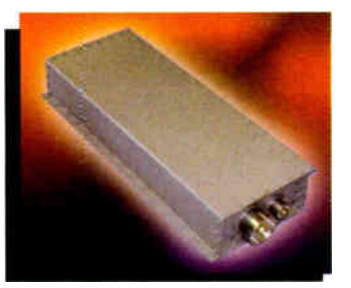

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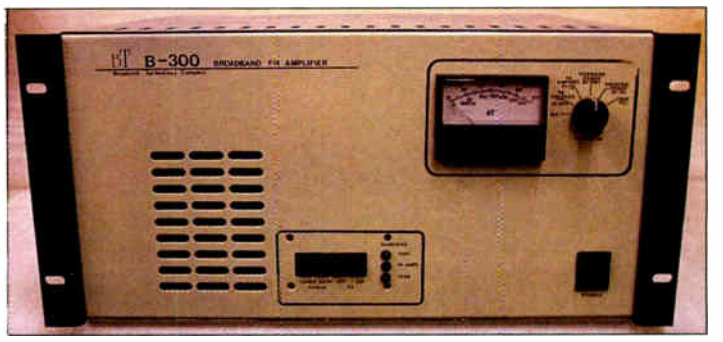

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Processing Guide

by Jim Somich

Processing: Yesterday, Today, and Tomorrow

Part 6: Peering Ahead

As our series on the history and future of audio processing reaches its climax, Jim Somich takes the opportunity to use the past as a viewport to the future. What changes can we expect in the way broadcasters process audio? Jim's predictions, based on his long history in the industry and his personal work in building processors, are worth our consideration.

It is always a challenge to speculate about the future. As we have seen over the past months, audio processing for broadcast radio has a rich heritage starting with WE, RCA, and GE peak limiters, the Langevin Pro-Gar, Uni-Levels, the Audimax/Volumax reign, DAPs, Prisms, Optimods and Omnias.

But, what does the future hold for audio processing? I am glad you asked. OK, the crystal ball is out of the closet and booting up. The robes are a bit musty and moth eaten, and my pointy cap is a bit shopworn – but here goes!

ALL NEW, BUT IT GETS BETTER

If you have been reading from the beginning, you know that we have come a long way from the beginnings of sound manipulation – that of an operator sitting at a "Master Control" desk, adjusting levels as best he could and hoping he was fast enough to prevent peaks from knocking the station off the air.

Today's Digital Signal Processing (DSP) products also are a world apart from those boxes of yesteryear, with their variable-mu tubes, analog delay lines, diode limiters, and hard-wired, epoxied, proprietary circuits. The power of the computer has brought us processing techniques unimaginable twenty years ago.

But I have been hiding a little secret under the robe. The gods of processing (Orban and Foti) have tipped their hand. They, and others, are already dreaming up the next generation of "magic boxes" that will continue to exploit leading-edge technology and adapt to the new sound of HD radio – and beyond!

BUT WAIT! WE LIKED THE OLD SOUND

It is ironic that some of the newest processing algorithms emulate the classic processors of the past, including all their shortcomings. Call it nostalgia for how things used to be, or admit that some of that old gear imparted a certain "magic" to the station's sound.

The point is that when a pristine Fairchild 660/670 peak limiter can sell for the price of a new Mustang, it is fair to assume that the "golden ears" hear something in the old boxes that they cannot get with the latest, greatest processing machine. Thousands of hours of programming time have been spent trying to duplicate the sound of classic processors, including the Fairchild boxes, the UREI 1176, and LA series of compressors and limiters.

However, it is not just the same old broadcast industry today, and the way we handle audio in the future will also change markedly from past and present processing. We know it will be digital – and the bits will be manipulated by digital signal processing – but the *needs* will be different.

We are moving into a bit-reduced world in broadcast audio and the best new algorithms will exploit every trick of data manipulation to produce a sound that transcends the micro-bitrates that are required to cram all the new audio into paths ranging from legacy STLs to cell phone audio streams.

THE NEXT FIVE YEARS: PROCESSING EVOLVES AGAIN

The processing of the near future is already being developed in the labs of the processing gurus. The changes will be evolutionary rather than revolutionary, but the new processing will depart in many ways from the digital processing of the past decade.

But you do not have to trust me. Listen to one of the men who knows:

"My view is that we employ algorithms that will diagnose the signal and modify the architecture in order to reduce sonic artifacts. (We're doing this already in the codec world with our SENSUS Technology.) Reduction of distortion, THD and IMD, while maintaining competitive audio is the goal. Then again, hasn't that always been the goal?

"Depending upon how the digital transmission services settle, we could see META data come to radio, and that opens a whole new frontier. HDTV has this already with Dolby-Digital, but I foresee a method that would be far more sophisticated and comprehensive, not just a wideband method, as the TV counterpart employs.

"Processing platforms are already beginning a paradigm shift. We're moving towards a transition period where we have dedicated boxes and the early stages of doing all processing as a PC application.

(Continued on Page 16)

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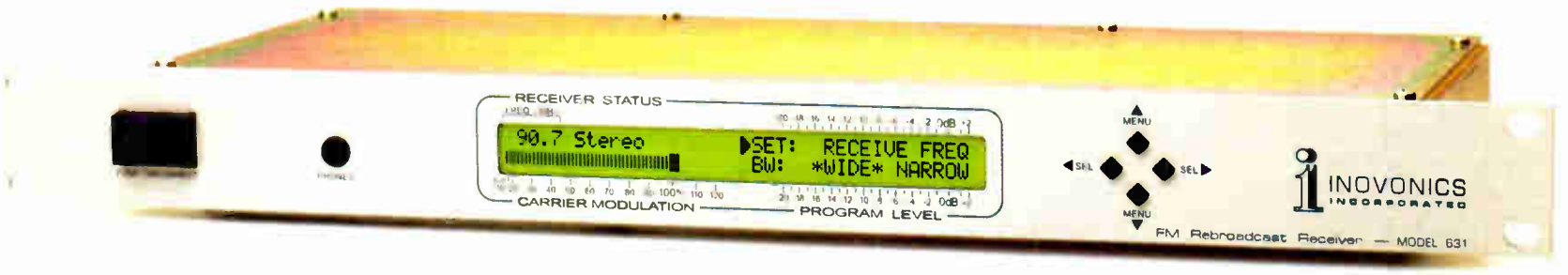

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Processing Guide

by Jim Somich

Continued from Page 14

"We have already developed a processing farm where many instances of an audio processing application are operating within one "engine" – a single box that allows up to a preset number of audio processors to run independently of one another. All I/O is Ethernet to the stations infrastructure or can be routed to dedicated nodes that are AES or analog.

"Additionally, utility functions regarding processing are becoming more elaborate. The ability to display detailed information about a signal, or segment thereof, is now available. Processing power, which once was a premium in cost, is now quite affordable in the digital domain, just as the lower-cost high-performance opamps and VCA's became during the analog years."

...Frank Foti, Omnia Audio

I think Frank nailed it here – and that is why I quoted him from our processing roundtable. Pay special attention to the words "diagnose the signal" and "modify the architecture." This is a real insight as to how the processor of the future will exploit the inherent advantages of DSP. Today, we are only scratching the surface in this area.

A BETTER SOLUTION

Imagine a processor that can diagnose in real time and modify itself to produce the best possible sound.

Yet, that is not the real leap. History repeats itself again: Back in the 70s, we were experimenting with dual processing chains for voice and music. We knew that voice processing, if it was to be optimal, was radically different from music processing. The only way we could use this to our advantage was to build two processing chains.

On the other hand, DSP will allow us to use one box that can be many separate processing chains with one engine. Now, this is exciting! The future holds much promise as long as creative engineers are constantly pushing the processing envelope.

TAKING ADVANTAGE OF THE PC PLATFORM

We will see more processing applications designed for PC platforms. Even better is a PC platform with a high performance DSP card to hot rod the audio performance. The Orban Optimod PC Audio Signal Processing PCI card is an excellent example of what we are discussing.

Using a naked PC is often possible, but there are some inherent disadvantages:

Using the PC Platform for Processing Applications

Strengths:

- Big address space.
- Good proamming tools.
- Well-documented operating systems.
- Fast floating point.

Weaknesses:

- Low main memory bandwidth/small cache.
- Poor interrupt response and few interrupts available.
- CPU used to do I/O instead of DMA in many cases.
- Slow bulk storage.

- Digital Audio Signal Processing, Coulter pp 198

Latency can also become a problem when using a PC platform, but this is becoming less of a concern in the brave new HD world with its built-in eight second delay. Remember, Windows was never designed as a real-time operating system. You need *tons* of processing power to avoid bottlenecks and delays.

As the cost of processing power continues to drop, processor sophistication will increase. Even today, much of this is possible, but at a substantial cost. In the future, prices will drop and, at the same time, features will increase (Moore's Law).

TEN YEARS DOWN THE ROAD

To be completely honest, this part of the future may come even sooner. As we seek to grasp the direction of audio processing evolution, I think we can learn a little something from the recording business. Recording engineers have taken a different approach to processing: starting with computer platforms, rather than dedicated boxes, but immediately building "on top" of the computer.

Already many people are experimenting with PC platforms, using practical software that is available today at no cost. If you want a real education on this topic, peruse some of the back issues of the on-line Universal Audio webzine at http://www.uaudio.com/webzine/backissues_text.html

The performance of these studio PC's has been enhanced by hotrodding them with multiple processor DSP cards. Pick up a copy of Mix or EQ magazine and get an education about what the "other guys" are doing with their audio processing. You will be surprised what you can learn about the latest PC expansion slot, the PCI Express (PCIe), and how the recording industry has been revolutionized by PC platforms and 3rd party plug-ins.

BROADCASTING "CATCHES UP"

I predict the same thing will happen in broadcasting. For many broadcast production rooms, ProTools is the

(Continued on Page 18)

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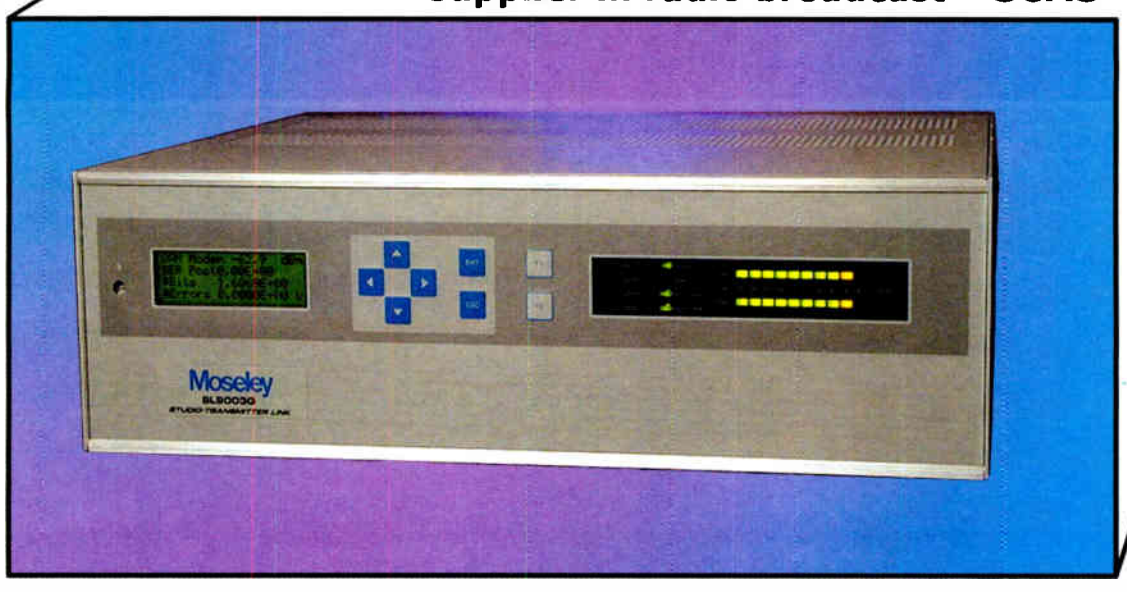

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Processing Guide

by Jim Somich

Continued from Page 16

current program of choice, and hundreds of plug-ins are available for it, with more written every day.

Want the sound of a vintage LA-2 compressor? It is as close as the click of your mouse. Fascinated by the WLS sound of the 70s? The "soft" compression of voice through tube units? There could be plug-ins for those, too.

It is true that third-party software for our DSP broadcast processors is unheard of today. While the software provided by the manufacturers is top notch, you do not have a choice – you live within the confines of the algorithms designed by the manufacturer.

Nevertheless, in the not too distant future, you will find a Baskin-Robbins' menu available with dozens or hundreds of processing flavors, bringing together and merging the processing philosophies from scores of processing gurus from the past 70 years.

DRAGGING RADIO INTO THE FUTURE

Will the major manufacturers open up their platforms to allow third party plug-ins? Perhaps. In fact, I am pretty sure they will not want to do so willingly. But even if they do not, it will not stop progress.

Willingly or unwillingly, they will be dragged screaming into the future. It *will* happen. Some enterprising company will introduce a generic processing platform and make the code available to developers free of charge. Then watch the fun!

Possibly you have an oldies station and want to experiment with that classic "Sta-Level pumping sound." Or, maybe you are running some disco sounds and want that classic "DAP EQ of the day" sound: plug-ins will be available.

A FUTURE OF CHOICES

"Sound-alike" plug-ins are just the beginning. How well can you tailor your audio? Today's daypart processing is just the beginning. In the future, it will be possible to change algorithms from cut to cut!

I could go on with the possibilities, but you get the idea. It is all about processing power and cost. Power is going up and cost is coming down. We will only be limited by our own imaginations.

Even now, we are seeing products like the Behringer DSP-9024 six-band processor (amazingly, it is already discontinued). It was a stereo DSP box that sold for just 250 bucks!

The Behringer had tons of features including an aural exciter as well as tube emulation. You could choose your bandsplits, and it even had look-ahead limiting. A very good example of how a mass-produced product can provide professional performance at amateur prices.

Oddly enough, broadcast processing is a small slice of the processing pie. So you can expect to find more processors designed for the prosumer market adapted for use in broadcast chains. In short order, the mass production from China will make economical processors that outperform the top boxes of today.

A NEW "PLAYER" EMERGES

Surround Sound adds an exciting dimension to music and several approaches have been proposed as an adjunct to iBiquity's HD Radio. However, whatever system is finally selected by broadcasters, surround sound will also add many new demands to the processing load.

A new company has emerged to market bleeding-edge processors for the new era of radio and TV broadcasting. Linear Acoustics (www.linearacoustics.com) was founded by Tim Carroll, previously of Dolby Labs.

Along with George E. Smith, Rod Campbell, and Erik Booth (who last created bits for Sigma Electronics, a company known more for video equipment than audio processing), their "AeroMaxHD" is a serious attempt at bridging the gap between the digital processors of today and the needs of tomorrow's multi-channel world. The AeroMaxHD takes on the challenge of developing algorithms for the linking of 5.1 channels of audio and the synthesis of surround sound from two-channel sources. It sure is an exciting concept.

More new companies will emerge to take their place on the NAB exhibit floor as broadcast processing technology continues to evolve.

Next time we will finish our look ahead at the future of audio processing with the unveiling of my vision of the Ultimate Processor of the future.

Jim Somich's respected broadcast career included positions as major market Chief Engineer, Director of Engineering for large group, and as the designer of a number of products, including the FlexiMod FM Processor.

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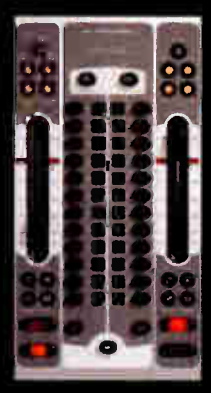

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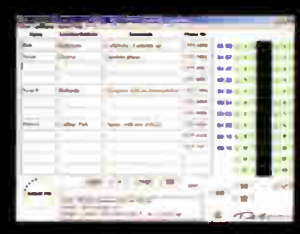

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Field Guide

by Francis Nash

The JK Audio RemoteMix 4

The JK Audio RemoteMix 4 is a full-featured box that fills many broadcast needs, all in one unit. It is a small (9.5 x 8 x 3), lightweight and sleek piece of equipment that our station has found to be a perfect fit for every application, especially sports.

WGOH-WUGO is a small-town broadcast facility that typically does an average of a remote a week and over 70 ballgames during high school season. I have been doing remotes and games for 40 years and have been through several remote units.

In the early days, we started with a tube-type Gates board, but soon built our own battery-operated, solid state unit to take to games. We have used several other units from different manufacturers through the years.

CONNECTING UP

Of course, the JK unit has a straight analog phone connection. The sound from a ballgame with a POTS line was noticeably better than our previous units.

However, among our biggest problems in the past have been the times when our cell broadcasts were bothered by interference and/or instability in the wire connections from the cell phone to the remote unit jack. The RemoteMix 4 solves some these common problems with its cell phone and handset interface features.

For example, the RemoteMix 4 has a connecting cord included with a 1/4-inch plug that works very well in going from cell phone to the remote unit. We have noticed very little interference if you keep the cell phone about a foot or so away. With that out of the way, we conducted several in-store remotes using an LG cell phone with cord and the sound was very good.

Since there are an increasing number of phones featuring "Bluetooth," the RemoteMix 4 also has that option. We have used that connection with a Nokia phone with good results. The connection is easy with a switch in front of the unit to activate "Bluetooth;" you then go to the cell phone and allow it to find the unit.

The JK Audio RemoteMix 4

This feature certainly makes the RemoteMix 4 flexible. The unit will connect to any Bluetooth-enabled cell phone or other device that allows a stereo wireless headset connection. The mode offers full 20 Hz to 20 kHz audio bandwidth. A soft limiter is included, and a bass boost switch helps with overall balanced fidelity.

There is also a "Universal Handset Interface" for those times when you find yourself needing to use a PBX system phone. You just plug the handset cord into the special jack in the back of the unit – and you are on the air. There is an A B C switch beside the universal handset interface to match the different kinds of handset microphones you might encounter.

PLENTY OF INPUTS

This is our first JK Audio unit. Some of their previous sports remote boxes were compact but did not have all the inputs we liked. The RemoteMix 4 has four channels with balanced XLR jacks and low-noise amplifiers. Microphone inputs 3 and 4 are also switchable to line inputs with XLR connections and 40 dB pad. We use three channels for headset microphones and the fourth for a wireless mike after we have used that input for a taped interview in the pre-game program.

The input and output connections on the rear of the RemoteMix 4.

There is a stereo 3.5 mm line level input that can be used in addition to channel 4 or instead of it. You can connect either a stereo or mono signal to the mini-jack. If you use a stereo signal, both channels will be summed together. Then the audio from the mini-jack and the XLR would be added together and treated as one mono signal on channel 4.

By the way, all of the four microphone inputs have phantom power available with separate switches to turn it on as needed for any input. We usually never need phantom power for mikes, but it is nice to know it is there.

One of the features we truly love is the separate volume controls for the headphones, as our stat man always likes a little more push in his ear. Each headphone has separate switch for return and mix to hear the station cues or pick up only the mixer audio. The manufacturer seems to have thought of everything in this unit. It could also, of course, make a good front-end mixer for your POTS, ISDN or IP codec.

ADDITIONAL FEATURES

You should not have any problems with volume out of the unit – each channel control has an LED to indicate clipping and a Master control with LED VU meter that ranges from -30 dB to +3 dB. It works nicely, but can be a bit tough to see on a daylight remote.

There is a Cue Control knob on the front of the unit which controls the level of the Cue input on the back. This input serves a dual-purpose. It is where you connect your cell phone to the unit and therefore can control the return volume to hear the station on the other end. It can also input other audio devices such as your portable radio and that will be fed to your headphones when they are set on "return." (With a switch you can select which option you want for each headphone.)

The RemoteMix4 has a keypad on/off switch to prevent unwanted tones from your dial pad going out during the broadcast. The phone pad is activated with the hang up/dial talk switch, but beware: the phone does not ring in. The incoming call is indicated by a flashing light, so if you are expecting the control room to buzz you, keep your eyes open. There is also a redial button for your convenience right beside the keypad.

The previous remote units we have used have all been powered by internal rechargable battery packs. We have been used to plugging in the unit after each game or remote. This new JK unit takes a different approach and is powered by two 9-Volt alkaline batteries located in separate compartments on the side.

The manufacturer estimates about 10 hours or more on the two batteries for continuous use without the Bluetooth turned on or the phantom power; less if you are using those two features. The instruction book states that the light in front will dim when the juice is getting low.

This did require a little change in strategy. We have many venues where battery power is the best option. Instead of making sure that the unit was charged, we now need to keep track of the battery life. A nice aspect is that the batteries are in parallel and you can change one at a time during the broadcast and not lose a beat.

The RemoteMix 4 in action.

The first weekend in use, we had a two-hour remote broadcast in the morning, a 45-minute on-the-scene sports program, and then another two-hour remote in the afternoon with no battery change.

Certainly, if AC is handy at your remote site, you will want to take the cord and plug in. The AC adaptor connects in the rear and overrides the battery power when connected; if someone trips over your cord during the game, the batteries automatically kick in.

AUDIO OUT

There are two ways to feed audio out of the unit. The Master XLR output is the sum of all four XLR inputs and the 3.5 mm input. There is also audio out using a stereo mini-plug. In this method, the master output will be on the left channel and the receive mix on the right channel.

We have found the quality of sound out of the mixer to recording devices is excellent. Obviously the unit is a great way to feed any on-site audio back to the studio or record two-way conversations.

There are a couple of warnings in the User Guide. If you lose the interface cable for cell-phone operation, it is custom-made and you will have to order one from JK Audio. And, do not try any other power supply with the unit, as permanent damage could result.

The set-up for the RemoteMix 4 is quick and easy in the field. The folks at JK Audio have provided sports crews with a unit that is truly versatile for any situation in covering local sports and also for great remotes from most anywhere.

Francis Nash, General Manager of WGOH-WUGO, Grayson KY, is the author of Towers of Kentucky *(Host Communications, 1995). His email is fmn@wgohwugo.com*

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Okay, back to work now. (Consoles don't build themselves, you know.)

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Remote Guide

by Kevin Webb, Tieline

Where Do We Go From ISDN

The choices (and quality) available for getting audio from remote broadcasts back to the studio continue to grow. Of course, many broadcasters are resistant to change, both for monetary reasons and, after all, "if it works, don't mess with it!" Nevertheless, as Kevin Webb explains, this is a good time to examine today's options – and what is coming up in the near future.

It is hard to believe we already have reached an era where ISDN lines are flat-out, no longer available in some areas of the US.

ISDN ENVY

If you are fortunate, the worst *you* have to deal with to get ISDN lines is the time (weeks) it takes the telephone company to provision them. Some would say "At least you have ISDN."

I have spoken with many large market broadcasters who call for an ISDN to be installed only to be told that particular location no longer has ISDN available. Or worse yet: "We no longer install new ISDN lines." Yikes!

It seems the phone company wants to wean us off our nasty ISDN habit. We consider it necessary; the phone company asks "Why don't you just use IP like everybody else? It's faster you know." Yes, we know. Remember the tortoise and the hare? Faster is not always better.

And it is at that point that the phone company's Gen Y phone representative dismisses us with a "Whatever" and hangs up. I imagine they will then turn and tell everyone in the phone stable "OMG you guys I just got another one of those dinosaurs that want that ISDN thing. Like that is so 1980s."

STILL THE BEST – WHEN IT WORKS

Do not misunderstand me: ISDN is still the best way to do a remote broadcast – *if* ISDN is available. It is, after all, a temporary, dedicated point-to-point data network every time you connect. This is the reason broadcasters just *love* those two B channels (and the D channel).

ISDN lines are reliable – at least when they actually work and/or are actually connected by the phone company field tech. [Insert your own ISDN war story here.] My war story is simple: I called to report that one of our ISDN line's B channels had gone down and, since we were about to uplink our nightly talk show to 21 other stations via satellite in two hours, I danged well needed it to work. So, I called the ISDN Repair Line and explained my problem. (Prepare to shudder.)

"Oh, well, what's a B channel?" replied the voice on the line. "Oh, I'm sorry, I thought I had called ISDN Repair Line." *"Oh, you have."* "Well could I speak with your supervisor?" *"Oh, that's me!"* (She was so proud.) "OK, you're the supervisor of the ISDN Repair Department and you don't know what a B channel is??" *"Well I just got hired and I'm still training. So tell me, what's this B channel you're talking about?"* (Shudder!)

WHY ISDN IS WASTING AWAY

Usually, ISDN just works. The problem is that the phone company does not understand and – essentially – does not care. It is the simple law of Supply and Demand.

Then again, who uses ISDN anymore except broadcasters and some "special needs" companies? As a result, phone companies do not want to continue to support the ISDN switches and infrastructure. And broadcasters are getting caught in the technological squeeze between what we know to be the most reliable and cost-effective temporary point-to-point network available and the new IP technology available to us.

The future for broadcasters lies in having a mix of connection methods with you at any remote – and preferably in one box, since that makes it a lot easier for everyone involved.

BEING PREPARED

Being the proper alpha geek, certainly you have told people regarding a hard drive: "It's not a matter of if but when the hard drive will fail, so always have a backup."

A backup? What a great idea! The same applies to any remote. Eventually, you *will* experience a failure of your primary *and* secondary method of getting remotes on the air. If you do not have a tertiary backup plan you will not look good to those who write your check.

The days of "phoning in a remote" are way behind us. With iPods and high-quality devices for delivering music available to your listeners you must understand they really *do* care about how a remote sounds. And if you do not understand that then you really should not do a remote. We no longer live in the 1980s.

MULTI-MODE

Any codec you consider for remotes should have as many connection capabilities as possible. A bare minimum should be four. And ISDN is still the best way to connect when available, so the codec you choose should still be able to deliver over ISDN as well.

What four connection types should you be sure to have as a minimum?

- ISDN
- Wired IP
- POTS (analog and digital)
- Wireless IP

When making an initial investment toward better remote quality, it is important that you do your research. Check out the different codecs available, and always start by asking yourself how many ways the unit can get you out of trouble.

COMPARING MODELS

Then test drive those codecs available and carefully compare the connection methods – being very sure to see *how well* each connects. Is any method from one manufacturer more stable than that from another? Will a connection automatically "fail over to a backup connection" without your staff having to do anything?

Always do a literal side-by-side comparison whenever possible. I know of one example where a station cluster in a major market did just that after buying a particular brand (we will call it "Brand A"). They invited another brand ("Brand B") to allow them to do in-the-field, live side-by-side tests to compare against that which they had already purchased.

They did the side-by-side test – B against A at the same time – on their wireless remotes. They realized immediately there were serious disadvantages with the brand they bought and replaced it with the other brand. The station cluster uses high-speed wireless cellular data for their primary remote connection with GSM as their standby, POTS as tertiary and (heaven forbid) analog audio through a cell phone's handset as their fourth backup connection.

VERSATILITY

Let us take a real world example of multiple connectivity in one box. Any Tieline Commander G3 unit comes standard with Wired IP and POTS, and has jacks to connect to your cell phone's handset jack in an emergency.

The Tieline G3 comes ready to connect in a number of ways.

With this one box you can connect in at least *eight* different ways: Audio over Wired IP (T1, DSL, Cable, etc.), 15 kHz digital POTS, analog POTS, satellite (including BGAN systems), analog cell phone (through cell phone headset jack), IP phones*, ISDN lines*, and some VoIP applications* (* using new SIP protocol and G.711 algorithm).

One of the more fascinating ways to connect using SIP is with the HP IPAQ PDA. Since it has G.711 already included, it could make up one end of the connection to connect to a Tieline at the studio. G.711 is a voice algorithm but has the possibility of delivering up to 8 kHz audio.

EVEN MORE OPTIONS

Add the new Wireless Module (a self-contained high-speed cellular data and voice transceiver) and you can do FM-broadcast-quality wireless remotes and make voice calls too. That brings the total to 10 connection methods and still it is all contained in one box.

Add an ISDN module for #11 and GSM module for #12. An external WiFi bridge for a WiFi connection and support for the X.21 protocol bring the total to 14 possible connection methods. It will also auto-reconnect if (oops, I should say "when") the connection fails and there is a Failsafe feature (optional) that will automatically connect your backup when your main connection fails.

Each manufacturer has its own selection "menu" of connection types, so you have different options and can select the one that fits your needs the best. Clearly, flexibility is on the minds of all the designers – flexibility which must be balanced with the price a station is willing to pay for the gear.

POTS IS STILL GOOD

After ISDN, the very best connection method for remotes is, believe it or not, POTS. That is, of course, if you have a good quality POTS codec.

Yes, good old fashioned POTS (Plain Old Telephone Service) is still going to be your best bet when all else fails. I mean, who knew late-1800's-Alexander-Graham-Bell technology would still be saving your bacon into the 21st century?

The next best connection? Wired IP – followed by Wireless IP if there is a good enough signal and high-speed data bandwidth. Is Audio over IP (AoIP) ready for prime time? The real question is whether the codec can handle the challenges of varying data rates over an IP connection. This is why you should always test drive a codec and try it out on your system.

There are some important caveats to learn regarding AoIP for a broadcast station: At the studio it is always best to set up an exclusive connection for your IP codec such as a stand-alone DSL line. If you *must* share with an existing IP connection at the studio (almost never a good idea for so many reasons), follow these six basic rules:

(Continued on Page 24)

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Remote Guide

by Kevin Webb
Tieline

Continued from Page 22

1. Set up a true QoS (Quality of Service) to your codec so it has plenty of dedicated bandwidth.

2. Set up Port Forwarding in your router so an incoming "call" is routed to the codec, a lot like a PBX.

3. Set up a Static Public IP Address with which to connect to from the outside world.

4. Set up two ports, one for the connection and one for audio for the codec.

5. Make sure *both* UDP and TCP are open in *both* directions on *both* ports.

6. Repeat Step 5. Seriously. You will swear up and down Step 5 has been done ("I checked it myself"), but when we get a tech support call and we scan the ports we will almost always see Step 5 has not been completed.

Step 5 is way too easy to overlook and in fact accounts for the most common problem we see when dealing with IT folks in the field (though you might have guessed that by now).

But seriously – just get a stand-alone DSL and be done with it. Just remember: Murphy is out there, waiting. As sure as you are sitting and reading this, someone (or something) will reset your QoS or NAT or port settings just as you get started with the big, annual two-day remote where the entire city tunes into your station(s). What a bad day to have to deal with IT complications!

If you have any questions regarding the setup of IP at the studio (and IP in general) visit tieline.com/ip, which is an easy link to remember. It tells you everything you need to know about IP and how to set it up correctly.

PRIME TIME FOR WIRELESS REMOTES

I wanted to save the best for last. Wireless remotes will revolutionize how broadcasters do remotes from now on, and the cellular wars between Verizon, Sprint and AT&T (formerly known as Cingular) mean that finally, you *can* do FM-quality wireless remotes.

Just imagine – going to a remote, turning on your codec, doing your broadcast, power everything down, and leave. No more borrowed POTS lines or setting up ISDN. No fuss, no muss.

Wireless IP uses wireless broadband high-speed data from Verizon, Sprint and AT&T (as well as some regional carriers such as Alltel) to get an IP data stream just as if you had plugged into the RJ45 jack in the wall next to your desk. How well that works depends entirely on whether you have broadband high-speed wireless data available in the areas where you wish to do remotes.

But please do check out your cellular carrier's web site first before assuming there is wireless high-speed data fast enough for your remote. What you want to look for is what is known in general as "broadband" data rates. Verizon and Sprint each call their broadband data services (fast enough to support decent-to-excellent quality audio) Rev 0 (that is Rev Zero, also known as 1xEVDO) and Rev A which is the preferred faster speed. With AT&T, look for UMTS or HSDPA – with HSDPA being the preferred service by far.

A PROMISING FUTURE

The good news regarding wireless remotes is that broadcasters stand to gain big time from all the heated competition among the three main carriers. The best news is that wireless data is only going to get better, faster and cheaper with less delay. Heck, WiMAX promises wireless download speeds of 30 MB. That sure beats fiber optic cable!

In San Francisco, Sprint is experimenting with offering consumers a bundled cellular plan including unlimited voice as well as high speed data as one package to replace wired phones. They will need to cover the entire US with high speed data to accomplish this feat.

Remember those ads for live TV on a Verizon phone? That is a voracious beast that needs to be fed with massive amounts of uninterrupted high speed data. Verizon has aggressive plans to roll out their high speed Rev A wireless data service by the end of the year. Ditto with Sprint.

And then there is AT&T and the new Apple iPhone. That little product is about to change the way we use a cell phone. It also needs massive data to allow users to surf the Internet, download songs, etc., in a package that will make the iPod soon seem somewhat quaint.

I have seen the future and it is wireless. ISDN? We don't need no stinking ISDN.

Kevin Webb is the GM of Tieline Technology in Indianapolis, IN. You can contact Kevin at kevin@tieline.com

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	10 kW	2001	Henry 10,000D-95
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Practical Engineering

by Dave Dunsmoor

Good Connections Keep Things Going Well

Construction at a station is always a major project. It is almost impossible not to disrupt normal operations during the project. Therefore, as Dave Dunsmoor points out, it is worth taking the time and effort to do the whole job – and do it right – the first time. This is especially true for the electrical and ground systems.

I would like to discuss a few things that will add significant longevity to your broadcast plant. These are things that should be considered when doing the annual inspections of your plant, when you are adding equipment, and especially when building new.

START AT THE POWER ENTRANCE

As you might expect, there are some things that should always be looked at first. For most projects, that means the AC power

Whether you are building a new studio, remodeling an old one, replacing an old control board, upgrading your transmitter, adding new equipment to a newsroom, or adding HVAC equipment – and not even touching the rest of the plant – stop and carefully consider your current electrical usage as well as what your project may be adding.

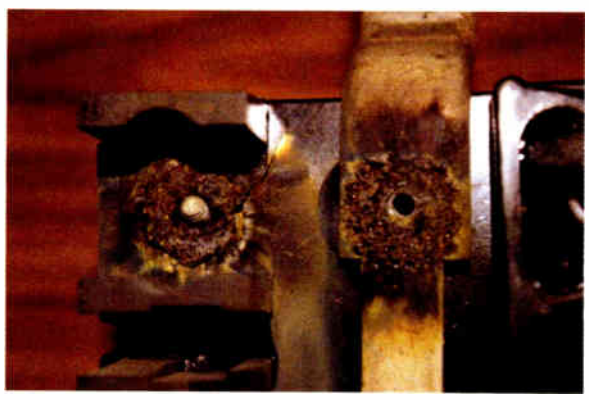
And "carefully" here means more than just a quick peek to decide that the existing breakers or wall sockets are sufficient to power whatever is being installed.

KEEP TIGHT CONNECTIONS TO POWER

Certainly a cursory check of the service panel (breaker box) should be done to assure yourself that there is indeed enough capacity for the new equipment. It is most likely that if you are installing new equipment, any gear you install today will draw less power than what is being replaced. But when was the last time you did a diagnostic on the entire system?

For example, how long has it been since *all* the mechanical aspects of the electrical connections were either physically checked and tightening as needed – or observed by the use of an infrared thermometer? Over time, various heating and cooling cycles can really stress connections.

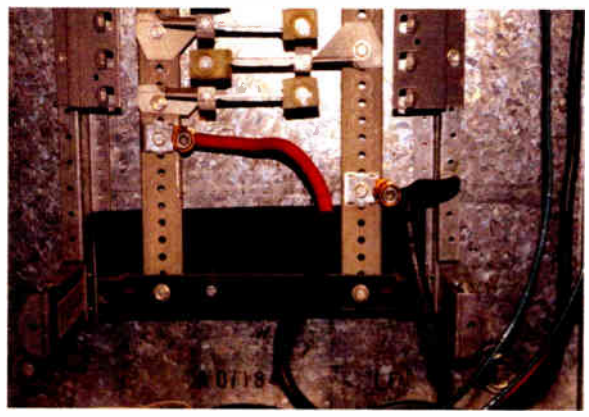
Here is a graphic example of what can happen if the electrical service is not checked periodically: a main service panel breaker – in service for many years – can fail drastically. Even though it had many years on it, there would have been no problem had it been properly tightened on a regular basis.



A loose connection caused this failure.

The point of failure is readily apparent. The guy who discovered this one did not need an IR thermometer to see where the problem was located; the connection under the buss mounting screw was glowing when he opened the panel!

A light touch stopped the glowing and (temporarily) restored power to the equipment rack. A little quick thinking and the problem was resolved (again, temporarily) by bypassing the breaker and connecting the incoming mains to the panel distribution buss bars.



A *temporary* way to get a station back on the air.

This got the station back on the air. The entrance switch now served as the emergency on/off switch instead of the service panel main breaker. More permanent repairs involved a new service panel, some labor, and some down time – at least it was down time that could be scheduled.

OVERHEATING PREVENTION

Over many years I have seen more than a few problems caused by overheated components. Often, a routine inspection would have caught the problem before it affected station operations.

One situation that comes to mind: a neutral wire that had been overheating for so long that the white insulation had burned back for an inch or two. The neutral wire had come loose at the utility transformer and had been causing one side of the 120 VAC to go to 185 VAC. The other leg was around 65 VAC. Neither equipment rack liked it.

I really prefer to brush (with either a stainless steel or brass bristle brush available at welder's supply houses) all connecting surfaces prior to mating.

Surfaces like this could develop problems over time.

Buss bars, breakers, power supply transformers – every connection should be cleaned prior to assembly, especially the ones that will be carrying large current loads.

It helps to coat both surfaces with anti-oxidant grease to further retard oxidation and subsequent heat buildup.

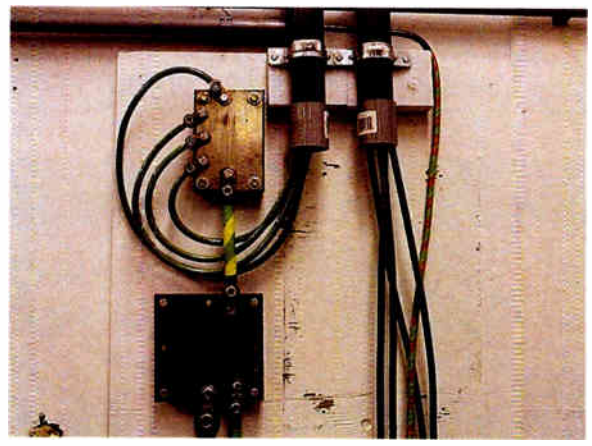
A well-cleaned surface will help to prevent problems from developing.

A WELL-GROUNDED SYSTEM PROMOTES SAFETY

Another consideration after the electrical supply is determined to be in good health might be the studio and/or transmitter building ground system. Generally, there are two aspects to ground: AC (safety) and RF.

Safety ground is designed to prevent people from being hurt (or worse) while operating electrical equipment. This is applicable to power tools, appliances, computers, remote broadcast gear, transmitters, studio gear – anything that is powered from the wall socket.

The National Electrical Code (NEC) describes how safety grounds are to be implemented, so I will not try here to describe all that is required for this to be done correctly. Generally speaking though, if there is DC continuity between the equipment chassis and the service entrance ground, it is going to work for its intended purpose.



A ground buss system.

In the illustration above, please note also that the ground wires are run through PVC and not EMT. We want the ground connections (all wires included) to be as transparent as possible. On the other hand, a ferrous metal surrounding a section of wire will act as a choke to high frequency RF (lightning), impeding its transfer to ground. When that happens, the voltage gradient can be great enough to cause damage that otherwise might have been avoided.

RF GROUNDS

RF ground – and I will include audio noise suppression here also, as it is sometimes as (or more) elusive as RF to "get right" – is another matter. This is primarily because of the wavelengths involved.

The wavelength of 60 Hz is 16.4 *million* feet, a quarter-wavelength is still 4.1 million feet. This means that any length of wiring within a building, or even between buildings, will be an insignificant number of electrical degrees long, therefore any 60 Hz AC voltage impressed upon any portion of a wire will be essentially the same at any point along its length.

However, at RF frequencies, it is much easier to have an RF voltage differential between neighboring wires because at the lowest RF frequency we are concerned with (540 kHz), a quarter-wavelength is about 456 feet. At 105 MHz, a quarter-wavelength it is only about 2-1/3 feet.

(Continued on Page 28)

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Continued From Page 26

Good Connections Keep Things Going Well

The significance of the quarter-wavelength is the fact that RF voltage will go from a minimum to a maximum over the distance of a quarter-wavelength. Unwanted RF voltages can be introduced into equipment by way of audio leads, power and control wires – even some so-called ground wires – and this unwanted RF, if detected (that is, rectified by individual semi-conductor junctions) will cause noise and interference (RFI).

At increasingly higher frequencies, increasingly shorter lengths of wire will become an effective receive antenna. Unless wiring is properly configured, routed, and grounded, it can contribute significantly to noise problems.

SYSTEM DESIGN TO ACHIEVE SUCCESS

I imagine the electrical system as being similar to a hydraulic system. With the pump being powered by an appropriately sized engine, and appropriately sized hoses and control valves for the work to be done, it will smoothly, quickly and efficiently move the payload from "A" to "B".

However, if small fittings (high resistance connections) were used because the correct ones were not readily available during installation, you can easily see how much harder the system will have to work, generating more heat, and causing the engine to consume more fuel to do the same work.

This is very much the same principle that we use in designing and evaluating electrical systems.

KEEP YOUR COOL WITH SOLID GROUNDS

Many years ago I worked for the Boeing Company, doing RFI/EMP shielding of equipment racks. The final check of all ground and shield connections was done by using a milli-ohmmeter. It was used to assure that every connection had a resistance value about .01 Ohm or less.

The reason for this is the same as why we want low resistance connections in all our equipment: high current across a (relatively) high resistance will create a voltage across the connection, which increases the heat buildup, which in turn accelerates the oxidation process – and the cycle continues until a situation like the breaker incident above occurs, all the while the available power to the equipment is decreased.

At Boeing, the low resistance specification was to ensure as transparent as possible a ground connection that will direct high current transients such as lightning away from the equipment. This is our purpose also.

CHECKING RF CONNECTIONS

This same line of reasoning applies to the RF portion of the broadcast plant. The RF transmitter connection to the transmission line, then to all the caps and coils and ground straps in the ATU, on to the feed point to the tower and the tower leg section joints – every part should be cleaned and bonded tightly at installation.

And just like the electrical system, they need to be checked periodically. Every little portion of an Ohm reduced helps not only in getting the signal out to the receivers, but also in increased stability. Stability in a single tower system is good, in a directional array it is essential.

I doubt that many tower leg joints were cleaned as carefully as I have described above when they were installed, but this can be remedied (if it is suspected as being a problem) by having each section joint welded.

No, I am not suggesting everyone go out right now and have all your tower joints welded. But if noise is heard on your signal during high winds and it cannot be attributed to any other cause – at that point I would recommend having a reputable crew inspect the tower. Tell them just what it is you are looking for and let them determine what methods to use to decide if the tower is electrically as well as mechanically sound.

CLEAN AND TIGHT IS THE GOAL

The point I am making is this: all electrical connections are most effective when they are "clean and tight."

Clean means removal of oxidation, down to bright metal before assembly. Tight means, as much as possible, an air-tight connection. Clean occurs at the time of assembly, tight starts at assembly, but needs to be revisited every year thereafter.

Clean and tight assures you of a lower cost of operation, and reduces the chance of catastrophic failure and unintended downtime.

Dave Dunsmoor is a contract engineer in the Minot, ND area, as well as a Navigation/Communications (NAVCOM) Technician for the FAA. Contact him at mrfixit@min.midco.net

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The Leaning Tower of Rust

Following deregulation by the FCC of the past decade or so, station operations have often be guided more by budgets than by "Good Engineering Practice." In fact, far too often the level of transmitter maintenance at many stations can often be quantified as an inverse ratio of the site's distance from the GM's office.

Sometimes an FCC Inspector stumbles upon a poorly maintained site, sometimes it is an engineer called in to help a station that is off the air. As Kevin Kidd found, there are some really sad sites out there.

Even before you get to the tower base, you just *know* there is going to be trouble.

"I responded to an emergency off-air call from a non-client station," Kevin relates. "After inspecting the transmitter, I found some minor lightning damage on their BE AM1 and got it repaired it quickly.

"Then, I walked around behind the transmitter building and found more than a little surprise. The tower fence was mostly lying on the ground – and as soon as I saw the tower itself, I knew it very shortly be joining the fence."

A TOWER THAT WAS NOT ON THE LEVEL

As he approached the tower base, Kevin had a hard time deciding whether to continue the inspection – or run away rapidly: "The legs of the home-built tower had rusted out and collapsed. The base plate was tilted at about 30 degrees."

A tenuous link from the station to the listeners.

But that was not all. As Kevin looked closer, he discovered that "the tower legs had broken loose from the base plate and obviously had been rewelded. Not only that, they had rebroken!"

Saying this tower had loose legs was not an understatement.

"Interestingly, the client was LMAing the station and was reportedly in final negotiations to purchase it as the LMA expired – *without* knowing about this 'little problem.'" Kevin explained, "After I discovered this mess and submitting proposals for repair (can you say 'bolt cutters?'), the client decided the whole thing would be cost prohibitive; he walked away and allowed the LMA to expire."

As usual, the exact station and location will remain unknown to protect the silly. Please share with us some of your pictures of the strange things that go on out your way. Send them to editor@radio-guide.com

Transmission Guide

by Ron Nott

Ferrites and the Broadcaster

Modern ferrites bring great value and promise to today's broadcasters, whether in detuning, filtering, or eliminating stray RF problems anywhere from towers to computer keyboards, from microphone audio circuits to cleaning up power lines. Ron Nott muses over the possibilities.

A great deal of information is available about the use of ferrite material, but it is so versatile that new applications keep popping up. There are several different kinds of materials for different specific frequency ranges and applications.

To utilize them properly, their characteristics must be understood. A good source of available information is from the various manufacturers.

THE RF CONNECTION

One fundamental use of ferrites is to provide impedance to RF current flowing on a conductor. However, there is more to the concept – it is not quite as simple as it first seems.

We must be careful to realize that the impedance provided by ferrites is a complex impedance (R + j X), *[See box on page 34]* not just simply resistance or inductive reactance alone. Radio engineers should be familiar with this from tuning networks and such.

At low power level applications, such as placing ferrites on audio lines to keep RF out of them, complex impedances are not really significant. However, at higher power levels they must be considered. Also bear in mind that the values of R and +j X vary in different ferrite materials and with different frequencies, so this must be taken into account for a specific application.

DEALING WITH THE HEAT

Because part of the impedance is resistance, it will convert some of the RF energy to heat which must be dissipated into the air. "The increased permeability of the ferrite material causes an increase in the inductance of the conductor on which the ferrite is installed." So RF current traveling on conductors is impeded by both factors, real (resistance) and imaginary (reactance).

A very common application is to place ferrite beads on certain leads around a computer. You may notice a lump of some sort in the cable between the monitor and the computer.

Computer and camera cables often have ferrites to keep signals clean.

This is ferrite material in the form of beads to block RF energy in the form of sync pulses and/or digital data. The energy dissipated as heat in this application is so small that it is insignificant.

Broadcast engineers sometimes place ferrite beads on telephone and audio wires to keep RF energy from flowing on them. Again, the energy dissipated in the resistive component of the ferrite is insignificant.

DEALING WITH HEAT

However, we want to look at a few applications in which the power dissipated may generate significant heat. If ferrite beads get hot enough, they may crack and become useless. If cracking occurs, the RF impedance ability becomes greatly diminished.

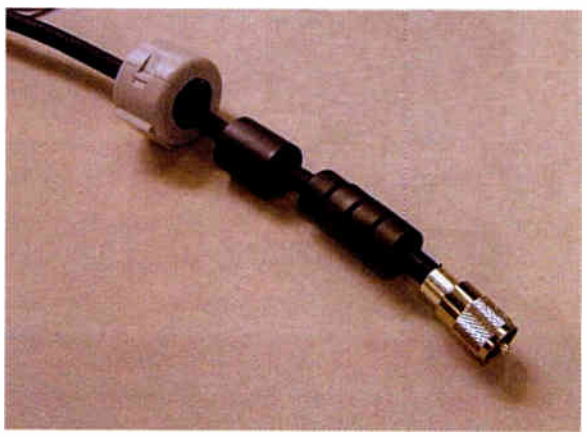
As an example: when it is necessary to place a VHF or UHF antenna on a series fed AM broadcast antenna, the transmission line must cross the base insulator without affecting the AM antenna.

Several means have been developed for this purpose. An isocoupler is a device that will couple the higher frequency signal through it to get to its antenna, but has little effect on the AM antenna. Another method is called the bazooka feed, and a third is to convert the AM antenna to a folded unipole. However, all of these take some doing and are relatively expensive.

A COST EFFECTIVE SOLUTION

Ferrites may provide a simple and inexpensive way of doing this for antennas that use a small transmission line such as RG8 coax, 1/2-inch Heliax or something similar.

You simply fabricate a jumper that is two feet or so in length and place ferrite beads of the proper material over the jumper, using a weatherproof sleeve when necessary.



Several ferrites can be used when various frequencies are involved.

The top end of the jumper shield is connected to the tower metal and the bottom end is connected to ground near the tower base. This allows the VHF or UHF energy to travel through the coaxial cable while the AM RF energy is prevented from flowing on the outer surface of the cable.

While this should work, now we must address a caveat about the AM energy that will try to flow on the outside of the coaxial cable shield. Recall that the impedance of the

(Continued on Page 34)

Transmission Guide

by Ron Nott

Continued from Page 32

ferrite material is complex, meaning that part of the energy will be dissipated as heat. Will it be enough to damage the ferrite material? At the moment, we do not know.

Someone could fabricate a test jumper as described and place it across the base insulator of an AM antenna. Will it affect the input impedance of the AM antenna? The test should be conducted while observing an RF impedance bridge.

This method may work on AM antennas of lower power, but may or may not be adequate on a higher-powered station. If it works we could call it an iso-jumper. And if someone tests this, please let me know your results. I am too old and lazy to do it myself.

DETUNING

Ferrite material also has the ability to make an electrical conductor appear to be an open circuit. Coincidentally, this is the end purpose of detuning: to eliminate the flow of RF energy on a conductor.

How would it work for detuning a tall structure? Suppose that a new cell phone tower has been erected in the near field of an AM station. FCC Rules require that the owner of the new structure install detuning apparatus so that the pattern of the AM station will return to its proper shape.

If we could install enough ferrite material on the tower legs at a low height, the AM RF current should be impeded to the point where it would not re-radiate the AM signal. Discovering how much ferrite material would be needed to make it work well again requires experimentation, but theoretically it is possible.

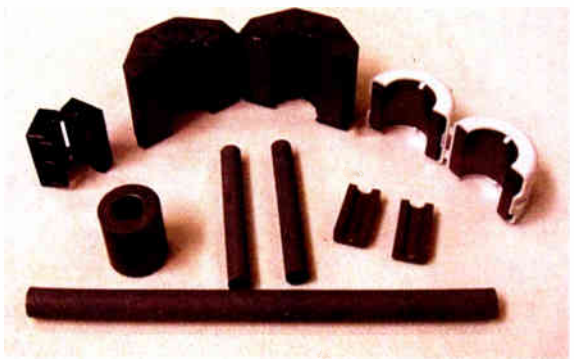
It is sometimes desirable to place an FM or TV antenna onto the side or leg of a tower with large cross section. However, the tower members may re-radiate some of the energy causing distortion of the radiation pattern. Sometimes detuning stubs are welded in various locations in an attempt to get the proper pattern shape.

Once again, in theory, placing ferrite materials on the vertical and horizontal tower members near the high frequency antenna could make the tower steel disappear, allowing the desired pattern to be radiated. It would not be necessary to cover the members entirely, just enough to break the members into segments that would not re-radiate.

FERRITE PAINT?

It would be great if ferrite paint was available. We could just paint all conductors in which we do not want RF current. Shades of stealth technology!

Of course, it would probably have to be pretty thick to be effective. I did purchase a bag of ferrite powder that is to be mixed into paint in order to make a refrigerator magnet stick to a wall with which it is painted. I just have not gotten around to trying it for RF absorption yet.



A variety of ferrite materials.

The most common shape of ferrite material to stop RF current flow is in the form of a bead or donut. They are available split into two halves, but the two halves must be very close to each other when installed on a conductor.

It might be possible to use powdered ferrite material and place it in a cylinder surrounding a tower leg, for example. It would have to be very tightly packed for good performance. The cylinder material should be non-conductive, capable of standing the compressive force needed to pack the material inside and then provide long term weather proofing. A plastic such as Teflon might be suitable.

This method might be used to detune a monopole. A band of ferrite material (maybe powder) would surround the monopole some distance above the base with a non-conductive compression band holding it in place.

SOME USES, SOME POSSIBILITIES

We have reviewed a few old standard applications for ferrite materials and introduced some new ones.

We also pointed out that ferrite material has not a simple, but a complex impedance which consists of increased inductance of a conductor by surrounding it with material of high relative permeability (r), which also has resistive loss. The ratio of R and +j X will vary depending on frequency and the material used, so it must be taken into account when planning an application.

Another way of looking at a complex impedance is to calculate:

$$Z = \sqrt{R^2 + X^2}$$

Ferrite materials are great stuff with many useful applications, but their limitations as well as their advantages must be understood to obtain the best results. An excellent book on the subject is the *Ferromagnetic Core Design & Application Handbook* by Doug DeMaw. It is published by MFJ Enterprises and available on their website. The stock number is MFJ-3506 and price is $19.95. If you get a copy, be sure to read the section on the B-H curve and saturation.

Ron Nott operates Nott Ltd. in Farmington, NM, where he provides a wide array of tower systems and solutions. Contact Ron at ron@nottltd.com

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AHR-1 Active Headphone Remote

The Active Headphone Remote (AHR-1) contains a stereo amplifier designed to work with any combination of high-efficiency headphones with impedances between 24 and 600 ohms. The AHR-1 is equipped with 1/8" and 1/4" headphone jacks, level control, user-configured utility momentary pushbutton and LED indicator. Two rear panel RJ45 jacks are provided for connection via CAT5 cable to the FlexPhones Master. The AHR-1 may be desktop mounted, under counter or with the optional HR-1/MP or HR-1/MP-XLR mounting plates, which may be turret or counter-top mounted.

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RF Guide

by Grant W. Bingeman, P.E.

Ground Systems for Balanced Dipoles

Buried radial ground systems are traditional for vertical monopoles, but they are not ordinarily installed beneath horizontal dipoles. However, when a dipole is operating close to earth, the ground losses can be significant.

MODELING A DIPOLE

Consider a 71-foot-long dipole, 20 feet above ground, trimmed for 50 Ohms center resistance. Operating at 7.1 MHz in the 20 meter amateur radio band, the input impedance over perfect earth is 50.1 + j125 Ohms. (No sag is assumed in the 10 AWG copper wire span.)

The radiation pattern at an elevation angle of 45 degrees (shown in **Figure 1**) is typical. The vertically polarized E field is greatest off the ends of the dipole and the horizontally polarized field is greatest broadside. Sharp nulls appear orthogonally to the maxima. The maximum 45 degree sky-wave electric field is 218 mV/m (6.2 dBi) at one mile bearing North.

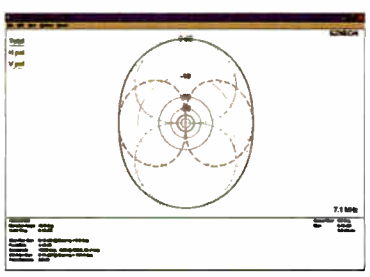

Figure 1: Dipole radiation at an elevation of 45 degrees.

If we change the earth conductivity to 5 mS/m, a dielectric constant of 13, the input impedance becomes 72.3 + j110 Ohms. The maximum 45 degree sky-wave electric field is 173 mV/m (4.1 dBi) at a mile bearing North. This is a 2.1 dB loss compared to the perfect case.

What would be the effect of adding 60 radial copper wires buried a few inches below the earth, each 32 feet long (as in **Figure 2**)? Will this ground system reduce losses?

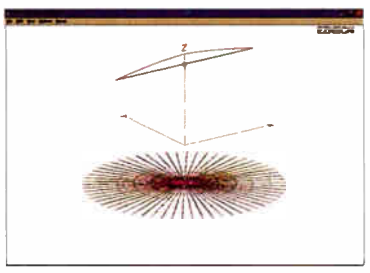

Figure 2: Dipole over a radial ground system.

With this new ground system, the input impedance becomes 62.6 + j117 Ohms, and the maximum sky-wave field at one mile is 188 mV/m. This is a 0.7 dB improvement; not a lot, but significant.

20 METER BAND

Consider a 26.4-foot-long horizontal dipole, 20 feet above ground, trimmed for 50 Ohms center input resistance. Operating at 14.2 MHz in the 20 meter amateur radio band, the input impedance over perfect earth is 49.6 - j292 Ohms, substantially different from the 40 meter band case.

The radiation pattern at an elevation angle of 45 degrees is the same shape as **Figure 1**, but a bit larger. The maximum 45 degree sky-wave electric field is 227 mV/m (6.5 dBi) at one mile bearing North. This slight increase compared to the previous case is caused by the fact that electrically the dipole is twice as high off the ground.

If we change earth conductivity to 5 mS/m (dielectric constant 13), the input impedance then becomes 45.3 - j297 Ohms. The maximum 45 degree sky-wave electric field is 203 mV/m at a mile bearing North. This is a 1.0 dB loss compared to the perfect case.

Can we reduce losses by adding 60 radial copper wires buried a few inches below the earth, each 16 feet long per **Figure 2**? The input impedance becomes 46.3 - j295 Ohms, and the maximum sky-wave field at one mile is 207 mV/m. This is only a slight improvement compared to the case without a buried ground system.

CLOSER TO EARTH

But what happens if the dipole is only ten feet (52 degrees) off the ground, electrically the same as the 40 meter band example? Will 14.2 MHz losses be greater than the 20-foot high case?

Over perfect ground the input impedance is 21.8 - j283 Ohms. The 45 degree elevation electric field bearing North is 215 mV/m (6.0 dBi) at a mile. This is our new reference value.

Over 5 mS/m earth the input impedance becomes 32.8 - j291 Ohms, and the sky-wave field is only 160 mV/m at a mile. This is a loss of 2.6 dB, quite a lot. If we add 60 radials beneath this dipole, the input impedance becomes 27.9 - j287 Ohms, and the sky-wave field is 177 mV/m at a mile, a 0.9 dB improvement.

SUMMARY

As expected, the closer spacing between the dipole and its image below ground invokes greater currents and losses.

A ground system may not be attractive from a performance standpoint unless the installation height is limited by neighborhood covenants, etc. Of course it becomes more of an issue at lower frequencies.

If your site is blessed with high conductivity earth, or you can erect your antennas high off the ground, then earth losses and other proximity effects are minimal. Otherwise you might want to consider adding a radial ground system beneath your *not* free-space antennas.

Grant Bingeman is a design engineer, well-known in the broadcast industry for his work at Gates/Harris, Rockwell/Collins, and Continental Electronics. His email is GrantBingeman@cs.com

Radio Guide Book Shelf

by Richard Burden

The New Stereo Soundbook

3rd Edition

For those intending to better understand the Stereophonic Illusion and how to produce a better stereophonic product, here is a book written for you.

The *New Stereo Soundbook, Third Edition* by Ron Streicher & F. Alton Everest provides an excellent reference source on the subject of Stereophonic recording.

COVERING THE TOPIC

The text blends the Stereophonic Illusion with the art of "Microphony" and the fundamental physics of sound. The use of diagrams and photos instead of relying on mathematics makes the book easier to read.

New material gathered and updated over the past decade since the Second Edition includes microphone techniques, multi-channel and surround sound.

The book starts by recalling the history of early stereophonic research. While many consider stereophonic sound a product of the 1950's, much of the stereophonic illusion we enjoy today relates to the research of Alan Blumlein in 1931.

The book has thoughtfully included the text of Blumlein's patent application. When you consider that today's classical recording techniques, stereophonic phonograph recordings, and the matrix for stereophonic broadcasting are all derived from this 75-year-old patent, we do owe much to Alan Blumlein for what we enjoy today.

SOUND TRANSMISSION

A basic discussion of how sound waves are conveyed leads to the dimensional transformation of the listening experience with the addition of a second path and stereophonic principles.

Chapter 3 relates the stereophonic illusion to the human auditory system. I find a number of interesting experiments with respect to masking, intensity and delay in this chapter. Try them. You will find these simple experiments useful in gaining a better understanding of the stereophonic illusion. Do not pass over this chapter!

The principles of locating an image in a two-channel sound field are provided, as well as a simple procedure to determine that the two loudspeakers are of the same polarity.

BEFORE THE RECORDING STARTS

The book explains the process – before you engage that Record Button – of taking the time to understand the nature of the recording and what you are attempting to accomplish. It uses a consideration of "the five W's," as well as the tradeoffs associated with each stereophonic technique.

From the most basic of stereophonic recording techniques is the two microphone pickup. However, there are several adaptations of two microphone pickups, so the book reviews the various approaches and the sonic effects which result. Additionally, the difference between stereo and binaural listening is explained

MICROPHONE AND ROOM

Absolute Polarity is defined and explained as a major part of creating the stereophonic illusion through time and intensity differences between two paths.

Reflections, either in the recording or reproduction environment (either can be indoors or outside), affect the audibility of the content. Ambience, reverberation and comb filtering, their audible effects and how to evaluate these effects are discussed, as well as auditory spaciousness, perception of distance and definition, which are the result of the relationships of direct sound, propagation delays, reflections and reverberation as experienced by the listener.

Important techniques covered are the use of multi-microphone, multi-track, and pan pot technology to create the stereophonic illusion. Using directional microphone patterns and creative mixing build the stereo illusion.

MONO TO STEREO TO SURROUND

The book shows some various techniques used to create a pseudo-stereo effect when the original recording is monophonic, creating a difference between the two paths and enhance that difference to create a stereophonic effect.

While the basic subject of the book is based on the relationship between the two channels of a two-channel path, it offers some insight into Multi-dimensional and Surround systems. A trip is taken from "Fantasound" to Three Channel Stereo to Matrixed Quad Systems and Surround and Ambience Enhancement Systems such as the Ambisonics process along with its Soundfield Microphone.

One of the interesting discussions is the potential incompatible phase relationship of the Center Channel with the Phantom Center Channel as derived from the sum of the Left and Right Channels. This is an issue which needs to be understood and resolved during the recording process.

CONSIDERING THE LISTENER

While the home theatre has begun to mandate Surround Sound, many living room environments prefer the simplicity of a two-channel stereophonic system, thus, the attention to compatibility issues becomes important.

In fact, the book makes clear that once the recording has been captured on the medium, attention must then turn to the playback.

The book concludes with guidance in preparing the listening environment as the final step in optimizing the intended sonic experience. The enclosure, its geometry, resonances, reflections, absorption, and treatment as they relate to the resultant sound are discussed.

The New Stereo Soundbook, Third Edition is available direct from Audio Engineering Associates in Pasadena, CA. The price is $68 plus shipping. Information is available at www.stereosoundbook.com or 800-798-9127.

Richard Burden has worked in all phases of broadcast engineering for over 55 years. Contact Dick at rwburden@pacbell.net

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Radio History

by Bob Doll

A Move-In: Just Eighty-One Years Ago

Computer programs have allowed station moves of 75 miles or more in recent years, with at least one jump of 150 miles. But stations have always moved around – in the 1920s, there was even a special class of "portable" stations that operated all over the Midwest. Bob Doll now shares some history of a move-in that is special to him – the station where, as a young fellow, he got his start in the business by running errands.

It was eighty-one years ago when the station where I first brushed shoulders with broadcasting picked up its transmitter and moved some 75 miles into Cincinnati, Ohio.

MODEST BEGINNINGS

John Van deWalle had started a radio station in his retail store in downtown Seymour, Indiana in December, 1924. WFBE operated with 20 Watts each Monday, Wednesday, and Friday from 9:00 to 10:00 p.m.

However, it took just over a year before Van deWalle decided that the little farm town was unlikely ever to make the radio station profitable. The U.S. Commerce Department, radio's regulator at the time, gave Van deWalle permission to move his station 75 miles to the east, and across the Ohio state line into Cincinnati.

In Cincinnati, WFBE operated with 250 Watts at 1290 kHz. A long-wire antenna was stretched out on the Garfield Hotel's small roof. The transmitter was in unused space on the top floor (the 4th). The studio was in the basement.

Hotel owner Earl Fuller, a musician, no doubt knew Van deWalle through the music business. Fuller not only managed the hotel and conducted the orchestra which entertained in the hotel's little night club, he also managed WFBE in its early Cincinnati years. Fuller, by all accounts, was an energetic, hands-on manager with a lot of imagination. When WFBE got a cable address, Earl picked its identifier as "Ear Full."

STRUGGLING TO BE HEARD

From the beginning, WFBE was overshadowed power-wise by its radio competitors. In 1927, WLW and WSAI were broadcasting with 5,000 Watts, WKRC operated with 500 Watts. Within a couple of years, WCKY would sign on across the Ohio River at Covington ("One Minute from Cincinnati") with 5,000 Watts, and WLW would grow to 50 kW on its way to the legendary 500 kW operations in the 1930s.

As with the other stations, WFBE depended on local musicians and singers for much of its programming. Of course, local entertainers preferred to appear on the more powerful stations, WSAI, WKRC, WCKY and WLW. Because of WFBE's more modest coverage, the best singers and musicians tried out at the other stations first.

THE SPORTS "VOICE"

To make itself stand out, WFBE concentrated on – and "shined" in – sports. As early as 1928, a local newspaper sportswriter, "Irish" O'Conner gave breathless accounts of the wrestling card at the city's famed Music Hall. Broadcasts of boxing matches were also popular.

One night, the regular WFBE boxing announcer failed to show up. Station manager Fuller hastily recruited a young clerk from a local men's store that he had noticed. An avid fan, Harry Hartman not only did the boxing matches from then on, he also did the Cincinnati Reds baseball games in the late 1920s and during the 1930s. Eventually, Hartman gave up selling men's suits to sell radio time and became the station's top local time salesman until his death in the early 1950s.

Another accidental radio "star" was National Players leading man Bob Bentley. His "road company" stopped at Cincinnati's Cox Theatre. After a matinee, Bentley walked the two and a half blocks to the WFBE studios "to get a look at this thing called radio." He "instantly fell in love with it." He gave up the stage and for a decade he was one of WFBE's most versatile radio announcers – remembered long after he left the air for his "Man on the Street" broadcasts.

Building on its popularity, in 1931 WFBE moved its studios to a more prestigious location, the Hotel Sinton, one block south of the city's famed Fountain Square. The transmitter and antenna remained at the Garfield Hotel.

OWNED BY THE NEWSPAPER

In 1935, WFBE became the first broadcast property of the Scripps Howard Newspapers, changing call letters on October 1st to WCPO to reflect its association with the local newspaper, the Cincinnati Post.

Roy Howard, the legendary newspaper man, had no interest in radio, but his son Jack did. A Yale graduate, he gave up a middle management position at a Washington, D.C. newspaper to learn the radio business from the ground up. When Scripps Howard bought WNOX, Knoxville, TN, soon after WCPO, Jack Howard moved to Knoxville, eventually becoming President of the radio group in 1940.

The new owners improved the station's coverage by installing a 199-foot tower on top of an industrial building east of the downtown area. A new 250-watt Western Electric transmitter was placed inside a small building constructed on the factory roof. Copper radials were strung from the tower across the roof.

Soon WCPO relocated studios and offices a half a block north of Fountain Square, creating one of the country's first "showcase broadcast facilities." Passersby could view broadcasts though what had been a store display window.

DELIVERING THE NEWS

WCPO started calling itself "Cincinnati's News Station." It was one of the first radio stations to offer listeners "news every hour on the hour."

To ensure having the latest news, regular broadcasts soon began to originate from what had been a storage closet just off the City Room at the Post. The push into news was firmly established during the disastrous 1937 Ohio River Flood.

To give listeners nearly nonstop coverage of the flood, the station preempted almost the entire regular schedule. The broadcasts delivered a huge career boost to one of the young staffers broadcasting around the clock during the emergency, Frank Swygart. Hired away by competitor L.B. Wilson at 50 kW, CBS affiliated WCKY, Swygert did newscasts and a dinner hour celebrity interview program as Rex Davis. Swygart/Davis eventually landed at CBS O&O KMOX, St. Louis, where he was a key figure at that station into the 1980s

A NEW SHERIFF IN TOWN

Still dwarfed in power by its competition, WCPO sought ways to stand out in the market. The fall of 1938 brought with it a manager who saw no reason WCPO could not be a real contender.

Mort Watters was just 29 years old when he arrived at WCPO. The Rochester, New York, native had attended Georgetown University in Washington, D.C. where he studied logic and other courses designed to help students learn how to think out and solve problems. Upon graduation, he decided to learn something about what he saw as the promising new field of radio broadcasting. He could not find a job, so he went to work "for experience initially – no pay" at a Washington ad agency.

Soon he was a radio sales manager and, at age 25, was running a group of three stations in West Virginia – including the state's leading station, WCHS, in the capital city, Charleston. Watters arrived at WCPO, ready for a challenge.

A BIG VOICE FOR A SMALL STATION

WCPO continued to develop some of the top talent in the city. The first big move Watters made was to hire Tom McCarthy. Only 23 years old, McCarthy sounded like a "razor sharp" 40 or 50 year-old on the air, with a delivery much like that of Paul Harvey, who would come on the national scene a dozen years later.

McCarthey opened his broadcasts with a signature, "It's a beautiful day in Cincinnati," no matter what the current conditions or the forecast was. His lead story always had a local tie-in. And, he always ended his broadcasts with "One for the Book," a human interest story that Tom told with a tinge of Irish brogue in his voice.

As his hourly broadcasts from 11:00 a.m. to 6:00 p.m. gained in popularity, McCarthy delivered the middle commercial on his broadcasts, personally endorsing the sponsor's product or service. McCarthy reached his zenith at WCPO on Sunday, December 7, 1941 when war broke out. He was "the anchor" around the clock during the first few days of the war.

NOT ENOUGH POWER

But, alas, WCPO was still only 250 Watts. As with Swygart, McCarthy's work caught the attention of the competition, including the management at WKRC – members of the Taft Family who owned the Post's rival evening newspaper, the Times Star.

When WKRC lost their star performer and "business magnet" Ruth Lyons to the Crosley Corporation's WLW in early 1942, they came after McCarthy, offering him $250 per week – a very big paycheck for 1942 and a third more than WCPO was paying him. Station Manager Watters pointed out that he had brought McCarthy to Cincinnati and thought he should have been given a chance to counter the Taft offer. McCarthy countered with, "Far more people will be able to hear me over there."

Nevertheless, even without McCarthy, WCPO did well during the "war years" thanks to its reputation as "Cincinnati's News Station" and its steady serving of popular recorded music. Watters told close friends that he had learned his lesson and decided, "From now on, we'll promote the station, not 'stars.' We won't get caught like we did with McCarthy."

SUCCESS FROM THE SMALL SIGNAL

Watters soon changed his mind on that score. In 1944, WCPO hired another high profile personality, Malcomb Richards, from a small radio station in Atlanta. WCPO scheduled Richards from 6:00 to 10:00 a.m.

There was something very special about him on the air. He hummed along with some of the records, whistled to others. He was very easy going, not peppy and animated like most morning radio personalities.

(Continued on Page 42)

This boring ad can save your butt, make your job easier, and keep the boss happy.

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Radio History

Continued From Page 40

A Move-In: Just Eighty-One Years Ago

He told his audience that he did not like getting up in the morning; most of his listeners seem to have felt the same way. It was "a perfect marriage." Despite the signal limitations, WCPO consistently won the early morning ratings with Richards.

The following year, WCPO got another break. The Cincinnati Reds gave exclusive rights for their radio broadcasts to the Burgher Brewing Company and brought retired Yankee pitcher Waite Hoyt to town to do their broadcasts on WKRC. But WKRC had gotten a fat network contract to rejoin the CBS network. Carrying baseball would interfere with that.

Reds owner, Powell Crosley, would have carried the games on his WSAI (he did not wish to put the Reds on WLW and bump any of the NBC programs), but was forced to sell the station in 1943 to comply with the then new "one to a market" FCC Rules. WSAI's new owner, Chicago department store heir Marshall Field, with a lucrative ABC network contract, had no interest in carrying the Reds.

So little WCPO got the Reds' games exclusively for a decade; it brought top ratings every spring and summer. Waite Hoyt also brought a big department store with him as sponsor of his dinner hour sports program, *"According to Hoyt."*

THE NEWS KEEPS FLOWING

Thanks to the success of Malcomb Richard in the morning and getting the Reds' contract, Watters had a good deal of self confidence. As WWII was "winding down," he started planning for changes that would come with peacetime. Watters soon added Paul Dixon as the afternoon newscaster and a Saturday night telephone request show.

A good reader, Dixon gave a straightforward news broadcast. He "shined" during the 3-1/2 hours on Saturday night. Dixon became a local hero in 1947 when an old downtown warehouse building collapsed, burying several workman under the debris. Dixon covered the rescue of the men on the spot; the effort lasting several days. Most dramatically and dangerously, Dixon went "under the building" to interview the trapped workmen live on the air.

For years, WCPO's management had lusted for a more powerful facility. They tried again in 1948, when Scripps Howard asked the FCC permission to buy WVLK from former Kentucky Governor Happy Chandler. (As Commissioner of Baseball, his office was in the same building as WCPO.) The FCC turned down the transfer because Scripps Howard wanted to move it from the small town of Versailles, Kentucky, which would leave that town without a local station.

After the failed WVLK purchase, an application was made to put WCPO on 630 kHz with 5,000 Watts. WCPO was turned down again because Cincinnati already had four stations with 5,000 Watts or more. The 630 facility went to Lexington, Kentucky which at the time had no 5,000 Watt stations. Curiously, just two years later WVLK would move from Versailles to Lexington.

TELEVISION TAKES OVER FOR A WHILE

From 1946 through 1949, WCPO was the highest billing 250 Watt station in the United States. As television stations started rolling out, Watters parlayed WCPO into an aggressive TV station; within a month of sign-on in 1949, the station was on the air 18, then 24 hours a day, something unheard of at the time.

Believing his radio personalities would be popular on television, Watters brought many of them to the new medium. Besides filling time, it worked well. Paul Dixon who could not sing or dance or even tell a joke very well was a great success on TV, just as he had been on radio by "being himself." Dixon proved to be as great an on-air salesman as he had been on radio. Filling up three hours a day on TV, bantering good naturedly with his co-hosts, Dixon and his program were picked up, first by ABC, and then on the short lived DuMont TV Network.

Although the radio station was still doing well, Watters believed that television would replace radio as talking pictures had replaced silent pictures. Hence the radio side did not receive as much attention from management. Eventually, WCPO lost the Reds' broadcasts, and the station started to swoon a bit.

A ROCKY TIME IN THE 50's

Thanks mainly to owners without TV interests like Elmo Ellis, Todd Storz, and Gordon McLendon, radio had a stunning rebirth in the Mid-1950s – the Rock Era had begun.

When Mort Watters, at the urging of the station's national "ad rep," OK'd an increase in the WCPO Radio budget, he said publicly, "I was so wrapped up in TV, I missed out on this." He installed Pat Grafton, one of the stars in his TV sales department as radio station manager. A barrage of TV spots and billboards hyped "Color Radio." New high energy disc jockeys were brought in from places where the "radio miracle was in full swing."

WCPO Color Radio was well received by the public and the advertising community. Then, the scrappy little station was stopped "dead in its tracks" by much more powerful WSAI, which gave up baseball for "Top 40" music – a format in which it would reign supreme for over two decades.

SINKING LOWER AND LOWER

After Color Radio "died," WCPO unsuccessfully tried a several formats including an all-hootenanny (folk music) format. After WKRC dropped the CBS Radio Network, WCPO took it over and programmed a classical music format. That did not work either. WCPO now was losing money. In 1966, Mort Watters, reluctantly closed his 28-year association with the radio station and sold it to world famous entertainer Danny Kaye and his partner, west coast radio executive Lester Smith.

The "Radio Doctor" – without peer – in the mid-1960s was Bill Drake. Drake installed high profile jocks, a scientifically selected tight playlist, and an intriguing set of call letters, WUBE ("1-2-3-W-B").

However, even the Bill Drake "magic" (nor the FM simulcast) could not overcome the station's coverage problems. WSAI continued its dominance of the "Top 40" scene in Cincinnati; by the end of the decade, WUBE had segued from Rock to Country.

LOOKING FOR A NICHE

At least the AM/FM combo had "stick value." WUBE AM and FM was sold in 1981 to Plough, Inc. for $3.1 million, and the FM Country format has been a solid winner ever since. Less than 10 years later, Alan Beck's American Media bought WUBE-FM and its co-located AM for $9.8 million.

Like most FM stations WUBE-FM, was getting more valuable every year. The AM, however, continued its downward spiral, going through a bewildering turnover of formats, call letters, and owners. Even a power increase to 1,000 Watts in the mid-1980s did not really help much.

Big Band, Oldies, Country (hoping for some "pin action" from the successful FM), Sports Talk, Adult Standards, more Sports Talk. It seemed like the little station from Seymour, IN was fading away for good.

RESCUED!

Finally, in August, 2000, the station went to a local owner and once again began a lasting format. Ross Love, a native of Philadelphia, had spent 28 years with Cincinnati-based Proctor and Gamble. In 1996, he left behind ten years as Vice President of Marketing for the world's largest advertiser to become an entrepreneur.

Love ushered in a "new golden age" for the station as he capitalized on a niche that a change in demographics under the little station's tower would make available. WDBZ (formerly WFBE and WCPO, among other calls) began offering a unique information-talk format aimed at the 200,000 African Americans in the city.

It is interesting to note that this was not the first time the station had reached out to the black community. All the way back in 1948, WCPO had targeted some of its programming to the then comparatively small African-American population in the Cincinnati area. It donated 15-minutes a week to the Cincinnati Chapter of the National Association for the Advancement of Colored People (NAACP). That program focused on the local blacks' struggle for equality. The program was called *"Citizen 13."*

Also in 1948, the WCPO was the first general audience station in the country to employ a black man as a staff announcer. The late Bill Fields, then in his 20s, conducted the all-night program, which featured a lot of what, in those days, was called "Boogie and Blues." He also read newscasts and conducted other programs aimed at the general populace, before leaving for Nashville to put together one of the first full-time formatted stations aimed at the black audience.

BACK IN THE THICK OF THINGS

Like Ross Love, WDBZ has been deeply involved in the city's civic life with features like *"The Unsung Hero,"* and *"Community Clipboard."* The station even played gospel music all night.

Love's son, Jonathan, has been a program executive and station personality on WDBZ. The station carries nationally syndicated hosts Tom Joyner, Michael Dyson and Al Sharpton. Local personalities include Lincoln Ware, Sister Spector, J. Love, and former professional sports stars Eric Thomas and Box Miller.

Under Love's direction WDBZ was once more a strong voice in Cincinnati, reaching its target audience. Finally this spring Love sold WDBZ to Radio One (which previously had purchased his other stations) for approximately $2.5 million.

Today, the 82-plus year-old radio station that started its life in Seymour, Indiana as modest little WFBE reached its greatest heights as WCPO during the closing days of Radio's "Golden Age" in the 1940s, continues to be an important part of the Cincinnati market. That 75-mile move definitely made a difference.

Bob Doll is a native of Cincinnati. His broadcast career – now 56 years and counting – began at WCPO "at no pay." Since then Doll has worked at, managed, and owned stations in five states. Now a consultant and author (The Radio Funny Book - Infinity Publishing), *he can be reached at (830) 379-7549 or at dolbobbar@AOL.com*

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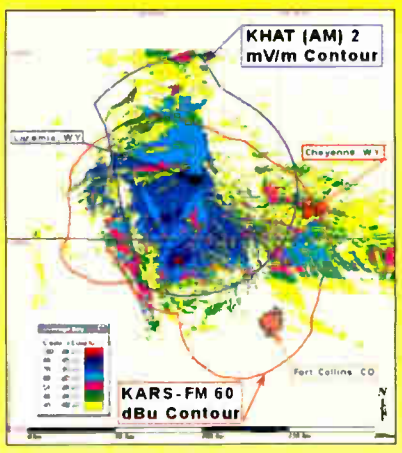

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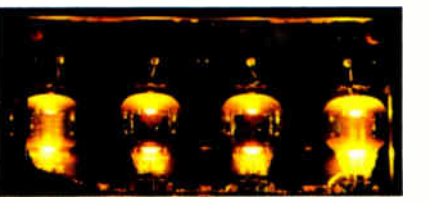

RADIO ROUNDUP

The Radio Guide Event Register

Email your dates and info to: ***radio@rconnect.com***

Texas Assoc. of Bdcstrs. (TAB)/SBE Convention
August 8-10, 2007
Austin, Texas
www.tab.org/convention.php

NAB 2007 Radio Show
September 26-28, 2007
Charlotte, North Carolina
www.nabradioshow.com

BOS-CON 2007
October 5, 2007
Marlborough, Massachusetts
www.bos-con.com

Madison Broadcasters Clinic
October 9-11, 2007
Madison, Wisconsin
www.sbe24.org

Pittsburgh SBE20 Regional Convention
October 10-11, 2007
Monroeville, Pennsylvania
www.sbe20.org

35th Annual SBE22 Broadcast/Technology Expo
October 16-17, 2007
Verona, New York
www.sbe22expo.org

5th Annual Ohio Broadcast Engineering Conf.
November 29, 2007
Worthington, Ohio
Contact: Patti Geary at pgeary@oab.org

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