Radio Guide

Radio Technology for Engineers and Managers

April 2007

Console Design That Goes Back to the Future

Inside Radio Guide

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Cover Photo
The new Rick Dees studio complex in Burbank, California

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Radio Waves

by Barry Mishkind – Editor

GOOD NEWS/BAD NEWS

As we prepare to head off for the annual NAB Spring Show, the FCC is readying its Spring "gifts" to the industry. Of course, you know the old line: "There is good news and bad news, which do you want first?"

The good news: FCC is finally authorizing full-time IBOC operations on AM channels. FM multi-channel and datacasting operations no longer are "experimental." And the first window in a long time for NCEFM filings will open. At least it appears there is good news.

Broadcasters have been waiting for these actions. For example, frustrated AM broadcasters, forced to drop their digital carriers – and improved audio – each day at 6:00 PM, wondered what good getting some sonic "parity" with FM meant if they could not operate consistently, 24/7.

But then the other shoe drops. Little attention was given to warnings of potential interference, much less equity. If a daytimer is not allowed a single Watt at night, how can the band survive stations tossing as much as 1250 Watts of signal – or more – on adjacent channels? No one seems to know. Finally – we should find out.

Meanwhile, NCEFM applicants worry about competing with entities filing hundreds or thousands of applications. Some tiny stations are in danger of being bumped off the dial by "creative" applications. LPFM operators are wandering around, hoping for any opportunity to serve their area. And what is this deal of issuing a wavier and STA so a pirate can operate a station?

Perhaps it is something in the DC water. A lot of folks are scratching their heads to determine which is the good news and which is the bad news. As the year progresses, we hope the FCC offers us some clarity on these matters.

LET'S HAVE LUNCH!

For those of you en route to Las Vegas for the NAB, or those of you reading this there, we hope to see you at Noon on Tuesday (17th) for our annual Lunch Gathering at the Riviera Hotel Buffet restaurant. *– Radio Guide –*

Back to the Future Console Design

The *Dees Digital Console*

by Barry Victor

In August of 2006 I was asked to be the Project Manager for a new studio complex being built in Burbank, California. The facility was being constructed for the well-known broadcaster, Rick Dees.

The whole complex was to consist of five studios, three of which were to be used for Rick's new morning show. The other two would be a production studio for Rick's weekly countdown show and a rental studio for any visiting radio shows.

The studio suite was to be designed around the SAS 32KD digital audio network and the Rubicon control surfaces for all of the studios. The one exception was Rick's main studio. Originally a new analog audio console with rotary pots was purchased for Rick to replace his beloved RCA BC-7A console, one he has been using for the last 20 years, only to learn later that a different approach for this studio would be required.

Still, as it turned out, the path to the new studios did indeed lead directly to the past.

A STAR RETURNS

In September 2006, Emmis Broadcasting changed formats on KZLA, their Los Angeles country radio station, to KMVN, Movin' 93.9, with a rhythmic dance format. They also brought Rick Dees back to Los Angeles morning radio after a three-year absence.

Unfortunately, Rick's new studios were not going to be ready until early 2007, so we had to work with Emmis' LA engineers to modify one of the production studios to get Rick's new morning show on-line in the interim. Faced with this task at the beginning of September 2006, we had three (3!) weeks to configure a temporary studio for an on-air date of September 25, 2006.

Rick had an RCA BC-7A console in storage – updated with solid-state electronics – which he would have liked to commission. But given that today's radio facility requires much more interfacing to ancillary devices it would have taken weeks to piece together a functional system around the old RCA. Instead, we took a modern day analog, rotary-pot console that had been purchased earlier and built a retro studio with Rick's familiar cart machines and instant replays, interfacing it to an existing BMX digital console in the ex-KZLA facility.

Rick Dees' debut on KMVN from the temporary studio was right on schedule. However, as much as Rick liked his rotary pot console, it was *not* his RCA BC-7A with the ergonomic design to which he had grown accustomed. He needed it to be more like the old RCA.

BACK TO THE FUTURE

Several discussions took place with Rick to decide what we would build into Rick's main studio at the new facility. The shortfalls of his new analog console and the lack of interfacing of the old RCA console required us to look into other alternatives.

Based on our meetings, I envisioned building a custom console that would look and feel as much as possible like the old RCA console. At the same time, the console had to function as a digital control surface on the SAS 32KD digital audio network in order to handle the many features, functions and flexibility required for today's radio facility. It had to have the retro/ergonomic design and function of the RCA console that Rick loves.

Since the new facility was to be built around the SAS 32KD digital audio network and Rubicon control surfaces, I knew right away how to realize my new digital/retro console: Go to SAS.

READY TO ROCK AND ROLL

Al Salci, Vice President of SAS, was immediately enthusiastic about the project and we went to work right away, since Rick's new studios were scheduled to be finished in January 2007. This gave SAS three months to design, construct, and deliver a working console.

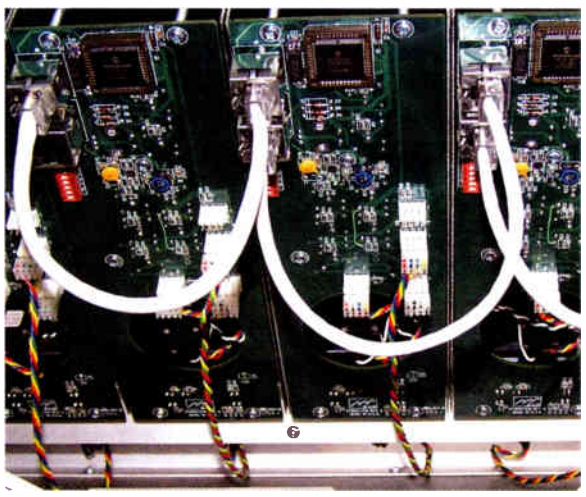
Rick, Mike Hagans of SAS, and I met to set the initial design criteria, and it was at these conferences with SAS that the new *Dees Digital Console* control surface was born.

There were several "must have" requirements that Rick insisted upon for the console. Some of these requirements included rotary level controls (of course) with two-inch knobs, a single button for module On/Off, detent cue with a lighted indicator, and analog meters. The input modules were to have a vertical slope of around 70 degrees.

Additionally Rick wanted a large shelf area above the input modules with a lip to hold copy. Analog meters were a must for the look and feel of the adored RCA console. For the modern functionality, a digital display readout on each fader channel would indicate the source selection from the A and B buttons or the external source selection for each module, giving a completely configurable console just as found in today's digital control surfaces.

BUILDING ON A GOOD FOUNDATION

The SAS Rubicon SL input module circuit topology was repackaged for the *Dees Digital Console*. The design required a new PC board (printed circuit) that was fitted with a rotary potentiometer and an "off" detent for the cue actuation.



Repackaged Rubicon input modules were adapted for the rotary pots.

The Rubicon SL circuitry was a perfect fit for the project and that helped to ensure a timely delivery. Additionally, the SL module software could be used for the new input module with very little changes to the mature firmware that SAS has been delivering for quite some time.

Each module channel is three inches wide to accommodate the two-inch knobs. The console enclosure was to be fitted with 15 input modules and a monitor module which put the overall width of the console at 50 inches. The height is just less than 13 inches, complete with meter bridge, which allowed for a two-inch deep cut into the furniture table top. The height limit was important since a higher profile would restrict the view to the guests on the other side of the console.

BRINGING IT TO LIFE

At this point I had a full-size print of the control surface and the meter bridge made. I attached it to art board and made a life size mockup of the console for Rick to review and approve. A few dimensions were adjusted, along with a tweak or two on the slope of the front surface, before the final sign off.

With the design now pretty much set, SAS's team went to work. Ed Fritz, President of SAS worked with me in regards to the details of the console enclosure. Rick wanted a natural aluminum finish on the console, a wood trim for the sides that would match his new custom furniture in the studio, and – of course – analog meters.

I found a company that specializes in recreating knobs for antique radios. Located in Los Angeles, Larry Bordanaro of Old Time Replications fabricated a replica of the bakelite two-inch knobs using an original knob from a 1952 vintage RCA board as a sample. He made us exact copies in five different colors, using modern materials.

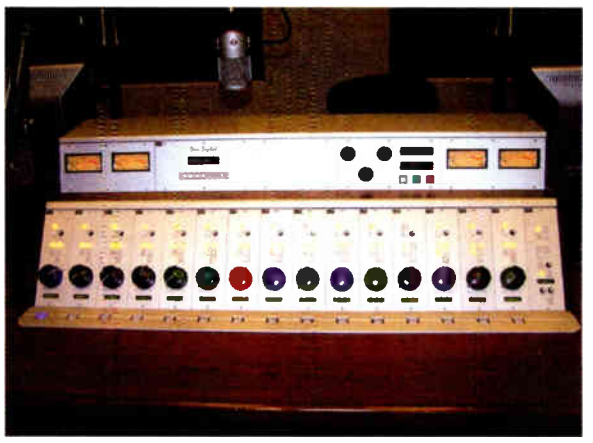
The fader knobs have the "look and feel" of the classic consoles.

Easy to work with and a novel concept, Larry provided timely and economical antique type knobs with modern molds and plastics. You may check them out at www.antiqueradioknobs.com. The knobs readily got the Rick Dees' "seal of approval."

"FULLY LOADED"

Some highlighted features of the new *Dees Digital Console* are as follows:

- Individual module for each fader input channel.
- Fifteen total input modules.
- Each module has an A and a B input select with three output bus select buttons, (2 Program, 1 Offline).
- Each module has an alphanumeric display to indicate the current source assigned to the channel and for other supplementary channel parameters such as Mode, Pan, and Phase etc.
- Each module has the ability to select any audio source available within the facility using the SAS 32KD digital audio network system.
- Each module has a lighted-detent cue position.
- The monitor panel has separate source selection for headphones and control room monitors and provides individual audio level controls for talkback, cue, control room monitors, and headphones.
- There are two analog stereo meters.
- The console houses an auto-start timer and a separate timer with manual controls
- There is a time-of-day clock
- An assignable eight-button panel for talkback to anywhere within the facility.
- Last but not least, by using the SAS 32KD digital audio network, an unlimited number of mix-minus lines can be automatically generated for as many destinations as required.



It looks good, it "feels" good.

LOOK MA, NO MOTHERBOARD!

One unique aspect of this control surface worthy of a mention is that all of the modules are installed into the enclosure much like turret modules. There is no motherboard for the modules to plug into. CAT 5 cables with RJ45 connectors are used to interconnect the RIO DSP engine system to modules 1 thru module 16 in a "daisy chain" method.

(Continued on Page 6)

Internet remotes... there's been talk.

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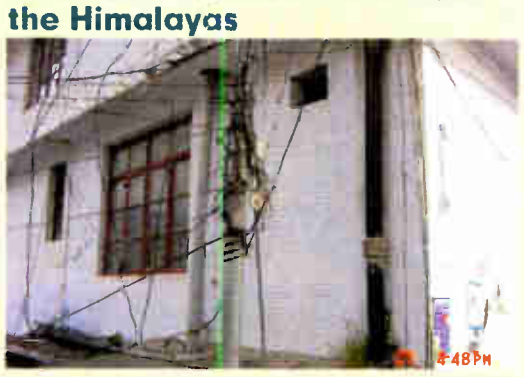

"The results [with ACCESS] were especially reliable considering that Dharamsala has one of most "problematic" Internet infrastructures that we have come across." — David Baden, Chief Technology Officer Radio Free Asia

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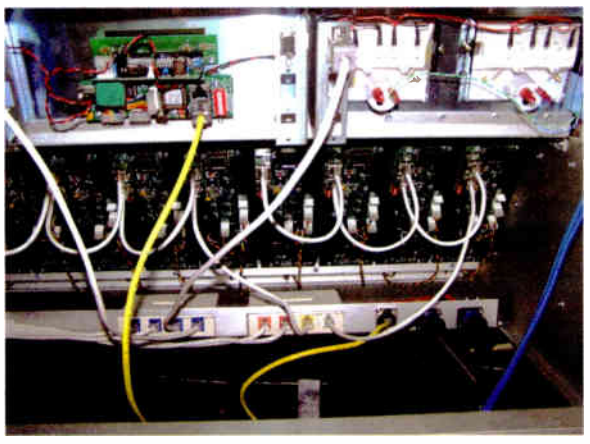
COMREX

Back to the Future Console Design

The *Dees Digital Console*

Continued from Page 4

The CAT 5 cable contains data and power "to and thru" each module. This is a unique yet simple system design. This same concept is accomplished in the Rubicon and Rubicon SL except that the CAT 5 cabling is replaced with a motherboard within the Rubicon enclosures (or Tub).



The console does not use a motherboard. The modules are interconnected and linked to the SAS 32KD.

The console utilizes an SAS RIO audio chassis that provides 32 signal inputs and 32 signal outputs complete with a DSP engine and is installed in the equipment bay of the control room. The RIO chassis also houses the serial ports that connect to the control surface using a standard CAT 5 cable with RJ45 connectors (daisy chained as mentioned above).

ANALOG OR DIGITAL ... OR BOTH

The RIO can be fitted with analog or digital IO or a combination of either signal domain. We decided on a 50% digital and 50% analog input and output configuration. This gave us 16 analog channels in and out which can be configured mono or stereo, and eight stereo digital channels in and out. RJ21 (25 pair) connectors are used for all audio-signal I/O, and connects directly to a RJ21 on Krone blocks.

All of the local media audio signals are punched down to the Krone blocks with short cable jumpers. The RIO connects to the centrally located SAS 32KD with a standard CAT 5 cable (RJ45) and operates as a 32 x 32 block within the bigger 32KD system that yields 512 inputs and 512 outputs total.

The RIO chassis also provides 16 relay outputs and are used for functions such as "on air" lights, and remote (or auto) start of playback devices (CD/Carts/Automation). Sixteen opto-isolator inputs are used for ready tallies from the playback devices, to reset the input modules to off, and for microphone cough-button inputs.

A FULL BROADCAST SUITE

Dees ordered a total of three consoles. SAS delivered the first one in February to the new Rick Dees facility here in Burbank California. This console connects to the SAS 32KD digital audio network system and allows studios to be shared, merged, and used for main programming or production, due to the inherent ability of the system to map any source to any destination.

The happy owner of the first *DEES DIGITAL CONSOLE.*

The other two consoles will be installed with RIO chassis as self-contained stand-alone systems. Each RIO will have the necessary software to operate as a standalone 32 X 32 system. One will be installed in Rick's studio at the KMVN facility and the other will be installed in his personal studio on his farm in Kentucky.

SAS delivered my concept product from "the idea in my head" to a complete delivered product within three months. I have worked with SAS for many years; it was a joy to work with them on this distinctive project and I am sure they are as proud of the new *Dees Digital Console* as I am.

For more information – and more photos – check out the SAS website at www.sasaudio.com

Barry Victor has been designing studios and running facilities from one station to entire networks for over thirty years. Contact him at barry@victorgroup.net

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Transmission Guide

by Jeff Welton, Nautel

Phase Rotators and Why You Need Them

One of the major positive effects of the move towards digital transmission has been the number of stations that have moved to clean up their transmitters, matching networks, and antenna systems. However, as Jeff Welton explains, installing a new transmitter could negate all the other work, if it is not done carefully.

If you are in the process of preparing for an upgrade to employ HD Radio technology at your AM station or if you are getting ready to upgrade an existing facility that may, at some point, broadcast a signal with HD Radio technology, you should be asking the following question:

"Why," you ask, "would I ever need a device to change the phasing of my antenna system? Isn't the phasor or ATU enough?"

In a nutshell, the answer is: no, not always. In the following paragraphs, I am going to tell you the steps for optimizing the antenna system for HD, and then give some examples where a phase rotator could make life easier.

BEYOND "50 j0"

The first thing to remember is that for optimum transmission of an HD radio signal, it is not enough to simply have a 50 j0 ohm impedance presented at the transmitter output connection. Nor is it sufficient to have the SWR within the specified limits of 1.4:1 at the + and – 15 kHz sidebands.

In order to minimize spectral regrowth (which we discussed in the December 2005 through May 2006 issues of ***Radio Guide***) it is also necessary for the load impedance to be symmetrical and to present a nominal 50 j0 ohm load at the output of the power amplifiers - but also with the sidebands being purely symmetrical and equal in deviation from 50 j0. It is no longer sufficient to tweak the load for minimum reflected power at the output of the transmitter and call it good enough.

Symptoms of a poorly matched load (with respect to phase delay and sideband symmetry) include long acquisition times by HD receivers, poor range, and frequent blending to analog, even in areas where the signal should be good.

PROPERLY SETTING AND MEASURING THE TRANSMITTER LOAD

Here is a step-by-step list of what you need to do to set up the load for a transmitter broadcasting HD.

First, it is necessary to know the existing load impedance. This means plotting the antenna impedance over the range of operating frequencies (Fc–15 kHz to Fc+15 kHz). It is also necessary to know how this appears to the RF amplifiers in the transmitter, which means we need to know the phase delay between the measuring point (where we plotted the antenna impedance) and the *RF amplifier outputs*.

Most manufacturers can and will provide the needed data on phase delay from RF amplifier output to transmitter output, making this is a much more convenient place to measure the antenna system impedance. (Nautel, for example, makes this information available on our website for all of our current HD compatible transmitters. Browse to http://www.nautel.com/ResourceCentre.aspx and simply scroll down to Information Sheets to view a chart of phase delay for our XR series transmitters.)

Most manufacturers also provide this data with the test results of transmitters shipped within the last few years. For older transmitters, it may be necessary to contact the transmitter maker for more information.

LOOKING AT THE ANTENNA SYSTEM

Next, it is necessary to know the antenna system SWR. The most visual way to do this is to plot the antenna impedance on a Smith chart. Things to remember are that the antenna impedance must present an SWR of less than 1.4:1 at Fc + and – 15 kHz and that the impedance plot must be symmetrical.

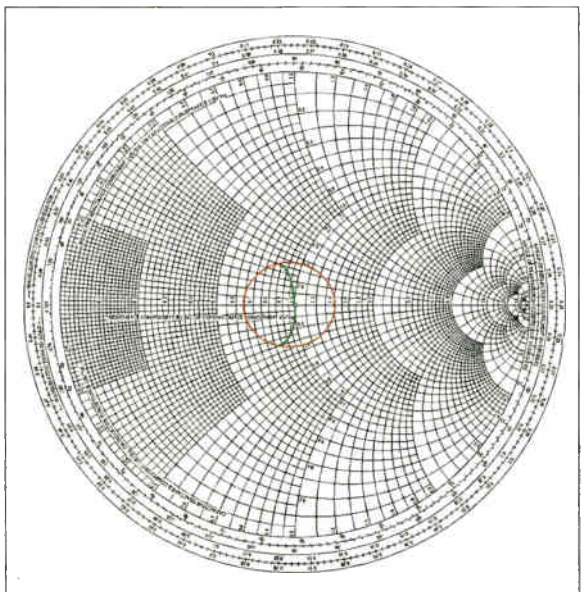


Figure 1

Load symmetry on a Smith Chart.

The preceding Smith chart (Figure 1) representation depicts the ideal RF amplifier *load symmetry*.

As you look at the graph, please remember that this is the ideal *phase rotation* for the load seen by the RF amplifier outputs; it will not necessarily look the same at the transmitter output connection. Also remember that the above is a "worst case," where the antenna impedance is 1.4:1 at the sidebands – a better load would look the same as the curve shown within the circle, but would not extend to the edges of the circle.

DETERMINING THE TRANSMITTER OUTPUT DELAY

Assuming that data is not available for delay through the transmitter, it can be measured by using an oscilloscope to measure the RF output of the amplifiers and comparing that to the output of the transmitter.

Caution!!!

A suitable high voltage probe must be used if attempting to measure transmitter output directly, as lethal voltages (to both equipment and personnel) may be present at this point.

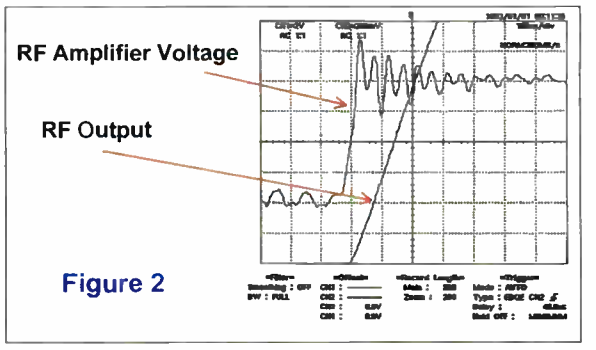


Figure 2

Comparing the RF Amplifier and RF Output.

In this display we see that the RF Amplifier leads the RF Output by 1.4 divisions, or 140 nanoseconds. Assuming our test frequency is 1000 kHz, we know that the signal oscillates at 1 million cycles per second. We can invert this to determine that the time period for this frequency is 1 microsecond per cycle.

Therefore, 140 nanoseconds divided by 1 microsecond per cycle gives us a phase delay of 0.14 cycles. Multiply this number by 360 degrees per cycle and we find that the delay shown by this waveform is 50.4 degrees. Note that this is not a typical output network phase delay, the waveform was merely selected to illustrate the calculations required.

Once we know the impedance of the load at the transmitter output and the phase delay between the RF amplifier outputs and the transmitter output, we can optimize the antenna at the transmitter output terminals, setting it so that the sidebands are symmetrical and within the 1.4:1 SWR limitations.

Then we need to phase rotate it to create the best load to the amplifiers. This is done by rotating the antenna

(Continued on Page 10)

Transmission Guide

by Jeff Welton

Continued from Page 8

plot on the Smith chart by the amount of phase delay through the transmitter, then calculating how much additional delay is required to achieve the ideal load characteristics indicated in Figure 1.

A PRACTICAL EXAMPLE

As an example, if I were planning to use a Nautel XR12 transmitter at 690 kHz, the chart on our website shows me that the transmitter has a nominal phase delay of 152 degrees.

If I want to see an optimum load at the amplifier output, then I can draw a radial on the Smith chart at 152 degrees to show me the plot I should achieve when the load is properly tuned to match the delay through the transmitter. Alternately, I can subtract the phase delay through the transmitter's output filter from 180 degrees and obtain the phase delay needed to achieve optimum symmetry in that fashion.

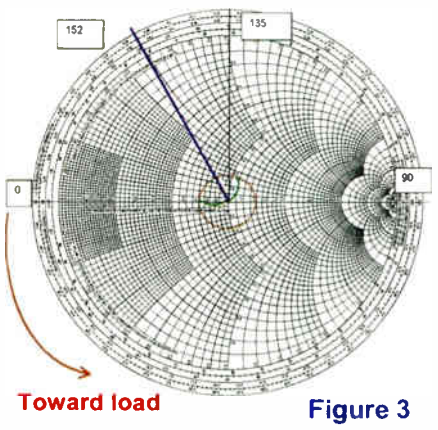


Figure 3

A Smith chart representation of the load shifted away from the RF Amplifier.

In analyzing the results, this shows me that I need an additional 28 degrees of phase shift in order to achieve an optimum load to the RF amplifiers. This can be done by installing a Pi network at the output of the transmitter. (Design of a Pi network is outside the scope of this article, but information can be found from many sources, including the NAB Engineering Handbook.)

Using the phase rotator to adjust the delay will move the curve right back to the "sweet spot" and allow you to continue to peak the entire transmission system.

PHASE ROTATOR BENEFITS

Something to note during the design of a phase rotator is that ideally it will be built in such a way that if it needs to be adjusted at a later date, the adjustment does not require wholesale component replacement.

The reason for this is simple: at some point in the future, you are probably going to want to replace your transmitter. Our XR12 at 690 kHz has a phase delay from RF amplifiers to output connector of 152 degrees – but another transmitter may not.

For example, I have done HD upgrades on Nautel transmitters that were 15+ years old. Those transmitters will be nearing the end of their lifecycle shortly and will be getting replaced by new transmitters. An adjustable phase rotator will ensure that such a replacement is made easier and does not require a wholesale revision of the input stages to the antenna system in order to accommodate the HD technology.

As with most other things, you can readily see that a little bit of foresight at this point could save significant time and expense later on.

MATCHING MULTIPLE TRANSMITTERS

Another example where a phase rotator could become useful is when even backup transmitters are configured for broadcasting with HD Radio technology. Using nominal 15 year transmitter lifecycles, this point is not all that far away.

Then we are facing the same scenario – but this time, with two different transmitters with different phase delays. The options are to make the phase rotator common to both and variable, so that if we end up on standby we can go to the site as soon as possible to reset the delay for the backup transmitter, or to have a separate delay circuit for each transmitter, prior to the common point.

It always helps to contact your manufacturer. Once the antenna system is swept and optimized for the specific transmitter, provide us with the phase and amplitude response of a generator looking into the antenna system. We can usually find ways to help you optimize HD performance into the antenna system.

One of these methods is by employing a pre-correction algorithm to the HD generator to overcome any non-linearities with respect to phase or amplitude response. This has been done and tested in the field and will be a subject for a future topic somewhere down the road, as we discover and develop newer and more exciting ways to move broadcast technology forward.

Jeff's earlier articles on HD installation on AM and FM can be found at http://www.radio-guide.com/#Radio Guide 2005 On-Line and http://www.radio-guide.com/#Radio Guide 2006 On-Line
NOTE: These URLs are available at www.radio-guide.com/URL.htm

After 16-1/2 years in the technical and field support department, Jeff Welton was recently promoted to the position of Technical Sales Representative at Nautel. A frequent contributor to ***Radio Guide****, you can contact him at jwelton@nautel.com*

Processing Guide

by Jim Somich

Processing: Yesterday, Today, and Tomorrow

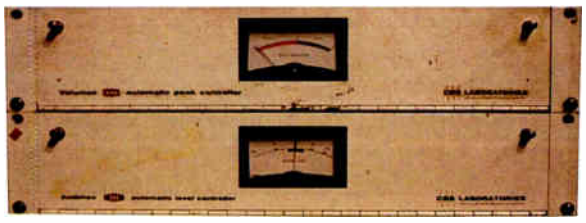
Part 3: Talking with Today's Masters

Before his recent death, Jim Somich was very interested in just how audio processing has changed over the years – but even more so in considering what is to come in the future. Of course, understanding the current technology and the reasoning behind it is what gives us the foundation to discuss the future. In preparation for this article, Jim had conversations with some of the current masters of processing – and some of the future masters.

"History Repeats Itself. First as tragedy, then as farce." – Karl Marx

Today, we may deride the Audimaxes and Sta-Levels of the past and assure ourselves that we are "state-of-the art" all the way. After all, digital is perfect is it not? And we do have digital boxes, do we not?

Well, perhaps it is time to break a few eggs: I predict that in thirty years we will look back on the DSP processors of today in much the same way as we smile condescendingly at the mention of an Audimax or Volumax of yesteryear.



Are the Maxx Brothers worthy of respect or derision?

What will it take to develop the first 21st century audio processor? We sure do not have all the answers today. In fact, we do not even know many of the questions. But let us give it a try!

BRIDGING THE PAST AND FUTURE

The digital processors of today are based on the best analog designs of the past. Those digital boxes, introduced in the last millennium, have been enhancements and improvements on older designs. We are still waiting for the first breakthrough processor of the 21st century!

Most stations which can afford anything they want are using either Orban or Omnia digital processors. Processing strategies that are virtually impossible in analog are relatively easy in digital. Each box has its own unique processing strategy; these new strategies will be the hallmark of the first major processor of the new millennium, and so we want to discuss those strategies.

Yet, it is important that we do not embrace digital just because it is digital. Many analog designs from the past are still performing exceptionally well on the air, proving that you do not need the latest digital box to sound great.

The ultimate goal of this series is to speculate on the future, but our task today is to take a cold, hard look at the world around us: what is good and what is bad about broadcasting in general – and audio processing in particular.

A PROCESSING "ROUNDTABLE"

Designing and building broadcast processors is a highly competitive business, so it is not so unusual that the guys at the top of the field are usually closed-mouthed about anything but their companies' standard talking points.

Therefore, having the opportunity to sit down and talk with the men behind the leading processors of our day is really something. Of course, given everyone's schedule, we have to settle for a virtual roundtable, a combination of live, email, and telephone conversations. Still, the chance to chat and learn something about their thought processes is pretty neat, no matter which way we accomplish it.

We were fortunate to be able to interview Bob Orban, a living legend in the processing world, Frank Foti, the challenger to the throne, and Cornelius Gould, a young turk who might just develop the first great processor of the 21st Century. So, let us take a break from my pontificating. Maybe these three guys will give us some insights on the present state of audio processing – and what we can expect in the years ahead.

DECONSTRUCTING AN "OVERNIGHT" SUCCESS

We will start by listening to the reigning champs, Bob and Frank, in this article. Next time, we will push into the future with Corny Gould. If we are fortunate, we might learn something that we did not know before.

Jim Somich: Frank, I know you are not the overnight sensation that many people think you are. What were your early influences, and how did the Vigilante, your first processor, come about?

Frank Foti

Frank Foti: During my stint at Z-100 (1983-1987) we had the Texar Audio Prisms. Up until that time, FM audio processors generally employed pre-emphasis before the (multiband) limiters. Upon grasping the full understanding about how that multi-band system worked, I kept thinking about a limiter system that managed pre-emphasis after the multi-bands, rather than before them.

My thinking was that the control loops in that architecture were essentially tilted upwards a bit, due to the emphasis, and that was causing uneven processing in the upper frequencies. Essentially the upper range of each audio band had a lower limiting threshold. The question – and quest – became finding out what happens if the control loops are flat and the limiters are set to manage pre-emphasis via differing threshold levels?

ADAPTATION

Jim Somich: Your first processor was actually an adaptation of an existing processor, was it not?

Frank Foti: The Vigilante, as most know, grew out of the Aphex Dominator, Model 700. I had seen the prototype Dominator at NAB 1985, but it was a lot more elaborate than the finished product. The prototype appeared to be a direct answer to the Orban Optimod 8100, but with auto-adjusting crossover frequencies, and a few other new tricks. I never knew why that version never appeared.

However, upon playing with the original Dominator – which sounded very good if not pushed too hard – it became apparent that the timing was the same in all three bands. That caused the unit to become "busy" sounding quite rapidly, especially when set aggressively. Before ever having a schematic at hand, I found the R-C networks that governed the timing and began playing. It did not take long to "tune" the unit for a CHR station.

Eventually, a schematic was acquired. I began playing with the ALT (Automatic Limiting Threshold) circuit and more advancement in the Vigilante's gestation occurred.

The original Vigilante was built on an Aphex foundation.

Being able to modify the threshold settings in the Dominator empowered the box to manage pre-emphasis very consistently. The "attack" and "release" functions were brought out to the front panel via three-position switches. The limiting thresholds were also brought out via numeric "dial pots" that, in fact, were suggested to me by you!

But – the key sonic element and improvement that we heard on-the-air was how much the high frequency domain opened up. This was the result of pre-emphasis insertion *after* the multi-bands.

BRINGING THE PARTS TOGETHER

Jim Somich: Was the Vigilante an all-in-one, stand-alone box or did it require support by other processors?

Frank Foti: At this early stage the unit only did the dynamic limiting. We used the clippers (cards 8/9) from the Orban 8100, which worked quite well. Upon launching "Cutting Edge," and building these full-time, radio stations wanted an integrated solution; I designed our first distortion-controlled clipper, which was added to the Vigilante sometime in 1989.

Jim Somich: Which processor designers influenced you most strongly at this time?

Frank Foti: The influence here was mainly Glen Clark. I thought his Audio Prism concept to be very good. I used to tell him that he needed to create a multi-band limiter version of the Prism. While the Dominator was multi-band, that was not the idea that was lurking in my head. Upon the modifications to the Dominator, it got closer, but those ideas eventually manifested themselves in the Unity – and eventually in the Omnia.

BRINGING THE PARTS TOGETHER

Jim Somich: OK, that progression makes sense. Now what was the Unity, and how did it differ from the Vigilante?

Frank Foti: The Unity was our attempt at putting the rack of individual processor units in one box. The technology used was known as "digitally-sampled-analog." The idea was to clone a rack of gear that would have been a wideband AGC, multi-band compression, multi-band limiting, pre-emphasis, distortion controlled clipping, and the stereo generator. It worked quite well.

The clipper design came right from the Vigilante. The stereo generator included a composite clipper that performed clipping before the pilot was inserted. The entire system was governed by a microprocessor; it could save and recall a default, as well as user presets.

A concept we introduced with Unity, and carried forward to Omnia, was the idea to employ differing architecture into the dynamic sections. The Unity had feedback control on the lower two limiters and feed-forward on the upper two bands. This enabled the system to maintain the warm IMD-ish sound on lower frequencies, which feedback limiters tend to offer.

(Continued on Page 14)

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Processing Guide

by Jim Somich

Processing: Yesterday, Today, and Tomorrow

– Continued from Page 12 –

Jim Somich: That approach is a sort of double-edge sword, right? IMD not normally a desirable audio component.

Frank Foti: That is true. IMD is quite irritating on presence and high frequencies. On those bands, we utilized feed-forward control, which is inherently much lower in IMD. This type of processing offers a clean, open, and smooth high end, while retaining a rich fullness to the low end. We still use this method within Omnia processors.

The Cutting Edge "Unity"

Jim Somich: If you were to point out the main weakness of the Unity, what would that be?

Frank Foti: In hindsight, the Unity never had the internal flexibility that a DSP box has. As such, there were many hindering factors that kept me from getting it to where the ideas that were still lingering up in the foggy grey matter needed to go.

Of course, the Unity was successful enough in that it made the worldwide broadcast industry aware of our efforts. If anything, it got the company noticed when we introduced the Omnia, which was our first full DSP processor.

DSP REALLY TAKES THE STAGE

Jim Somich: That brings us to the dawn of DSP audio processing – and Bob Orban.

Bob, I always thought of you as an "analog guru." How did you make the transition into the digital age? It seems like you got real good, real fast!

Bob Orban

Bob Orban: I don't write DSP code, but I create the algorithmic architecture and do most of the coefficient computations – in other words I create "schematic diagrams with parts values" that other engineers at Orban turn into actual code.

I credit my ability to learn DSP in mid-career to an excellent engineering education at Princeton and Stanford that emphasized timeless engineering fundamentals, particularly math. I learned DSP myself by studying textbooks and journal articles, but I couldn't have done it without the university education that I got.

Jim Somich: The Orban 8200 Optimod was the first DSP broadcast processor in the world to achieve commercial success – and that was quite an accomplishment. Bob, what were the influences that moved Orban from being an analog company into the digital era?

Bob Orban: The 8200 project originally started as a DSP model of the Orban 424 compressor using the then-new Motorola 56001 24-bit DSP chips. (It was the Motorola 24-bit architecture that finally allowed high-quality DSP filters suitable for pro audio applications.)

We got far enough along with that to realize that we could build a complete DSP broadcast audio processor that modeled our analog processors and had a few "DSP-only" innovations besides. At that time, Greg Ogonowski, a long-time friend and "friendly competitor" in the Gregg Labs days, was formally hired as a consultant on the 8200 project and we decided to make the 8200's multi-band algorithm five-band (as it was in the Gregg Labs processors) instead of six-band as it has been in the XT2.

The Orban Optimod 8200

Overall, though, most of the influences for the 8200 came from earlier processing I had developed, including the 8100 and the XT2. We learned a lot doing the 8200, and I combined this with new ideas that could finally be realized because we now had enough DSP power to pull them off. The 8400 was the end result. I should add that the 8400 project was the first Orban DSP-based processor that really exploited the things that one could do in DSP that were impossible in analog.

DOING THE FORMERLY IMPOSSIBLE

Jim Somich: That certainly sounds like a major jump forward. What sort of things were now possible using DSP?

Bob Orban: In my opinion, the big advantage of DSP compared to analog processing is that one can implement look-ahead processing economically because making delay lines is just a matter of writing data to memory and reading it out later. By being able to "look into the future," the DSP-based processing can make intelligent decisions that are impossible in analog designs.

The 8400 brought full DSP audio processing to the market.

Look-ahead limiting is just one example of look-ahead processing. The 8400 and 8500 use look-ahead processing for clipping distortion control and for our "half-cosine interpolation" composite limiting, among other functions.

Another important thing we did in the 8400 was to add a speech/music detector, which allowed the processing to be optimized separately for speech and music. Some of the most sophisticated of the old-school, major-market processing chains actually had separate speech and music processing because these really require separate adjustments. DSP allowed us to do this automatically within one processor.

DSP CREATES A STUDIO ISSUE

Jim Somich: There was some surprising feedback from the field from the effects of the look-ahead limiter. What happened?

Bob Orban: The most important decision that we had to make before designing the 8400 was whether it was acceptable to make a processor with a throughput delay so long that it was impractical for talent to monitor its output through headphones when speaking. We assumed that the improvements in processing would be more important to broadcasters than the inconvenience of arranging a separate monitoring chain for talent headphones.

Unfortunately, we were surprised when the 8400 was released – we got lots of complaints about headphone monitoring. Accordingly, in version 2.0 of the 8400 software, we cut the delay in half without compromising the look-ahead algorithms by looking at every delay in the chain and getting rid of the ones that were not actually necessary to implement the look-ahead processing.

We also allowed users to configure the 8400 to emit a low-delay headphone monitor signal from an unused output. And when we designed the 8500, which maintained a 64 kHz minimum sample rate (as opposed to 32 kHz in the 8400), we further reduced delay by about 4 ms by eliminating 64/32 and 32/64 kHz sample rate conversions in the signal path.

However, even with all this effort, the best-quality processing available in the 8500 (using look-ahead in the most favorable way to reduce distortion) exhibits a 37 ms delay, which is too long for headphone monitoring.

Fortunately, most of the advantages of look-ahead processing are still available with a 17 ms delay, which is the delay of most of the 8500 factory presets. Additionally, we made available a separate ultra-low-latency processing chain without look-ahead for those applications where the low delay was considered necessary, such as remote off-air cueing.

WE HAD TO ASK

Jim Somich: Would you care to take out your crystal ball and give us a few predictions on what we can expect from Orban in the future?

Bob Orban: That would be telling! Seriously, I don't want to say anything that might give away future plans to my competition.

Jim Somich: Understood ... and thank you for taking the time to share with us as much as you did.

OMNIA ENTERS THE RING

Jim Somich: Frank, how did your first DSP processor, the Omnia come about?

Frank Foti: Omnia was an outgrowth of the Unity, along with input from all those who were critical of the Unity. Moving into DSP illuminated many things for us; most notably was the whole notion about how to clip pre-emphasized audio without causing aliasing distortion. Steve Church and I put a solid two years into researching that one alone.

Omnia's lineage follows my thinking all the way back to Z-100 and the rack of gear we had in NYC. The first goal – and what would have been the deal-breaker – was to create a hard-limiter (clipper) that didn't generate that awful grunge effect that was obvious to the sound of other units and was giving DSP-based processing a bad name.

Within the dynamic sections, we were able to take advantage of the DSP processing power to add functions like "Make-Up Gain." This allows the compressors to operate with slower overall timing, but "knows" when softer segments are occurring and will speed up the system only during those intervals.

The Omnia.fm enters the DSP marketplace.

Additionally, Omnia offers gating that is very intelligent. It can reset the dynamic gain to a preset platform level or just freeze gain during periods of gating. Stereo-EFX was designed to enhance stereo without destroying the natural soundfield *or* exaggerate multipath due increased RMS levels of the L-R signal.

(Continued on Page 16)

Processing Guide

by Jim Somich

– Continued from Page 14 –

The composite clipper that is incorporated into Omnia also contains a DSP version of "The Dividend" which keeps composite clipping products in the SCA region down to a minimum. This was a first for an integrated audio processor.

Jim Somich: Once you had a working prototype, how did you introduce it?

Frank Foti: I personally took the beta version of Omnia.fm to those customers who were not fans of the Unity. I figured if we could please the critics, then we were on to something. With all honesty, I can say that we visited close to 25 customers (the world over) and *every one of them* purchased the Omnia!

AND THAT QUESTION AGAIN

Jim Somich: That is quite an achievement for any product. So, looking ahead – can I get any predictions from you? What can we expect out of you and your team in the future?

Frank Foti: Looking into the future is always fun. Here in 2007, we now live in a coded-audio world. Thus, audio processing is becoming more focused on that transmission method. Still, I feel there's still at least one more, if not two, conventional broadcast processors yet to be designed for FM and AM (at least from our company). I'm not sure that those will be focused on more loudness. As we all know, processing creates L-O-U-D audio today, all the way from the CD source straight through to the eardrum.

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?

GETTING MORE FUNCTIONS FROM THE TECHNOLOGY

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 from where we have dedicated boxes into the early stages of doing all processing as a PC application.

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 station's 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.

Jim Somich: Thank you, Frank. Talking with you is always an education.

Folks, I hope you have enjoyed this discussion with Bob and Frank – today's masters of audio processing. Join us next month when we will take a look at the way the next generation of audio processor designers is thinking. I promise it will be interesting!

TRYING TO KEEP FACTS STRAIGHT

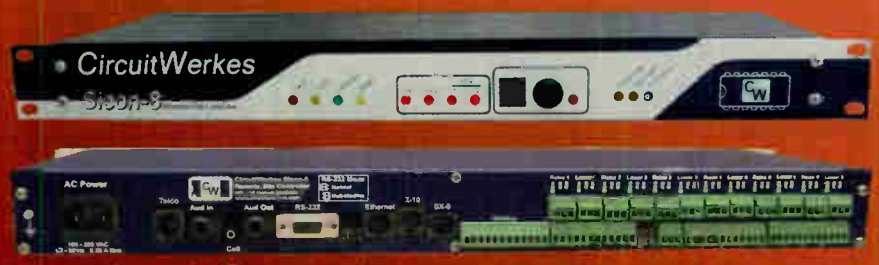
Memories are a tricky thing. As we try to recap the history of audio processing over the past 70 years, it is inevitable our memory cells will fail once or twice. Last time, in discussing the BL-40 Modulimiter – indeed a revolutionary product – I attributed the patent to Bill Putnam.

However, as Paul Gregg kindly pointed out, while Putnam did own the patent, it was originally issued to Jim Lawrence, who first used the optical gain control in his Teletronix LA-1 and LA-2. Shortly thereafter, Teletronix (and the patents) was sold to Babcock Electronics and then Bill Putnam's UREI.

The author would like to thank Barry Mishkind, Frank Foti, Bob Orban, and Corny Gould for their invaluable assistance in the writing of this series.

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

The New Sicon-8 Voice Remote Control



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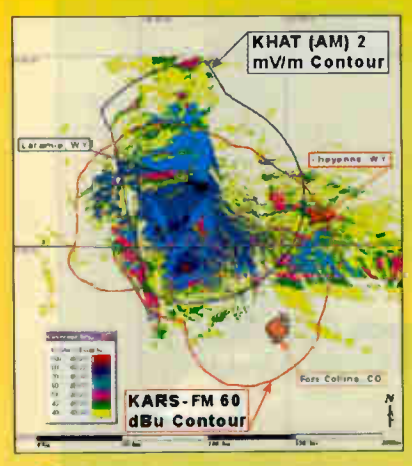

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Field Guide

by John McCloy

Improving on a Great Product

The Davicom MAC Transmitter Remote Control

Back in 1999, I wrote a User Report about what I described then as the niftiest remote control system I had ever worked with: the Davicom MAC (*M*onitoring, *A*larm and remote *C*ontrol).

Recently, I installed a set of new MACs at a station in Western Canada. Davicom has redesigned their unit to a new generation, and the results are impressive indeed. With this redesign, they have added many new features that again put it well ahead of the competition – and give it one of the best price/functionality ratios on the market.

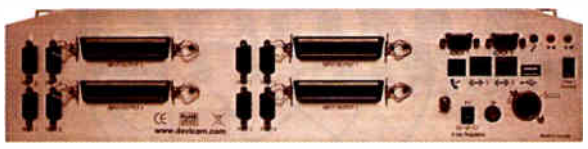
QUICK EASY, INSTALLATION

The unit comes with a CD, a quick-start guide, a detailed reference manual, a small wall wart for AC power-loss detection and all the cables (telephone, network, RS-232, USB, 12 VDC) required for quick hook-up. The CD contains the MacComm communication/configuration program as well as the USB drivers and other utility programs. A 12 VDC power supply with battery backup can be purchased from Davicom or you can use your own.

Although I had a few minor problems with the hardware configuration, and there was some lack of clarity in the manual, the installation went very smoothly and the units quickly showed off their versatility. More on this later.

The latest MAC from Davicom.

The new generation is currently available in two models, the MAC208 and MAC216, which both take two rack units of space. (A smaller model is to be announced at NAB.) Besides a 12 VDC power supply, the MACs do not require any more modules or separate relay panels that take up valuable rack space – everything is already mounted *inside* the unit.



The MAC handles all necessary inputs and control lines without using a separate relay panel.

My installation used MAC216s which have 16 Metering Inputs, 32 Status Inputs, 32 Relays, 128 Logic Gates and 128 Timers (to name just a few features). Davicom is also working on a new firmware update that will make it possible to expand the units as the sites grow by "Ether-networking" up to eight MACs together.

BROADCAST-FRIENDLY FEATURES

The unit is still "designed for broadcast," meaning that it has built-in features that are specific to the broadcast world. For example, the MACs are designed for and (according to Davicom) have been tested to operate in electric fields of up to 10 V/m. Units are also "ESD tested" up to 12 kV.

Another "broadcast" feature: you can enter a site's latitude and longitude into the unit and it will automatically calculate local sunrise and sunset for every day of the year. The resultant Sunrise Flag can then be used as a cross-check for tower lights and other functions. Silence-sensors are built-in (by adding optional True-RMS detector chips into the internal socket).

Two more features that are really useful at a transmitter site are the audio monitoring capability and the RS-232 pass-through function. The first allows you to call a site on the phone and listen to different points in the audio chain. The RS-232 pass-through function lets you can connect to the serial ports on other on-site equipment via the MAC's communication channel.

A prime example of the unit's versatility was demonstrated recently when we switched to Daylight Saving Time (DST) according to the new Rules. The new MAC has the new switchover dates already loaded into its firmware (but, to be honest, the older units also allowed user-settable switchover dates to be programmed yearly).

I like the fact that the unit does *not* require a computer or other device be connected to it constantly for proper operation. In fact, the Davicom MAC itself has no moving parts such as fans or hard disk drives.

I find that this enhances reliability, since we all know how PCs have a tendency to be fickle.

LOGICALLY PROGRAMMED

One aspect of the Davicoms that does require a different mind-set is the way they are programmed for automation. Instead of using a script language and macro commands, you use logic diagrams.

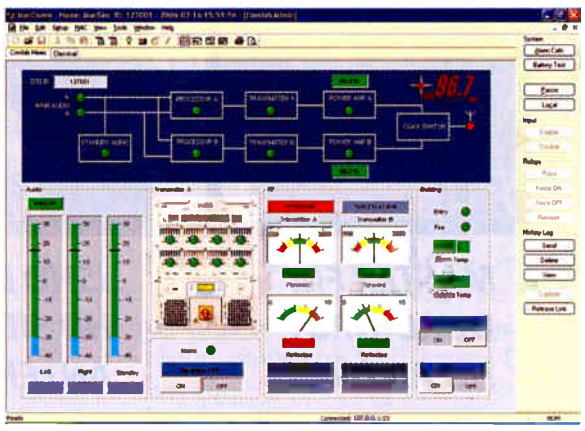
Each input to – and output from – the unit, as well as all the internal flags and timers, can be used as inputs for virtual logic gates that you program. What this means is that starting from a simple (or complex) logic diagram of the gates, timers and delays you need, you then can program the unit to act upon these conditions to automatically control outputs and/or to send alarms.

Furthermore, the alarms themselves can be "gated" to eliminate nuisances or to send them to *different* persons depending on different factors such as time of day, day of week or even type of alarm. The new Davicoms have eight separate call-lists for major alarms and eight more for minor alarms, and these alarms can be called out in an impressive variety of ways.

With no additional hardware besides the built-in modem, the Davicoms can make voice calls to landline phones, cell phones or vocal pagers; they can send faxes, e-mail, SNMP Traps, and data to a PC; they also can send pages to DTMF or alphanumeric pagers. A wireless link can be used as a backup for the landline.

EASY PROGRAMMING AND SECURE CONTROL

Control of the Davicom is done via DTMF (on the telephone network) or on a PC (via modem or Ethernet/Internet). Configuring and programming is done with the Windows-based MacComm software and can be done from anywhere in the world by modem or over the Internet.



A typical display page.

Speaking of the Internet, Davicom has ensured that communication with the unit remains secure thanks to 128 bit AES encryption. Security is further enhanced by the use of four different access levels that are password-controlled and user-name tracked. Up to 16 different users can be created in the unit's configuration, and four separate users can access the unit simultaneously (although only one will be in control).

SOLID TECH SUPPORT

It must be mentioned that the company's e-mail and telephone technical support are exceptionally good. They are quick to respond to questions and can often implement a bug-fix in a firmware or software revision within a few days. They are also very open to integrating non-urgent customer requests and suggestions into subsequent firmware/software versions.

During the recent installation I ran into a few snags with the new units. One issue revolved around the voltage levels read by the status inputs. Another issue involved the new MAC's "bilingual" capability.

On my preceding installations, I had used diodes to create logical OR gates in order to save on the number of status inputs required. On the new units, an internal hardware change caused the inputs to have a different behavior from the input of older units. Even though they were both operating according to their specifications, I would have liked the new units to better mimic the voltage levels of the old units.

Fortunately, after discussing the problem with Davicom's technical support staff, they quickly proposed an easy fix that would allow my preceding circuit designs to be re-used with the new unit.

SPEAKING THE RIGHT LANGUAGE

The bilingual feature allows supervisors to configure the unit to respond to different users in one of two different languages according to their preference. It works well, as long as you configure carefully.

At one point during this installation, there were two fields in which we had to enter input and alarm descriptions. Unknowingly, we had entered the English description in the Unicode field (that cannot be sent via FAX or alphanumeric pager – which we needed). Again, a quick call to tech support and some "cut & paste" quickly resolved the problem.

To sum up: Davicom has been manufacturing the MACs since 1994, and their constant improvement over the years has ensured that they are still the niftiest remote control around.

John McCloy is a self-employed installer and designer of technical equipment who has been in the broadcast field for close to 25 years. He can be reached at jsmccloy@cogeco.ca

The New Sicon-8 Voice Remote Control

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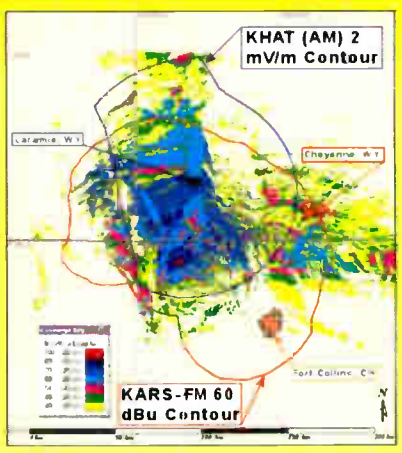

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Studio Guide

by George Zahn

Blast From Past a Learning Experience

The first thing we should all learn as broadcast professionals is that the minute we think we know pretty much everything about a subject, that cockiness is bound to sneak up behind us and (well, to put it nicely) give us a quick boot to the seat of the pants.

In contributing to ***Radio Guide***, I have received some enlightening and intriguing correspondence about microphones. Even after some thirty years in the broadcast business and more than a decade of teaching audio production, I am struck by how immersed we can be in our field, yet it seems we only swim in a small part of the giant audio aquarium.

A READER'S QUERY

As an example, witness this recent e-mail from Jim Jenkins, the owner and General Manager of WAGS-AM Radio in Bishopville, South Carolina:

"Your article in ***Radio Guide*** prompted me to ask about the ElectroVoice Model 676. One was here at WAGS when I bought the station in November 2000 (My first venture into radio since college in 68)."

Jenkins says, "It sounds pretty good on AM, with very little audio processing (I suppose almost none) going into the Gates BC-1F. Compared to the SM 58 and some other microphones people have brought by it sounds just fine. Can you tell me anything about it?"

DIGGING FOR HISTORY

This one sent me searching, because while I have had experience with a number of different ElectroVoice models (one of my first radio jobs was in a news/sports department with the great old hammer, the 635A dynamic microphone) and I have done my share of announce work on RE20's, I had never encountered the 676. Jim inadvertently sent me on an exploration that took me to the glory days of blues, classic rock, and a Star Wars flashback!

The ElectroVoice 676 is a dynamic microphone (dynamics are pretty much the specialty of ElectroVoice) that was introduced in the mid-1960s and found its way into technical notation on some early 1970s recordings.

One of the earliest notations I could find was on Dave "Snaker" Ray's website (jdray.com) which listed the 676 as a kick drum microphone on a session with blues man "Spider" John Koerner on the album entitled "Music Is Just a Bunch of Notes" recorded in May, 1972 at Sweet Jane studios in Minneapolis.

An ad for the 676 touts its ability to handle high sound levels.

The 676 served ably as a kick drum microphone on the session, a great test of a truly dependable dynamic microphone. It simply had to handle high sound pressure levels. There are several forums that indicate the 676 was a staple on many recordings by Jim Morrison and the Doors. If you are fascinated by reading technical specifications on recordings, you will find the 676 used in applications in the 1960s and 1970s, with a simple Internet search.

TRUST THE MIC, LUKE

What I actually loved about discovering this microphone was the psychedelic-era design. Photos of the microphone will remind you of Luke Skywalker's light saber.

Would a Jedi use an EV 676?

Phantom Productions in Alpine, Texas and Tone Float Productions in New York City still list this very "mod" chrome beauty with highly visible ports as available for recording in their studios. Not surprisingly, it appears that the studios/stations who still revere the 676 and its kin are also those who still offer, and even actively embrace, the fuzzy comfort of analog tape recording.

The on-line source Mosslive.com is a repository for information on live music and recording in the northwestern U.S., and they featured Oregon musician/producer Eric Lovre (to whom I owe the original light saber analogy). Lovre has performed and recorded worldwide, and still lists the 676 as one of his top five microphones for recording music, along with other vintage choices, the ElectroVoice 664, the Shure SM 57, the Astatic 77, and the Shure 51.

In the Mosslive interview, Lovre confesses that he uses tube amplifiers and these classic microphones along with analog recording because in his words "that's the way sound is" – these microphones simply "gel" with the sound he is seeking.

A FITTING MICROPHONE

Likewise the EV 676 fits beautifully with the vintage offerings on Jim Jenkins' AM station, WAGS. As Jenkins puts it, "WAGS Radio is live radio – real people in real time playing from CDs, LPs, 45s, and yes some 78s. Country, traditional Country, we can cry in our beer and do. I've been in the radio biz since Nov 2000 and don't buy into all the plastic stuff we see today."

Jim Jenkins and his ElectroVoice 676 microphone.

Jenkins is a real rarity in the radio business, a General Manager with extensive technical and engineering experience. I asked Mr. Jenkins to give us some details on his broadcast chain that starts with his historic 676. The chain is delightfully low tech on the front end, but yields the results he is seeking.

The 676, turntable pre-amps, and CD player are mixed through a Behringer MX2004A with no EQ modification at the console. The mixer output then is routed through a Radio Shack EQ that came with WAGS when Jenkins bought the station in 2000. The EQ is flat in the bass range, then starts boosting the midrange at about 500 Hz, peaking at +7 dB at 1.7 kHz and +6 dB at 3 kHz, then rolling back to 0 above 5 kHz.

The EQ output then enters an Alesis 3630 compressor-limiter in mono mode. Side one of the Alesis, according to Jenkins, is set "Threshold: -20; Ratio: 4:1; Attack: 50 ms; Release: 500 ms; Output: +10; Soft Knee button: out." The output from the first part of the Alesis is fed to the second part to limit. Settings are: "Threshold: -10; Ratio: infinity:1; Attack: 50 ms; Release: 500 ms; Output: +10; Soft Knee button: out."

From the Alesis, Jenkins continues, "The audio passes through a choke on each wire (course wire around ferrite rod, rated 100 microhenries at 1 kHz, 2 Amp maximum) to stop RF from making lights on the Alesis light up when the transmitter is on. From there it goes to the audio input terminal board inside the Gates BC-1F."

A VALUABLE LESSON

If you are trying to find a 676 for your studio – or your collection – a quick recent check on eBay showed a number of options ranging from a few bucks to just under $160. As with any purchase of a used item on-line, it is often difficult to gauge the working status of the device – so buyer beware. But if you are adept at repairs, you might find a cheap "fixer-upper."

Here is the real lesson we learn from stories such as Jim Jenkins' 676 microphone: in today's all digital, all "brand spanking new" world, we are inundated with ads that promote the newest, the latest, and supposedly the best in technology. As broadcasters, we have to discover often there are no absolute right or wrong answers when we chose equipment. Just because something looks like an artifact does not mean it should be retired to the Smithsonian.

The music industry has acknowledged this for years. Many artists still insist on recording to analog tape for the first generation, then utilizing the luxury of digital editing later in the production. The analog recording still gives these artists the grittier, more natural, throwback sound they are seeking. According to Eric Lovre in the Mosslive.com interview, "People have warmed up to the sound (of analog), corrected the hard edges of digital audio."

Likewise, if the microphone fits what we are broadcasting, should we not use it? Just as the music industry still uses a wide array of the classic dynamic, condenser, ribbon, and tube microphones we have discussed in recent months in ***Radio Guide***, many stations have stepped forward to preserve some great technological history, not just under a glass case, but live and immediately *on the air* today!

What is your favorite microphone? Why so? Let us know what has worked best – or the worst – for you. Send email to George at gzahn@lifesphere.org

Operations Guide

by Rich Wood

Wanted: More HD Ears

With the present reduced staffing levels at many stations, it is sadly not uncommon to find no live staffer monitoring things – and the station's sound signature becomes "dead air." As Rich Wood points out, if HD Radio is left alone without someone paying attention, there is a new set of things that can go wrong.

If a tree falls in the forest and no one hears it, does it make noise? How about a radio station with no audio?

Nowhere does this apply more than in the *Catch-22* situation of monitoring HD Radio with multiple programs on one carrier.

A NEW PROBLEM

HD Radio has nested *Catch-22s* in the sense that most digital receivers have no way of forcing the radio back to analog if the HD signal exists but no audio accompanies it.

Like many of you, I own an HD radio. Whether or not you support the IBOC system as currently engineered is not important. The number of stations broadcasting it is also not important. The number of receivers is.

Since each of our futures will be affected by its success, I often spot check the stations I can hear to see how important the digital signals are to those responsible for seeing that they make noise. Sadly, I hear a lot of dead air. Perhaps sadder, when I call a station to tell them their digital signals are dead they often see me as a troublemaker rather than a concerned broadcaster/listener.

Is it any wonder that many retailers see little reason to "feature" an unreliable source to show off HD receivers? The head of the HD Alliance has practically been begging stations to pay attention to their digital signals. Unless those signals are there 24/7 retailers will find little reason to display (and consumers will find little reason to buy) HD receivers.

In my market, only two retailers carry IBOC receivers – and one is about to close most of its stores.

MULTICHANNEL PROBLEM

I understand the anger directed at me by engineers who have so much to do that they cannot be devoting a lot of listening time to channels that have so few listeners they can be counted without taking shoes off.

This leaves us with trying to find a way to monitor the HD signal without taking the engineer away from some revenue-generating activity. Stations that have invested great sums of money in this system need to be sure the same reliability exists in digital as it does in analog. Would you allow your analog signal to transmit dead air for days at a time?

Of course, this technology is based on computers that have a tendency to lock up. In my experience, rebooting fixes the problem. But some live person needs to be alert and available to do this.

SOMEONE TO HANDLE IT

Recently, I ran across a station whose audio system had locked up, repeating a six-second loop of audio for hours. There was audio, so the silence sense saw nothing wrong and kept quiet. Another station ran double spots – one on top of the other – *for two hours* before anyone noticed. Again, there was audio, so the technical monitor saw no problem.

This is why the monitoring of digital channels must include human ears. Those ears do not have to be critical listeners. They simply have to hear that something is happening: if there is an obvious problem, bring in the engineer to reboot or fix the system.

Nevertheless, we may have reached the point where we need to take the engineer out of the monitoring loop. With some facilities running 12, 16 or more program channels, the Program Directors or Station Managers are unable to do it all, either. They have revenue-generating duties, as well.

On the other hand, most stations do routinely assign salespeople to monitor competing stations, in order to see what commercials they are running. So there should be someone with a few seconds an hour somewhere in the station to check the digital.

THE SOLUTION

Here is the simple solution: each station *must assign someone*, probably the receptionist (after all, her title spells it out!), to spot check the program channels; every hour or so someone should swing through the digital channels to make sure *something* is there.

For obvious reasons, any cluster's ceiling monitors are limited to one station at a time. One small solution for a single station is to feed the PA system with the digital signal. Nothing makes people in a radio station move faster than silence.

Often the ceiling monitor rotates the stations in a cluster to make the programming folks feel they share equal importance. If you can, set the receiver to remain in digital mode at all times. Your analog has plenty of ears paying attention. Someone should be ready to notice a problem when one surfaces.

Again, regardless of your feelings about HD Radio, the station has a responsibility to its digital future and that of everyone else using it to be sure a signal that will sell receivers is operating. In my opinion, everyone is in this together. Stations must provide reliable signals and retailers must ensure they can be received on display models.

A frequent contributor to ***Radio Guide****, Rich Wood has a long history of experience in programming and station operations. Contact him at richwood@pobox.com*

Tech Tip

by Warren Shulz

Adding an Extra Button Reduces Surprises

After walking up to the Burk ARC-16 more than a few times and getting the channel step up/down buttons confused with the function raise/lower buttons – and a resulting undesired action – it became apparent a remedy was needed.

UP/DOWN OR RAISE/LOWER

The original design of the ARC-16 used four white buttons on the lower right of the unit to handle both the selection of the desired remote control channel and the control actions themselves.

Although labeled on the ARC-16, it was nonetheless easy to mistake the buttons, especially when in a hurry. However, I reasoned that if you had some sort of momentary fail-safe, it would practically eliminate mistaken raise/lower actions.

This modification we made is a somewhat involved and difficult job and not for the faint of heart. You have to disassemble the front panel (and display) and add a push button in an open area on the panel to left of status display. This requires drilling and filing a square hole into the front panel. (A less pretty but quicker alternative might be to use a round button.)

The "Enable" button on the left prevents unintended actions.

Although I have done this to at least eight units – and it does take lot of time – all of them were successful. The result is you no longer get a "raise" when you meant to change/scroll up one channel. It now takes two buttons to get a raise/lower action.

MAKING THE MODIFICATION

How is it wired? First, you cut the trace between S2 (Channel up) and S5 (Maintenance). This opens the raise/lower from pulling to ground. Then you will need to restore ground for S1 (Channel Down) and S2 Channel Up).

The new button takes up that cut trace from between S2 and S5. When the new enable button is held down it provides ground to S3 (Raise) and S4 (Lower).

A jumper from the enable to the mode LED gives you a red LED when the enable button is pressed. The enable button is identical to other push button switches in use.

Carefully installed, it almost looks like a factory button.

I would consider this a major modification to the ARC-16, and I did share the idea with Peter Burk. Subsequent ARC-16 units came with different colored raise/lower buttons as a solution. While this is an answer, I surely still prefer the need for *two* buttons to be pressed simultaneously to fire off any action.

Warren Shulz is the Chief Engineer at WLS in Chicago, Il. Over the years, Warren has discovered a lot of ways to reduce operator error, and is happy to share them all. His email address is: Warren.G.Shulz@abc.com

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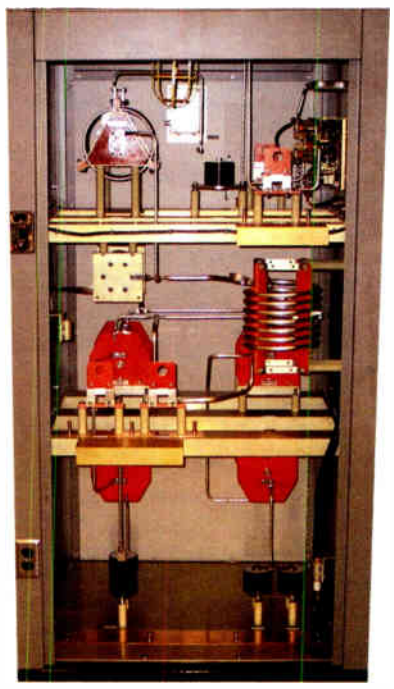

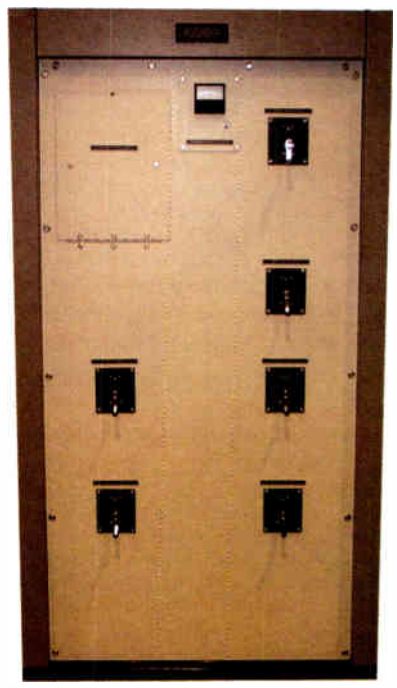

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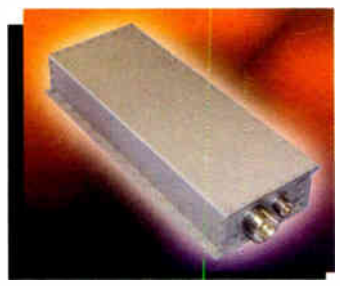

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HD READY

Field Guide

by John McCloy

Improving on a Great Product

The Davicom MAC Transmitter Remote Control

Back in 1999, I wrote a User Report about what I described then as the niftiest remote control system I had ever worked with: the Davicom MAC (*M*onitoring, *A*larm and remote *C*ontrol).

Recently, I installed a set of new MACs at a station in Western Canada. Davicom has redesigned their unit to a new generation, and the results are impressive indeed. With this redesign, they have added many new features that again put it well ahead of the competition – and give it one of the best price/functionality ratios on the market.

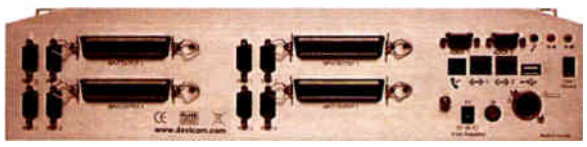
QUICK EASY, INSTALLATION

The unit comes with a CD, a quick-start guide, a detailed reference manual, a small wall wart for AC power-loss detection and all the cables (telephone, network, RS-232, USB, 12 VDC) required for quick hook-up. The CD contains the MacComm communication/configuration program as well as the USB drivers and other utility programs. A 12 VDC power supply with battery backup can be purchased from Davicom or you can use your own.

Although I had a few minor problems with the hardware configuration, and there was some lack of clarity in the manual, the installation went very smoothly and the units quickly showed off their versatility. More on this later.

The latest MAC from Davicom.

The new generation is currently available in two models, the MAC208 and MAC216, which both take two rack units of space. (A smaller model is to be announced at NAB.) Besides a 12 VDC power supply, the MACs do not require any more modules or separate relay panels that take up valuable rack space – everything is already mounted *inside* the unit.



The MAC handles all necessary inputs and control lines without using a separate relay panel.

My installation used MAC216s which have 16 Metering Inputs, 32 Status Inputs, 32 Relays, 128 Logic Gates and 128 Timers (to name just a few features). Davicom is also working on a new firmware update that will make it possible to expand the units as the sites grow by "Ether-networking" up to eight MACs together.

BROADCAST-FRIENDLY FEATURES

The unit is still "designed for broadcast," meaning that it has built-in features that are specific to the broadcast world. For example, the MACs are designed for and (according to Davicom) have been tested to operate in electric fields of up to 10 V/m. Units are also "ESD tested" up to 12 kV.

Another "broadcast" feature: you can enter a site's latitude and longitude into the unit and it will automatically calculate local sunrise and sunset for every day of the year. The resultant Sunrise Flag can then be used as a cross-check for tower lights and other functions. Silence-sensors are built-in (by adding optional True-RMS detector chips into the internal socket).

Two more features that are really useful at a transmitter site are the audio monitoring capability and the RS-232 pass-through function. The first allows you to call a site on the phone and listen to different points in the audio chain. The RS-232 pass-through function lets you can connect to the serial ports on other on-site equipment via the MAC's communication channel.

A prime example of the unit's versatility was demonstrated recently when we switched to Daylight Saving Time (DST) according to the new Rules. The new MAC has the new switchover dates already loaded into its firmware (but, to be honest, the older units also allowed user-settable switchover dates to be programmed yearly).

I like the fact that the unit does *not* require a computer or other device be connected to it constantly for proper operation. In fact, the Davicom MAC itself has no moving parts such as fans or hard disk drives.

I find that this enhances reliability, since we all know how PCs have a tendency to be fickle.

LOGICALLY PROGRAMMED

One aspect of the Davicoms that does require a different mind-set is the way they are programmed for automation. Instead of using a script language and macro commands, you use logic diagrams.

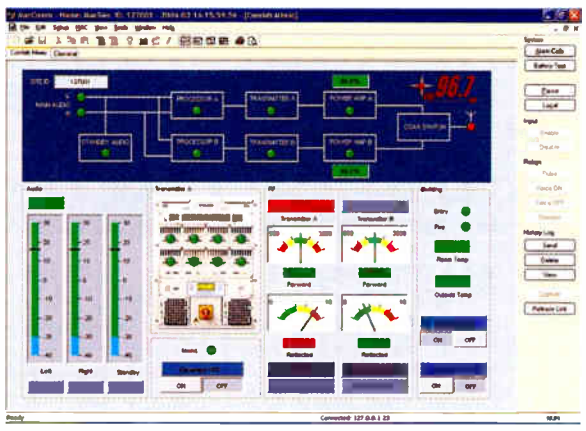
Each input to – and output from – the unit, as well as all the internal flags and timers, can be used as inputs for virtual logic gates that you program. What this means is that starting from a simple (or complex) logic diagram of the gates, timers and delays you need, you then can program the unit to act upon these conditions to automatically control outputs and/or to send alarms.

Furthermore, the alarms themselves can be "gated" to eliminate nuisances or to send them to *different* persons depending on different factors such as time of day, day of week or even type of alarm. The new Davicoms have eight separate call-lists for major alarms and eight more for minor alarms, and these alarms can be called out in an impressive variety of ways.

With no additional hardware besides the built-in modem, the Davicoms can make voice calls to landline phones, cell phones or vocal pagers; they can send faxes, e-mail, SNMP Traps, and data to a PC; they also can send pages to DTMF or alphanumeric pagers. A wireless link can be used as a backup for the landline.

EASY PROGRAMMING AND SECURE CONTROL

Control of the Davicom is done via DTMF (on the telephone network) or on a PC (via modem or Ethernet/Internet). Configuring and programming is done with the Windows-based MacComm software and can be done from anywhere in the world by modem or over the Internet.



A typical display page.

Speaking of the Internet, Davicom has ensured that communication with the unit remains secure thanks to 128 bit AES encryption. Security is further enhanced by the use of four different access levels that are password-controlled and user-name tracked. Up to 16 different users can be created in the unit's configuration, and four separate users can access the unit simultaneously (although only one will be in control).

SOLID TECH SUPPORT

It must be mentioned that the company's e-mail and telephone technical support are exceptionally good. They are quick to respond to questions and can often implement a bug-fix in a firmware or software revision within a few days. They are also very open to integrating non-urgent customer requests and suggestions into subsequent firmware/software versions.

During the recent installation I ran into a few snags with the new units. One issue revolved around the voltage levels read by the status inputs. Another issue involved the new MAC's "bilingual" capability.

On my preceding installations, I had used diodes to create logical OR gates in order to save on the number of status inputs required. On the new units, an internal hardware change caused the inputs to have a different behavior from the input of older units. Even though they were both operating according to their specifications, I would have liked the new units to better mimic the voltage levels of the old units.

Fortunately, after discussing the problem with Davicom's technical support staff, they quickly proposed an easy fix that would allow my preceding circuit designs to be re-used with the new unit.

SPEAKING THE RIGHT LANGUAGE

The bilingual feature allows supervisors to configure the unit to respond to different users in one of two different languages according to their preference. It works well, as long as you configure carefully.

At one point during this installation, there were two fields in which we had to enter input and alarm descriptions. Unknowingly, we had entered the English description in the Unicode field (that cannot be sent via FAX or alphanumeric pager – which we needed). Again, a quick call to tech support and some "cut & paste" quickly resolved the problem.

To sum up: Davicom has been manufacturing the MACs since 1994, and their constant improvement over the years has ensured that they are still the niftiest remote control around.

John McCloy is a self-employed installer and designer of technical equipment who has been in the broadcast field for close to 25 years. He can be reached at jsmccloy@cogeco.ca

Audio Guide

by Jeff Schroeder

Audio File Standards for the Broadcast Industry

Most broadcasters work hard to present the cleanest audio possible. However, there is one part of the chain – hard to measure with traditional test gear – that can undo your careful effort at quality. To avoid distortion from "stacked algorithms" Jeff Schroeder suggests we get together as an industry and create standards for incoming audio files.

It began when we got the first CD decks in our on-air studios. *"Now in full digital quality, it's Huey Lewis and the News on KIQY-FM!"* I remember saying those exact words at least a dozen times in my "other" life on the air. That was 1985.

Fast forward to 2006 – and for the most part we still are saying the same thing: *"Broadcasting in full digital quality."* Only now a very high percentage – if not *all* – of the music, commercials, jingles, and liners are actually of a much *lower* audio quality than that first Huey Lewis CD I played from a Technics consumer CD deck back in 1985. What happened?

WE PAUSE FOR A WORD ABOUT AUDIO QUALITY

I can hear you saying: *"but we are playing the files in linear file format from a $3,000 audio card on a $2,000 computer."* Yes, you are. But, *where* did the original files come from? iTunes? NewMusicServer? Your friend's iPod? Or did you actually take the time to rip it from the original CD?

And what about the commercials that are running on your air now? When was the last time you actually got a commercial on a CD or Tape? The vast majority of – if not all – commercials are now delivered in file form.

Have you really ever taken the time to inspect the properties of the audio files coming into your facility? Looked at the sample rate? Bit rate? RMS levels of the audio? Most people have not. The commercial/song/liner simply comes in the building, gets converted to the automation system file format and uploaded.

When I travel around the country I am amazed at some of the audio that I hear on the air – commercials in particular. The sound is so bad that it is often stressful to listen to them.

WHY QUALITY IS SUFFERING

It is clear to anyone literate in producing clean audio that it is getting harder to find. Far too many of the current CDs are already smashed, crunched, and clipped before they get to you. But then they enter the typical broadcast audio chain where stacked compression algorithms are digital audio's worst enemy. To illustrate, just look at the typical distribution path used today to get audio on the air:

1. Production happens in full digital multi-track editor and mixed down to a linear wave file.

2. The "send out" copy is made from the file and saved in a minimum "standard" 256 kbps MP3 file (with 5.5:1 compression) to save on upload/download bandwidth *(Generation 1)*

3. The local production dude (or dudette) downloads the file and opens an editor to put on the local tag. Then he/she saves the file in 128 kbps MP3 format, compressed 11:1. *(Generation 2)*

4. The file is then sent to the automation system, typically using 4.4:1 compressed MP2. *(Generation 3)*

5. The file makes it to the air. Audio processors and HD exciters add coding *Generation 4 or even 5!*

Sadly, this is sometimes the best case scenario. Often the process is repeated many times over, creating files that are technically digital audio, but sound so bad they should not be played on a $9 clock radio.

At one time or another, we have all been told by the sales manager that we *"must play the commercial"* that we received from the client because *"it's $(insert dollar figure) per minute – and they pay fast!"* Even if the file turns out to be a copy of a 6.3:1 MP2 that a station across town pulled of their automation and emailed to you.

(Continued on Page 26)

End-to-End Solutions From SCMS

Shively Labs Rigid Coax

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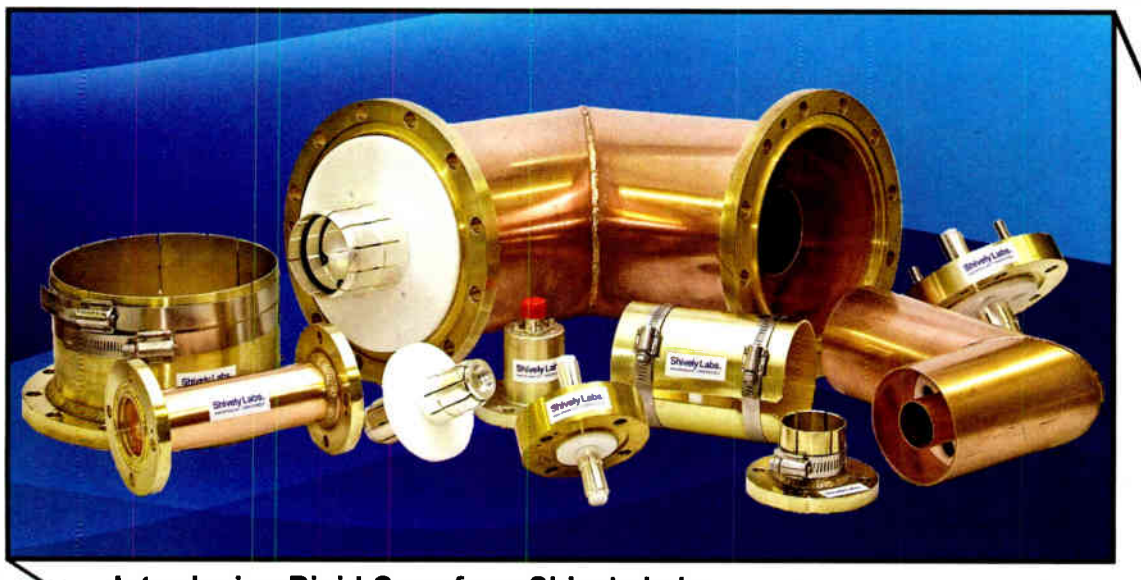

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Redesigned in 2006 – Shively's coax components incorporate more than 40 years of high power RF engineering experience with modern manufacturing techniques to bring you products that are as affordable as they are reliable.

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Audio Guide

by Jeff Schroeder

Continued from Page 24

CRUCIAL DECISIONS

I clearly remember the very loud outcry about the 4.4:1 MP2 compressed audio coming from PD's when we first started playing music from hard drives on automation computers. This was only 7 to 10 years ago. Oh, how things have changed in this very short time!

We as an industry (Radio) are at a true turning point. With more and more stations turning on HD signals and the added compression algorithm involved with HD, there must be something done about the quality of audio files that we will accept and actually play on our radio stations.

Our listeners now have a vast selection of digital products from which to choose. We have to sound better than those choices in *content and sound.* Content is another subject which must be addressed by all the programming guru's. What I am talking about is the quality of the audio *sound.*

The problem is that currently there are no real standards that would improve this. What is the solution?

EDUCATION

We will take the easy one first: *Education.*

It is imperative that the people who are handling the files (Program Directors, Music Directors, Production People, etc.) learn and *understand* what digital compression is and how it affects the overall quality of the finished product – which is, after all, the on-air sound of your station(s).

Your staff does not have to go out and buy their own copy of *Audio Files for Dummies.* However, if they see a file come into the building that is a 128 kbps MP3, they do need to know enough so that they quickly can identify the file type and "properties" of the file. Then, if necessary, they are able to identify problems and do everything in their power to get that file replaced with a higher quality file.

This point is particularly important for music that will go into the library and be there for a long time.

LIFTING THE HOOD ON MP3 FILES

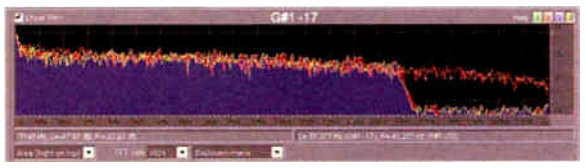
Here is a chart of the compression ratios of MP3 files and the file sizes they generate, compared with a linear file.

MP3 Stereo File Attributes

Bitrate (kbps)	Bandwidth (Hz)	Comp Ratio	Approx File Size Per Min.
56	22050	25.2:1	440k
64	22050	22.1:1	470k
80	22050	17.6:1	590k
96	44100	14.7:1	700k
112	44100	12.6:1	820k
128	44100	11.0:1	939k
160	44100	8.8:1	1,173k
192	44100	7.4:1	1,408k
224	44100	6.3:1	1,643k
256	44100	5.5:11	1,877k
320	44100	4.4:1	2,346k
Linear	44100	0	10,000k

You can see that the consumer standard of 128 kbps is at 11.0:1 compression. You can also see that the highest quality bit-rate of *any* MP3 file is still running 4.4:1 compression.

A good visual example comes from a current country song on the charts today. A very simple comparison of the frequency spectrum before and after a file is pulled from a CD will be instructive. This is something every one of your production and air people should be able to grasp in an instant.



Comparing native CD audio to an MP3 dub.

The solid lines at the top reflect the frequency response of the original WAV file ripped directly from the CD. The solid filled-in (blue) part is the exact same section of the song after converting it to 192 kbps MP3. You can see the dramatic and absolute roll-off at 16 kHz. This happens with *every* file converted to MP3 on the very first generation – it is "by design."

This is just the most graphic example of what happens to an audio file being compressed; there are other, more harmful artifacts that happen, but that is something for a future discussion. You cannot reduce the size of an audio file without removing little "pieces" of the audio itself. These pieces can never be replaced and if the file is compressed more than once the audible quality denigration becomes almost exponential.

DEALING WITH THE URGENT NEEDS

Now, I am a realist. I understand that music now is being sent out on "release day" in compressed file format. In a competitive environment, stations have to

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"My Number One Codec Rental is Zephyr Xstream"

-Steve Kirsch, President Silver Lake Audio

Rack 'em and stack 'em! The Silver Lake Audio Crew pictured from left to right: Steve Kirsch, Ken Stiver, Kirby Miovac and Jay Shoemaker

"When ISDN equipment rentals began in the early 1990s, we started with an equal number of different companies' codecs. Today, Silver Lake has over 100 Zephyrs in stock, ten times more than any other brand." says Steve Kirsch, owner of Silver Lake Audio.

The reasons should be obvious. Reliability, ease of use, compatibility, great support.

Telos: The Best Way To Hear From There.

And there. And there. And there.

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Audio Guide

by Jeff Schroeder

Audio File Standards for the Broadcast Industry

Continued from Page 26

play some songs the second they enter the building – and sometimes the only way they can get that file "right now" is downloading a compressed file.

The solution: yes – use it. But then *replace* it as soon as you can get your hands on a CD or linear copy of the song. Never archive original audio in MP3 format! Yet, I see this all the time, all over the country. For any audio that has a chance of making it back on the air from an archive, all work should be done and saved in full linear uncompressed file format. Hard drives are cheap now. Again: archive all original audio in linear wave format.

Indeed, why archive bad audio for future use? Too many times an element gets put into the automation system with the best intentions of eventually replacing it. Yet, if you were to go back into the system a couple of years later, the file likely would still be there largely because it does not sound so bad next to all of the other bad files.

SOURCE ISSUES

Another area of education deals with understanding the on-Line download "stores" such as iTunes. Not even taking into account the legality of downloading a song for "personal use" and playing it on the air, the files are compressed – sometimes highly compressed – and that compression will live on forever with that original source file.

Please understand, I am not saying not to use all legally available means to get a song or file that you cannot get anywhere else. But if this is going to remain in your library, *replace it* with a high quality linear wave file as soon as possible.

Unfortunately, as bad as such artifacts are now, HD will only make it worse. A badly compressed file will only be amplified by the compression algorithm of HD. It really is "Garbage in, Really Bad Stinky Rotten Garbage Out." (I am not very opinionated, am I?)

STANDARDS

Now the more difficult issue: *Standards*.

I am of the opinion that we – as an industry – can and should set the bar for what we are going to accept into our buildings from a file format standard.

The problems:

What should that standard be?

Who should set the standard?

And of the *most* importance, *who* is going to *enforce* the standard?

WORKING TOGETHER

As you might guess from the tone of this article, a lot of us at Citadel Broadcasting have been seriously discussing this topic at length, But it really does come down to cooperation from the entire industry.

If we (Citadel) set a standard for music that we are going to accept and the competition across the street does not have the same standard, are we going to forgo being first with a "Debut" song from a core artist because the file is below our standards? Of course not. That is just *not* going to happen. I know it, you know it. But there goes the standard!

The only way any standard is going to work is if we (Radio) set the bar and tell all of the music labels, production houses, and any other providers what our standards are – and stick by those agreed upon standards. I have had informal discussions with some of the second hand providers already, and for the most part they are as frustrated as we are. They are simply not receiving high quality linear files from the record labels on a consistent basis – and when they do they are limited by drive space and bandwidth just as we are.

So, how do we begin? I would be willing to get together with any company, provider, or record label that would be willing to open the subject and possibly come up with some "base-line" standards that we could – over time – implement and eventually get the providers to adhere to.

Is this possible? Is this something that we as an industry can get together on and put the power of numbers on our side? I am willing to try. Are you?

Jeff Schroeder is the Corporate Director of Digital Technology for Citadel Broadcasting Company. If you feel strongly about today's broadcast audio quality, contact Jeff at jeff.schroeder@citcomm.com

Feature packed.

(Kind of like our ads.)

Go (con)figure • The folks at MPR say they really love being able to configure and administer an entire building full of consoles and routing equipment from the comfort of their own offices. Put an Internet gateway in your Axia network and you can even log into Element (or any other part of an Axia system) remotely from home, where there's plenty of Cheetos and Pepsi. Great for handling those 6 P.M. Sunday "help me!" phone calls from the new weekend jock.

Who are these guys? • Why buy a console from Axia? Element was designed by Mike Dosch and his team of ex-PR&E renegades (who know a bit about consoles). And Axia is a division of Telos, the DSP experts.

Perfect timing • You can't have too much time. That's why Element's control display contains **four different chronometers**: a digital time-of-day readout that you can slave to an NTP (Network Time Protocol) server, an elapsed-time event timer, an adjustable count-down timer... and there's also that big, honkin' analog clock in the center of the screen (Big Ben chimes not included).

Screen play • Use any display screen you choose, to suit your space and decor. Get a space-saving 12" LCD, or go for a big 21" monster. (This is Dave Ramsey's favorite Element feature, by the way. Anyone want to bet he bought his monitors on sale?)

Lovely Rita • LED program meters? How 1990's. SVGA display has lots of room for timers, meters, annunciators and more — enough to show meters for all four main buses at once. Reboot to 5.1 surround mode and the light show is even cooler, with surround audio and associated stereo mixes all going at once.

Memory enhancer • We know how forgetful jocks can be. That's why Element remembers their favorite settings for them. Element's Show Profiles are like a "snapshot" that saves sources, voice processing settings, monitor assignments and more for **instant recall**. Profiles are easy to make, too: just have talent set up the board the way they like it, then capture their preferences with a single click for later use. (Hey, make *them* do some work for a change.)

Black velvet • Some things **just feel right**. Like our premium, silky-smooth conductive plastic faders and aircraft quality switches. We build Element consoles with the most durable, reliable components in the industry — then we add special touches, like custom-molded plastic bezels that protect on/off switches from accidental activation and impact. Because we know how rough jocks can be on equipment. And nothing's more embarrassing than a sudden case of *broadcastus interruptus*.

Split decision • No, you're not seeing double: Element gives you the choice of single-frame or split-frame configurations of **up to 40 faders**. Perfect for complicated talk or morning shows where the producer wants his own mini-mixer, or to give talent space for copy, newspapers and such. Solomon would be proud.

Swap meet • Element modules hot-swap easily. In fact, the **entire console** hot-swaps — unplug it and audio keeps going; an external Studio Engine does all the mixing.

Stage hook • This button activates the emergency ejector seat. OK, not really. It's the Record Mode key: when you press it, Element is instantly ready to record off-air phone bits, interviews with guest callers, or remote talent drop-ins. One button press starts your record device, configures an off-air mix-minus and sends a split feed (host on one side, guest on the other) to the record bus. Like nearly everything about Element, Record Mode is **completely configurable** — its behavior can even be customized for individual jocks. Sweeeet.

How many? •
How many engineers does it take to change these light bulbs? None... they're LEDs.

Talk to me • Need some one-on-one time with your talent? Talk to studio guests, remote talent, phone callers — **talk back to anyone** just by pushing a button.

Missing features • Did we forget something? Program these **custom button panels** with any macro you want, from recorder start/stop to one-touch activation of complex routing and scene changes using PathfinderPC™ software. You could probably even program one to start the coffee machine (black, no sugar, thanks).

Great Phones • With Element, jocks never have to take their eyes or hands off the board to use the phones. Element works with any phone system, but really clicks with the Telos Series 2101, TWOx12, and new NX-12 that connects four hybrids plus control with a **single Ethernet cable.** Status Symbols' (cool little information icons) tell talent at a glance whether a line is in use, busy, pre-screened, locked on air, etc. Even dial out with the built-in keypad.

The Busy Box for jocks • Element comes standard with a lot of cool production room goodies you'd pay extra for with other consoles: like per-fader EQ, aux sends and returns and custom voice processing by Omnia, enabling you to quickly build and capture compression, noise gating and de-essing combinations for **each and every jock** that load automatically when they recall their personal Show Profiles. Context-sensitive SoftKnobs let production gurus easily tweak these settings, while simultaneously satisfying their tactile fixations. (Don't worry, for on-air use, you can turn off access to all that EQ stuff.)

Mix-plus • If constructing a complicated mix-minus on the fly brings a big grin to your face, you're excused. But if you're like us, you'll love the fact that Element does mix-minus **automagically**. Forget using all your buses for a four-person call-in, or scrambling to set up last-minute interviews. When you put remote codecs or phone calls on air, Element figures out who should hear what and gives it to 'em — as many custom mix-minuses as you have faders.

AXIA
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AxiaAudio.com

Shown: 16-position split-frame Element, nicely equipped, $12,558.00 U.S. MSRP. Not shown but available: 4-, 8-, 12-, 16-, 24- and 28-position Element. Dual exhaust and whitewalls optional at extra cost.

Element

The Worst I've Ever Seen

A Visual Display of the Good, the Bad, and the Plain Hard-to-Believe

Going Ice Fishing for an ATU

by Jon Hosford

Mike Raymond and I share responsibility for the eleven stations in Vermont owned by Northeast Broadcasting. On a normal, frigid day in February, Mike got the call that WFAD in Middlebury was off the air and the station staff could not get the transmitter back on via remote control.

NOT THE USUAL SUSPECTS

At first we suspected the Harris SX-1A transmitter, which is notorious for being finicky about the load presented by the ATU and antenna. It is not uncommon for the station to have problems with tall cattails or snow shorting the tower causing the transmitter to fault.

We both made the assumption snow had drifted deep enough to bridge the insulator. But, after the hour drive, Mike arrived to find that the problem was not snow.

This site is in a fairly low area that is a wet swamp in the summer. This winter had somehow caused the water level to climb over three feet above normal level and then freeze. Luckily, this was still well short of the tower base. However, it was high enough that the water got well into the ATU cabinet – and then it froze. The transmitter did not like that!

ICE FISHING

The ice was about two inches think, and the air temperature was well below freezing, so we decided (at least we hoped!) it was safe to walk on. The tower fence gates were frozen in the same ice, so we had to take the gates apart and climb through. The ATU was not a pretty sight.

Once we chipped the ice away from the cabinet, it was time to figure out how to loosen the Heliax and metering connections that enter the ATU from the bottom. I drew the short straw and spent 10 or 15 minutes with my arms in 32-degree water, with a hacksaw, cutting off everything I could feel.

Too cold even for the fishes.

After making the cuts – and thawing out a bit – we realized there was still something holding it down. Unfortunately, due to the severely cold water, we just could not cut all the way through a piece of steel conduit.

This site is adjacent to a state highway department facility, so we walked over and borrowed a 10-foot pry bar. Using it and hoping the ice would hold us, we finally broke the last connection. We wrestled the ATU through the fence and into the building to clean out the ice and dry it out.

MAKING IT WORK AGAIN

At this point, we had been working in the wet and cold for several hours. It was not just the ATU that needed some serious drying out – and warming up.

The one problem left was how to mount the ATU so that the spring thaw would not let it sink through the ice and short out again. Obviously, there was no way we could put any kind of post into the ground – and setting it on top of the ice was not a viable option.

This is not what you would call a fun project!

I came up with the idea to use two, two-by-fours to hang the ATU from the side of the tower itself. The wood allowed us to keep the grounds insulated and still hold the ATU off the ice.

Back on the air with an ATU that is high and dry!

Using four U-bolts, two boards, and a new piece of coax, we had the station back on the air. The station operated well for many months until we could dig again and correctly mount the cabinet on posts.

Jon Hosford is the Director of Engineering for Northeast Broadcasting, based in Montpelier, VT. His circulation is almost back to normal now. You can contact him at jhosford@pointfm.com

HAPPY 10TH ANNIVERSARY!

The Best Is Yet To Come!

Omnia

Omnia
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Radio History

by Don kimberlin

Serendipity in the South
The WBT Story

An old Persian fairy tale concerns some men who were sent on a mission. The Three Princes of Serendip (modern-day Sri Lanka) kept finding things seemingly unneeded or unknown at the outset but ultimately found to be useful. The word "serendipity," an aptitude for making desirable discoveries by accident, was coined in 1754 by English author Horace Walpole.

It must have been from serendipity. How else could you explain the growth of WBT, Charlotte, NC, from an amateur radio hobby in 1912 to one of the "Grande Dames" of today's radio stations?

HUMBLE ROOTS

By his own account, the first of WBT's three founders, Earle Gluck, obtained his Federal "Wireless Operator" license at Baltimore in 1912 and an "Amateur Station" license there in 1914. World War I, though, caused the silencing of all non-government radio operations, whereupon Gluck took his skills to sea with the U.S. Navy.

After the war, Gluck gained employment with Southern Bell Telephone in Charlotte. One day in late 1920 he went shopping in a Charlotte electrical store for materials to rebuild his amateur station. There, he happened upon two others with similar interests. One was an engineer at Westinghouse Electric and Manufacturing, Frank Bunker. The other was Fred Laxton, of the electrical contracting firm Tucker and Laxton in Charlotte. The three soon became fast friends.

From his previous employment at General Electric, Laxton knew of some (for the time) "high powered" vacuum tubes under development at GE that could drive a radiotelephone transmitter. The notion of being able to communicate with other hams by voice rather than telegraph appealed to the three when Laxton said he thought he could get a pair of the new tubes through his GE connections.

4XD GOES ON THE AIR

In short order the trio had assembled a transmitter in an abandoned chicken coop behind Laxton's house on Mecklenburg Avenue in Charlotte, across from the Charlotte Country Club. Their test receiver and microphone were located in the comfort of the house. With the technology of the day, one can imagine that careful watching was needed to avoid damage to the precious tubes. By March 1921, the balky apparatus had been sufficiently tamed to secure a station license for Experimental Station 4XD.

According to Gluck, as the junior partner he had to stay in the house to talk on the microphone while the others went outside to observe the fantastic new hardware in operation. He soon struck on the notion of playing a record on the phonograph with the microphone placed in front of it. Thus, he could at least get a glimpse of the transmitter for several minutes at a time.

Even though there were few transmitters or receivers in early 1921, it did not take long for Laxton's phone to begin ringing with calls from people who had built receivers and were pleasantly amazed to hear music in their earphones. In fact, the trio realized they could create a going business selling the components, supplies and instructions for home building radio receivers, since no complete receivers were being sold in the Charlotte market at the time.

The Southern Radio Corporation set up on the eighth floor of the Independence Building in "uptown" Charlotte. For the sake of business efficiency, the three moved the 4XD transmitter to the roof of the Independence Building and there gave it a fan-shaped transmitting antenna dangling down the face of the building.

FROM 4XD TO WBT

Gluck had by this time been routinely assigned duty as a "combo man," operating the transmitter, making announcements, and playing the records for music. He continued to be dogged by colleagues for the balance of his career about his beginnings as the "talent." In doing so, he also started a long-standing tradition of WBT having "combo men."

In January 1922, the Commerce Department formally established the broadcast service; Gluck and company applied for one of the first such licenses. So it was that on Monday, April 10, 1922, former Experimental Station 4XD changed its radiated identity to WBT. Nevertheless, one could say that, like many others around the nation, WBT had started licensed operations earlier – as early as March 1921.

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Radio History

by Don Kimberlin

Continued from Page 34

COMPLETING THE PROJECT

Finally, on October 1, 1928 the new transmitter building had been roofed and major parts of the General Electric 5,000 Watt transmitter began to arrive – unfortunately with some damage in transit. Meanwhile, WBT obtained permission from the Federal Radio Commission to radiate up to 10,000 Watts.

Unfortunately, as the tower riggers were just finishing up at the transmitter site, they pulled the antenna wire too tight, causing the top 35 feet of one of the towers to fold over. There was more delay waiting for replacements as well as items in short supply, like lead-sheathed, twisted-pair wire for audio wiring.

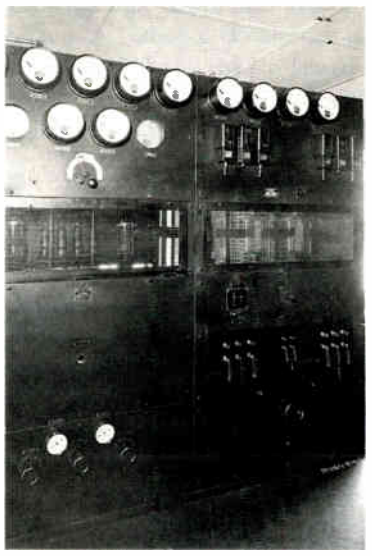
Finally, on November 19, 1928, the last needed items were received from General Electric and a short test commenced at 1:00 AM. With high anticipation, the first airing of the new 5,000 watt transmitter was planned for 10:30 PM the following evening, November 21st.

ELATION AND SADNESS

Operating first at just 2,500 Watts, WBT got excellent reception reports from 38 states and several Canadian provinces. The signal must have boomed in to Rhode Island, as 20 telegram reports came from Providence alone, while other Rhode Island locations added 50 more telegrams to the stack. At 1:00 AM, full 5,000 Watt operation began and continued thereafter, starting a WBT tradition of having a skywave audience every night.

By the end of the month, the new 5,000 Watt transmitter was deemed sufficiently reliable to permit disconnection of the Western Electric 106-A in town and shipment to its new Florida owner.

Regrettably, on December 3 – just weeks after seeing his proud new WBT on the air – C. C. Coddington suddenly dropped dead from a heart attack at the age of just 50. On the same date, WBT was reported having been received in the Hawaiian Islands, about 5,500 miles distant.



WBT moved up to a GE 5 kW transmitter in 1928.

It is almost hard to believe how this major station grew in just eight short years from the inception of 4XD as a fun project for three young men. Serendipity, indeed.

THE BEANCOUNTERS ARRIVE

But a new era for WBT was about to begin. Control reverted to the executor of Coddington's estate, Union National Bank. A lull occurred for a few months as the bank controllers took over the business.

The station had been a healthy business, but the bankers made it quite a bit more profitable, increasing airtime hours and profits considerably. One note from early December 1928 indicates that the cost of network lines had been "eliminated," along with the NBC affiliation.

In September 1929, WBT continued to grow, and even had its own 10-piece studio orchestra, while still carrying the nightly theatre organ recitals. There was plenty of musical fare being broadcast from Charlotte on WBT.

Around this time, Earle Gluck seems to have dropped out of the WBT picture. However, he continued to figure in Charlotte radio with the establishment of competing WSOC in 1931, along with other former WBT staffers.

A NEW FAMILY

During 1929, the bank arranged the sale of WBT to a holding agent company affiliated with CBS, beginning a long relation with the network. WBT was an "O & O" until 1945, and remains a network affiliate today.

WBT joined an august family of radio stations that included such fabled call signs as WCBS, KNX, KMOX, KCBS, WBBM, WTOP and WCCO to name a few. CBS was, at the time, a most aggressive business in both technology and programming. CBS hired many famous early radio entertainers away from NBC, and WBT enjoyed carrying such audience draws as Bing Crosby, Al Jolson, George Burns and Gracie Allen, and Kate Smith.

After its purchase by CBS, WBT got a hefty transmitter power increase in 1931 to 25,000 Watts. The records are vacant on the reason for a power level of 25,000 Watts, but the installation of a Blaw-Know "diamond" tower and a power increase to 50,000 Watts in 1933 suggests the triatic-wire antenna for the 5,000 Watt transmitter was simply unworkable with the high voltages and currents of 50,000 Watt operation.

The 50 kilowatt WBT AM signal grew to international prominence, being one of the American stations regularly heard across the Atlantic Ocean and listed in aeronautical publications as a reliable radio direction-finding signal for air pilots. By 1940, the WBT AM transmitter site with its distinctive Blaw-Knox "diamond" tower was listed on air navigation charts not only as a landmark, but as a guide for landing at nearby Charlotte Douglas Airport.

(Continued on Page 38)

Radio History

by Don Kimberlin

Continued from Page 32

Operating on 360 meters, WBT published an operating schedule of 10:00 to 11:45 AM and 7:30 to 9:45 PM daily. In later years, Gluck admitted that operations in the early days were often "spasmodic," as he found it difficult to find adequate material to fill the schedule.

That situation did not last long. Soon, performers who were to become household names across the nation began to appear on WBT. Among these were bandleader Hal Kemp, and Freeman Gosden and Charlie Correll, headlined as "Two Black Crows." The duo would later move to Chicago and broadcast nationwide for many years as "Amos 'n Andy."

Another future famous Big Band leader, John Scott Trotter, appeared on WBT. Trotter was later to spend years in close association with Bing Crosby as Crosby's band leader on nationwide broadcasts.

NEW OWNER, NEW HOME, NEW SLOGAN

In 1927, the three friends decided it was time to liquidate their interests in Southern Radio Corporation, so they sold the receiver sales business (by then an RCA distributorship) to the Carolina States Electric Company and WBT to Charlotte's Buick dealer, C. C. Coddington. Gluck stayed on with his radio baby.

Coddington's ownership signaled the start of a period of quite benevolent ownership of WBT. At the outset, the WBT "home brew" transmitter and studio were installed in a penthouse atop the Coddington Building, with two new 80-foot towers to support an improved transmitting antenna; office space was provided below on the third floor. WBT was beginning to look like a stand-alone radio station business rather than a sales adjunct to a parts supply house.

Coddington's sales manager, Lee Folger, displayed pride in the radio station by applying the logo, "Watch Buick Travel" to the stations' call sign.

GROWING THE SIGNAL

Under Coddington ownership, Gluck was able to secure affiliation with the new National Broadcasting Company's networks, thus WBT now had a steady supply of program material from the famously known national network programs of the day.

WBT moved to its current transmission site in 1928; the current, larger building, was constructed in 1933. This later building included the image of a microphone in the lintel.

The "home brew" transmitter that was rated at 250 Watts got beefed up to 500 Watts and, in early 1928, Coddington purchased a Western Electric 106-A transmitter that could operate at 1,000 Watts. Within months, Coddington planned to procure a 5,000 Watt transmitter from General Electric and move the WBT location to his farm, seven miles south of "uptown."

On Coddington's farm, WBT would get a fine new transmitter building and a triatic-wire antenna, suspended between two used 250-foot windmill towers spaced 600 feet apart in a cotton field.

The antenna had a ground plane of 47 radial wires planted in trenches two feet deep to avoid damage from the cotton farming on the field. This site, along Nations Ford Road in Charlotte, has been the home of WBT's AM transmitters ever since.

During this expansion phase, Coddington increased the WBT staff considerably with a Station Manager, an audio supervisor and several control engineers. Gluck was made Chief Engineer.

Curiously, despite many modern conveniences at the new transmitter site (like a Kelvinator electric refrigerator, a toaster, a percolator and a waffle iron), the site had no telephone. In its place, Gluck's amateur station W4CQ and a new one, W4AJJ, were operated as a link to the city.

A PAUSE FOR THE WEATHER

The expanded capital plan also included all-new studio and audio equipment from RCA. For example, two superb new condenser microphones arrived, permitting even better quality audio originations at WBT. Such microphones cost $400 each in 1928 (about $4,500 in 2007 money).

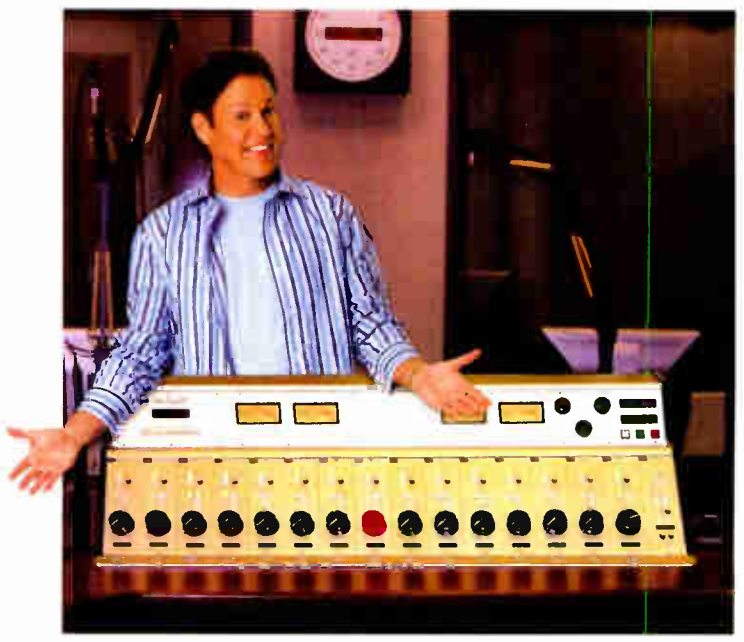
Completion was planned for September 1928, just about a year after the Coddington acquisition. Sale of the used WBT apparatus, right down to its 80-foot towers, was arranged with a Florida buyer. Unfortunately, manufacturing delays at General Electric, combined with heavy rains and a hurricane in the Southeast, slowed the transmitter site project.

WBT moved to support the community during the emergency. With telephone facilities in much of Florida and Georgia down, WBT used the amateur operation to get news from the outside world; for example, relaying news of Charlotte students stranded in Charleston by the storm. Famed entertainer Jimmy Rodgers came to Charlotte to broadcast an appeal for hurricane relief donations. Rodgers raised $3,100 (2007 equivalent: over $35,000) in one short program.

(Continued on Page 36)

Congrats to you, Rick Dees, on your inauguration into the **Radio Hall of Fame**.

Yo Rick! You Rock!



Hey, when Rick talks, we listen.

Rick Dees has always liked the look and feel of the traditional 50s- and 60s-style rotary fader consoles. For his new studio complex, SAS custom designed and built the **Dees Digital Rubicon**, a true Rubicon digital console control surface in the traditional style.

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Radio History

by Don Kimberlin

Continued from Page 34

COMPLETING THE PROJECT

Finally, on October 1, 1928 the new transmitter building had been roofed and major parts of the General Electric 5,000 Watt transmitter began to arrive – unfortunately with some damage in transit. Meanwhile, WBT obtained permission from the Federal Radio Commission to radiate up to 10,000 Watts.

Unfortunately, as the tower riggers were just finishing up at the transmitter site, they pulled the antenna wire too tight, causing the top 35 feet of one of the towers to fold over. There was more delay waiting for replacements as well as items in short supply, like lead-sheathed, twisted-pair wire for audio wiring.

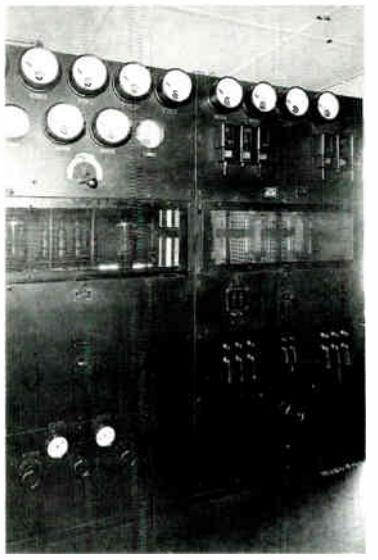
Finally, on November 19, 1928, the last needed items were received from General Electric and a short test commenced at 1:00 AM. With high anticipation, the first airing of the new 5,000 watt transmitter was planned for 10:30 PM the following evening, November 21st.

ELATION AND SADNESS

Operating first at just 2,500 Watts, WBT got excellent reception reports from 38 states and several Canadian provinces. The signal must have boomed in to Rhode Island, as 20 telegram reports came from Providence alone, while other Rhode Island locations added 50 more telegrams to the stack. At 1:00 AM, full 5,000 Watt operation began and continued thereafter, starting a WBT tradition of having a skywave audience every night.

By the end of the month, the new 5,000 Watt transmitter was deemed sufficiently reliable to permit disconnection of the Western Electric 106-A in town and shipment to its new Florida owner.

Regrettably, on December 3 – just weeks after seeing his proud new WBT on the air – C. C. Coddington suddenly dropped dead from a heart attack at the age of just 50. On the same date, WBT was reported having been received in the Hawaiian Islands, about 5,500 miles distant.



WBT moved up to a GE 5 kW transmitter in 1928.

It is almost hard to believe how this major station grew in just eight short years from the inception of 4XD as a fun project for three young men. Serendipity, indeed.

THE BEANCOUNTERS ARRIVE

But a new era for WBT was about to begin. Control reverted to the executor of Coddington's estate, Union National Bank. A lull occurred for a few months as the bank controllers took over the business.

The station had been a healthy business, but the bankers made it quite a bit more profitable, increasing airtime hours and profits considerably. One note from early December 1928 indicates that the cost of network lines had been "eliminated," along with the NBC affiliation.

In September 1929, WBT continued to grow, and even had its own 10-piece studio orchestra, while still carrying the nightly theatre organ recitals. There was plenty of musical fare being broadcast from Charlotte on WBT.

Around this time, Earle Gluck seems to have dropped out of the WBT picture. However, he continued to figure in Charlotte radio with the establishment of competing WSOC in 1931, along with other former WBT staffers.

A NEW FAMILY

During 1929, the bank arranged the sale of WBT to a holding agent company affiliated with CBS, beginning a long relation with the network. WBT was an "O & O" until 1945, and remains a network affiliate today.

WBT joined an august family of radio stations that included such fabled call signs as WCBS, KNX, KMOX, KCBS, WBBM, WTOP and WCCO to name a few. CBS was, at the time, a most aggressive business in both technology and programming. CBS hired many famous early radio entertainers away from NBC, and WBT enjoyed carrying such audience draws as Bing Crosby, Al Jolson, George Burns and Gracie Allen, and Kate Smith.

After its purchase by CBS, WBT got a hefty transmitter power increase in 1931 to 25,000 Watts. The records are vacant on the reason for a power level of 25,000 Watts, but the installation of a Blaw-Know "diamond" tower and a power increase to 50,000 Watts in 1933 suggests the triatic-wire antenna for the 5,000 Watt transmitter was simply unworkable with the high voltages and currents of 50,000 Watt operation.

The 50 kilowatt WBT AM signal grew to international prominence, being one of the American stations regularly heard across the Atlantic Ocean and listed in aeronautical publications as a reliable radio direction-finding signal for air pilots. By 1940, the WBT AM transmitter site with its distinctive Blaw-Knox "diamond" tower was listed on air navigation charts not only as a landmark, but as a guide for landing at nearby Charlotte Douglas Airport.

(Continued on Page 38)

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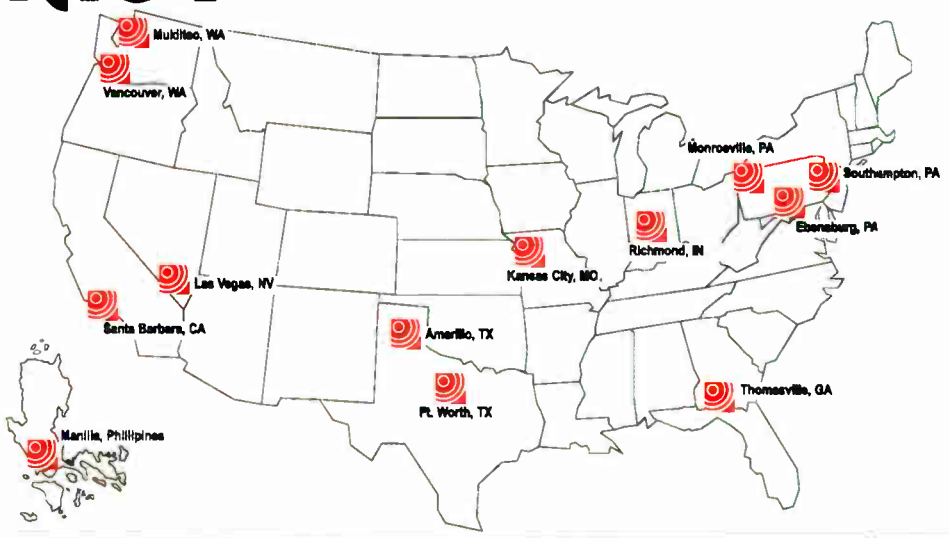

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Radio History

by Don Kimberlin

Continued from Page 36

LOCAL RADIO WITH A NATIONAL IMPACT

The autumn of 1930 witnessed the first noon news readings by well-known Charlotte radio personality Grady Cole. Cole's career at WBT was to last until 1961, an almost unheard of span of 31 years for a single "morning man," including later years as an early days "combo man," doing the morning show from the WBT transmitter site.

In 1933, another long-time Charlotte radio luminary, Charles Crutchfield, joined the staff. Many well-known programming aspects of WBT's on-air "southern personality" owe their aegis to Charles Crutchfield.

As a CBS "O & O," WBT became a sort of "farm club" for the CBS radio network. Andy Griffith applied at WBT in 1941, but was rejected because he expected a salary of $75 (which would be more than $1,000 today) per week. The Carter family sang on WBT, including young June who would later become country luminary June Carter Cash. Surprisingly, Charlotte-bred Charles Kuralt, one of CBS Radio's all-time luminaries, grew up writing for Charlotte newspapers but never broadcast his mellifluous voice on WBT until after his employment by the network.

Federal ownership constraints enacted after WWII required CBS to sell WBT in 1945. Jefferson-Pilot Insurance bought the property for $1,505,000 (2007 equivalent: $16.7 million). More recently, Jefferson-Pilot merged with Lincoln Financial Group, giving WBT a new ownership identity.

EMERGENCY RESOURCE

With WWII looming in 1941, the FCC made WBT a "key station," to function as a communication source and center for about 25 other stations in event of national emergency. This became a root of the Conelrad system.

Later in WBT's Conelrad career, a small control room was built below ground level into the second sub-basement of the WBT transmitter building, complete with Cold War style survival fittings, in an effort to make WBT-AM the most survivable of radio stations.

The WBT emergency studio is still "stocked" with supplies.

During WWII, it was discovered that German U-Boats favored WBT as a navigational aid, so to aid the US war effort; WBT broadcast false news items to mislead U-Boat listeners about the status of the United States homeland.

In the later "Cold War" Era, WBT changed its overnight programming to a locally produced "Radio Moscow," intended to counteract the Soviet propaganda being sent to the U.S. by Russia. "Radio Moscow" ultimately grew to syndication on 26 stations, and was subsumed by "Radio Liberty." Evidence that it aggravated Castro and the Soviets was seen in the extensive jamming attempted against WBT from Cuba.

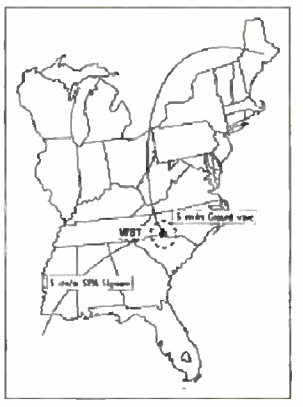
MULTIPLYING TOWERS

Like a number of other conflicts that resulted from the 1941 NARBA changes, WBT encountered objection to its nighttime skywave from KFAB, Omaha NE, which was moved from 780 to 1110 by the NARBA treaty. For some years, WBT operated on STA's while seeking a solution to the KFAB problem.

WBT's Directional Antenna is designed to protect KFAB, Omaha.

A first effort toward reducing WBT's radiation toward KFAB was a directional antenna, made of three towers. Still there today, WBT's tower site is a well-known visual feature of Charlotte, seen by travelers on I-77. The towers operate with flashing white strobes at night.

The DA resulted in a significant loss of nighttime local signal to the west – in particular near Shelby, North Carolina and westward. A map on the station's QSL card shows the sharp notch in its nighttime 50/50 0.5 mV/m contour.



Trying to solve this, WBT's engineers built a 1 kW synchronous repeater in 1946 at Shelby NC, backfilling the null toward KFAB. Unfortunately, this combination still did not settle the KFAB matter.

ADJUSTING SKYWAVE

A skywave lobe is a well-known characteristic of the "diamonds," dating back at least to observations in the 1930s by RCA's doyen of directionals, George H. Brown. His engineering purist view (perhaps also encouraged by the fact that the "diamonds" were sold by his employer's arch rival, Western Electric) was that skywave lobe is wasted power, lost from local groundwave coverage.

However, as WBT's loyal evening skywave audience shows, WBT turned an apparent flaw into a feature, As some in the South would say, WBT "made lemonade out of a lemon." WBT's nighttime skywave signal in fact, was an audience asset rather than a liability, garnering listener responses all the way from Canada to Cuba. Over the years, WBT evening personalities have played to that surprisingly loyal skywave audience.

The elevated ground screen "tuned" the vertical radiation.

Still, WBT continued to address the KFAB conflict. Rather than make surgical changes to its steel as WSM had done in a similar situation, WBT's engineers placed an elevated ground screen around its tower bases to modify the vertical radiation characteristics of the Blaw-Knox diamond towers.

This change did reduce WBT's skywave toward KFAB, but only momentarily. At the very time of completing a whole new AM-DA Proof of Performance that included the effect of some 16 cellular and two-way towers in its near field, the WBT engineers discovered a new (17th) tower, necessitating further adjustments and a new complete proof to finally get back on direct power measurement. Today's operators should be grateful for the later Rulemaking that protects AM operators from the effects of others in their near field!

RECOVERING AGAIN FROM WEATHER

Not that many years after finally achieving a stable state for the WBT DA, disaster struck in the form of Hurricane Hugo in 1989, destroying two of the three Blaw-Knox diamonds.

In order to restore stable DA operation, it was necessary to have two new towers built exactly as the originals, and that meant reconstructing manufacturing drawings and work, a process which took several years. As an indication of the high regard WBT commands in the broadcasting world, the FCC authorized unlimited non-directional operation at full power during the long repair process. Few stations might expect such a relaxation of licensed parameters.

As part of a final settlement of the KFAB issue, WBT shut down the Shelby synchronous repeater and currently uses an FM at Chester, SC to provide WBT programming to the area.

INTO THE NEW CENTURY

As many stations have done, WBT has upgraded over the years. After the Western Electric, an RCA 50B, an RCA BTA-50F1, and an MW50A served over the years until the Harris 3DX50 Destiny came on line. The WBT signal has always been rock solid.

Chief Engineer Jerry Dowd shows off WBT's 50 kW Harris Destiny transmitter.

From 1927 hurricane coverage, to WWII propaganda through the Cold War to Vietnam, and natural disasters since, WBT and its air staff have been good public citizens of the first order. All the while, WBT has drawn top ratings for its programs and its air staff right through the Big Band, radio drama and soap opera, Top 40, and Talk Radio eras

And, not to be obsoleted by changes in communications technology, WBT's news/talk is streamed to the Internet at www.wbt.com.

For some 85 years, it has truly been a serendipitous journey for WBT and its audience.

Don Kimberlin's career has ranged from engineering local stations to the video circuits for the Moon Landing. Contact Don at dkimberlin@earthlink.net

Heavy Metal

by Stanley Adams

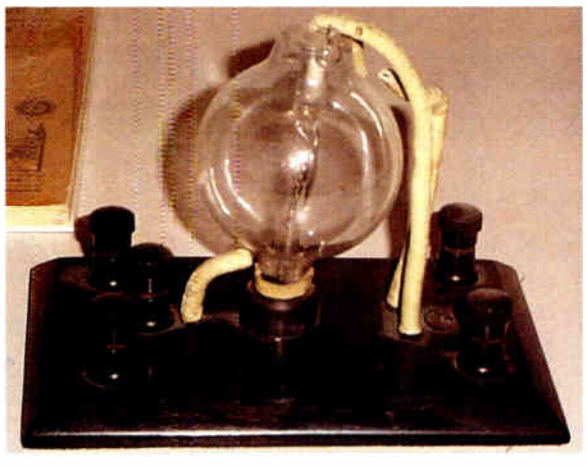
The Transmitters That Lit Up the Dial

*This month we start a new **Radio Guide** feature: a look at the big transmitters that took the industry from the small power levels of the early 1920s to the pinnacle of American radio operations – the WLW flamethrower that enabled the marketing of cheap radio receivers, lit up light bulbs, and annoyed the Germans. How did we get from there to here? Stan Adams starts us on the historical pathway.*

Heavy Metal? You mean like AC/DC or Guns and Roses? Maybe Anthrax? No? How about five or six big guys holding up their metal horns in a Polka band. No, not that either. Grab a cup of your favorite beverage and sit back; we are about to enjoy just a little reminiscing about the hard work, the glowing tubes, and the heavy metal that drove – and still drives – the big signals in radio broadcasting.

LOWER POWER BEGINNINGS

To properly track the growth of broadcast transmitters, we must begin at the time of Dr. Lee de Forest. He was the one who added the all important third element – the control grid – to the vacuum tube. Although it is an historical fact that de Forest did not know exactly how it all worked, he did figure out enough to be instrumental in broadcasting's growth.



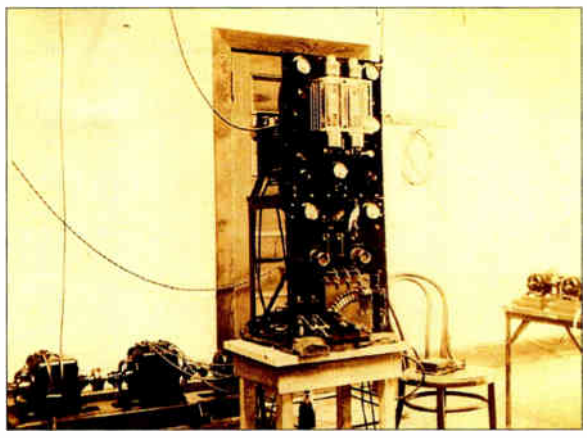
The de Forest Audion.

Following on the heels of Reginald Fessenden, de Forest became determined to broadcast audio over a wide area. However, his early attempts were only marginally successful; Enrico Caruso, for example, complained that his early broadcasts were all but inaudible.

After Edwin Armstrong explained and improved the Audion so that it truly amplified the input, progress in building transmitters started. De Forest made several models, leading up to his broadcasts in 1915-1916 from high atop the High Bridge Building in New York City (Bronx). Then 2ZK came into existence as he broadcast from New Rochelle, New York.

De Forest was broadcasting with music and voice into his OT-201C modulated oscillator using 1 kW input tubes; a model such as this provided the first transmitters for WOR in New York City and WWJ of Detroit, Michigan. These transmitters were poor at best with high amounts of harmonic distortion, carrier shift, and other such maladies.

Soon de Forest moved to the West and set up station 6XC/KZY in San Francisco. While there he would operate for over a year and make thousands of broadcasts. From his documented work in New York and California, it is a well-known fact that he predated KDKA in the craft of broadcasting.



A de Forest transmitter, used at WOR.
Courtesy: Cliff Uzmann

Nevertheless, as more able men were to explain the operation of the vacuum tube, we find de Forest simply disappearing from the scene. His next major project would be the investigation and development of "sound on film" movies.

ADDING POWER

The war to "end all wars" was certainly World War I. Millions of people were killed or displaced, and the youth of Europe were gone for at least an entire generation. And yet it was this horrific event that spurred America into the development of radio and electronics.

Much of the development is credited to the quasi-governmental setup of the Radio Corporation of America by those firms which possessed the capacity (capital and patents) to see the development of communications through all of the early days. The General Electric Company headed up the negotiations with Westinghouse, American Telephone and Telegraph, and two smaller companies – Wireless Specialty and United Fruit. During 1919 and 1920, negotiations would take place that would allow "patent pooling" and the sharing of engineering knowledge.

Compared to Europe, the U.S. had a slight head start in communication system design, based on de Forest's tube architecture. De Forest sold his Audion rights to Western Electric during the 1912 to 1915 time frame under the suggestion of Dr. John Stone Stone. As the GE negotiations were completed, a much better grade of tube began coming from the factories of Western Electric and General Electric where such notables as Drs. Irving Langmuir and H.D. Arnold added their developmental skills.

KILOWATTS OF AUDIO

The Telephone Company began not only to build their amplifying repeater for the long-haul transcontinental line but their attention was quickly turned to short haul transmission testing. One of the first experiments was made between Montauk, Long Island, and Wilmington, Delaware, a 250 mile distance.

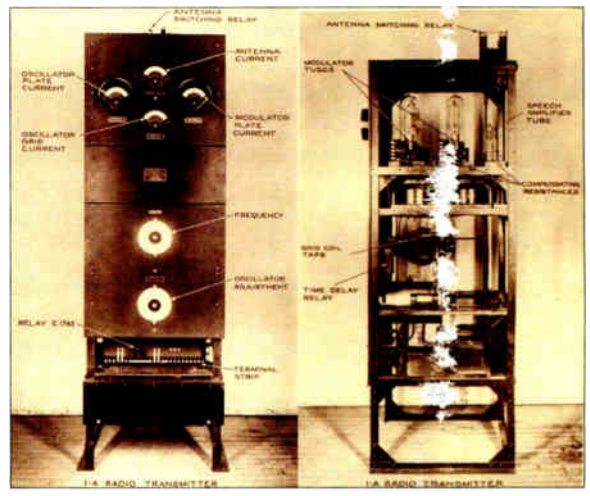
In April of 1915, 900 miles was achieved with duplex transmission to St. Simon's Island, Georgia. In late summer 1915, the famous Arlington, Virginia, to Paris, France, tests were accomplished using 50 Watt tubes – some 300 to 500 of them in parallel – which provided a sustained output of about 2 to 3 kW.

Meanwhile, as the "Great War" began, WE and GE spent much of their early research activity in the development of basic circuits and also of military and ship-to-shore equipment. It would be following the war that a goodly amount of that attention would be re-directed toward the concept of broadcasting.

WESTERN ELECTRIC TURNS UP THE RF

The Western Electric Company built ship-to-shore and point-to-point communications equipment as they learned how to develop broadcasting equipment. Construction of the transmitters in Deal Beach, New Jersey and Montauk Point, L.I. led to the first practical application of this and was used to communicate from the mainland of California to Catalina Island. That system was used for many decades.

The first broadcast transmitters that WE made were for 2XB, later WEAF in NYC, 1920. The equipment worked so well that a 500 watt unit was released: the 1-A transmitter. One was sold to WBL (WWJ Detroit). Similar higher power transmitters went to WBAY and WEAF in 1922.



Western Electric 1-A allowed stations to jump from 20 or 50 Watts to 500 Watts.

Complete with its power supply cabinet, the 1-A transmitter system was known as the 101A series; the 101B was later released which was basically the same transmitter. The tube complement was four Type 212's and one Type 211.

Quite a few of these transmitters were sold to early broadcast companies primarily due to two reasons: (1) it was the first "real" broadcast equipment that was available which offered fairly adequate performance and (2) due to the legal pressure from the AT&T company, which threatened to sue any broadcasters who did not use their transmission equipment. This was part of their territorial rights as agreed to under the incorporation of the RCA.

The early transmitter list also showed a 2A (Transmitter Code)/102A (System Code), a 100-watt unit that came out about the middle of 1923 and had five Type 211 tubes. The smaller 3C (Transmitter Code)/103A (System Code) was for a 50 watt unit that came out in early 1924 and used two of the Type 211 tubes. All of these systems used the "constant current" modulation scheme (also known as Heising modulation).

At the end of 1923, WEAF added a 5 kW water-cooled amplifier to the Type 1, 500 watt transmitter. This combination was termed as a Type 4 transmitter (and the 104 system), and was used by a number of stations.

BIGGER AND BIGGER

Later additions to the Western Electric lineup were the 5C (Transmitter Code)/105B (System Code) with a power of 5 kW and manufactured about early 1928, this unit had two Type 220 tubes and it used the 500 Watt transmitter as the low level driver. This principle of low level modulation and driving became a classic hallmark of all WE high power transmitters in future years.

The 6B (Transmitter code)/106B (System Code) came out in mid-1928 was a 1 kW transmitter using one Type 228 tube. Finally, in early 1928, the 7A (Transmitter code)/107A (System Code) was born and became the first of many 50 kW units. This consisted of six Type 232 tubes. *(Continued on Page 42)*

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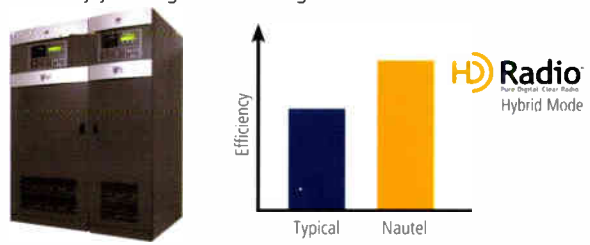

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Continental Electronics

Heavy Metal

by Stanley Adams

The Transmitters That Lit Up the Dial

Continued from Page 40

WLW leaped to 50 kW with the WE 107A.

This new set of transmitters was, as it were, a "second generation" system which offered higher power, greater stability, improved frequency response, and a reduction in audio and RF distortion products. Much of this grew out of on-going research: low level modulation techniques were developed for trans-Atlantic telephonic transmissions and the incorporation of crystal frequency control was developed at WEAF and WBAY.

With this second generation, 100% modulation became possible and all transmitters used some form of this basic design until the seminal design development of W.H. Doherty. (The Doherty amplifier was first applied to station WHAS in Louisville, KY, in 1938.)

Overall, this second-generation series' superior performance placed aural broadcasting in a professional light. On the other hand, it was during this developmental period that we find engineers and broadcasters alike wanting to work on the "power principle." Namely, "I can beat you if I have more power than you do."

PROGRESS AT GE AND RCA

General Electric did much with WGY radio, Schenectady. The station really was their "commercial laboratory." GE worked with 50 and even 60 kilowatts of power according to the FCC license cards of the period. Additionally, experimental operation after midnight tested a working GE transmitter at 100 kW.


STATION APPLICATION RECORD
No. 1.
APPLICANT: General Electric Company
CALL LETTERS: WGY
Present Assignment
Requested:

A portion of WGY's FCC Application Record.

Here is the one from WGY which reflects, we believe, the first high power transmitter (range of 50 kW). The station was running 56 kW on 790 kHz in April of 1927. Other reports indicate testing at 50 kW began in 1925, a license issued in 1926. Either way, this was more than a full year before WLW ran the first WE 107A 50 kW station in Cincinnati or RCA's 50A in New York City.

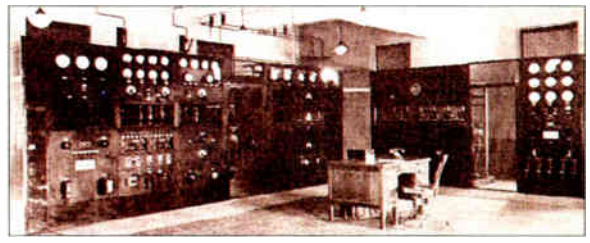
Unlike the compact transmitters of today, WGY had a large open room where all the transmitter sections, tubes and power supplies were laid out in a nice symmetrical manner; safety rails surrounded each module. It must have been a sight to behold!

Looking through WGY's Control Room to the Transmitter Room.

Perhaps it would be a good time to mention what I consider a fairly true statement: the power development ran alongside the tube manufacturers' capabilities. And who were they? GE and WECo, of course.

WJZ, another of the early stations, claimed to have used 50,000 watts intermittently since 1925 at Bound Brook, NJ; 1935 was the year in which this power level became "full time." However, checking the FCC record cards, I could find it only requesting this power as far back as 1927. In all fairness though, a number of the earliest records are missing as the station changed hands and call letters quite a few times, finally ending up as WABC.

WEAF, the main station for AT&T/RCA, did become home to an RCA 50A in 1927. Whether there were other 50As is unclear, but the 50B (possibly an "upgrade" from the 50A) was a major success, with installations from coast to coast.



Serial No. 1 of the RCA 50B series was installed at WTIC.

HOW HIGH CAN YOU GO?

For a short time, fifty thousand Watts seemed to be the pinnacle of transmitter power, at least for those who were wealthy enough to afford the expensive units and their power bill. Manufacturers scrambled to build larger models, but although many stations in the late 1920s and 1930s applied for higher power, only one station received approval for it from the government.

Powel Crosley was determined that his Cincinnati station – WLW – would be the "first with the most" power in the land. Among other things, it would permit his receiver manufacturing company to make and sell less expensive radios.

In late 1928/early 1929 WLW was pouring out its 50,000 Watts but it just seemed to be too little for a station that served the center of the nation, consisting of rural Americans. Only a station in the range of 500,000 Watts could adequately cover what for most stations was a secondary service.

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Consultations with General Electric, Westinghouse and the RCA went on as early as 1930, and in 1934 WLW made it happen – including the ability to bill the same rates as an entire national radio network. Rural America became the primary coverage for WLW and, at a time when receivers could cost several year's salary, the Crosley Harko sold for as little as nine dollars. Indeed, it sold well enough that Crosley stopped manufacturing anything else at the time.

Interpreting Early Western Electric Codes

System Code	Transmitter Code	Power Rating	Manufacture Date	High Power Tube Complement
101 A	1A	500 watts	Early 1923	4-212; 1-211
102 A	2A	100 watts	Mid-1923	5-211
103 A	3C	50 watts	Mid-1924	2-211
104 A	4A	5000 watts	1923/1924	1A plus 2-220
105 B	5C	5000 watts	Mid-1928	1B plus 2-220
106 B	6B	1000 watts	Late 1928	1-228
107 A	7A	50,000 watts	Mid 1928	Drivers plus 6-232

But we are starting to get a bit ahead of our story about heavy metal in broadcast. Stay tuned for our next installment about the big rigs that made broadcasting "happen."

Stan Adams' family has been involved in broadcasting since the 1940s. He currently works at in the Memphis RF Engineering department of Sprint. Email contact is: stanleybadams@yahoo.com

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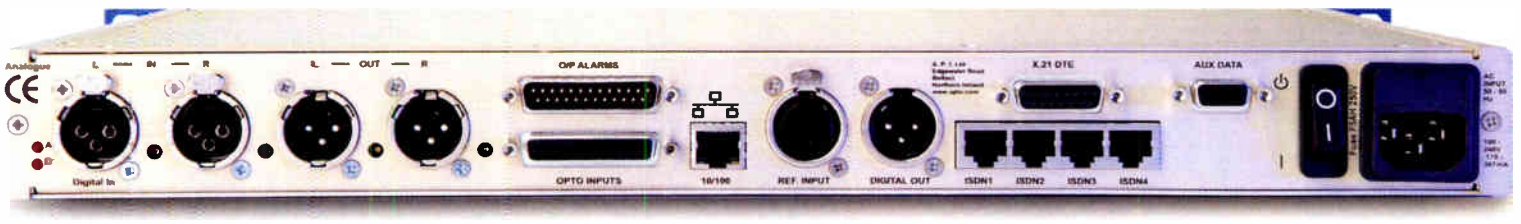

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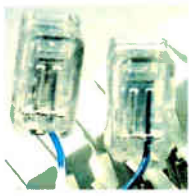

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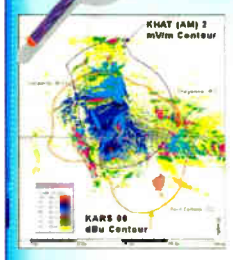

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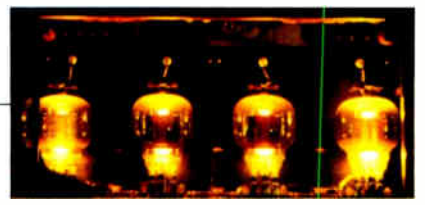

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www.pab.org/conventions.html

Dayton Hamvention
May 18-20, 2007
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www.hamvention.org

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

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September 26-28, 2007
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www.nabradioshow.com

Pittsburgh SBE20 Regional Convention
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