Radio Guide

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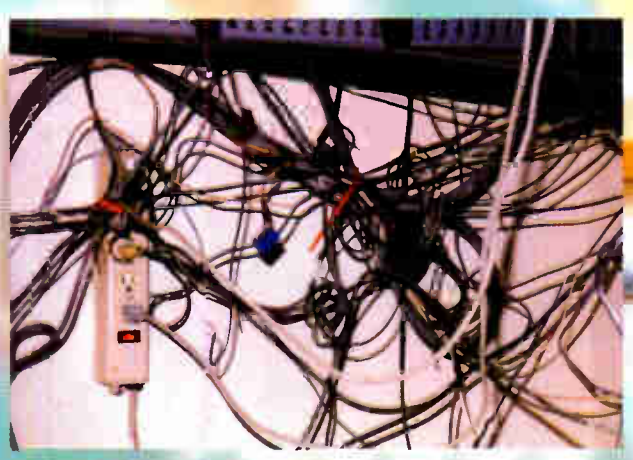
July 2003
Volume 11 Issue 7

The Digital Studio

Digital transmission now a reality. Is it time to convert your studios?



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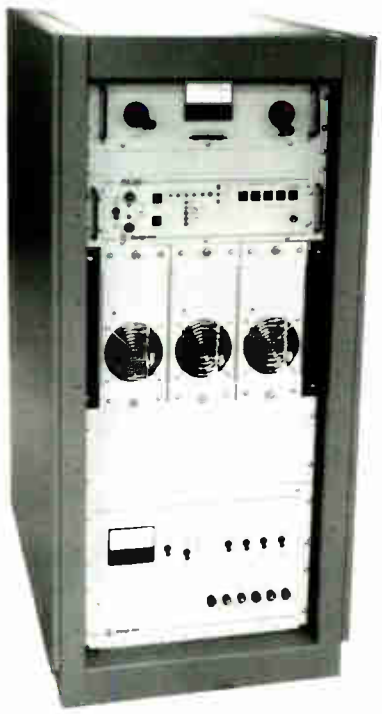

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Columns & Articles

Radio Guide
Volume 11 Issue 7
July 2003

Building a Digital Studio *Part-1*

Audio Processing – Part 7

A Primer on DRM™ Digital Radio

Networking 101 – Part 6

Our thanks go to Logitek and to Mark Lucas for this month's cover photos.

Barry's tribute to Richard Haskey can be found on page 6.

Precious Resources

Whenever someone close to us dies, it brings sadness, and tends to give us a momentary pause, reflecting upon our own mortality and how we are using our lives. The passing of Richard Haskey last month also brings into focus how the radio industry is losing, but not replacing, some of its most valuable assets: the folks that can plan, build and maintain radio stations from the ground up.

One of Richard's friends noted there are few engineers out there who can be shown a vacant piece of land, and be trusted to do the site research, file the applications, specify equipment, organize and build the station (often fabricating needed parts on site), and finish it all off by producing the first programming.

As corporate budget cutting continues, we hear more and more stories about engineers forced to work five, six and seven stations with ... well, with themselves. Either "corporate policy" says the billing level is insufficient to have a second engineer, or GMs, anxious to prove themselves to their corporate masters, continue slash more and more from the technical budget. Anecdotal evidence is that the average working engineer puts in far more than 40 hours of work each week. Time for personal education, proper maintenance and training of new engineers is harder and harder to find.

It is any wonder then that young engineers continue to flee into the computer realm or other jobs that do not subject them to constant pressure, slimming budgets, corporate politics and mediocre salaries?

Where will the new "Richard Haskeys" come from?

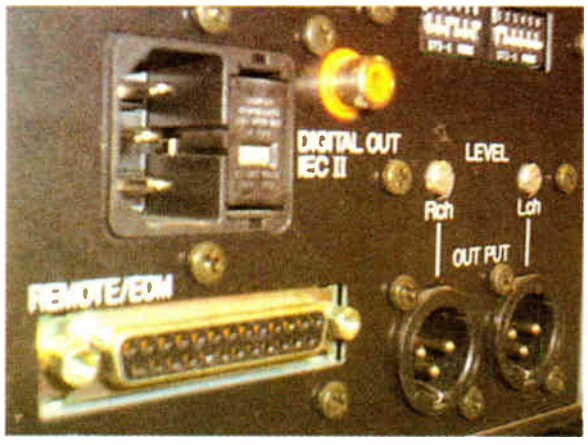
We ... you ... are precious resources. Something upon which to reflect.

Building a Digital Studio

by Mark Lucas

Part-1: Going Digital?

[While many in the industry have been focused on getting ready for digital transmission systems, some manufacturers are reporting digital consoles are now the majority of their sales. The question is how and when to convert or construct studios to take full advantage of digital operation. Mark Lucas relates some of the plans he made for conversion, as well as the lessons learned in the process. Ed.]



[KNOXVILLE, Tennessee - July 2003] Remember when you unboxed your first component with a connector labeled "Digital?" Perhaps it was a CD player with a RCA or coax connector on the rear. It probably has been a long time since you looked at that first connector and wondered what "perfect" audio would sound like and how to access it. The next thought, though, was probably about interfacing the player to the transformer-based console. So you moved on and forgot about the wish for the "perfect" audio that might come our way some day.

Since then, the day has been getting closer and closer. First came audio processors sporting AES ports. Then came digital STLs, followed by automation systems with digital outputs. Digital transmission has been the buzz for the past year. Really, "some day" is here now and it is time to connect – from the beginning to the end of our air chain – to digital audio.

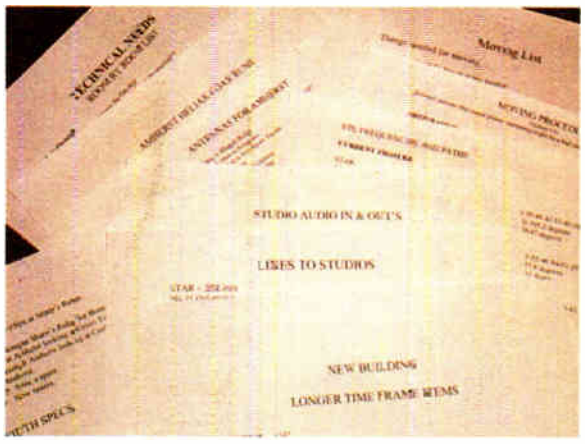
With the dawn of digital radio broadcasting upon us, we need to be preparing – maybe even rapidly – for the capabilities it presents. Any flavors of compressed audio need to be on their way out. Noise floor problems you may not even realize you have can now consume bits in the digital chain and rob you of precious modulation.

When is the last time you checked signal to noise through the whole chain? Since then, how many new studios and stations have been added with the additional cross connects making new loads on shared equipment? And I will bet everything sounded just fine at 3 a.m. as you completed the move; the last thing on your mind was hum problems down around -60 dB.

These are some of the issues of the day, and it is time to sort through what may cause problems (and extra expenses), and know how to get from here to there. So let us examine how to make the digital leap and determine where the critical decisions lie. And as we tie together those digitals parts you already have, we will develop a system that might well justify some of the more expensive pieces you will need to acquire.

SYSTEM INVENTORY

Looking at what you already have in house may be your first surprise. As mentioned, by now we are so used to seeing those digital ports on our equipment, we may not *really* have noticed them lately. So grab a pad of paper and look through your studios and equipment racks.



Make a note of exactly what has the digital connections and what is still just trusty old analog. While you are looking, make a quick list of all the sources in your facility. Note all of the A and B inputs and the outboard sources from each of the remote inputs. Make a list of where the outputs go. Then make a mental scan of the outboard mixing and distributing you do and make sure it is all represented on the list. When you have completed this survey, studio by studio, rack by rack, you will have a basic list of the inputs and outputs necessary for a new digital console/switching system.

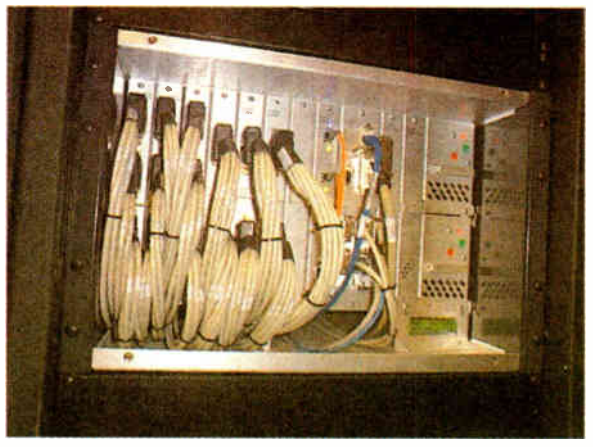
This is likely to be the *big* piece necessary to tie together your end-to-end digital system and become the hub of your audio chain. Interestingly, with the audio engine in place, the console itself may not be as big as the list you just made. Having a complete count of what all comes and goes as audio will be the basis for the size of system needed. While it is similar to the selection process of picking an 8, 12 or 16 input frame, we now can include much more in the system than ever before.

With many of the digital systems, you can easily build the various sub mixes and distributions from within the system instead of relying on so many outboard devices, such as the "black magic boxes" you have assembled under the counter to feed the phone. For example, the mix for on-air recording and editing, the separate mix for the caller, and both the program feed and post-delay "off air" monitor can now all come programmed from within the "console"!

Logitek Remora

And if you happen to be part of the modern age of radio, and have several stations under one roof, you have even more advantages. The sharing of sources is very convenient and carries important benefits. No more distribution amps for all the stations to send the various off-air feeds needed. Just set up a balanced out at +4 and an unbalanced output at -10 and, with attention to what is being fed, you may not need anything more. That is because, with the benefit of the digital switching, you can make the same off-air audio (or any feed) available at each console without any wiring or additional outputs needed.

While we are redirecting ourselves from the op-amp world to the age of microprocessors, let us notice that we also have the opportunity to free the on-air work surface from being the common point for the entire stations livelihood. The console can now become just a remote control of the switcher or audio engine. We can locate the engine wherever the station physicals require. Whether the decision is dictated by space, security, cleanliness or wiring needs, we can set up a system to address the individual problem. The central switching point can be in the studio, a central rack room or a combination.



Logitek Audio Engine

So when you start to rethink your audio plant, many devices maybe able to go away. Needs for distribution amps, level matching devices, custom relay switching and other things that we so carefully and proudly built or installed, may now be built into a new audio system. This will impact the space, power, sockets and layout needed.

LESS WIRE, MORE AUDIO

Another big factor that will play into your selecting a new audio system is the wiring and audio distribution needed. If you are in a new build-out situation, then you almost certainly will be installing a new base of wiring that will not include our tried and true analog pairs. Most likely some fiber will be a part of things and many will use Cat5 twisted pair. Fiber interconnects between studio mounted engines for example can allow the bulk of cabling to go away. And maybe we should say a lot of *expensive* bulk to go away.

"Computer" wiring can be used for digital and analog audio interchangeably. This is a huge leap to imagine at first but very interesting when looked into carefully. Connectors are inexpensive and lots of connections can happen in a small amount of real estate. You can also find people that are very good at working with computer wiring and hire outside help for your build-out. They know the tricks of working with this kind of wiring, and are familiar with many of the needed mounting methods, trays, loops and have the testing tools needed.

If you are moving into new space, then computer wiring for the office side of things is going to be installed anyway. A great way for thin engineering staffs to get more done is to be able to put this work into the capable hands of experienced people.

To get a head start on the various methods of interconnecting, the size of the engine frames, if used, and details on the console surfaces, surfing the web sites of the manufacturers. It will pretty quickly to show you what is out there. Armed with your list of the audio ins and outs, you can start to look at a configuration that would work in your plant. Once you start to get familiar with the offerings you might want to talk to knowledgeable sales people, and connect the different systems with the all important dollars.

(Continued on page 6)

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Building a Digital Studio

Continued from page 4.

Which type of system you settle on most likely will be decided in part by the costs, since they can vary so much. Make sure you take into account the wiring costs, the physical configurations that can be done and space considerations. The wiring wall of 66 blocks may be in the past, but connections still have to be made in some form somewhere.

You may want to go back to your equipment list and enter each piece of equipment and where it might best be located. Digital audio gives you the choice of locating the equipment in its natural location, instead of automatically close to the individual station's console.

COMPUTER CITY!

A consideration that I found to weigh heavily on the design phase was all the computers that are needed in today's studio. Count for a moment all the keyboards, screens and similar devices that can easily wind up making our studios look more like amateur hour than a technically sophisticated, creative entertainment area.

Studios commonly need an internet surfing machine, an on-air automation system, an editing system for phone calls, maybe a sound effects box or a co-host automation screen. Do not forget the television that all the jocks want too. Cleanly dealing with all the keyboards, mice and screens is not just for looks, it helps the on-air folks do their job better too. While considering the keyboard needs, remember that a surface-top or a through-the-counter design console may impact your placement options.

But not only do we have to find a place for the computer controls, we also have the computer too! Today's fast processors need lots of air moving through them and it is tough to keep it quiet enough. With the aid of the KVM extenders available from several different manufacturers, we do have the option of placing the computer chassis in central rack areas.

This is where it enters into our audio system selection and design; particularly so for the automation system with all of its noisy disks and fans spinning away. Remoting it moves not only lots of

noise, but also audio sources from the studio out to the racks. Furthermore, the typical automation chassis is usually deep and often on slide out rails and the equipment racks are better places to deal with this than in the studio.

If you are in a situation where enough change is happening, especially when consolidating stations under one roof or a new build-out, then you have the opportunity to really free yourself of the old way of doing things. Imagine an all AES audio path, all within the same rack; a route out of the automation straight into an engine that is located within a couple feet. The audio engine output goes up to an audio processor and then to the digital STL. The entire path can be all AES, maybe within the same rack and with no more than 10 to 12 feet of wire.

So what audio sources are left in the studio, anyway? Well it does not have to be much! Your microphone chains probably will be there. Back up CD players with either analog or digital outputs. I have Apple based audio editors that were harder to remote out, so they stayed. Do not forget we need the monitors and headphones to be driven, so they create an audio need in the studio. And we should build in extra sets of jacks for impromptu needs. Most of the systems will allow you to use either digital or analog.

So, if you have not yet heard a digital microphone preamp that pleases you or simply are put off by the dollars required, there is no problem. Or if the engine is located out of the studio and you have designed for audio on twisted pair cabling, either digital or analog can go again. So in any case, a mix of a digital and analog really does not become a limitation.

Next time, we will look at some specific problems that can be encountered and solutions. We will also check into interfacing requirements from the engine, automation, studio logic and EAS.

Mark Lucas is the Engineering Manager for the Journal Broadcast Group stations in Knoxville, TN. Contact him at: mlucas@journalbroadcastgroup.com

Remembering Richard Haskey

(1939 - 6/10/2003)

Radio's answer to Dr. Marconi.

Richard Haskey, aka Dr. Marconi, Dr. Haskey, The Hask, Dr. Haskapopolous, R, KG7BT, Kate Smith, and a host of other characters, was born in a transmitter room at approximately the time WLW retired its 500 kW transmitter. It is widely thought all that energy was channeled to Richard's mind, causing an amazing number of "things."

If Richard Haskey were to send us a message today, he would likely point out that he was now officially "defunct." Either that or he would spin a tail of how the IGH (Intergalactic Headquarters), as he called the Western Wireless Works facility, was being taken over by a hoard of Rhythmic Trolls led by "Sheriff Joe," and he was seeking refuge in some nefarious place. Regardless, he would much rather we remember his joy of life than his "demise."

A true veteran radio engineer, Richard's abilities have been known by engineers around the world for over 40 years. From Southern California, to the beaches (and Internet Cafes) of Cyprus, from Arizona to the IGH Annex (next to the Fish Sellers) somewhere in Africa, Richard was sought out for projects from tiny translators to megawatt installations, leaving behind a legacy of well built facilities.

And always there was this wonderfully warped sense of humor. No one who spent any time around Richard could miss his love of radio ... and his impatience with those who just didn't "get it."

It would be hard to count the number of transmitters, phasors and antennas that Richard had installed, tuned, repaired, renovated, or was consulted on. If asked to calculate the extent of his broadcast construction activities over the years, Richard would probably answer something like "41 x (Euler's Constant) ^ (Chairman Mao's temperature) / -3.1416 = Total kW" ... and then sputter: "You know, that's the worst I've ever heard!"

Whenever I answered my phone, and heard "The Voice" bellowing "B!" ... I knew it was time for the highlight conversation of my day. Often he was calling from his "cage," as he called his office (I always felt Dr. Haskey preferred "out in the field," practicing radio). Anytime from then, the discussion could include a project he was handling for me, a uniquely Haskeyan view of life, the vagaries of email, or a rant about "Sheriff Joe."

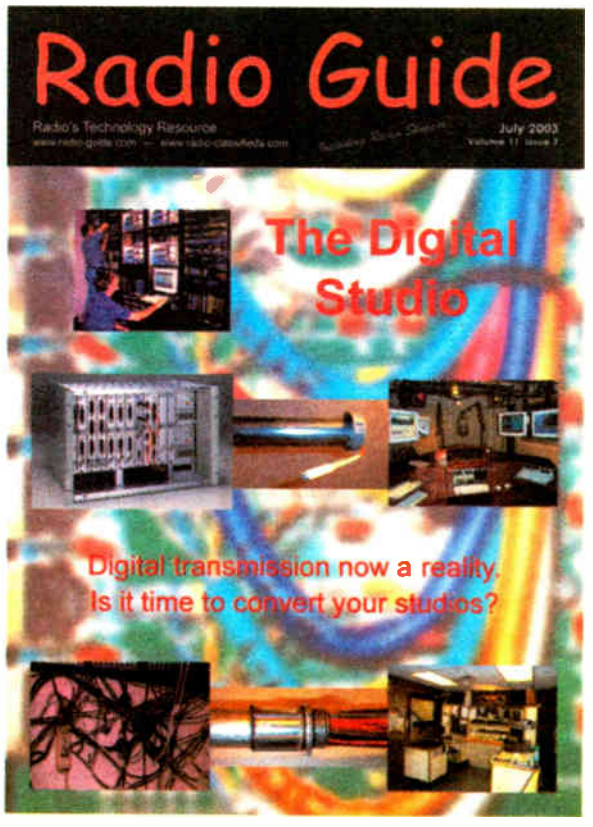
"Quick! We'll be able to hear them any time from now:

"This is the Wisconsin Farm Network, FM station WCCF transmitting from high atop the Baraboo bluffs in Greenfield Township, using a federally non-authorized power of 27 watts (Authorized power is 28.414 watts)"

In my last conversation with Richard, he seemed to be quite saddened about what had happened to the industry that he loved. "It isn't the same any more," he said, "and it never will be." But, then, his wit asserted itself: "I've got to talk to Dr. Marconi about that!"

Those of us who knew Richard, truly were richer for it. The industry is poorer without him. – *Barry*

There is a web page for those who wish to recall Richard's life at: **www.oldradio.com/people/haskey.htm** The family also plans something to appear at www.westernwirelessworks.com



Audio Processing From the Ground Up

by Cornelius Gould

Part 7 – Digital Signal Processing

[CLEVELAND, Ohio - July 2003] Our discussion of Audio Processing basics thus far has largely been rooted in the analog domain. These days though, we are in transition: Analog processing, aside from a few exceptions, is now pretty much the domain of the DSP (Digital Signal Processing) chips, with audio converted from analog to digital, and manipulated in the domain of 0's and 1's. The concepts remain very similar but DSPs do bring many improvements to the table.

First of all, with DSP, audio processing can be repeatable. In the analog past, normal variations in components such as resistors and capacitors meant chances were good your processor was fairly unique to your station. Even having the same settings as another station's processing did not necessarily mean you could duplicate the sound on yours.

Yes, the basic sound could be the same, but when it came down to it, the exact sound of a particular radio station was fairly unique to that station. Multiply the component variations in the processor with those in the analog consoles, STLs, and transmitter plant, and you get the picture really fast!

With DSP, everything is the same. A 12 dB per second release time in one DSP processor is exactly the same 12 dB per second release time in another unit (same model and software version is assumed here).

COPING WITH AGE

Another factor in analog processing is that components can change with time, temperature, and humidity. Some analog processors are engineered better than others, and the good ones will hold up better with respect to humidity and temperature, but time is not so easily compensated for.

For capacitors (necessary to set the release time(s) in an analog processor), time is a *big* enemy. Typically speaking, most electrolytic capacitors will start changing values on their own after five years or so. Other types of caps do change with age as well, they just have different life-spans.

This means that slowly ... bit by bit ... the timing networks in an analog processor will degrade, and it will not sound quite the same as it did originally. The same goes for the rest of your analog chain, so if you have the time, refurbishing your older gear in house, or through the manufacturer, is a good idea.

Digital gear can be designed to be much more tolerant of these changes, and as far as audio processing goes, the timing network functions are treated in digital as the math equations that they are. What this means is that to a DSP processor, 1+1 = 2, and if it is really humid today, 1+1 still equals 2, and on a cold day, 1+1 still equals 2! The end result: the sound of your station suddenly becomes extremely consistent, regardless of the conditions around the processing unit.

REPEATABILITY

Another advantage is with presets. How many times did someone on your staff with a "golden ear for processing" come in and fiddle with (read: screwed up) the processor settings, and from that point on, no one could get it to sound quite like it did before? Those days are gone with DSP as the settings you create can be saved and recalled instantly.

They can even be saved to your office desktop hard drive as a file and burned to CD from there for true archival storage. That way, if some one does mess with it, it is just a matter of reloading the old settings.

You can even e-mail the file to a sister station, and they can load it into their processor (of the same make and model) and get the same processing settings!

How about this one: How many times have you been up late fiddling with an analog processing chain, and felt you had achieved a "killer" sound, yet the next day, you wondered if it really made a difference? Or worse, woke up to hear it sounding like "poo" – or even worse yet, were rudely jarred out of bed by the PD telling you so?

With DSP, you easily can recall the last preset for comparison (even dialing in by computer from your house for a quick change, or to A/B what you have now vs. what you had before). You can do some really cool stuff with the latest generation of processing!

For the audio processing designers, DSP has turned out to be the holy grail of development. While working at Cutting Edge, I had the chance to play with some DSP coding equipment for a few months, and I was able to go through the equivalent of 3 or 4 years of tinkering (literally!) in just two weeks.

This is due to all the time saved from not having to solder and breadboard parts all night long just to test one idea, and then starting over to fix the things that did not quite work out that first try. I could go through months and months of idea testing in just one hour.

It was amazing! Ironically, I was able to model a good chunk of my original Audio Chameleon, and improve it greatly. The result is the much improved analog guts used in the scary looking box displayed in the first article in this series. Life moves in funny little circles like that when it comes to audio processing.

I developed a lot of other ideas that I never got to follow up on further (or at least ... not yet.) to fully take advantage of them, and I hope to do that soon. These ideas are ones really hard to implement in analog, and some are literally impossible.

Speaking of impossible: In the article about diode clippers, I mentioned that DSP has the ability to do away with hard clipping altogether, if that is what you are looking for. It does it by what is called Look-Ahead Limiting. To understand look-ahead limiting, let us review in detail how a conventional limiter works.

DSP AUGMENTED LIMITING

Program audio comes into the limiter. A control circuit will monitor the output level of the limiter, and develop a voltage representing the audio level. This voltage is fed into a voltage controlled amplifier (VCA) inside the limiter so that as the output level increases, so does the control voltage. This voltage, when fed to the control port of the VCA, will then cause a proportional decrease in gain, thus reducing the level.

Remember "Attack Time?" It is the amount of time it takes to react to a change in level, and send the appropriate correction voltage to the VCA. Any conventional limiter will always have a delay between when a sudden loud passage occurs and the resulting level correction. The resulting "overshoot" must then be removed by a clipper. The Holy Grail for some (and, as we will learn later, for HD Radio and Internet Broadcast) is to have an audio processor that can predict the peak, and make the appropriate correction in gain in such a way as to not cause overshoots.

With DSP, this can be done with something called a "look-ahead limiter." A look-ahead limiter works by analyzing audio levels the same way a typical limiter's control system would, but with one advantage. In the digital world, you can build in a delay to sort of "buy some time" to do the job right, so to speak. Here is how:

The audio path going to a virtual digital VCA has a pre-determined amount of delay, let us say 10 ms. The digital processor's computers analyze the audio in real time and looks for peaks. When these peaks occur, it knows it has 10 ms to get the VCA down to a level to prevent the peak from occurring. Because it knows about this peak, it can smoothly reduce the gain, truncate the peak, and recover to full level again without much audible damage to the original signal.

Pretty clever, eh? Well, before you get too excited, there are some trade-offs here. Look-ahead limiting is most useful when treated like a clipper. You can only use so much of it before audio becomes filled with "Intermodulation Distortion" ("Intermod," or IM Distortion for short). If you push a clipper to similar amounts as the look-ahead limiter, you get audio filled with harmonic distortion.

LISTEN TO IT

The difference is this: Harmonic Distortion is the type of distortion you get when you turn an amplifier up too loud, and it distorts. Intermodulation Distortion (IM Distortion) is more of a "gritty" "busy" sound to the audio. Since an audio clip is worth a thousand words, I have put a few on my web site: **www.cgould.com/radioguide/audio** to demonstrate the differences for you.

In many ways, look-ahead limiting is part of the "new frontier" in audio processing: Mastering the look-ahead limiter beast. We are all familiar with an early attempt in this area in one of the first commercial digital exciters. It was a very crude version of look-ahead limiting, but at the time it was cutting edge, pushing the limits of DSP processing.

Ten years later the type of look-ahead limiting now being offered by the big audio processing manufacturers is light years ahead, and there is even more progress to be made! Most of the advancements being made now consist of schemes to allow more look-ahead limiting without so much IM distortion ... (Sound familiar?). Look-ahead limiting is in its infancy, and yet, it is quickly becoming a common tool in the audio processing grab bag.

Furthermore, many more mundane but typical functions of audio processing such as Distortion Controlled Clippers, Crossover networks, and "attack" and "release" time networks are becoming highly refined and being taken to new levels by DSP processing.

One thing I found fascinating about doing audio processing in DSP, (and still have yet to fully learn) is the concept of modeling the ultimate capacitor in DSP. When you sit down and gloss over it, one would think that modeling a timing network is as simple as saying, attack is wait "this long", and turn the signal down by "x" amount to correct the gain, and increase gain at "x" dB's a second for a recovery time.

This *does* work, but not the same as it would with good 'ol capacitors and resistors. When you design a time constant in DSP this cut and dry, it sounds very unnatural.

Why? It comes down to the exact characteristics of the particular capacitor used in your timing networks in the analog world. Due to factors in construction and construction materials, Capacitors rarely function in a linear fashion, and as a result, play a large part in the sound of your favorite audio processor, so understanding this will allow a designer to not only mimic a classic audio processor in DSP, but to improve on it, and do things not possible with a resistor and capacitor.

Next month, we will look at how the Digital Age (HD Radio and Netcasting) has highlighted the need for good DSP-based audio processors.

Cornelius Gould has a passion for audio processors, and has built his own! He is the Chief Engineer for WJCU 88.7 FM in Cleveland, Ohio, as well as Senior Staff Engineer for Infinity Broadcasting, Cleveland. You can reach him at: cg@radiocleveland.com

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Tower Topics

So You Have a New Neighbor

Part 3 - Tower Detuning

by Bix Bixby

In the two prior installments, we looked at the FCC rules and policies that apply when a cellular operator builds a tower in proximity to an AM antenna system, and at reradiation, the mechanism by which a cellular tower may "interfere" with a nearby AM station. In this, the final installment, we will look at tower detuning and at measurement procedures appropriate to reradiation situations.

[LYKENS, Pennsylvania - July 2003] Many directional AM stations have towers which are not used in either the day or night pattern and which are detuned. Typical AM towers are base-insulated so detuning is relatively simple. In most cases, it takes the form of a lumped constant reactance that is switched in when needed, between the tower base and ground.

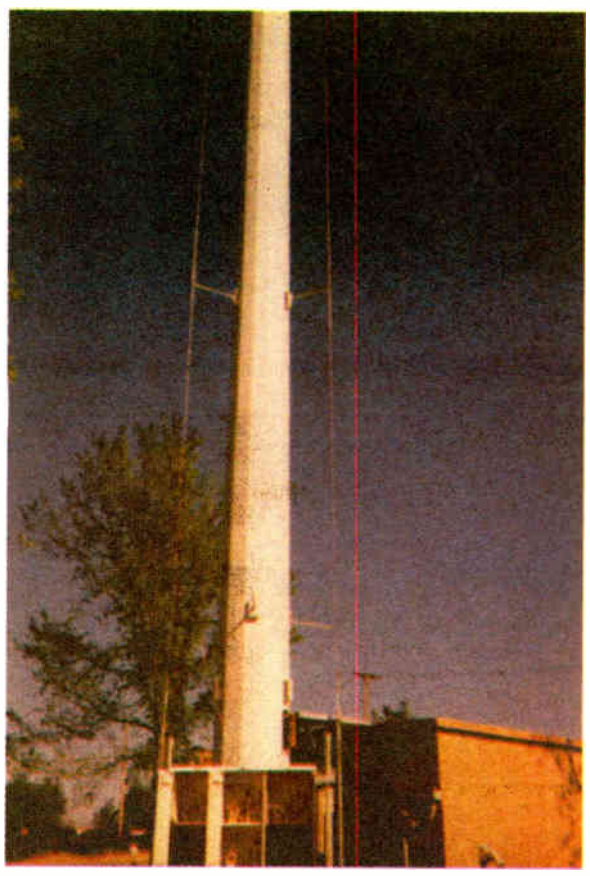

Figure 1

Detuning grounded cellular requires a somewhat different approach. In most cases, the towers are equipped with "skirt wires" which run vertically along the tower from near the top to a point 8 to 10 feet above the ground at the tower base. The wires are attached to the tower at the top and are supported along the tower with insulated brackets at appropriate intervals. At the base, the skirt wires are joined together by a "collector ring" which in turn connects to the detuning network. The installation closely resembles a folded unipole and the theory of operation is the same.

Cellular monopole towers typically are detuned using three detuning skirt wires equally disposed about the tower as shown in **Figure 1**. Briefly, the monopole forms the inner conductor of a coaxial transmission line and the wires form the outer conductor.

Large self-supporting towers may be detuned with a similar arrangement of wires but we have found better results are obtained using an arrangement of six (eight wires for square towers), one wire running on each side of each tower leg as shown schematically in the sketch of **Figure 2** and in the photo of **Figure 3**. This system forms a three-wire transmission line at each leg. The tower leg forms the center wire; the detuning wires are in parallel and make up the other wires of the line. The transmission lines at each tower leg are themselves in parallel with each other. They are joined at the base using a "spider" connection and connected to the detuning network.

As we noted in the last installment, towers that require detuning are those which are capable of significant reradiation – typically those which are nominally 70°-110° at the AM station's frequency. Therefore, the transmission line sections we are concerned with are, more or less, quarter-wavelength shorted stubs.

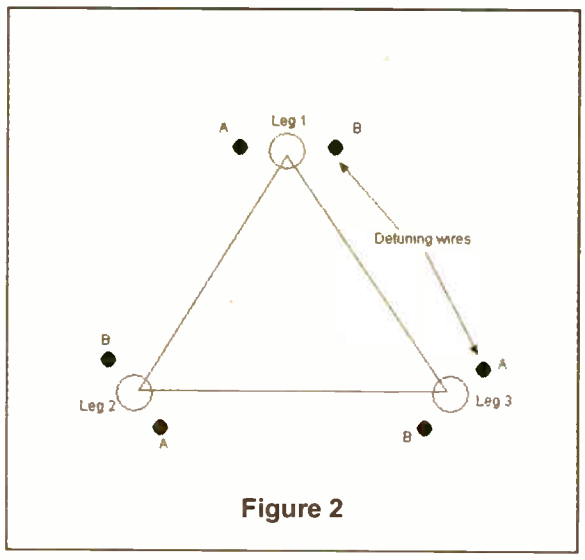

Figure 2

As we have already mentioned, detuned cell towers closely resemble AM folded unipoles and employ the same principles. And, anyone who noticed that these systems also resemble the quarter wave or "bazooka section" isolation technique for isolating FM transmission lines on AM towers gets a gold star. The folded unipole, the "bazooka section", and skirt wire detuning are closely related concepts and all are based on transmission line theory.

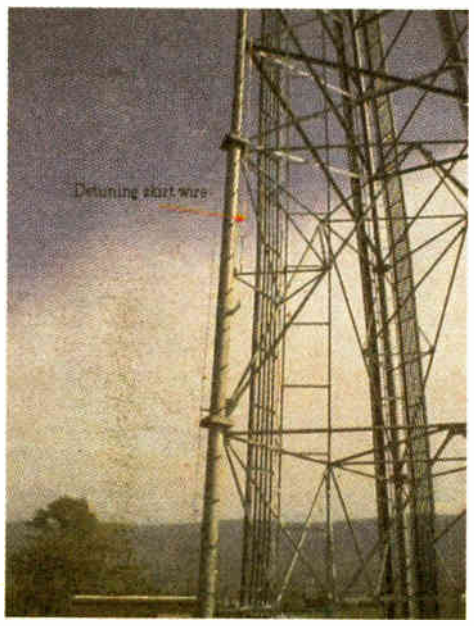

Figure 3

DETUNING NETWORKS

In nearly all cases, optimum detuning will require a reactive load connected between the bottom of the detuning skirt and ground. The required component value depends on a number of factors that include, but are not limited to, the length and characteristic impedance (Z0) formed by the tower and the skirt wires. The appropriate value is theoretically calculable, but gathering the detailed information required for the calculation would be a daunting task. Use of a carefully designed variable network allows a range of adjustment both at the initial detuning and subsequently as the tower is modified, for example, by the addition of new antenna platforms.

Parallel resonant or "tank circuits" are ideal for this application. The blue curves on **Figure 4** show the range of impedances available using a 60 uH variable coil in parallel with a 1000 pF fixed capacitor. Adjusted to resonance, the circuit exhibits a very high resonant impedance. Adjusting the circuit on the inductive side, we can set to a wide range of reactance values ranging down to j0. On the capacitive side, we have a similar range except that we cannot set to very low values of -jX. If necessary, though, the components can be reconfigured easily to a series LC network making available small values of -jX. The series configuration reactance values are shown in red on **Figure 4**.

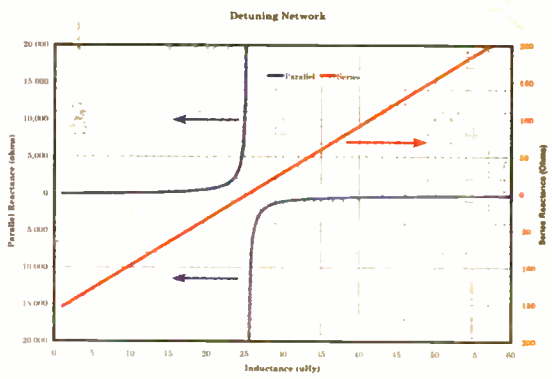

Figure 4

MULTI-STATION DETUNING

From time to time, the need arises to detune a tower simultaneously with respect to more than one station. A number of techniques have been tried, including subdividing the skirt wires into sets and using one set for the first station, the second set for the second station, and so on. For example, looking again at **Figure 2**, imagine that the "A" wires at Legs 1, 2, and 3 are joined and used to detune the first station with a detuning network mounted at Leg 1. The "B" wires at Legs 1 and 2 were joined and connected a detuning network on Leg 2 for the second station. Finally, the "B" wire at Leg 3 was used with a detuning network mounted on Leg 3 for the third station. It seems inevitable that substantial interaction among the three "sub-systems" would make tuning this system extremely difficult, not only when the tower is initially detuned, but on each subsequent occasion when readjustment is required.

Figure 5 shows a system of filters and detuning networks for a three station detuning system. The cabinet is subdivided into 9 sections, with the networks pertaining to each station arrayed vertically. For example, in the left-most compartments, the upper section contains a filter network tuned to pass station A and reject station B. Immediately below it, another filter passes Station A and rejects station C.

Figure 5

Behind the closed door in the bottom section, a parallel LC network is used to adjust the detuning for station A. The center set of compartments has filters to pass station B while rejecting stations A and C and a detuning network for station B. Finally, the right-most set of compartments has filters to reject stations A and B and a detuning network for station C. Although it seems complicated, in practice, the filter networks can be factory tuned and optimized in the field in a matter of a few minutes.

(Continued on page 12)

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Tower Topics

Continued from page 10.

Once that is done, the detuning network for each station can be set individually with no interaction. The savings in engineering time (again, both initially and at every subsequent readjustment) more than makes up for the added hardware cost.

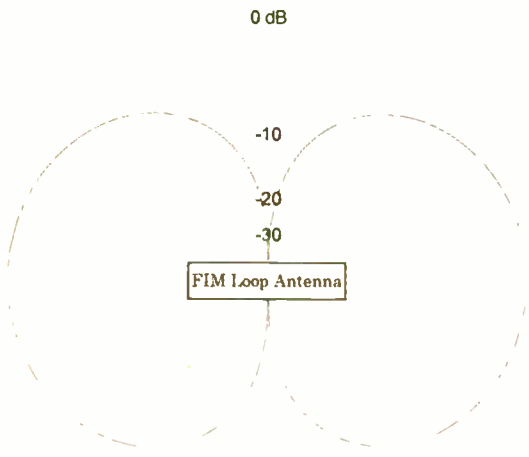

Figure 6

DETUNING MEASUREMENTS

Measurements in a reradiation environment require particular care and attention to detail. In most cases, the signal from the source will be quite strong and may mask the signal from the reradiator. And, although it is frequently done, simply walking up to a structure and noting that the meter reading increases does not give us much useful information. Fortunately, the loop antennas used on field strength meters are very directional with a pattern similar to that shown in **Figure 6**. The maximum sensitivity is in directions off the ends of the loop antenna. Broadside to the loop, the pattern has very deep and sharp nulls. By positioning ourselves such that the source and the reradiator are at right angles to each other, we can exploit this characteristic to discriminate between the field coming from the source and that coming from the reradiator.

Figure 7 shows a circle drawn such that a line from the source to the reradiator is a diameter of the circle. From any point on that circle, a line from the point to the source and a line from the point to the reradiator

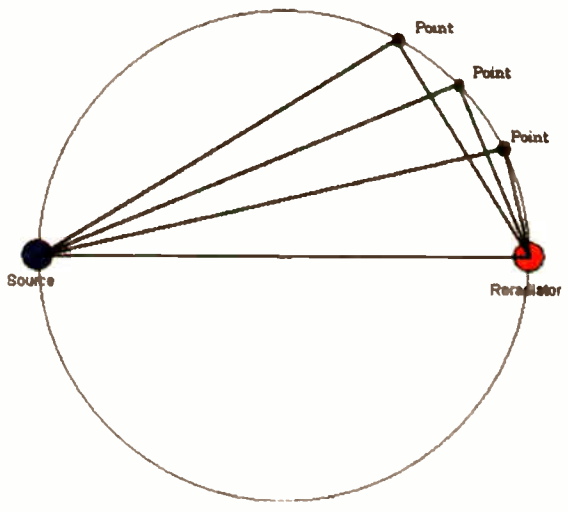

Figure 7

will be at right angles to each other. Therefore, if the meter is oriented for maximum sensitivity toward the reradiator, it is simultaneously oriented for minimum sensitivity to the source. As shown in **Figure 8**, that right angle relationship does not hold for points that are not on the circle.

At these locations, it is quite likely that the direct signal, that from the source, will mask the signal from the reradiator.

CONCLUSION

The cellular construction should be coordinated in advance, and you should receive written documentation, if not at the beginning, at least in the form of a final report once the project is complete. It is likely that most of your contacts will be with a contractor to the cellular carrier, most likely, one of a small handful of firms that provide "AM Coordination" services to the wireless industry. You should get the name, telephone number, and mailing address of the responsible person within the carrier's organization. If this is a new site, it will probably be a site acquisition or implementation specialist.

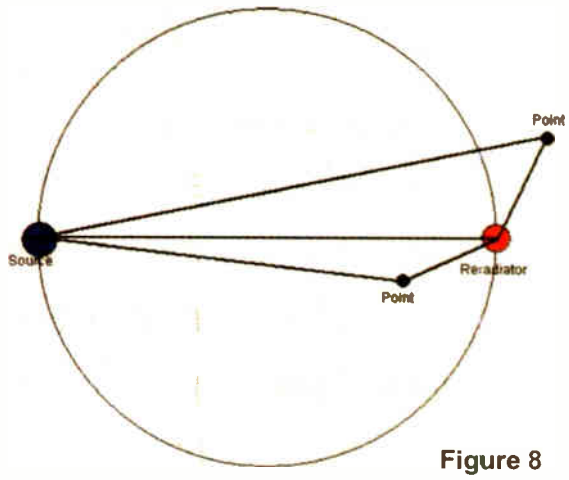

Figure 8

Finding out you are going to have a new cellular neighbor may not be the best news you ever got, but does not have to be the worst, either. The key is in knowing exactly what they propose to build or modify, how it will impact your station, and what steps they propose to mitigate the impact. And, like anything else, the more you know about it, the better equipped you will be to look out for your station's interests.

A consultant to the broadcast and wireless telecommunications industries, J. M. "Bix" Bixby is President of BixTech, LLC, in Lykens, PA.. He can be reached at bix@bixtech.com

Full Duplex

The :60 Second Engineer*

by George Nicholas

[CEDAR RAPIDS, Iowa - July 2003] I have been fortunate to meet dozens, if not hundreds of engineers and managers in my career as a Regional Engineering Manager and Technical Consultant. When time allows, I always ask key questions on what makes that individual excel in their job. The following fifteen qualities – out of many more – were consistent among most successful engineers. These are in no particular order of importance

The Most Successful Engineers and Managers...

1. Follow a Plan. Refer back a few issues to "The Plan." We will keep reminding you how developing and trying to follow a plan makes your job easier and gets the job done faster. Have a Daytimer© or Palm Pilot©. Even a 39-cent pocket spiral note pad is better than nothing. When scheduling projects, leave blocks of time available that can be used if a project runs long.

2. Stay Under Budget. If you want to paint a target on yourself, especially in a large company, continually go over budget! However, if you are known to stay within your budget, chances are good you will earn a larger budget in the future.

3. Meet on a regular basis with their boss. When I was a CE, I had regular Friday morning breakfast meetings with my GM, at a local pancake house down the street from the station. We typically met at 7:30 a.m. because it allowed uninterrupted dialog and breakfast was a great start to the day for both of us. Alternate picking up the tab. If you cannot meet outside the office, at least try to schedule uninterrupted time in the GM's office or yours.

4. Keep a Schedule. We all know broadcast engineering is not a 9 to 5 job. Having regularly-scheduled office hours, or at least being available quickly, is appreciated by all who work with you.

5. Have regularly scheduled Department Head meetings. Wednesdays are good days for those, as you still have time to accomplish something for the week if it is deemed necessary. Knowing what is going on in the departments around you is important to the success of the station. The meetings should have an agenda and a time limit. It is okay to end early – use that extra time to get ahead.

6. Keep Their Area Clean. An unorganized tech room or office is a window into your psyche. That is not to say things do not get crazy, especially during a project. But when the tech area remains the same for days, weeks or months on end, it sends mixed signals to the boss: "How can he be taking care of us, when he cannot take care of himself?"

7. Dress for Success. On days in the office, there is nothing wrong with wearing better clothes, and saving the jeans and station t-shirts for visits to the transmitter site. Khakis cost the same as jeans.

8. Take time off to "recharge their batteries." You are not doing yourself, or the company, any good by working 24/7. (As a friend of mine once stated, "Even God took a day off!"). Take a day or two away from anything job-related. You will be more productive when you return. Family, friends and your fishing rod will all feel vindicated.

9. Stay current on required paperwork. The FCC and FAA do not require much these days – but what they do require is critical! Keep a paper trail. Any time you visit a site, log it. Even if nothing is done, other than visit the site, it should be logged. At least you will have a record of inspecting the site

10. Respect the Boss. I have been fortunate in my career, it was no problem doing so. However, if you are in the unfortunate situation of not liking the person you work for, I still suggest you respect the Boss, at least for their position. That does not mean you have to love them. Remember, they were smart enough to somehow get the job. And that goes for the company as well.

11. Stay in Control. While it is fun to let your hair down every once and a while, be reminded that someone is always sober, and they are the one who will remember every word you used to describe the Boss' spouses' hair (or lack thereof). [Note: That is also referred to as a "career-limiting move.]

12. Under-promise and over-deliver. The person who gets the job done on time or ahead of time is always more respected.

13. Never stop growing professionally. Participate in related organizations and show your support by attending meetings when time allows. Networking is also helpful when trying to solve problems.

14. Never burn their bridges. It is a small world out there. Never gossip or talk down on fellow employees or your employer – word always gets back to them.

15. Maintain a positive attitude. If you discover you are known around the plant as "unapproachable" or "grouch" or "Mr. Happy (not)" then take time to evaluate what it is that is causing you grief – then change it! It is okay to ask for advice. You may not like what you hear at first, but discussing with others is the first step to changing your attitude. And it gives others a chance to clear the air with you as well.

There are more ideas for the list. Remember, this column is full duplex. So let us know if you have one to add!

(*with apologies to Ken Blanchard, of the :60 Second Manager)

George Nicholas has been in the broadcasting business since 1975. He now operates George Nicholas Communications, specializing in technical and communication consulting throughout the US. You can contact him via Editor@radio-guide.com

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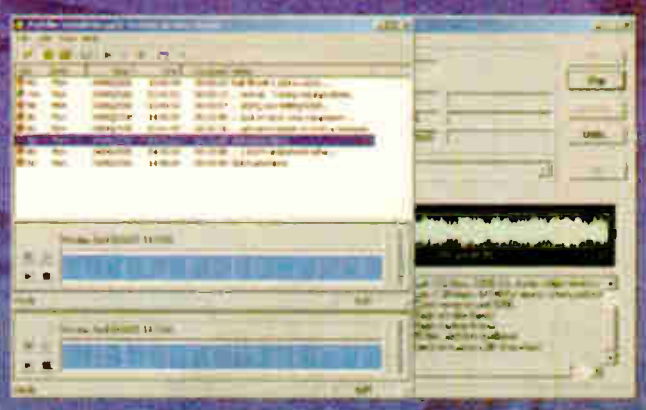

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A Primer on DRM™ Digital AM Radio

Spectrum Occupancy Issues

by Peter Jackson
Strategy Adviser Digitalisation, VT Merlin Communications, U.K.

[Last month Peter shared with us the basic building blocks of the DRM system. Since June 16th, DRM has been in regular use in many countries. Could DRM be useful to US AM stations? This month, the issue of spectrum occupancy is addressed. Ed.]

[PARIS, France - July 2003] As explained in last month's introduction to the basic features of the DRM system, the transmitted OFDM signal is composed of a number of closely and equally spaced carriers each of which contributes to the overall transmitted data.

The base component of any DRM signal is always the 4.5kHz kernel group of carriers that contains the FAC cells. These FAC data cells contain the basic information, which the receiver requires to start decoding the rest of the signal. Other DRM signal bandwidth options are built up from this basic 4.5kHz kernel group.

In parts of the world where 9kHz channel spacing is used (The MW and LW bands in ITU-R Region 1 and MW in Region 3) this kernel group can be used on its own or in conjunction with an additional 4.5kHz group of carriers to make up a 9kHz wide DRM signal. An additional 9kHz group of carriers can be added to make up an 18kHz wide group.

To provide a signal suitable for a 5 or 10kHz frequency grid (ITU-R Region 2 for MW and worldwide for the SW bands) a 0.5kHz group of carriers is added to the kernel group. After this, groups of carriers of 5kHz or 10kHz bandwidth can be added to make up 10 or 20kHz wide DRM signals. It should be noted that none of these additional groups of carriers contain any FAC cells.

By convention, and to ensure that the receiver can find the 4.5kHz kernel group as quickly as possible when initially scanning the band, this group is always located on the high side of a channel's nominal centre frequency. **Figure 1** illustrates some of the DRM bandwidth options mentioned above. Note that for clarity the analogue and digital signals are shown at similar levels, whereas in reality the DRM digital signals will be significantly lower in level.

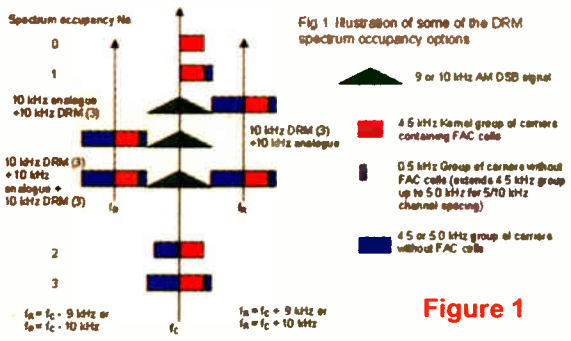


Figure 1

THE DRM SPECTRUM MASK

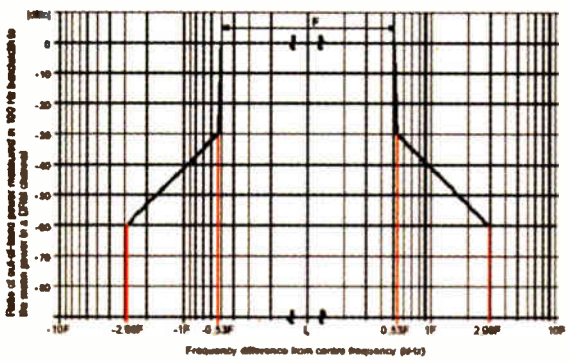
An important issue for the transmitted DRM signal is its spectrum occupancy. Initially it was decided to adopt a spectrum mask which was directly drawn from the ITU-R analogue signal spectrum mask. This mask has an initial shoulder of 35dBs followed by a 12dB/octave attenuation slope down to a level of 60dB below the top of the mask. However further work on the protection ratios for analogue AM signals interfered with by DRM signals showed that this did not provide the optimum spectrum shape for sharing between adjacent DRM and analogue signals.

In light of this, and after discussions with transmitter manufacturers, the DRM spectrum mask was adjusted to have an initial 30dB shoulder but with the shoulder slope increased so that the -30dB point is reached at a frequency which is ±0.53 x the exact bandwidth of the DRM signal. The attenuation slope then continues at 12dB/octave down to -60dB, as for the analogue mask.

Because the OFDM carrier spacing varies, depending on the DRM robustness mode (modes A-D), the exact signal bandwidth varies slightly with the mode. A simplified table of these occupancy bandwidths looks like that of **Table 1**. From this we can see that a nominal 10kHz wide DRM signal using mode A (typical daytime MW ground-wave service) occupies 9.542 kHz and has shoulders which should be at least -30dB at ± 5.057kHz (0.53 x 9.542) from the channel centre frequency and below -60dB at ±28.44kHz (2.98 x 9.542). The general shape of this spectrum mask is shown in **Fig. 2**

Table 1		Spectrum Occupancy Type			
Robustness Mode		0	1	2	3
Increasing robustness v	A	4.208	4.708	8.542	9.542
	B	4.266	4.828	8.578	9.703
	C				9.477
	D				9.536
Nominal Bandwidth		4.5	5.0	9.0	10.0

Fig. 2, Proposed DRM Spectrum Mask



DRM 'SIMULCAST' OPERATION

For operation in the channel adjacent to an analogue AM signal, the DRM signal must be at least 16 dB below the level of the carrier of the adjacent analogue signal if it is not to cause unacceptable interference to it. This interference manifests itself as a general increase in background noise on the analogue service (this is because the DRM signal is designed to have characteristics which sound as noise-like as possible, when the signal is received on an analogue receiver).

However as the digital signal is more robust than the analogue one, a good service area can be obtained operating a so called simulcast service, where the analogue and digital services occupy adjacent channels but the programme content is the same. Furthermore the DRM signal can be in the channel above or below the analogue signal or even in the channels both above and below.

If the DRM signal occupies both channels it can be demonstrated that a suitable receiver, capable of simultaneously demodulating both DRM signals, provides improved reception performance[1]. **Fig. 1** shows various configurations of DRM and analogue AM signals including a double DRM option.

Although a double DRM option has some resemblance to an IBOC signal, in terms of spectrum occupancy, it goes no further since there is never any digital signal buried under the analogue signal and the parameters of the digital signal can be any of those available from the DRM toolbox of options. This allows the tailoring of the digital signal to the prevailing propagation conditions.

So, for the example of a MW signal during the daytime when ground-wave propagation predominates and there is little or no interference from incoming sky-wave signals, the audio quality can be optimised as the signal does not need to use the most robust option. During night-time, when incoming sky-wave signals can start to cause interference, the transmitted DRM signal parameters can be adjusted to increase robustness at some expense to the audio quality. Thus the digital signal's service area can be more readily maintained or adjusted.

TRANSMITTER CONSIDERATIONS

The maintenance of the required spectrum mask for DRM signals places a considerable constraint on a transmitter. It is common practice to use non-linear class D modulation in high-powered transmitters in order to achieve good electrical efficiency. In this case the OFDM output signal has to be generated indirectly (see **Fig. 3**).

Firstly, amplitude and phase components are derived, in the exciter, from the composite OFDM signal. The phase component is then applied to the transmitter as a phase modulated carrier in place of the normal fixed carrier. The amplitude signal component is simultaneously applied to the transmitter's usual audio input.

In order for the two signals to be combined correctly in the transmitter's modulator, to produce an OFDM signal within the required spectrum mask, the transmitter's modulator bandwidth needs to be a minimum of three times that of the digital signal bandwidth. So for a 10kHz wide DRM signal the modulator requires a minimum of 30kHz bandwidth.

This has implications for the switching frequency used in class D modulators, which must be at least twice that of the highest audio frequency to be modulated. In addition, the amplitude and phase components must be time aligned at the modulator. This can be achieved by allowing the relative time alignment between the amplitude and phase components to be adjusted within the exciter.

Ideally this alignment is achieved automatically and maintained continuously by the exciter, due to feedback from the transmitter's output. In order to ensure adherence to the mask is maintained, the modulator may need to be improved. It is anticipated that it will become common practice to use feedback around the transmitter to improve overall linearity and thus the transmitted spectrum shape.

If a linear transmitter is used then the composite DRM signal is used at the transmitter input and the problem of containing the DRM signal inside the mask is much reduced. In some cases it may be worthwhile modifying a non-linear transmitter to convert it to linear operation. Although this significantly reduces the transmitter's electrical efficiency it does considerably reduce the problems of generating a compliant spectrum.

In terms of audience covered per Kilowatt of input power, the result is comparable to analogue transmission, due to the much lower signal level required by the digital service for satisfactory reception. Where 'simulcast' operation is required it may be easier and more economic to add an additional lower powered digital transmitter, coupled into the same antenna, rather than trying to modify the existing high power transmitter so that it can transmit both signals. However sufficient antenna bandwidth will also be a key issue, particularly at the lower frequency end of the MW band.

Peter Jackson, Strategy Adviser Digitalisation, VT Merlin Communications, U.K, volunteers his time on the Steering Board for DRM. He can be contacted via projectoffice@drm.org. More information on DRM is located at www.drm.org.

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[1] In fact the greater the frequency difference between the two signals the less correlation there will be between them and a statistically better chance that one of the received signals will be good if the other is poor. During WRC 2003 in Geneva a working demonstration was given of a BBC developed diversity receiver. This could simultaneously resolve two identical SW signals transmitted in different bands (7320 and 9410kHz) from the U.K. The result was a significant improvement in overall service reliability.

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Networking 101

by Tren P. Barnett

Part 6 – Time: A Key Player in the Network

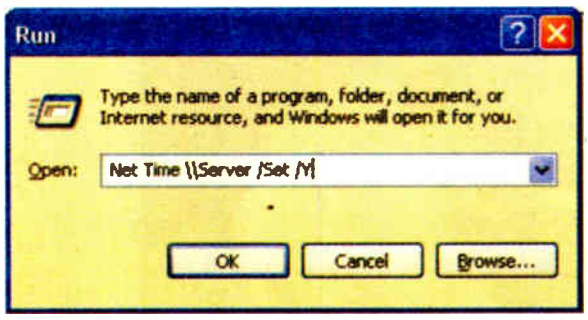
[TUCSON, Arizona - July 2003] As a quick review, in the preceding five articles we have created a small network, installed workstations, set up the necessary networking components, and dabbled in their management. If you have followed the articles, you should be able to be up and running with your own network. Please note though, the word *should* in the previous sentence. Those who regularly work within the field know it is the little things that can make managing and running an IT Department difficult. Sometimes the greater challenges come in the form of help-desk type questions from users trying to accomplish tasks.

One of the challenges occasionally arising when dealing with a network is instance time. Not the time needed to manage all of the network settings, which can keep you busy, but the time that displays down in the lower right corner of the taskbar, unless you have moved the taskbar.

Why is the time so important? Because Kerberos authentication protocol requires that all Windows 2000 or later systems *(in other words those using the protocol for security)* be the same time. Simply put, a Windows 2000 domain requires that the workstations agree with the time of the domain. This does not mean that the time has to be accurate, but they need to agree, because if they do not, they will not gain access.

SYNCHRONIZING WATCHES

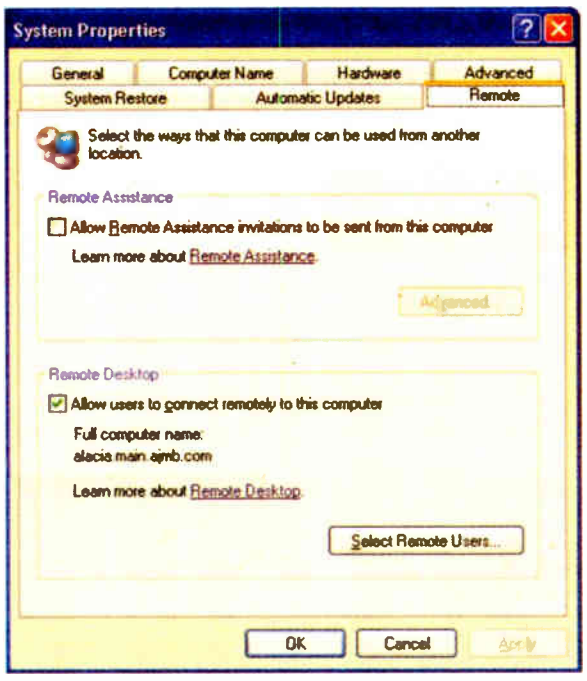
How can you set the time if you do not have access to the system? The denial actually comes from the authenticating domain. Access to the workstation or computer having issues is still available through a local computer account. With Windows XP or 2000, this will require a local administrators account, as standard users do not have the privilege of setting system time. Don't forget – time zones are important. If you are in a different time zone than what the server is set for, be sure to compensate accordingly.



The domain's time can be set at anytime, i.e. it could be ten minutes off, so how do you know what time to set the workstation to? A simple command typed on the Open line of the "Run" dialog box sets the time to that of the server. Now in a domain, unless there has been specific other settings, the PDC or main domain controller is the time server. So then setting the time consists of the command **Net Time \\<ServerName> /Set /Y**. Typing this command on the *Open* line is telling the workstation to get the time from this server, *Set* the time, and *Yes* to confirm that you want it set.

If the workstation is at the other office, and you cannot get there, and you do not want to give out the Administrators password, what can you do? If you are using Windows XP, you have some options. The place to start is at the System Properties box. Click on the "Remote" tab.

In Windows XP you can enable the option for *Allow users to connect remotely to this computer.* However, once you do this, do not forget to authorize the users you want remotely connecting. You do this by clicking on the *Select Remote Users* button. By default the local administrators are authorized, along with the domain administrators when this feature is enabled. This means you can connect to the remote computer system and set the time without ever leaving the comfort of your office. The time discrepancy is with the domain's security. It does not inhibit network connectivity, just domain authentication through the Kerberos authentication protocol. Local users do not get authenticated this way, and will not be restricted form logging on to the workstation.



A Windows XP remote desktop can be started through *Client Terminal Services Client*, and through Windows XP's Remote Desktop Connection window. *(Both of these applications are discussed in last month's article, along with how to install and use them.)* Unlike the terminal services connection that Windows 2000 server provides, Windows XP only provides one user connection at a time, either remotely or locally. Connecting to the workstation remotely will lock the workstation until you log off.

Disconnecting will not unlock the computer. This can come in handy. Suppose you need to lock down a workstation for software updates or the like. All you need to do is start a remote desktop connection, logging in as an administrator of the workstation. If another user is logged on, you will be asked if you want to log off the current user. If you say "yes" *as an administrator*, they are logged off and you are connected. As long as you are logged on to the workstation, it remains locked and under your control.

FIXING THE PROBLEM

Now back to why we got here, time. In our original scenario we cannot authenticate our domain user because of a difference in time between their workstation and our server. The good news is that you can avoid all of this by setting an authoritative time server. A server that itself if connected to the Internet can get its time from a reliable source such as by the U.S. Naval Observatory. If you have Internet access, then the simple command on your server of **net time /setsntp: 192.5.41.209** will do this. Another time server is tock.usno.navy.mil at 192.5.41.41.

After you set the SNTP time server as authoritative, run either of the following commands on a computer other than the domain controller to reset the local computer's time against the authoritative time server: Last but not least, on the workstations, when you are setting them up, type **net time /DOMAIN:Your.Domain.com /set**. Please note the lack of spaces in this command. Finally stop the *w32time* service by typing the following with an enter after each one.

- net stop w32time
- net start w32time

Help for the net time command is available at a command prompt if you type the following command: **net time /?**

QUESTION BOX

I recently have received several questions that go beyond the theme of networks. I enjoy these questions and welcome them. One common question I have been receiving is about printing, so let us finish this month's column with a discussion on the question of how Windows prints.

How Does Printing Work in Windows?

Have you ever wondered how printing works in Microsoft Windows? It is supposed to be WYSIWYG (What You See Is What You Get) printing and it seems to work well until that dreadful moment when the document you created on your computer gets used on another computer. The frustration builds, especially when you have created the perfect template in Excel or Word, and then you pass it out and it does not print as you expected. Is there a solution? Yes, but first how does Windows print, and why does it vary so much from computer to computer? Understanding this helps us understand the resolution.

In an attempt to achieve WYSIWYG, which we must admit works reasonably well, Microsoft created a means (program) for all the needed printing equipment to communicate and decide how to print. This means that when we created our document the layout was dependant upon our printer and its capabilities. A well-written printer driver lets Windows know exactly what it can do. If the printer can only print in a resolution of 300 x 300 dpi (dots per inch), then in order to achieve WYSIWYG, Windows needs to know this.

When rendering to the screen what will be displayed, in harmony with what will be printed, the printer's resolution becomes important, along with paper size and margins and many other things. Obviously then, when we try to use our document on another computer or workstation, the printer we are using becomes a key ingredient in how the job will end up being printed.

"This is logical," you say. It is only reasonable that if we move to a computer with a printer that prints at 1200 x 1200 or 1200 x 2400 dpi the job may change in its appearance from what we may have created on our computer with our 600 x 1200 dpi printer.

But now you say, "I share the same printer over the network, yet the job doesn't print consistently from computer to computer." A different version of Windows can make a difference. "Yes" you say, "but all of my computers are running the same version of Windows with the same exact service packs installed and yet they don't render the print job to the same printer the same way." True, but another important part comes into play.

Whenever you have two computers set up using the same printer, with even minor version differences in the printer driver, the workstation can cause this upset. As stated above, Windows queries the printer driver to see what its capabilities are. Those

(Continued on page 20)

Networking 101

Continued from page 18.

different driver versions may respond differently on computers that may otherwise seem to be the same, and these variances can cause different renderings of the same document on different computers using the same printer.

"Whew, I have updated all of my computers. They all are running the same version of Windows and they all have the same service packs installed for both Office and for the OS. Likewise all the printer driver versions are exactly the same version. With that out of the way, we should be able to move that document from computer to computer without issue right?"

No, not yet. Are all of our fonts the same? Are all of our fonts the same version? If you do not have the same font on the computers, another background calculation happens. Windows does some of its quality guessing. Yes, this is a thorn in our flesh, but it really is pretty cool how it works. Consider: I create a document on my computer using "Joe Bob's Extended Font's" that I ordered off of the Internet.

Now these may be the next best thing to canned beer, but if they are not on each workstation *(which may require special licensing – ouch!)* the print job still will not be the same. Windows is going to look at the font specification and say "this is the closest I can come," and print the document as legibly as possible for you, using its closest matched font. For that reason, using default fonts *(those with that come with your Office Suite and or Windows itself)* helps to guarantee consistency.

Really this best guess font matching is a must. If this did not occur then it would be near impossible to share documents. The benefits go further though; this process even occurs with web pages and e-mail. If Windows did not do this, we would be limited to reading from the fonts we had licensed and miss the documents created with other fonts. How long would you use Windows then?

"Ok", you say, "That is pretty cool. But I have the same printer, the same OS, the same font and all of the versions of drivers and fonts are the same, but it still comes out differently from computer to computer. Why?" This answer is the one most people would never guess, and most people overlook. When Windows is rendering the WYSIWYG, the computer queries the printer driver and the video driver.

The video driver shows you what you see on the screen, so in order to get WYSIWYG, both must get in a non-fatal argument and come out with common ground on what they will display and what they will print. Yes different video cards will get you variances in renderings. Likewise, different drivers for the same card will "get" you just like the printer drivers. WYSIWYG is based on fonts, printers, video cards and display settings, along with their drivers.

"Ahhhh, but didn't you say there was a solution?" Yes, there is. Instead of trying to match up all of the permutations on our computers (and being ready to spend a small fortune) in order to achieve the needed common ground, we can (for much less money in most cases) buy software that is not reliant on the system for what is printed. If we will change the method and just render our document as a picture, then from computer to computer it will print close enough to satisfy most all user needs.

"But I can't edit a picture easily." Yes, you can. One way to accomplish this is with Adobe Acrobat. There are several others ways to accomplish this, but a fill-able PDF file is my personal preference. With Acrobat installed, many applications become capable of generating documents as editable PDFs, which then can be used as forms across your agency without issues. This is the sort of file you get when you download your tax forms off of the Internet.

To summarize: You can create a document using Acrobat and rather consistently allow users to print or fill out forms for printing using any computer without notable variances in appearance. If you buy software for the workstation that will be used to create these forms, you will render your jobs consistently from computer to computer for less money than all the potentially needed changes in hardware and software.

That is how successful printing works in Windows.

Tren Barnett is a System Administrator and Programmer in Tucson, Arizona. He welcomes your questions on solving network problems in your facility. Contact Tren at tpb@aires.org

From the Transmitter Shack

The Day the Transmitter Died

by Danny Tabor

December 16, 1997 at 5:55 PM is a day and time I will remember as long as I live. I had just started the play-by-play of a high school basketball game, when the station went off the air.

I am a micro market broadcaster. (I use the word micro instead of small, because having attended enough NAB small market sessions I realize their definition of small is not the same as mine.) Being a micro market owner-operator, you do it all, or as much as you can. Since purchasing the stations, we upgraded everything from control room to tower and antennas – everything except the 1967 CCA 3kW FM transmitter.

Over the years it had several modifications done to it, including changing the 8122 driver tube out, and making it a 6kW box. The CCA is a simple design; maybe that is why I loved that ole box or maybe it is because I spent so much time with it.

I have always felt a clean shiny car runs better, so why not have a clean shiny transmitter? I would regularly clean the transmitter, even going as far as giving the outside cabinet a wax job. The old CCA must have liked it cause she just ran and ran. She ran that is, until 5:55 PM, December 16, 1997.

When the station dropped off the air, I called the remote control. Never before had I gotten so many high and low limit alarms. It was a cold December night, with no storms anywhere around, what could be wrong? Did the Burke remote control develop Alzheimer's?

ANXIETY AND DIAGNOSIS

I left the gym for the transmitter site. Thank goodness this was a home game and not somewhere halfway across the state. The transmitter site is only about three miles from the school, so getting there did not take long. I hoped I could reset things and be back by the end of the quarter to broadcast the rest of the game.

Arriving at the transmitter site, I listened for familiar sounds, but heard nothing. When you do not hear the blower motor running, your brain starts trouble shooting before you even open the door to the building. I pulled the main power disconnect and opened the door to the transmitter. It was a scene I hope no one else ever has to witness.

There is nothing worse than being hit with the smell of smoke and absolute silence when you unlock the door to the transmitter. It is a feeling that hits you in the pit of your stomach, much the same as when you lose your first love. You feel sick and helpless, like the world is coming to an end. The inside cabinet was black with soot. Insulation was burned off wires, and the components were charred. I could have thrown up. I started to shake, and then just sat on the floor and cried. It was ten days before Christmas, and I had a transmitter off the air and beyond repair. But what caused it? Looking at the pressure on the transmission line, the gauge read zero.

I called my best friend, another owner-operator and good engineer, and explained the situation. He immediately came over and we put the 50-watt Continental exciter on the air, with a 1-5/8" to type "N" adapter, one I had purchased several years earlier, just in case of an emergency. The coverage from 50 watts into a 3-bay Shively, at 100 meters, was amazing.

My tower guy lives about 60 miles away; he arrived the next morning. After switching the dehydrator on, he started climbing the tower, checking for leaks. About three feet from the end of the transmission line he found the source of the leak: a bullet hole. The line had taken a hit, causing an arc back down the line and into the transmitter. Why the transmitter overloads did not work nor the breaker trip, we will never know. All I knew was I was up a creek without a paddle, or least I thought I was.

There was an old 2-bay still on the tower for backup, and a little over a week later a new Nautel FM5 was feeding it. While replacing the bad transmission line, the bullet was recovered, and given to the State Police. They were pointed in the direction from which it came, a mobile home park. Apparently a teenage boy was aiming for the top beacon. His aim was good, but the distance the bullet traveled caused it to fall off and hit the transmission line. No charges were ever filed, but I understand they put the fear of God in him.

ALIVE BUT MOVING ON

During my spare time I would go out to the transmitter site and clean up the old CCA. I re-wired it all, and replaced bad components. Turning on the filaments, I crossed my fingers and waited for the time delay relays to kick in. There is no sweeter sound than that of hitting the plate button and hearing a contactor make, and see readings from the meters. The ole gal came back to life!

About six months later, someone called and bought the CCA. It was sad time when the day came to take her apart and move from the building that had been her home for over 30 years. When she was loaded, I looked around and the building seemed so empty. This was the transmitter that broadcast my very first words, when I got into this crazy business. I stood in the doorway of the transmitter building and watched her leave the site in the back of a pickup truck and another tear fell down my cheek.

Danny Tabor is the owner, engineer, play-by-play announcer and janitor at WLCK and WVLE in Scottsville, KY. He can be reached at wlckwvle@nctc.com

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	3.0 kW	1996	QEI Quantum
	3.5 kW	1985	BE FM 3.5A
	10 kW	1980	Harris FM 10K
	10 kW	1991	QEI FMQ10,000B
	20 kW	1976	Collins 831G2
	20 kW	1982	Harris FM20K
	20 IW	1989	QEI FMQ20,000B
	25 kW	1980	CSI T-25-FA *(amplifier only)*
	30 kW	1984	BE FM-30
	35 kW	1989	Harris HT35
	40 kW	1978	2-RCA BTF-20E1 *(combined)*
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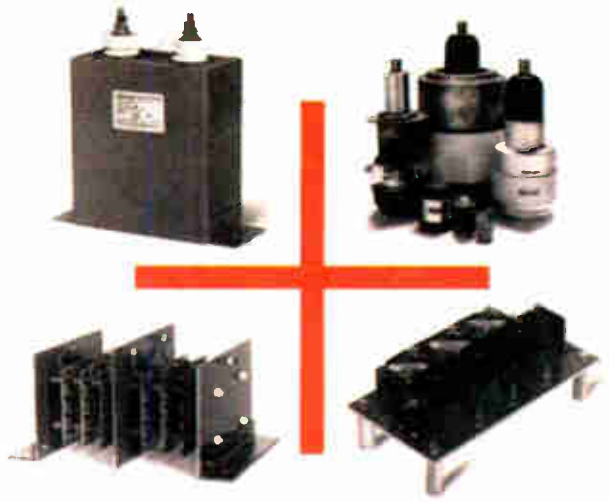

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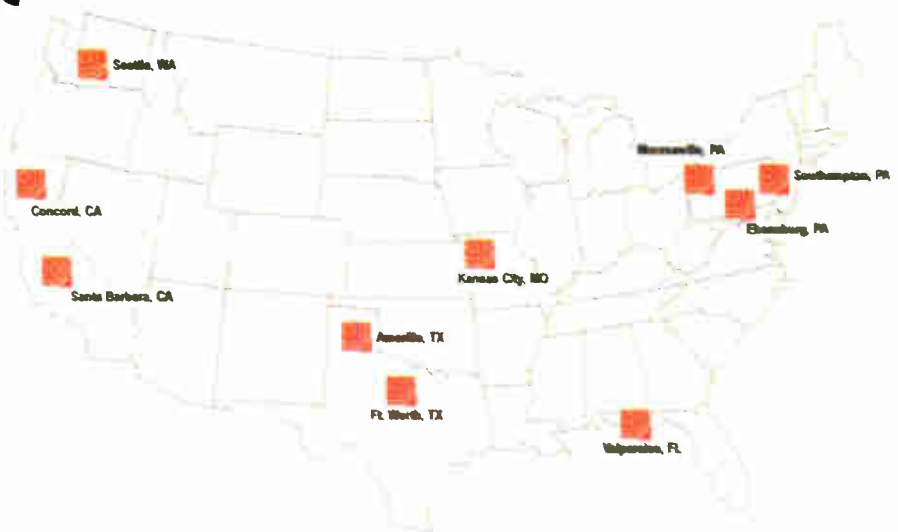

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Answers to Your EAS Questions

EAS Q&A

by Clay Freinwald

[SEATTLE, Washington - July 2003] This month Clay answers some of the questions sent in by readers, as well as some other questions he has encountered at his many EAS seminars.

Bob Wyatt - Clay, I am trying to get our station to run all the EAS messages my stations receive but management only wants to forward certain ones. I'm confused, If we are a PN station does not this mean we are obligated to forward all messages we receive?

Clay - First, it is important to remember there are two parts to EAS. 1) REQUIRED (EAN's and Presidential/Federal Messages and, 2) The VOLUNTARY portion.

Let us separate the "Required" aspects of EAS from the "Voluntary" portions. Part 11 of the rules tell us there are indeed two types of stations. Those that do not wish to participate in the federal/national level EAS (EAN – Presidential messages) can opt out, and upon receipt of an EAN simply sign off their station – check Part 11 for how to do this. Stations willing to participate in the broadcasting of EANs are called PN stations, meaning Participating National. When there is an EAN issued, and the President is addressing the country, the only Broadcasters on the air will be those with the PN designation.

Your management, for whatever reason, has determined they wish to relay some messages and not others. In the voluntary portion of EAS you can do just that, i.e. you can pick and choose which ones to air; for example, you could air Weather and ignore State and Local messages. The choice is your station's to make. Of course, I would prefer all stations run all EAS messages.

Bob - So, if our station agrees to run all or some EAS messages, do we have to relay them with all the digital noise-makers or can we just pass on the information?

Clay - This is a matter where your state (SECC) or local (LECC) EAS committee can help. Since your listeners are not likely to have an EAS decoder connected to their radio, the "Header Codes" or digital bursts really do not communicate information to them, so their only value is likely to be that of an attention signal. Check with the SECC and LECC to ensure no other entity is monitoring your station as their "source" of EAS messages. If no one is monitoring you for EAS messages, I feel it is fine to simply air the information.

We will use a Severe Weather Warning as an example. (These are initiated by NWR with all the digital information to enable your EAS decoder.) What is important is that your station get this information on the air to warn your listeners, using your own production capabilities, and do so often as you can (we could be talking about saving lives, after all). Your management might appreciate this approach also, come to think of it. Not many really like the sounds of the digital "noise makers" on their station.

Bob - I understand our station would certainly sound better if we "voice" our own EAS messages. But what about at night when we are operating unattended, what do we do then?

Clay - I guess you are stuck with telling your EAS box to automatically relay. In terms of EAS there are certainly some downsides in terms of your on-air sound when you are unattended. Remember, EAS is not the only thing that suffers. Automation, regardless of how sophisticated, does very poorly in handling non-planned events.

Larry Wilkins - Clay, Does an LP station have to be manned 24 hours a day?

Clay - Larry this is a common question, since EAS efforts in many areas are barely more than just "warmed over" EBS plans. One of the major reasons for scrapping EBS was the fact it did not work with unattended operations. Unfortunately, some areas have continued along with their EBS mind-set, using procedures where if a local government entity needed to get a public warning on the air, they would place a phone or radio call to the local EBS (EAS) station and the personnel there would encode the message and send it out.

Frankly, this is not how EAS is supposed to work. With EAS, all stations should be able to be operated unattended. The primary mission of an LP station is to relay EANs into a Local EAS Area. An LP station should have 'redundant' (at least two) means of receiving federal level EAS messages. (I am thinking of a regional PEP station as well as a participating NPR station). This work can certainly be done with the station operating unattended.

State or Local governmental entities can reach the station (or others) via State and Local relay networks. These are "background-channels" (*not* broadcasters) connecting these government entities to the EAS box at unattended facilities so EAS can indeed function *without* having to have someone on site.

Ken Evans reported one broadcast group in Delaware was concerned they would be giving up control of their broadcast signal by having RMTs generated outside the station by a government entity.

Clay - Ken, your situation is not unique, as many still confuse the attributes of EBS with EAS. I am far more concerned about the legal implications of a station initiating EAS tests and messages. Broadcasters are, by and large, in the entertainment business and are not trained in emergency management nor are they hired for their abilities in that area. I say leave the public warning stuff to the government. Can you imagine, if the tables were turned, having an emergency manager, or weather forecaster, running your station during drive time?

Michael, the owner of a new Low Power FM station in the Northeast wrote asking if an LP station had to be what he called a '50,000 watt flame-thrower'.

Clay - Not all, Michael. The role of an LP station is simply to connect the input of their EAS box to redundant sources of EAN's and relay this onto others within their coverage area. There are cases where a relatively low powered station can fill this bill quite nicely. This is not a function of "kilowatts," but rather more a function of cooperation and participation.

Really, in our roles with EAS, the majority of our work is voluntary. We volunteer our time, efforts, skills and in many cases, equipment and stations toward achieving the same goal: the saving of lives by providing a vehicle for public warning using existing broadcast facilities. Whether you are 4 foot 6 or 6 foot 4 – 50,000 watts or 50 watts – there is a role for all.

Here are some additional questions recently asked of Clay:

Q - I have set up a system whereby I check our EAS Log once a week as part of my Chief Operator Review. Please tell me again, in a given week, just how many tests should be shown on my log?

Clay - The FCC knows you are to be monitoring *two* sources that can potentially deliver to your station an EAN. These sources each transmit a Required Weekly Test (RMT). Therefore, your station should be receiving – and logging – two tests per week from those sources. Additionally your station should be receiving one Required Monthly Test (RMT) per month.

This means in some weeks you may have three tests received. Your log should indicate each reception, whether it was an RMT or RWT and from whom it was received

On the transmitting side of things, your log should also show your station has transmitted one RWT per week and relayed one RMT per month. Do not forget that a real EAS message received and/or relayed, counts as a test. In other words, if you run a real Weather Alert, you do not have to run that RWT that is on the log in the next hour.

Q - What about all these other tests we receive, it seems we are getting many more than those you describe?

Clay - As EAS improves, and areas get away from "daisy-chain" relay systems and broadcasters monitor a number of sources, you can well expect to be receiving additional tests. For example, in the Seattle area, various governmental entities transmit RWT's once a week and many of them transmit DMO's. We need to call upon the I.Q. of the EAS decoder and ask it to just "log" these tests and not bother the operator.

I still recommend these be logged, either on paper, or electronically. Nothing makes the FCC happier than to find you are monitoring a lot of sources and can produce lots of log entries clearly demonstrating that all is working well.

Q - What is a week? Some stations operate with a funny calendar where the first day is Monday with Saturday and Sunday on the right, while others operate with a conventional calendar.

Clay - This is a "grey area," with the FCC leaving the matter to the licensee. What is important is the interval between the receipt, transmission and forwarding of these tests. If I were an FCC inspector, I would be looking at your logs and counting the *interval* between tests.

If I saw a pattern where there was more than 7 days between RWTs, I would have a problem with your station. If you can be shown that within 7 day periods you are receiving and transmitting RWTs and within 30 day periods you are doing RMTs, you should be in safe territory. (You are welcome to quote me, but understand I have absolutely no clout with the FCC)

Q - Recently our area ran an AMBER Alert, and the message from the initiating law enforcement entity told everyone to tune to a certain news station in our area. Even the highway signs instructed people to tune to that certain station. My manager is not happy with this. What do I do?

Clay - I have to assume your station is not the station they were telling folks to tune to. Of course, AMBER is a very new tool and its best use is still being debated. Here is the problem: The folks who initiated the AMBER Alert know the message carried by AMBER is very short.

To be effective, people are going to need additional information, or simply hear it again to get the details right. The folks programming the highway signs also know motorists are whizzing by at high speed and are unlikely to be able to read more than a short line or two before they pass the sign.

I recently attended a meeting where this was discussed and heard DOT and State Patrol leaders say what they want is to give instructions to tune to a specific radio station – one they know will carry the information, and repeat it often – as opposed to simply ask people to turn on their radio. They understand not all stations are going to carry the information.

So, the best solution I can offer at this point is to have your management become an active participant in your state, regional or local EAS committees where these issues can be sorted out, perhaps committing your station to be a key station transmitting such messages during emergencies.

Clay Freinwald, Senior Facilities Engineer for Entercom in Seattle, is Chairman of the SBE's EAS Committee as well as chair of the Washington State SECC. He welcomes your questions about EAS at k7cr@wolfenet.com

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FCC Focus

A Day in the Life of an Alternative FCC Inspector

by Ken Benner, NCE

[TUCSON, Arizona - July 2003] It is **5:30 AM** The morning essentials have been completed and I am in front of the bathroom mirror rehearsing my mean, cold-blooded, steely-eyed, square-jawed Marine style persona. I remind myself; "If I am going to be an inspector, I had better give the impression of an inspector!"

My clipboard contains my Map Quest printout of my assigned inspection appointment addresses, a copy of the appropriate FCC checklists and notes about whom I am to contact at the station. Today's Manager is a member of the sponsoring Broadcaster Association's Board of Directors and his Contract Engineer is Chairman of the local chapter of the Society of Broadcast Engineers, so I had better be on my most professional behavior.

Time to rehearse a few good buzz words to create the proper impression. Let me see now – how about: complex impedance, decibels, standing wave ratios, Section 73.3526 and 27 (public files), the great old Conelrad alerting system (so they know I have been around awhile), etc.

6:00 AM: I check out of the motel and drive to the station and determine it is only six blocks from the motel. It is now 6:05 AM and I am not due at the station until 8 AM I clutch my courtesy copy of USA Today from the motel and head for the nearest McDonalds for my Egg McMuffins, orange juice and senior coffee with four or five refills.

7:45 AM: I pull into the station parking lot and note the tower in the "back forty" has a seven digit number properly posted at the base, is probably over 200 feet high, and has seven bands with top and bottom each aviation orange. I jot the registration number on the inspection report for later comparison with the 854 Tower Registration and compare the coordinates from my GPS with those listed in the *Broadcasting and Cable Yearbook*.

7:55 AM: I enter the station, wave to the combination Morning Announcer, General Manager, Chief Engineer, Account Executive, News and Program Director – who kills his mike just long enough to shout through the open control room door: "I'll be into the network news block in just a minute, help yourself to a cup of coffee."

8:00 AM: The pretty receptionist appears, explains she is the GM's daughter and is filling in for the regular receptionist on vacation. 8:03 AM the delivery truck from the local bakery appears with his morning variety box of donuts. Over the off-air monitor is heard "Ya know, ya just can't beat these great pastries from Bob's Bakery down at 5th and Main open every morning at 7:00 AM for your breakfast convenience." With a smile, I wonder if there just might be a tad of payola operating here.

I ask if she would kindly duplicate the various forms we will be using during my "educational" presentation. These include the list and definitions of the public file folders, samples of the forms for political files, issues and program lists, tower lighting requirements and whatever else I think they might use.

Paul Harvey is now in control for next fifteen minutes and the fellow behind the mike introduces himself, joins me with the coffee and donuts and I explain this is primarily an educational affair during which all questions relating to FCC compliance will be answered and it would be well if the entire staff were available to participate. He agrees and orders a staff meeting for 9:00 AM.

Ms. Receptionist returns from the copy machine and I ask that she would obtain 16 file folders and tab each according to the list she has just copied, then cut out the explanations and tape them under transparent tape for the front of each folder.

8:30 AM: Ken the Contract Engineer appears. Ken is from Ken's Radio, TV, Computer and Appliance Emporium. We discuss ham radio and how great everything used to be before deregulation. I ask him to locate a copy of the station license, renewal card, any auxiliary licenses, the tower's 854R registration form, EAS and tower light outage logs and the FCC Self Inspection Checklist supplied by the Broadcaster's Association when the station signed onto the program.

9:00 AM: Now our school begins. After I obtain the signature and title of all participants on the confidential "Inspection Report Form" we begin with: "Please understand this is a good faith effort on the part of your station, your State Broadcaster's Association, the Federal Communications Commission and yours truly to explain and simplify your compliance requirements, many of which have changed greatly in the past few years. I will explain many items that you no longer have to worry about as a result of deregulation.

"For example you no longer have to be a licensed operator, nor keep logs of meter readings, nor logs of your on air performance. I do ask one very important favor: We must be completely honest during the course of this inspection – I will not fib to you and you must not fib to me or we are both in trouble. Please understand much of what we discuss around this table is confidential and should not leave this room.

"I realize most of what is in the checklist you already know but I will touch on everything in there so as to bring to mind any clarification you would like to cover. Please pay close attention because (with a wink) there will be a quiz!

"Over 90% of the stations I inspect are certified before I leave the station. In those instances where there is a serious discrepancy, you will not fail, but rather, be left "pending" until I receive an affidavit from your Manager, Engineer or other qualified person certifying the noted discrepancy has been corrected. I am then authorized to issue your compliance certification for you to proudly frame and place on your reception room wall.

"Now let us review all items in the check list and please do not hesitate to raise even the slightest question. Remember, there is only one dumb question – and that is the question that is not asked! I especially appreciate questions I can't answer because in those instances we both learn from the reference books I carry, from Internet sources, from telephone calls to hundreds of Managers, Engineers, FCC Staffers, Your State Broadcasters Association Legal Counsel and other sources who are smarter than I am."

11:00 AM: We have covered the checklist and from here we "walk the walk," compare transmitter power output and all other license items, i.e. ownership, coordinates, transmitter address, signage, i.e. AM radiation signs and registration numbers. We review proper creation of the public files and the required items for each folder. I check the paint condition of the tower with a color chart. Perhaps we could run a weekly EAS test to see if it triggers my portable EAS receiver.

If this is a directional AM, we will need to check the phase relationships, tower current ratios and read the monitor points for comparison with the maximum field intensities stated on the license.

Ken Benner with his color chart at KNOM, Nome, Alaska.

Please note in the past I have had engineers try to trick me into phony field intensities by implying a monitor point is located other that the location indicated on the station license. No more! I enter the array coordinates into my GPS and note the radial and distance when we arrive at each point. Ol' Dad here, has been around the block a few times!

If the transmitter is at another location, we might stop for lunch before proceeding out to the site. Usually, this gives me the chance to chat with the engineer, and get a feeling for his familiarity with the facility and his level of engineering expertise. Sometimes we discuss the application of some of the FCC Rules and clarify some operational practices.

By now the weary Manager, Engineer and Staff wish to hell I would shut up and go home. If there are only a few minor things, I break out their pre-prepared certificate, apply the embossed seal, date, sign, and with fanfare present it and a congratulatory letter from the Broadcaster's Association.

Proud staff of KYUK-AM/TV, Bethel Arkansas with their new compliance certificates

If there are serious problems, i.e. transmitter power high or low, improper license posted, no EAS system, tower coordinates improper, tower registration incorrect, and any number of other things, I will write a letter to the licensee explaining what needs to be done within 60 days.

That, with an affidavit certifying such corrections faxed to me from a qualified person, will produce their certificate of compliance, and the FCC notified of such certification along with all other stations certified under that state's program.

It is a great program. The stations my colleagues, Jerry Miller, Arvid Sonstelie and I have inspected have saved well over 1.5 million dollars in potential fines and hundreds of thousands in legal fees, which might explain why some Washington FCC lawyers may not appreciate us.

Dedication, Integrity and Good Faith are the key elements that make this program work for all of us. And all the friends we have made make us the most fortunate people on the face of the Earth.

Ken Benner, a retired broadcast engineer, resides in Tucson, Arizona. As we go to press, he is roaming around Alaska in various small aircraft and other conveyances, performing inspections under the Alaska Broadcasters Association program. If he outruns the sled dogs and polar bears, he can be reached at bennerassociates@aol.com.

Things You Need to Know

STL Coordination and Licensing

Many stations and engineers are up in the air about the recent changes in the FCC Rules for coordinating and licensing STLs. The original information required quite an increase in complexity and cost for stations to use the 950 MHz band.

The old system was more or less informal; coordination was essentially between stations using STLs on the co-and adjacent channels, along with notification to the Frequency Coordinator for the area. The new system, under Docket 01-75, requires the use of Prior Coordination Procedures as laid out in Part 101 of the Rules for STLs and fixed TV BAS stations in the 950 MHz, 2.5 GHz, 7 GHz, 13 GHz and 18 GHz bands. It was scheduled to go into effect on April 16, 2003, and includes interference studies and written notices to all other licensees who might be affected. Costs related to this system are likely to be substantially more than radio stations have been used to in the past.

The good news for stations who need to license, or change existing facilities, is that the FCC granted a request filed by the SBE to "stay" the implementation of PCP for six months. Arguing that the FCC's ULS database was lacking a lot of information, and some of what was there was erroneous, the SBE asked for sufficient time for stations to correct the database records. Furthermore, there were insufficient standards in place for regarding interference among the various transmission methods.

At this time, procedures are being put into place to correct the ULS listings. While it has not been made clear what changes will be allowed without incurring a regulatory fee from the FCC, it is highly recommended that stations review all their licenses' imminent requirements and have correct data ready for filing. Both your station's communication attorney and the SBE will likely have information available shortly on how best to proceed.

After the six months stay is over in October, it is quite likely the new procedures will be put into operation. How this will affect the existing Frequency Coordination system is not entirely clear as yet, although it would appear that it may end up re-focused on other uses, such as the radio and TV RPU bands, including the 450 MHz band. But, it is certain that it will take more time and money to arrange an STL license than previously.

In the meantime, you need to know that it is to the station's benefit to prepare now for this important change in the way the STL band is regulated.

"Field Notes"

[Radio Guide welcomes your feedback. How can we serve you better? What do you need to know? Please let us know at editor@radio-guide.com Ed.]

From: Jim Looby, Chief Operator, KHPU-FM, Brownwood, TX

Thanks for Ken Benner's article on "The Public File – Part 2" in the June 2003 edition. It has been extremely helpful to our staff. Could I get a copy of the first part of the article?

Thanks!

[RG replies: Glad to hear Ken's material meets your needs. The first part is on its way to you. Ed.]

From: Ron Garrett, Chief Engineer, Baylor University

Just read [Cornelius'] your article (Part 6-FM Stereo) and had to respond. When I was 13-14 yrs. old, I tinkered with electronics and figured out how to make transmitters out of receiver oscillators.

I too was curious how to make FM stereo work & did the same thing you did by adding a 19 kHz tone to my homemade broadcast to make the FM Stereo light come on. But as you said, no stereo. But you are the first person I ever heard (or ever discuss with that would know what I was talking about) that had done the same thing I did as a young kid trying to figure out things in electronics.

It brings back great memories. Thanks for a great article and reminding some of us how it (we) all got started!

Do You Have the BDR on *Your* Desktop?

Version 1.52 of the BDR Now Available

The **Broadcaster's Desktop Reference** (BDR) is an ongoing effort to provide useful tools, information, and history of interest to broadcasters. A work in progress – it seems something new is added almost every month.

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To make the CD even more valuable, when you are at the transmitter site, we have added the FCC and EAS checklists, and some equipment manuals. And this is not the end ... more is planned.

You will find most of the CD contents are listed at: www.oldradio.com/latest.htm

The proceeds from this CD are going to be put into improving the next edition of the CD, and supporting Oldradio.com and its efforts to document and display the history of our industry.

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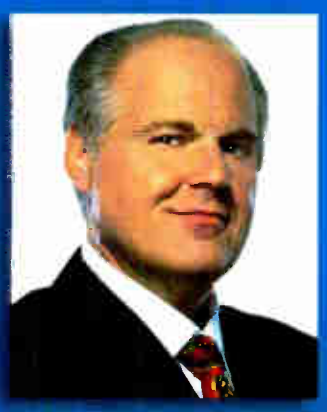

Thursday, October 2
Keynote Address

Rush Limbaugh
Premiere Radio Networks

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THE NAB RADIO SHOW

Thursday, October 2
Group Executive Session

Moderator
Sean Hannity
The Sean Hannity Show
ABC Radio Networks

Group Executives Including:

Mary Quass
NewRadio Group, LLC

Virginia "Ginny" Morris
Hubbard Radio

John Hogan
Clear Channel Radio

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