Radio Guide

Radio Technology for Engineers and Managers June 2007

Successfully Managing an Engineer's Responsibilities

Inside Radio Guide

Today's engineer often has to juggle any number of tasks and problems at several stations in a cluster – or even several clusters – located fairly far apart. Finding and implementing ways to handle all the responsibilities without losing one's mind (or family) can be difficult. Chris Tarr shares some of the tricks and lessons he has learned while keeping everything going.

It really is stunning to see the way technology has changed the work and life of an Engineering Manager. Let us take a look not only at how things are changing right in front of us but how we can cope – even prosper – as we deal with the job.

Radio Guide

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June 2007

Cover Photo

Chris Tarr, an Engineering Manager for Entercom, juggles his engineering and family responsibilities.

Created by Caroline Drier

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PO Box 20975, Sedona, AZ 86341
Phone: 928-284-3700 Fax: 866-728-5764

Ray Topp *(Publisher)*
Email: radio@rconnect.com

Barry Mishkind *(Editor)*
Email: editor@radio-guide.com

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Radio Waves

by Barry Mishkind – Editor

It will be a busy summer ahead for many in the broadcast community. And ***Radio Guide*** is here to help you navigate through it all, from the upcoming **AM Transmission Seminar** (see below) in September to providing the information you need to do your job.

For example: the first NCE-FM window in seven years opens in October. Laura Mizrahi explains on Page 12 why consulting engineers already are hard at work preparing applications and strategies. Existing stations should also be reviewing their situation now, lest they lose the opportunity for future signal improvements.

Meanwhile, the FCC is considering proposals of great interest to those building and maintaining AM directional antennas. Clarence Beverage gives the key points on Page 6.

Some major station sales are being consummated, and 24/7 digital operation for AM stations finally should get the "green light." Depending upon which prediction comes true, we are about to see digital radio take off like a jet or – to mix the metaphor – become a train wreck.

Even stations unaffected by any of these issues will stay busy. In our lead article on Page 4, Chris Tarr focuses on how engineers can effectively handle multiple responsibilities at widely separated facilities.

Changes are happening up in the sky, too. Programming services are beginning a migration to a new series of satellite receivers. Some stations will be installing these receivers. Others will find their repair options for their existing units are changing. On Page 30, you will find Tom Taggart's look at some of these issues.

And it will not be long before the series of Summer and Fall Conventions for broadcasters starts, including the NAB Radio show in Charlotte NC, in late September. If you are coming to Charlotte, make it an extra-productive week, by attending the ***Radio Guide*** **AM Transmission Seminar**. Look for the details on Page 36. – *Radio Guide* –

Managing the Tech Side

by Chris Tarr

Today's engineer often has to juggle any number of tasks and problems at several stations in a cluster – or even several clusters – located fairly far apart. Finding and implementing ways to handle all the responsibilities without losing one's mind (or family) can be difficult. Chris Tarr shares some of the tricks and lessons he has learned while keeping everything going.

It really is stunning to see the way technology has changed the work and life of an Engineering Manager. As the industry continues to change right in front of us, let us take a look at how we can cope – even prosper – as we deal with the job.

A FULL TIME JOB

For example, consider the scope of my responsibilities at Entercom. Not too long ago, I became responsible for six radio stations in two markets – one AM and five FM's. To accomplish this, we have a staff of 2-1/2 people. I work out of Milwaukee, my assistant works out of Madison, and I have a part-time employee who "floats" as needed.

So, to start, I had to make sure that those six streams were fully functional 24/7. (For the ease of the math coming up, I am going to refer to any method of audio delivery, digital or analog, as a stream.)

Next, we need to add our Internet streaming to the mix. We have thousands of listeners sampling our streaming audio at any given moment. Obviously, if that product does not work, our customers will go elsewhere. So making sure that they function 24/7 became a priority. Now we are at 12 streams.

Now here comes HD Radio. While the technology is new, there are people who are listening. Therefore, just like analog and streaming, keeping the HD programming running 24/7 is also a priority. I currently have three FM's running in HD. That is three streams. All three of them run HD-2 – and that means three more streams.

For those keeping score, the same 2-1/2 employees that were originally needed to keep six streams on the air now need to manage triple that – 18 separate streams that must be kept running reliably 24/7. Impossible? Not if you set yourself up to succeed!

You never know where you will be or what you will have to do on a given day.

THE ENGINEERING SUPPORT SYSTEM

The primary factor in all of this is your support system. I am not just talking about the engineering staff; this support system includes PD's, promotions and office staff, and, most importantly, the General Managers of the two clusters.

As you can well imagine, a fair part of my schedule is based on immediate needs, so the day's plans often can – and will – change at a moment's notice. While the variety of challenges facing a broadcast engineer keeps the job from becoming dull, there could be real problems if my performance were to be judged merely by my appearance at specific times and places.

I am fortunate to be working with two excellent GM's – Alan Kirshbom in Milwaukee and Amy Griesheimer in Madison. While they do have to share me, they both do a great job of trusting me to be where I need to be when I need to be there.

SUPPORT INCLUDES TRUST

Working together, we have built up enough trust with one another that I rarely need to justify a decision – which is great if I have to make one of those on-the-fly "executive" decisions that inevitably come up.

In fact, they *always* support me. And, in return, I always take time to communicate with them and get their feedback. That way, just a few minutes every day or two is all it takes to keep the GMs up to speed on what is happening with our facilities.

Furthermore, the rest of the staff at each cluster also understand that things like changing out studio light bulbs sometimes may need to wait a day or two if things are real busy. I – along with the rest of the "support system" – have helped them to understand that they are competing with 18 other program streams, and problems need to be fixed based on time and priority. Does this sound like "fantasy land"? Maybe, but it works!

So then, here is the big question: How do you set this up?

PRIORITIZE – BUT COMMUNICATE

The very first step is to get all of the people involved on the same page regarding expectations. I cannot emphasize this enough.

Clearly state how you plan to handle emergencies, non-emergencies, and then "wish-list" items. Make sure the GMs and PDs all agree on the criteria and protocols you intend to put in place. That way, these folks will be the buffer between you and the rest of the office.

If you all send the same message, the rest of the office will buy into the concept. All it takes is one of them not to take part – and problems will arise. That is why it is very important to take some time to listen to – and address – the concerns of everyone involved.

Furthermore, you need to have the discipline to under-promise and over-deliver, since all it takes to lose the trust you have worked so hard to build up is to allow some important project to slip through the cracks. So be honest about your abilities. If you have the right expectations set going in, there should be very few problems on a day-to-day basis.

DO NOT BE A MYSTERY

All too often, engineers are thought of as these mysterious beings that come and go as they please and are rarely seen, spoken to only during emergencies. But this will not work in today's environment. You need to be available to staff.

So the second step is fostering active communication throughout the facility. This is the key to turning everyone into support staff.

It is no secret that most of the time the trick in making people happy is simply stopping to make sure they know that you have acknowledged their problem. They need that positive feedback.

Our system here is for anyone on staff to email me with any issues that come up. My life (and career) saver is my Blackberry! Thanks to the Blackberry, I can respond to them immediately – even after hours and weekends – with an acknowledgment of their problem and an estimate on when I can have it addressed.

It only takes a minute of your time, but that kind of feedback makes all the difference in the world to them.

BE AVAILABLE TO EVERYONE

While some stations may not have email available to everybody, there are other solutions. For example, Microsoft FrontPage has tools to create an on-line form that can be filled out via website.

When the user submits the information about a problem, the contents get emailed to a designated email address. Though it takes some of the immediacy out of a reply (if the submitter does not have email, for example), it is another way to get trouble reports quickly. If web design is not your thing, you should be able to have the company that designs your station website help you put something together.

If none of that is available, go to the old standby – answer the phone! Anything you can do that immediately lets the person on the other end know that their problem is your problem will make a big difference. Sure, you might get a few calls at inconvenient times, but as the staff learns that you are working as quickly as you can to clear problems, they will know when it is appropriate to call – and when they should let you sleep.

The end result in my case is that to the employees of the two markets feel that I am still working on their problems even when I am not there.

USE ALL THE TOOLS AVAILABLE

The third step is to use technology to your advantage. Most of our delivery systems, including transmitters, are IP based. In previous articles (***Radio Guide***, *December 2006 and January 2007)*, I explained how to set up a secure VPN link. Set it up and use it.

It really is great when I can solve an IT problem in Milwaukee while I am in my Madison office or do routine server maintenance from my recliner at home in the evening. You will be amazed at how much freedom this tool alone will give you. I can access the key components of all 18 streams from anywhere there is an Internet connection.

My experience has been that a good 90% of all our trouble calls can be resolved with a quick hop onto the VPN.

WHEN LOSING IS WINNING

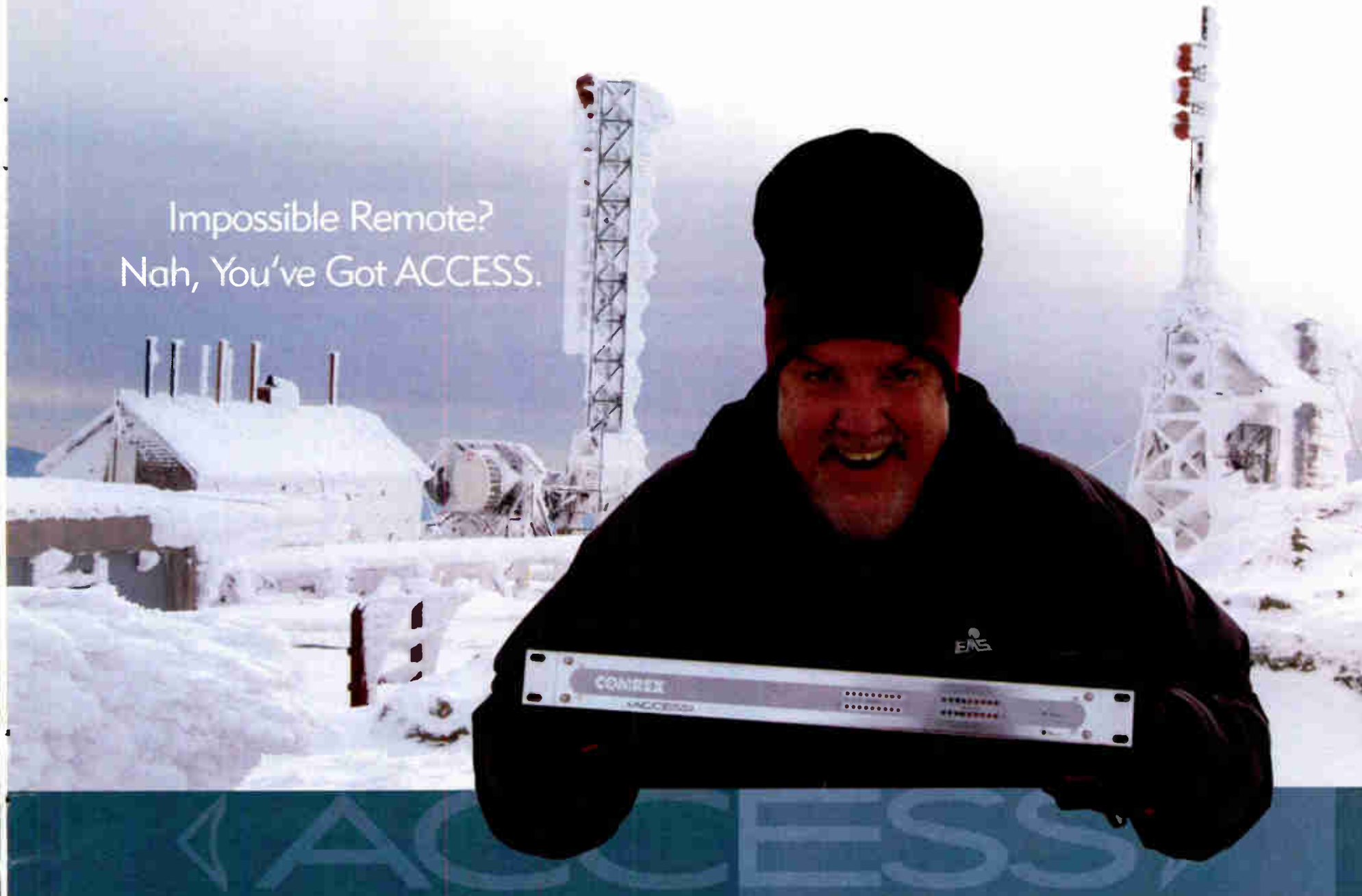
Finally, give your engineering staff the training and tools that they need to take some of the burden off of you.

The greatest accomplishment a manger can have is to lose an employee because he or she grew out of the position and is ready to step up. That may sound backwards, but it really is not.

A successful manager always surrounds themselves with smart people. I have no doubt in my mind that I could go on vacation, turn my phone off, and come back without missing a beat, because my guys are on the job. That can only come from taking the time to train and supervise them well.

Today's engineering manager has more responsibilities than ever. Fortunately, technology has gotten better, resulting in more reliable equipment and more tools to get the job done. In the end, it is all about working smarter, not working harder!

Chris Tarr, CBRE, CBNT, is the Director of Engineering for Entercom in Milwaukee and Madison, WI. While it might be hard to predict exactly where he is on any given day, you can contact Chris at ctarr@entercom.com



Meet Some Real-World Super Heroes...

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

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RF Guide

by Clarence Beverage

AM Directional Antenna Pattern Verification Advances

On May 23, 2007 the FCC Released a Public Notice titled "Comment Sought on Proposed Rules Permitting Antenna Modeling to Verify AM Directional Antenna Performance, MM Docket No. 93-177." This is a significant development for existing and future AM station licensees and, if the proposed new Rules are implemented, should have a substantial impact on the broadcast engineering community.

A LONG STANDING DOCKET

In June of 1999, the FCC released an NPRM in MM Docket No. 93-177. This put forth the proposition that a directional antenna proof of performance might not be necessary if an antenna system was adjusted pursuant to Numerical Electromagnetics Code (NEC) "moment method" analysis. Numerous comments, pro and con, were filed in response to the inquiry.

However, in the Report and Order released in March of 2001, the FCC stated *"... we believe that it is premature to take any action on the use of certain computer modeling methods to verify directional stations' operating parameters. We also seek additional comments on these methods."*

Meanwhile, it would seem that most everyone who is involved in adjusting and maintaining directional antenna systems would agree that the current process of taking and analyzing radial field strength measurements is time consuming and expensive. In many areas of the country, ongoing construction and urbanization make interpretation of new measurement data problematic and render historical measurement data used as a reference for correct pattern adjustment less than meaningful.

BACK TO THE FOREGROUND

These facts – coupled with a shortage of qualified AM field personnel, a desire by many stations to upgrade or refurbish their existing directional facilities, and a significant number of new construction permits to be implemented around the country – have led to a renewed interest in computer modeling as a tool to verify AM directional antenna performance.

In the fall of 2006, a group of consulting engineers, broadcasters, and manufacturers met at NAB headquarters, and continued to meet through the spring of 2007. NAB did not sponsor the meetings but did provide facilitation, meeting space, and administrative support.

The ad-hoc meetings provided an opportunity for engineers who are expert with AM directional antenna design and/or maintenance to share ideas regarding improvements to the science and provided material which individuals or organizations that wished to submit comments to the FCC relating to discussions and recommendations derived from the meetings could utilize. Because the meetings were unsponsored, FCC staff could participate in the discussions without showing bias to any particular agenda.

THE AMDAPV COALITION

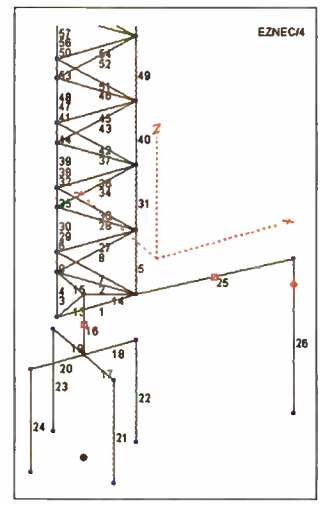
Participants in the group who wished to file a request with the FCC to reopen the discussion on computer modeling became known as "The AM Directional Antenna Performance Verification Coalition" (Coalition).

The Coalition then filed a request with the FCC on May 4, 2007 requesting that a set of proposed Rule changes be considered and the proceeding be reopened for public comment. The FCC's May 23rd Public Notice acknowledges the Coalition's filing and sets July 23, 2007 as the date for filing comments.

Here is what the Coalition proposed.

• Giving broadcasters the choice of licensing a directional antenna system using, 1) the traditional proof of performance employing field strength measurements, or, 2) computer modeling and sample system verification.

• Stations choosing to use computer modeling would be required to model each element of the directional array using a method of moments computer program in a manner that does not violate any of the constraints of the computer program used. *This wording gives the engineer the flexibility to use known NEC or Mininec based programs.*



(For those unfamiliar with "method of moments" programs, a partial representative wire model, created by Grant Bingeman, using EZNEC Pro, NEC-4, is shown. A program widely in use today for broadcast tower analysis is MININEC Broadcast Professional.)

• The computer model will be used to generate a set of drive impedances and sample system parameter values which, when verified by comparison to measured base impedance matrix data, will be used to determine the required antenna monitor setup parameters. Very specific requirements for sampling system documentation and accuracy are proposed including a requirement that each sample line be equal in both length and impedance. Tower spacing and orientation must be certified by a qualified professional.

• Reference field strength measurement locations are proposed to be established at certain directions corresponding to pattern minimum and maximum radiation. Since pattern adjustment is based on a very well-defined and stable system, the integrity of that system is proposed to be recertified every two years.

In the author's opinion, the very act of discussing and moving forward to perfect the methods proposed is beneficial to our industry. As with all technology changes, new and improved methods and test equipment will undoubtedly appear, further enhancing our ability to properly quantify DA pattern operation.

Clarence M. Beverage. of Communications Technologies, Inc., first began his career as a Broadcast Engineering Consultant in 1975. Questions relating to issues addressed in this article may be sent to cbeverage@commtechrf.com

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Tech Support Forum

by Jeff Welton, Nautel

Seeking and Delivering the Right Level of Tech Support

What do you consider sufficient levels of support from the folks on the other end of the phone when it comes to helping you stay on-air and legal? Jeff Welton was surprised at the responses he got to this question, especially regarding how they relate to the types of calls he has actually experienced during 16-1/2 years of providing technical support.

I recently asked a group of engineers on the BROADCAST Internet mailing list (at www.radiolists.net) just what they expect from technical support when they call the factory. The responses were several and varied from "whatever support is necessary" to "providing support should be limited to what a reasonably competent and experienced engineer might know, or be able to easily learn."

In a separate on-line conversation about a month after that, it became apparent to me that the issue of "how much is enough and how much is *too much*" regarding technical support expectations is not specific to us at Nautel and affects all manufacturers, broadcasters, and station/contract engineers. In fact, there are some very specific concerns which vary from one manufacturer to another, depending on equipment design and operating conditions.

With more programming and IT folks – even managers – who do not understand electronics calling for help when a transmitter goes off, we find ourselves balancing between wanting to help get stations back on the air and not wanting to harm someone in the process.

KNOW YOUR TRANSMITTER

As Nautel only makes solid state transmitters, the voltages tend to be much lower than in a tube transmitter and my tips are based on that model. But be aware that when working on tube transmitters, judicious use of the shorting stick is not a recommendation, but a *requirement which can directly affect your life-span.* If you do not know what a shorting stick is nor how to use it, make sure you tell the tech support person right away.

On that note, it is time to sharpen your crayons and jot down a note or two about what you can do to help us help you.

The first thing that comes to mind for me when we are talking about maximizing the return from the support experience is that it really helps the support person if they know what equipment they are supporting. In these days of changing call signs and corporate structures, sometimes the only constant is the serial number label on the back of the equipment. With that serial number, we can tell every module that was shipped in a particular box, as well as having access to the entire failure history of that unit.

Nevertheless, it is surprising how many calls we get where the caller is nowhere near the unit and has no idea as to what serial number is on the box. To counteract that, we have had to build a searchable database of equipment that allows us to look for any of several identifiers – frequency, power level, city, engineer name and the like. Even with that, the first five minutes of a call are frequently wasted trying to determine exactly what we are working on.

THE RIGHT INFORMATION

I suggest that having a list of equipment at each transmitter site, identified by serial number, would speed up the support process and allow much more efficient service. We do not necessarily need to know how you refer to the station (after all, "Jammin'96," "TalkRadio," or a call sign are all just labels), but knowing the equipment serial number will allow us to immediately get to the service history of the unit.

In addition, we are told quite frequently that either the manuals are not on the site at all – or they have been damaged by rodents. A lot of times helping you can be made more efficient if the support tech is able to walk the caller through the schematics of the equipment, allowing them to anticipate the next steps and frequently finding the problem on their own, based on our assessment of the circuit they should be troubleshooting.

Support techs like Nautel's Scott MacLeod can more easily help callers solve problems when they know exactly what gear is involved.

I usually recommend the set of paper manuals on site be placed inside a sealed container (raiding the Tupperware cupboard at home frequently works for this!). In sites where there is a computer with CD-ROM available, an electronic copy is useful, but it is much easier to page through a printed manual and add notes or measurements to the schematics.

Keep in mind, too, that while we can provide electronic manuals for newer equipment in an email at no charge, spare paper copies frequently come with a price, so protect the ones that are shipped with your equipment.

BE ON SITE

Very often we will get a call from an engineer (or worse – a non-technical person) who is nowhere near the equipment. The call usually starts with the comment that they are having a transmitter problem but are two hours from the site; could we provide ideas regarding the possible causes?

Sometimes they will then describe symptoms based upon what is being heard off-air or telling us which alarms are being reported by the remote control. Frequently all they know is that the audio is distorted, that there are spurs, or that it is completely off the air. Pressing a support tech to guess as to possible causes and solutions without having the information required to make an accurate diagnosis actually slows the support process down, rather than speeding it up.

If I have a choice, I would prefer that you wait until somebody – anybody – who can read the meters and alarm indications is at the site. Knowing exactly what the front panel meters are reading and what red lights are lit usually gives us a clear indication of what might be going on.

Telling us you are off the air and asking what could be causing that is not going to get you a useful response, unless you are looking for an explanation like the venerable: "No one has ever reported that before" (or the tech yields to the temptation to say something about an alien spaceship landing on the transmitter building and causing VSWR trips just prior to an abduction).

THE RIGHT TOOLS

It also is important to send the right person to the transmitter for troubleshooting – and ensure they have the right tools at hand. Many times we will get a call from a DJ/PD/GM at a small market station who is standing in front of a box that is off-air with nothing more than a low quality voltmeter and a multi-tool.

While we can frequently lead such an individual through the basic troubleshooting process to a point where we can get something on air, just as frequently we will have to tell him that more equipment or skilled personnel are required to identify the nature of the problem (including test equipment such as an oscilloscope or a proper tool kit).

As the customer is under a lot of pressure due to the lack of product being delivered to the listening audience, this can lead to frustrations that could have been avoided if either the site or the person making the call was better equipped. To that end, we have recommended a minimum list of tools and equipment that should be on hand before the customer picks up the phone, in order to speed up the troubleshooting of the unit and to reduce the tension/frustration on their end.

(Continued on Page 10)

Meet The New Innkeepers (they're a very functional family)

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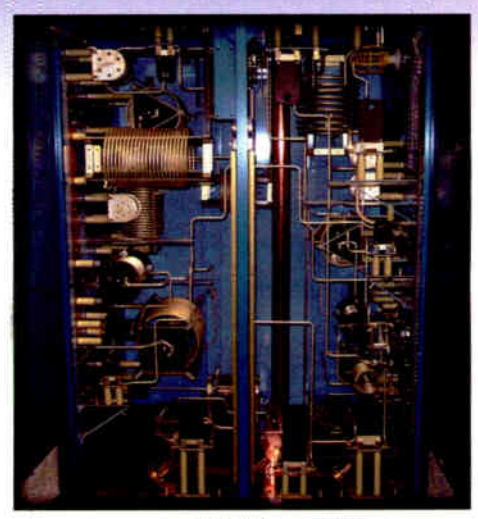

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Tech Support Forum

by Jeff Welton

Continued from Page 8

THE LIMITS OF TECH SUPPORT

As stations move to contract engineers or regional engineering departments that may be based in a different city, we are getting more and more calls from non-technical personnel regarding transmitter problems.

The result is that our techs are frequently put in the position of having to judge the technical ability of the person making the call, in order to determine whether or not they are a hazard to the equipment *or to themselves*. Quite often, despite their protests, we have to tell them that it is time to get a qualified engineer to finish the troubleshooting job.

This can happen for a variety of reasons. In addition to the obvious safety issues, there are several reasons why we will not recommend somebody going into, for example, an AC power supply cabinet, if we do not think they could do it safely.

Remember, transmitters consume a lot of electricity and convert most of it into RF – and there are several points inside that box where you can come in contact with that electricity if you do not know how to take the basic precautions. In addition to shortening your life expectancy, it is hard on the equipment!

BEING SAFETY CONSCIOUS

If a service tech tells you it is time to get some additional assistance on-site, that tech is working on the old premise that nobody ever died from a lack of rock and roll – but more than a few have died from electric shock and/or RF burns.

We find that we often have to remember to provide cautions that would be obvious to a trained engineer: things like switching off the transmitter *and* the wall breaker *before* you use the shorting stick on the RF output network of an AM transmitter. These are so clearly based on clear, common sense that it could be easy to forget to warn the person on the other end of the phone. Fortunately, we got the message and are quick to offer frequent warnings during tech support calls.

Furthermore, we will occasionally tell a caller that the transmitter simply is going to be off-air until somebody with more training or experience can look at it. Do not be angry! If your station does not have a full-time engineer, your support tech can frequently recommend an experienced contract engineer in your region or, if all else fails, arrange a fast site visit to look it over.

BUILDING IN SAFETY

At Nautel we have tried to resolve some of the safety issues by proper design in the manufacturing process. The idea is to make certain that the only way to access areas with dangerous voltages is with a tool of some sort (screwdriver, wrench, etc.) as opposed to simply being able to open a door (interlocked or not).

Then, all our support staff are trained that the line "now go grab a #1 Phillips screwdriver" should be preceded with "make sure the transmitter is off and the breaker is open."

However, once again, there still are going to be times when we will not make statement number one, let alone number two. This will be if we feel that you could be exposing yourself to a situation that you are not ready to handle. Station staff should view this positively. We are not unwilling to help, we just want you to survive the process.

GETTING THE BEST SUPPORT

So to summarize, if you have to call tech support, you will find the call much more efficient if you have the following information at hand:

- The serial number of the equipment.
- A summary of the symptoms and alarm indications. (This does require a physical presence at the site.)
- Tools and test equipment necessary for troubleshooting. At the minimum, a decent set of screwdrivers and wrenches, a good multimeter and, very possibly, an oscilloscope for off-air calls of any nature. For calls related to HD Radio systems, a laptop computer and RJ45 cable will also frequently speed up the process.
- If no skilled engineer is immediately available, one should be notified that their presence may be required, should we determine that your safety (or equipment) is at risk based on our assessment of your skill level.
- All the pertinent technical manuals!

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A frequent contributor to ***Radio Guide****, Jeff Welton spent 16-1/2 years in the Technical and Field Support Department, prior to be promoted to Technical Sales Representative at Nautel Ltd. You can contact him at jwelton@nautel.com*

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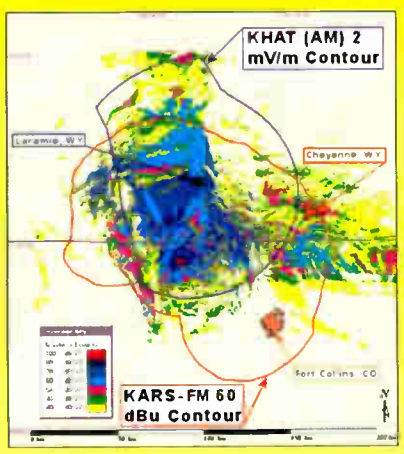

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FCC Focus

by Laura Mizrahi

Planning for the Future
The Upcoming NCE-FM Filing Window

If you are in this business and not living under a rock, you are no doubt aware that there is an imminent filing window regarding new or major changes for non-commercial FM facilities. It is scheduled to be open October 12th through October 19th, 2007.

A LONG WAIT

Some seven years have elapsed since April 2000, when the Commission imposed a freeze on the filing of all new or major change NCE-FM applications. There is, understandably, a great deal of interest and excitement being generated by this upcoming opportunity, and one can assume many applications will be filed during the window.

The implications of this filing window will, of course, vary based upon the perspective of the individual broadcaster, or hopeful broadcaster-to-be.

So, what should you be doing, either as an existing or potential broadcaster, in preparation for this filing window? The following questions, suggestions and examples may help you focus on how to make the most of the less than five months remaining before the feeding frenzy begins.

RULE CHANGE FOR EXISTING BROADCASTERS

In its Biennial Regulatory Review – Streamlining of Radio Technical Rules in Parts 73 and 74, MM Docket No. 98-93, First and Second Reports and Order released March 30, 1999 and November 1, 2000, respectively (which complete Rules became effective December 20, 2000), the Commission adopted a number of Rule changes which will be beneficial to the non-commercial FM broadcaster.

Among these changes was the modification of Section 73.509 – the portion of the Rules associated with non-commercial FM full service facilities. It now specifies using the less restrictive 100 dBu interfering contour (in lieu of the prior 80 dBu interfering contour) in overlap studies involving second-adjacent channel relationship NCE-FM (and FM translator) stations in the reserved portion of the FM band.

Adoption of this Rule change has brought the processing of non-commercial proposals in line with the processing standards in effect for commercial FM stations, with the interference ratio for predicting prohibited overlap for second adjacent stations to +40 dB from the prior +20 dB.

In addition to providing a common interference prediction standard between the commercial and non-commercial FM services, the adoption of this less preclusive standard was expected to create potential opportunities for NCE-FM (and FM translator) stations to increase power and coverage, as well as provide them with greater site selection flexibility.

GETTING AHEAD OF THE WINDOW

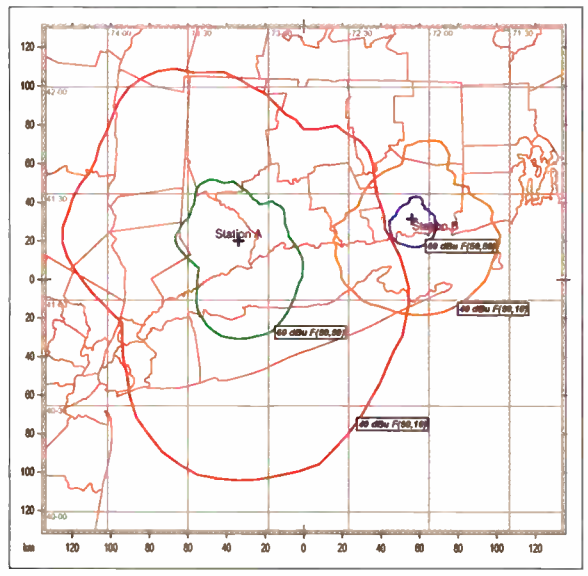
While a number of broadcasters were quick to jump at this favorable combination of circumstances to explore their ability to possibly enhance the extent of their facility's signal, it is unlikely that all existing stations have benefited from a study in this regard.

For example, in conjunction with this Rule modification, a number of facilities have moved to an adjacent frequency, changing what may have previously been, say, a co-channel allocation relationship to a first, second or even third-adjacent one. If such an allocation change has occurred in your area during the intervening time period, it is possible that your station's coverage area could be extended.

An example of how this second scenario could be advantageous is depicted in **Figures 1 and 2**.

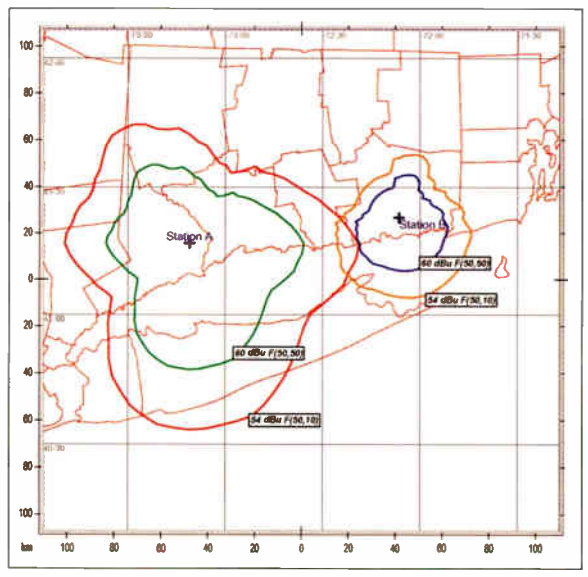
A SIMPLE EXAMPLE

Figure 1 shows Station A and Station B in their prior co-channel relationship, where the respective 40 dBu interfering contours could not overlap the protected 60 dBu contours of either station.



Two co-channel stations, with Station A limiting Station B's options.

When the Rule changes permitted Station B to file an application to specify a first-adjacent channel change from Station A, the resulting mutual interfering contour now becomes the less restrictive 54 dBu. As shown in **Figure 2**, this relaxation of the interference protection requirements permits both facilities to extend their signals in each other's direction as long as no new overlap is created. (It should be noted that Station A employs a directional antenna pattern while Station B does not; the variations in Station B's antenna pattern are strictly terrain induced).



With Station B moving one channel, both stations can improve their coverage.

Obviously, such a change is more beneficial and worth the associated engineering and legal fees in situations where the extended signal covers a significant population. In some instances the additional population could number easily into the thousands.

Therefore, as the NCE-FM filing window approaches, it would be prudent for existing NCE-FM broadcasters to ask their consulting engineer to review their station, or stations, to determine if any optimization under the current Rules is possible. Once the window opens, many of these options will be lost to the industrious potential new broadcaster who has been diligent (or lucky) enough to have ferreted out a "hole" in the spectrum – and forever precluding an improved signal for the existing station.

PREPARING FOR THE WINDOW

Of course, it should not be assumed that only potential *new* broadcasters will be taking advantage of this upcoming opportunity. Existing broadcasters will move to protect their commodity. And this is a word to the wise for the broadcasting neophyte – a large number of existing station owners are already beginning to explore new facility possibilities and preparing applications well in advance of the October 19, 2007 deadline.

Given the existing broadcaster's savvy in these matters, those hopeful to join their ranks must begin the exhaustive study process as far in advance of the deadline as possible. This means engaging the services of a qualified consulting engineer and FCC attorney *now*, as many firms will likely find themselves in a conflict of interest mode with those clients who have begun the process early and expressed an interest in a specific geographic location.

Once you have obtained the required technical and legal expertise, the most helpful information you can provide your consultant in the first phase of the project, the in-depth allocation study, is the coverage criteria most important to you. But it is also important to be realistic; even the most talented of consultants cannot create a facility opportunity located within highly populated urban geographic areas such as New York City, NY, Los Angeles, CA or Chicago, IL.

It may be possible, in some less densely populated vicinities, to uncover an allocation opening that may be able, with a creative engineering design, to provide secondary service to a more highly populated area. However, such studies are complex and have the greatest possibility of success when the consultant is given a significant amount of lead time.

THE POINT SYSTEM

Part of what led to the prior seven-year freeze was the fact that, in the early 1990's, the previously utilized comparative hearing process (which had been used to decide between mutually exclusive, or "mx'd" applications), was abolished by law as having been "arbitrary and capricious."

Several attempts by the Commission to establish an alternative process by which such a decision could be made were unsuccessful, until the year 2000, when a new "points system" was adopted by the Commission for this purpose. The system, as the name implies, awards points to each applicant based on the merits of both its technical and legal proposal, or proposals. Hence, it is in an applicant's best interest to try and fashion its application in the most favorable way, taking into account the points system as it currently exists.

Finally, given the length of the intervening time period since applications of this nature were last accepted, it should be assumed that there will be a large volume of applications filed. Thus, filing multiple applications for various locations may enhance your chances of successfully being awarded a construction permit in this filing window.

At the same time, although there has been some talk that the Commission is considering limiting the number of applications any one party may file, at the time this was written there has been no action in this regard.

Whether you are planning to file during the upcoming window or wondering if you have room to improve your existing station, it is well worth your time and effort to seek an opinion from your consulting engineer as soon as possible.

Laura Mizrahi, of Communications Technologies, Inc., has been involved in broadcast consulting engineering for over 20 years. Questions of a broadcast technical nature can be sent to lmizrahi@commtechrf.com

Studio Guide

by George Zahn

Your Air Studio Microphone, Your Sound, Your Brand

Is a microphone just a microphone – whatever is at hand will work? As George Zahn shows, there is good reason to give serious thought to which microphone you install in your control and production rooms.

It is one of those devices used in every air studio hundreds of times every day, yet most of the time we take it as much for granted as the pen and paper we use to jot down the temperature for the next break (or the forecast and temperature on the computer screen for those using more updated technology).

Yes, I mean the microphone.

All too often, when asked why they use a particular microphone in the control room, many simply answer: "That's the one we've always used." Or, perhaps the answer might be, "It was the microphone on 'sale' the week we bought the studio equipment," or "We got a great deal on it, so we just grabbed one."

If this describes microphone selection at your facility, please read on, there are some things you should know.

TALKING ABOUT FAMILY

This month, it is time to take measure of your primary air studio microphone.

Over the past months, we have discussed the microphone families and detailed the similarities between microphones in each of the three main families – dynamic, condenser, and ribbon microphones. Now it is time to meet a few of the individual family members and to dispel the theory that a dynamic microphone by any other name is basically a dynamic microphone.

Do you have an Electro-Voice RE27 or a Shure SM7B? If you are going to HD radio, do you upgrade to a condenser such as Shure KSM27 on an Electro-Voice Blue microphone? What about tube microphones? If your reaction is "Who cares?" you may not be maximizing your on-air sound.

Just as you would not show up to a job interview with muddy shoes, a muddy microphone can make a terrible first impression to a listener. Processing can help a bad microphone to some extent, but you really only can do so much to improve intelligibility.

This article is not going to try to tell you what microphone to choose for your air studio, but rather to get you to listen closely – and then to *think about what you hear.*

POPULAR DYNAMICS

We begin with a survey of control room microphones by considering dynamic models, since they constitute a majority of the on-air microphones for radio because of their lower cost and durability.

One of the first considerations is that a dynamic microphone made by one company is not going to sound the same as one made by another. In fact, even within the same manufacturer's offerings, two different microphone models will have different frequency response, transient response, and overall performance.

However, any two examples of the same make/model can have slight changes in performance. For that reason, recording studios that use two identical microphone models for stereo microphone techniques place a premium on getting sequentially serial-numbered microphones to ensure that the two microphones are as closely matched as possible.

The internal factors that create the difference include the size of the diaphragm which vibrates to the sound waves created by your announcers, the internal electronics, design, and quality of the workmanship and materials. External factors are obviously announcers, engineers, studios, and interference.

Two of the great staples of AM broadcast, and a number of FM stations, are the products from Electro-Voice and Shure. They definitely do not have an absolute "lock" on the market – and in future articles we hope to cover some of the many alternatives from other manufacturers.

Nevertheless, we want to take a few moments to discuss some of the true favorites you are bound to find in many stations. While the Electro-Voice RE20 and the Shure SM5B have evolved into the RE27 and the SM7B, all four models can be spotted in air studios all across the country.

FYI ABOUT EV

Electro-Voice is celebrating its 80th birthday in 2007. It is now a division of Bosch, which manufactures everything from automotive technology to power tools and security systems

The Electro-Voice RE20 and RE27 both feature large diaphragms that are welcomed by deep-voiced announcers, plus the older RE20 features a single-setting bass roll-off that can be used by the few that have too much bottom end.(!)

Electro-Voice RE27

The RE27 claims to produce a more uniform bass response to even out the exaggerated bass from working too close (the proximity effect). It allows you to mold the sound further with a high frequency attenuation that allows you to battle excess sibilance and two different bass roll-off settings to ward off the proximity effect. Both models work well without having to add large external windscreens.

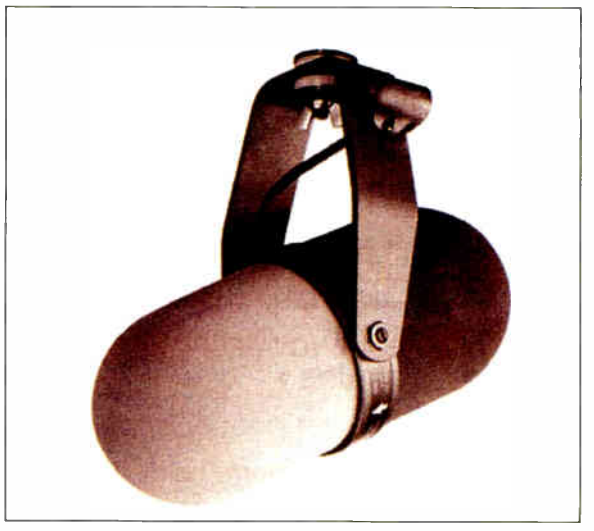
From this author's perspective, the two EV microphones in question are not the most aesthetically pleasing, although the finish on the newer RE27 is a shiny silver. The body design of both more resembles a German WWII hand grenade, but remember it is radio, so few have to look at them unless you have a webcam and, even then, they look big and official.

There are many houses that use the Electro-Voice microphones because of the bass response and yet there are some engineers who say they wish they could get a few more "brights" (or better treble response) from them. EV durability is very good, as would be expected from the maker of the famous "hammer" microphone, the Model 635A. The RE27 lists at about $860, and a quick Internet search shows street prices hovering under $500 as of this writing.

SHURE 'NUFF

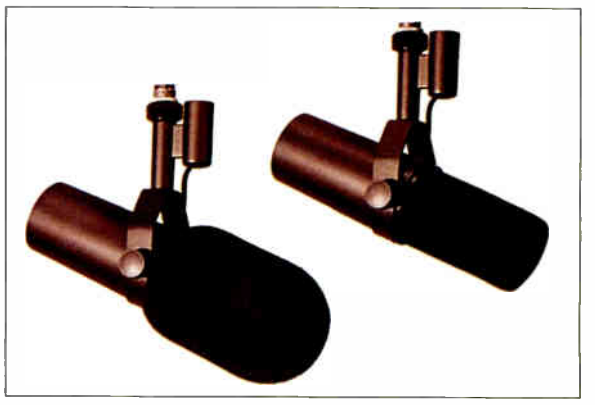
Shure has been a broadcast stalwart for decades and may be best known for its rugged and versatile sound reinforcement microphones, the SM57 and SM58.

The air studio Shure SM5B and SM7B are more defined by their large windscreens than by the appearance of the microphone itself. The SM5B resembles a time-release Contac cold capsule.



A long time favorite, the Shure SM5B.

The SM7B is less imposing, yet still boasts a large front wind screen that could hold a tornado at bay.



The Shure SM7B

The Shure products are known for their midrange frequency boost which adds presence to voice work. Their windscreens encourage announcers to work close to the microphone for plenty of bass without popping their "P's."

The SM7B also claims to have improved resistance to electromagnetic hum emitted by computer monitors which are creeping ever closer to consoles and microphones in many air studios. The 7B lists at just over $600 but can be found on the market at under $400 if you shop around.

MECHANICAL NOISE PROTECTION

Both the Electro-Voice and the Shure models have forms of internal shock mount protection that reduce handling noise or vibrations from those nasty springs on the boom arms holding the microphones in many studios. Furthermore, these microphones feature cardioid response, providing good rear and side rejection.

In looking at the specifications, the Electro-Voice and the Shure models all appear to be pretty good options with somewhat similar features. So why make the fuss over which one of them – or even another microphone – would make the best on-air product for your station?

It is a matter of your sound or, in today's marketing parlance, your brand.

The first thing we learn about microphones is that they are subjective choices. The choice, however, should be made on the sound you are creating, not merely based on what is on sale.

A TALE OF TWO COMPANIES

Here is a quick side note on the website research that was part of preparation for this article. A visit to

(Continued on Page 16)

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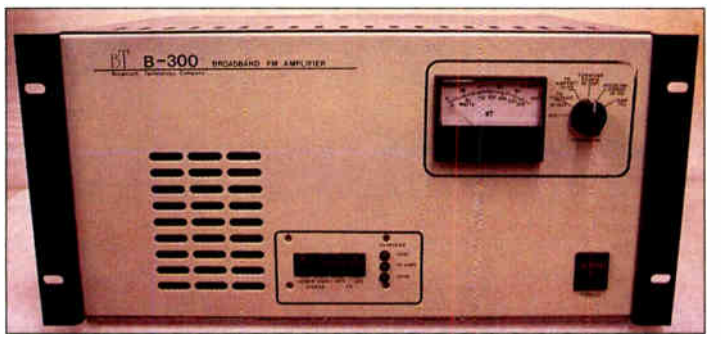

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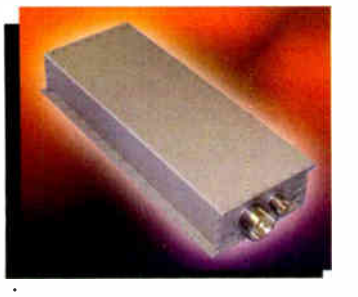

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HD READY

Studio Guide

by George Zahn

Continued from Page 14

www.electrovoice.com forces you to dig a bit to get to their broadcast microphones which are still prevalent in so many broadcast circles.

Judging solely from their website, Electro-Voice is gearing much more to live reinforcement and music, wireless microphones, television, and turnkey audio applications. The site features a link to their "old site" which features more of the broadcast and "wired microphones" as they put it.

Rest assured, by sheer numbers, EV products look to be in the market for years to come, but if their website is any indication, there is currently less emphasis on the broadcast spectrum than in previous versions of the site. It may well still be a work in progress.

Conversely, a visit to www.shure.com allows you to quickly link right to the company's "wired microphone" selections.

NIX THE MIX

If you are building a new studio or rebuilding an older one, starting over with new microphones, see if you can borrow a loaner or two of the models you are trying to make a decision about. If you have good relations with a broadcast supply company, they have an incentive to loan you a microphone or two if there is a potential sale involved.

Avoid unnecessary mixing of microphones. If you have microphones set up for interview purposes in your air studio, try not to end up with one brand as your announcer microphone and different brands around the table, unless they are used for picking up musical instruments during the interview – in which case you indeed may need different types of microphones.

The reason for this advice is that such a setup will likely affect your on-air sound adversely whenever more than one microphone is open on the air. Furthermore, multiple models of interview microphones look sloppy to guests coming into the studio.

So, try to stick with a single model and style of microphone. This makes swapping microphones – be it for an emergency or pulling an extra microphone from the production studio to the air studio when you need to handle a large interview – less likely to make a dramatic difference in your on-air product.

Standardizing on one make and model may not be the easiest nor cheapest solution but it is consistent, and our listeners hear more than we might give them credit for. Do not shortchange your announcers or listeners by saving a little bit on "whatever's on sale this week."

MEETING THE CHALLENGES AHEAD

Here are some of the questions that managers, program directors and engineers battle from time to time. We plan to focus on these in upcoming:

- With the migration of many stations to HD radio, has your station felt the need to switch to a condenser – or maybe even a ribbon microphone – for your announcers? (This certainly could become somewhat more costly if you plan consistency with the microphone models in your studios.)
- If your station is splitting bandwidth in HD, are you scaling back the quality of the microphones because of even more limited frequency response?
- If you are not using one of the Electro-Voice or Shure products (and there are a number of wonderful alternatives), what works for you, and why did you make your choice of microphones?
- How has your station created a consensus between programming, announcers, and engineers on selecting microphones?
- Do you find it necessary to have two different studios, each featuring different microphones?
- Just as NASCAR has a Car of Tomorrow, what would your Microphone of Tomorrow feature?

Let us know what works for you and your station or network, and share some tips or trends that you are encountering. You feedback is welcomed. Please send an e-mail to George Zahn at gzahn@lifesphere.org

Field Guide

by Steve Walker
Radio One – Dallas

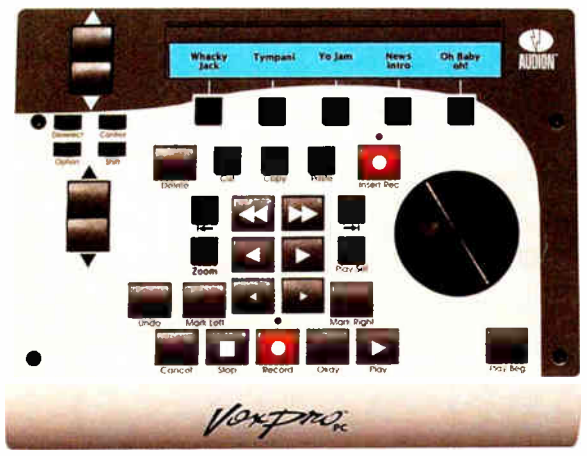
VoxPro PC User Report

VoxPro PC is a great system for on-the-fly editing of phoners and other material in the control room. And if that were not enough, our jocks love it.

A WELL-DEVELOPED SYSTEM

VoxPro is not new to radio stations. While many stations were still editing phone calls on Otari's and MCI's and Teac's, stations that wanted to stay up with technology were using the Mac version of VoxPro as early as 1994. This was considered by many to be the apex of editing systems.

VoxPro was the brainchild of Charlie Brown (no, not that one), of the *Charlie and Ty* morning show on Top 40 KUBE in Seattle. He proposed a digital audio editing system to Mac developer – and future Audion Labs partner – Buzz Hill. The rest is history.



The VoxPro control panel.

The system consists of a software component to run on your own computer, and an optional hardware control panel. The software does the real work. But it is the control panel that, according to the jocks, is the VoxPro.

GETTING BETTER AND BETTER

The four VoxPro systems we have for our two stations in Dallas are some of the most reliable pieces of software/hardware we use. Of course, like any growing, maturing product, there were some bumps along the way.

First introduced at the Spring NAB in 2001, the PC version of VoxPro has undergone major changes over the years, all for the better. For example, I have not-so-fond memories of coming to the station on the weekend, to crawl on my hands and knees under the furniture and pull the plug on the control panel, to cycle the power and reset it because the "Reset" button in the software often did not work. Once I tried to talk one of the jocks through that process over the phone and he ended up unplugging the monitor for the digital media system – oops!

The current version of VoxPro PC has a power button on the back of the control panel to make it easy to power cycle the unit, but we seldom use it because the hardware just does not lock up anymore.

All our studio computers are installed downstairs about 100-150 feet away from the studio core. We used the RS-232 version of the control panel (there is a USB version, too) and, with RS-232 extenders, used the Cat 5 cabling running from the TOC to the studio core to carry the control panel signals upstairs. If this was contributing to our control panel lockups early on, it definitely is not a problem now. We have not changed the wiring, but we did upgrade the software, and I think version 4.1 fixed that problem.

WORKING TOGETHER

With four systems, we need to be able to share files between VoxPros and the production room ProTools and Adobe Audition computers. This is easily accomplished with VoxPro's virtually bulletproof networking capabilities.

Prior to version 4.0, networking in VoxPro seemed a bit like an afterthought - you had to have a machine designated as the VoxPro Network Coordinator and, if that machine lost connectivity for whatever reason or did not have the network plug-in running, the other machines were on their own.

Current versions use something called Auto-Network, which simply means that if you plug a new VoxPro into an existing VoxPro network, it and the existing machines all will find each other and become happy immediately. And multiple machines can open the same user account at the same time, a welcome addition when you have a morning show production person who wants to start cutting audio before the morning show is even over.

RESPONSIVE TO USERS

One thing that strikes me about Audion Labs is that they respond to their users.

Take the control panel for example. When users clamored for a feature that was present on the original Mac control panel but missing on the PC control panel, the vertical array of six scrub buttons (forward and reverse at three different speeds) was added back in a recent redesign. The shuttle ring around the jog wheel, which had taken the place of the buttons, disappeared.

Another feature that was added due to user request was the Zoom button. This allows the jocks to zoom in very tightly (about 100X) for microediting of the waveform. For the perfectionist jock, you could not ask for anything better.

With microediting, the user can make precise edits.

If you have used VoxPro before and did not like the proprietary file format, it is gone now. They use standard Windows wave files with a proprietary chunk that contains the edit data. If you rename their .vpw file to .wav, it will play just like any other .wav file in any wave file player.

Another improvement: Versions 4 and up of VoxPro PC include a robust AGC that makes it easy to keep the jock and caller tracks at consistent levels. The setup of this feature is limited to administrators, as it should be, but can be disabled by each user as needed when compression is not welcome, such as for recording music.

STILL MORE

There are a couple of additional features worth noting, though we have not used them yet at our stations: the Auto-Import and CD Ripping functions.

Auto-Import: You can choose any folder that VoxPro has access to and the system will check that folder every 30 seconds for any incoming media files. If a file is detected it automatically gets "sucked-up" and into the user's current folder.

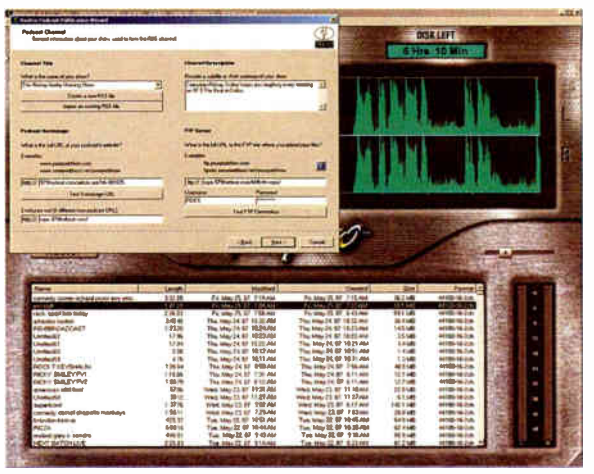
CD Ripping: You can quickly rip CDs with VoxPro, then import the files for editing or conversion to MP3 format.

PODCAST READY

We have recently begun using VoxPro for a new task. When Radio One corporate decided to increase the Internet penetration of their radio stations, we needed to come up with a foolproof way to create podcasts for the web. Our jocks and production personnel are already so overloaded, in many cases, that we needed something that would be easy to learn without them needing to understand HTML, XML, RSS and all that other geeky stuff.

We also had a webmaster with a full plate, and did not want him to have to be involved in the podcasting, except for creating the initial graphics for the webpage. Routine uploading of audio and modifications of the feed page were to be accomplished without his daily intervention. And it would not hurt if we could use equipment and software that most of our stations used already.

VoxPro turned out to be the answer. Beginning with version 4, VoxPro includes a podcast publication wizard that makes the whole thing a no-brainer. Our jocks or production guys can take a file created in VoxPro – or any other editing package – and step through the complete podcast publishing process in less than a minute (for a typical size podcast item).



Publishing a podcast is easy with VoxPro.

VoxPro compresses the audio to MP3 format if necessary, allows users to enter a title for each item (as well as ID3 and iTunes tags), reads the current XML file into memory, adds the new item to it, and uploads the modified file and the new audio file to our station website's ftp server, all automatically after initial setup.

(There is an undocumented feature in the latest build of VoxPro, too: if you want to use it to upload video podcasts, just make sure the file is an MP4 with the correct extension and VoxPro will publish it for you just like any audio podcast item.)

When we found some problems with the podcast publishing process, Audion was relatively quick to fix the bugs or add needed features and get out a maintenance release. This attention to users' needs, as in the control panel and software modifications already mentioned, make Audion Labs a company I would not hesitate to trade with in the future.

For additional information, you can visit the Audion Labs website: www.audionlabs.com, or call them at 206-842-5202. You will not be disappointed.

Steve Walker is the Assistant Chief Engineer for Radio One in Dallas, TX. You can contact Steve at swalker@radio-one.com

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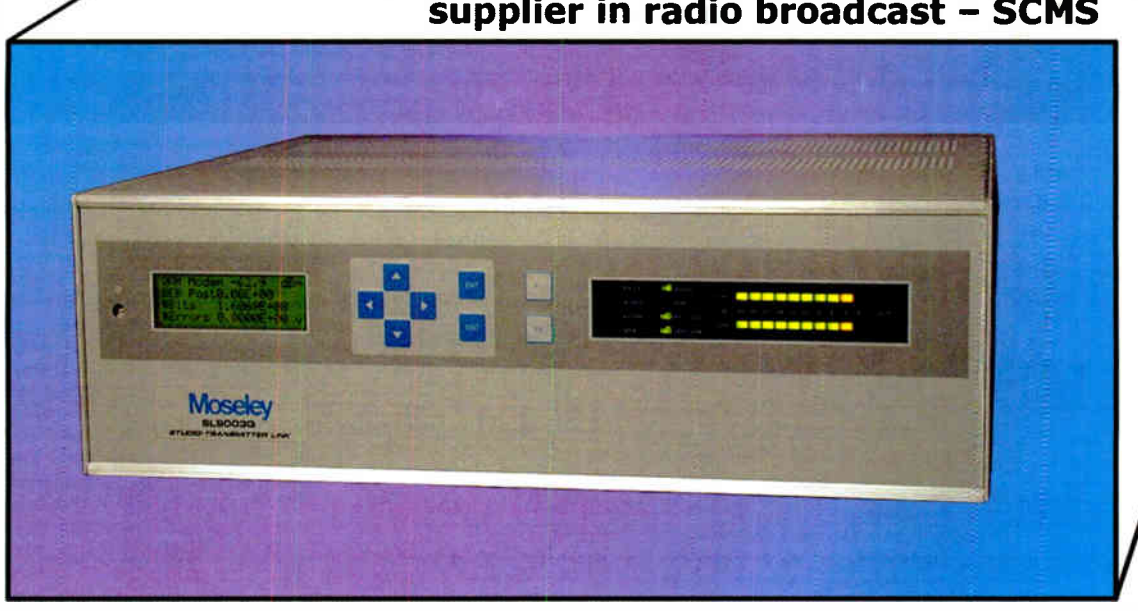

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Processing Guide

by Jim Somich

Processing: Yesterday, Today, and Tomorrow

Part 5: On the Edge of the Future

Understanding audio processing is a combination of electronics, history, and art. Creating a station's "sound" brings these concepts together; digital signal processing adds yet more options and flexibility. As Jim Somich writes, our ability to comprehend the totality of what is going on is essential to producing good audio that attracts listeners.

In the Good Ol' Days, it was relatively simple to physically modify a processor to change the sound in various ways. Hundreds of engineers had resistors and capacitors tacked on inside their Audimaxes and DAPs.

Each of these engineers felt they achieved something that the designer overlooked.

A DIFFERENT PLAYING FIELD

On the other hand, a DSP box is a computer and therefore it is not very simple to make major physical changes in the components.

Furthermore, as things stand today, the end user has no access to the software, except for the adjustments or presets permitted by the manufacturer. (This is an issue we will address more directly in a bit.)

And there is one more major change evident. Unlike in the past, the sound of today's stations is often created by non-technical types: consultants and program directors. The engineer may have some input, but he is no longer the decider when it comes to the final sound of the station.

PROCESSING BY PDS AND CONSULTANTS

This is not necessarily bad if the people making the decisions have a great set of ears and know what they want. Unfortunately, too often they have neither. It is then the job of the engineer to educate – and this can result in some contentious confrontations.

Some consultants just want to duplicate the sound of a station that "worked for them." Sadly, many PDs get involved in "pi**ing contests" that help no one, by destroying the sound of their station and forcing the competition to do the same. (I actually have worked with programmers who purposely destroyed the sound of their station, thereby "forcing" the competition to do the same or get lost in the noise. That is no way to run a radio station!)

Rabid button-pushing is no way to compare your station with the competition. That went out with manually tuned radios. And, unless the very same CD is being played, it is usually a pointless comparison anyway.

ONE STEP FORWARD, ONE STEP BACKWARD

Years ago Bob Orban remarked that the entertainment industry was the only business he knew of that purposely degraded their product. Since that time, Orban notes that the music industry, in particular, "has started to degrade CD sound to serve the same senseless loudness-fetish that has haunted broadcast signal processing for decades."

I think he has a point. Heavy-handed processing is not the same as turning up the volume. It fact, it is far worse and can, at best, severely limit your TSLs or, at worst, scare listeners away forever.

This is probably a good time to remind you that almost any audio processor can be made to sound quite good. Most designers have great ears and they usually develop processing that will please critical listeners when set up properly. But the designers have no defenses against reckless operation or setup.

A TWO-PROCESSOR WORLD

At the risk of seeming unfair to dozens of manufacturers, it is quite evident that in 2007 we live in a two-processor world.

Now, before you call me onto the carpet for making what on the surface seems like a sweeping generality, let me quickly qualify it a little bit: when it comes to top-of-the-line stations, in markets large, medium, or small, it appears that most are using DSP processors of the Orban or Omnia flavor. I think I can sum it up by stating that these companies make the best processors and they become the product of choice when cost is not a factor.

These processors set the pace for the audio processing industry.

The fact is the Orban Optimod 8500 and the Omnia-6 represent the leading edge of the state-of-the-art in 2007, yet they are two distinctly different flavors of processing. Depending on the processing strategy of your station, most often one will suit you more than the other.

Of course, you can fault any product, and certainly no processor is perfect, but these state-of-the-art DSP processors are the pinnacle of processor performance in the early 21st century.

At the same time, there are dozens of other manufacturers worldwide, all striving to enter this processor Winners' Circle. Personally, I wish them luck. The processing business can always use new ideas. To these folks I say, "build a better box and join the winners' club!"

BEYOND THE "SAFE CHOICE"

Some time ago, a computer geek immortalized himself by stating that "no one ever got fired for buying IBM."

Perhaps that sentiment might be a little dated today, but you get the idea. The top end of the processor business is a difficult club to break into. Buy an Optimod or an Omnia and your meager little paycheck is assured; you can keep your thankless job for a little while longer.

Sure, there are adventuresome souls who will put it all on the line for a "new guy" in the processing biz. But if you take a chance on Brand Z and the PD cannot get the sound he wants, you can quickly become the loneliest guy in the station. (You might even be more welcome flipping burgers at Mickey D's.) The reality is that most of us like to eat regularly and put a roof over the family's head.

None of this should be deemed a discouragement by the other manufacturers and designers. If new ideas were not useful, we would still be using those Sta-Levels and Max Brothers' units. Bob and Frank did good. And others are doing good work today. The proliferation of processors, especially those aimed at specific users – and their needs – is gratifying to see.

The challengers to the crown.

So, to all you Corny Goulds, Scott Inczs, and John Burnills out there: I hope you keep translating your aural dreams into new products. Someday, someone, will "beat the pants" off an established processor and – Shazam! – you will enter this select circle of creative engineers.

PROCESSING FOR HD RADIO

HD Radio is here – warts and all. A year ago, we were discussing processing for HD stations as "future processing" but, from the poor sound of many HD stations, the time to discuss it is right now. In highly data-compressed, coded audio systems, processing becomes even more important; it can make or break the digital sound of your station.

The worst offenders are those who use the same processing for both their analog and digital signals. One of the great advantages of HD is the lack of pre-emphasis – there is no need for heavy and fatiguing high-frequency limiting and clipping with HD. Offending stations are easy to spot: there is virtually no difference between the sound of their analog stations and digital streams.

Part of this comes from a distinct lack of attention to the digital channel, as it holds so few listeners. Yet, if HD is to capture the imagination of the listening public, many stations must start taking it more seriously. Dead air has to stop. Multiple audio sources running on top of each other have to stop.

TAKING PROPER CARE OF CODED AUDIO

It is also vitally important to avoid any form of clipping when processing coded audio. Look-ahead limiting is the answer – and it works. The processors of tomorrow will address the coded audio problem in very sophisticated ways. (Check out Frank Foti's thoughts on page 24.)

Lastly, there is no need to over-process the HD streams. Now is the time to establish a few dBs of "breathing room." We are at the dawn of digital radio and much will change in the years to come. But to insure the best possible results with today's gear, take your HD signal seriously – even if only a few people are listening right now. Think of this as a "dress rehearsal" for what is to come.

As an example of the variety of options available, many stations are using PCs with DSP cards like the Orban Optimod PC-1100. Reports from the field are that the results can be equal to using the finest dedicated hardware-platform processor. And we have not really begun exploiting the potentials for broadcasting surround-sound audio.

PROCESSING VISION AND DESIGN

With few exceptions, processors are the vision of one person. Even when multiple persons are involved, the overall focus normally has to be that of one "lead" designer.

The reason why processors designed by committee are seldom very successful is that each designer develops a personal strategy. Most of the time, this is reflected by the type of station that buys the product. The closer the processing strategy of your new box reflects your own strategy, the happier you will be with it.

(Continued on Page 22)

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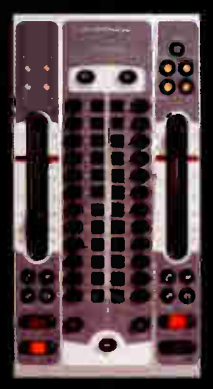

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Processing Guide

by Jim Somich

Continued from Page 20

The current Optimods are somewhat unique in this aspect: they represent a successful collaboration between Bob Orban and Greg Ogonowski. While Orban's original vision started the product line and had guided much of its growth, he credits Ogonowski with a critical part in the process.

Orban says: "I think this is very important: when there are two people involved in a design and each one respects the other's abilities, then each designer serves as a sanity check on the other and the combination brings a wider gamut of viewpoints into the design. This is particularly true with digital processors, where there may be dozens of factory presets. It is best when these are formed by the experience and taste of more than one designer."

Ogonowski's input is quite evident in the Optimod, as well as his design work on other recent Orban products, especially the Optimod PC and the Opticodec PC. These have led to some very interesting and innovative ways of bringing higher quality audio to Internet streaming using world-class standards-based MPEG-4 AAC/aacPlus audio codecs (the family of audio codecs that helped make iTunes the leading source of downloadable music).

PROCESSING STRATEGIES

As we noted at the start of this article, in the past (before DSP processors) a reasonably proficient engineer could alter the processing strategy of any box to more closely suit his needs. This was often accomplished by changing the values of certain components or by making fixed-value components variable.

On the other hand, in a DSP box, you are much more locked into the processing philosophy (strategy) of the designer. There appear to be two rather broad and somewhat overlapping strategies employed in modern day processors: consistency and aggressiveness. These strategies tend to be mutually exclusive.

The topology of a processor is usually a dead giveaway to the processing strategy in use. For example, a processor that relies more on clipping tends to be more aggressive and have a more obvious sonic signature. The same is true of a processor that uses more bands. The opposite is also true. A processor relying more on high speed limiting than clipping and has fewer bands tends to be more consistent at the expense of aggressiveness.

A sort of middle ground is emerging right now, made possible by the software: a single unit that can select between, for example, two or five band processing. Similarly, with the more powerful computer processors (CPUs) available today, it is easier to implement look-ahead-type limiting and balance it with clipping for better distortion control.

CHOOSING THE RIGHT APPROACH

All in all, the happiest customer is the one who has (wisely) selected a processor with a strategy close to his own.

Processor impressions are very personal and I am convinced that we all hear things a little differently. At the same time, all too often the choice of a processor (strategy) and the presets employed (tactics) are a committee decision. In other cases, sometimes only one person – usually the PD – has veto power over anyone else.

Of course, you can employ a processor with an aggressive strategy on a format that begs for consistency and pureness, but you will be fighting an uphill battle. There are other ways that the strategy of a processor can be morphed; the most common is to add additional processing either before or after. This was done with analog processing as well, but the procedure acquires more importance in a DSP world where all of a processor's strategy is etched in silicon.

So it would appear that this aspect is where we find the shortcomings cited by most as they work with current DSP processors. Unless you are smart enough (or lucky enough) to select a processor whose designer has a philosophy and a strategy like your own, you will always be a little unhappy with it.

Meanwhile, there are a quite a few engineers and programmers with new and different processing philosophies, each of whom would like a stab at trying something a little different. Next time we will don our robes, get the crystal ball out of the closet, and prognosticate about the future.

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

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

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It's not rude to point • Little kids tell mommy what they want by pointing – a pretty intuitive way of doing things. PathfinderPC software gives talent the same convenience. You can **build custom "button panels"** to execute complex operations with just one click. You can map these panels to controller modules on Element consoles or to turret mounted controls, place mini-applications on studio computer screens, even run them on touchscreen monitors.

Automation station • Wouldn't it be cool to have a **self-monitoring air chain with silence sense** that can fix problems then e-mail a status report? To be able to switch your programfeed from Studio A to Studio B with one button? Or build custom switching apps and scheduled scene changes based on Boolean logic and stacking events? PathfinderPC software can do all these things and more. But unlike HAL 9000, it doesn't talk back to you.

Nothin' but Net • Did you know you can plug a PC directly into an IP Audio network to exchange audio? Can't do that with a mainframe router. Well, you could add more input cards to the mainframe, buy high-end audio cards and run more wiring – but with Axia, you just install the **IP Audio Driver** on any Windows PC to send and receive pure digital audio right through the PC's Ethernet port. No sound card required, or additional router inputs needed. The single-stream version is great for audio workstations; the multi-stream version lets you send and record **16 stereo channels simultaneously** – perfect for digital automation systems.

Put that in your pipe • How many discrete wires can a CAT-6 cable replace? Well, a T-3 data link has 44.7 Mbps of throughput. But Axia networks' Gigabit Ethernet links give 1000 Mbps of throughput between studios — more than 22 times the capacity of a T-3, enough for 250 stereo channels per link – the equivalent of a **500-pair bundle on one skinny piece of CAT-6**. Use media converters and optical fiber for even higher signal density. Think that might save a little coin in a multi-studio build-out?

Jammin' on the mic • Radio studios and microphones go together like Homer Simpson and donuts. Unfortunately, so do preamps, mic compressors, EQ boxes, de-essers — let's face it, most studios house more flying saucers than Area 51. Axia helps clean up the clutter by including mic preamps with our Microphone Nodes; not bargain-basement units either, but **studio grade preamps** with headroom enough to handle Chaka Kahn. Phantom power, too. And if you choose to use Axia Element consoles in your studios, you'll find world-class mic processing built right in: vocal dynamics (compression and de-essing) from the audio processing gurus at Omnia, plus three-band parametric EQ with SmartQ, available on every mic input. Rap on, Grandmaster.

Very logical, Captain • Routing logic with audio used to be as hard as performing the Vulcan Mind Meld. But Axia makes it simple, converting machine logic to data and pairing it with audio streams. So **logic follows audio throughout the facility** on Axia's switched Ethernet backbone. Eight assignable GPI/GPO logic* ports, each with five opto-isolated inputs/outputs are built into every Element power supply, so you can control on-air lights, monitor mutes, CD players, DAT decks, profanity delays, etc. Got more than eight audio devices? Add a GPIO node like this one wherever you've got gear.

Level headed • These green, bouncing dots built into every Axia Audio Node are confidence meters. One glance and you know whether an audio source is really active — or just playing possum.

Heavyweight champion • This Axia StudioEngine works with our Element Modular Consoles (the fastest-growing console brand in the world, by the way) to direct multiple simultaneous inputs and outputs, mix audio, apply EQ, process voice dynamics, and generate multiple mix-minuses and monitor feeds on the fly. To make sure it delivers the reliability and ultra-low latency broadcast audio demands, we powered the StudioEngine with a fast, robust version of Linux — so fast that **total input to output latency is just a few hundred microseconds**. How can one little box do so much? There's a blazingly fast Intel processor inside, with enough CPU muscle to lift a small building. Strong *and* fast. Ali would approve.

AES yes • You like your audio to stay digital as much as possible, right? We get that, our AES/EBU Audio Nodes let you plug AES3 sources right into the network. Studio-grade sample-rate converters are inside; anything from **32 kHz to 96 kHz** will work. Oh, and there are 8 AES ins & 8 AES outs in each node. Digital distribution amp, anyone?

Brains in the box • The typical radio jock cares for studio equipment about the same as a five-year-old cares for a puppy: haphazardly, if at all. That's why we **took the CPU out** of our Element modular console and put it in here, with the power supply and GPIO ports. That means a greatly reduced chance of being taken off the air by a Coke spilled into the board. Because we know that you have better things to do on a Sunday night than trying to dehumidify circuit boards with a hair dryer.

Push to play • Axia Router Selector Nodes are **really advanced selector and monitor panels** that you can put anyplace you need access to audio streams. Like newsrooms, dubbing stations, or even the station's TOC, so you can monitor any of the thousands of audio streams on your network at a moment's notice. The LCD screen scrolls through a list of available streams; the eight Fast Access keys let you store and recall the streams you use most. There's even an input, for convenient connection of an analog or AES device. Sweet.

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You got to have friends • Delivery system providers like ENCO, Prophet, BSI, BE, iMediaTouch, DAVID Systems and more all have products that **work directly** with Axia networks. So do hardware makers like AudioScience, International Datacasting, 25-Seven, Telos and Omnia. Check out the whole list at AxiaAudio.com/partners.

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Routing

Audio Guide

by Frank Foti, Omnia Audio

A Sonic Tonic for Audio Coding

Coded audio is now a way of life in the professional and consumer sound industry, commonplace in all forms of media that utilize sound in one way or another. However, achieving great sounding coded audio is easier said than done. Nevertheless, as Frank Foti explains, it is not an impossible task.

Clearly, data-reduced audio systems have changed our world. With the rapid growth of ISO/MPEG Layer-III (MP3) and subsequent additional methods, the capability of transmitting multiple channels of audio is commonplace in this day and age.

Within the data payload that once contained a single stereo pair, many stereo channels now exist. Not long ago, high quality stereo feeds at 128 kbps, via ISDN, were thought to be the best our world could ever expect.

Typical of technology, the bar just keeps rising. Today, in the year 2007, a listener can experience high quality stereo (as well as surround) digital broadcasting at bitrates much lower than what we felt were the maximum a few short years ago.

CODECS ARE HERE TO STAY

Codecs are common in practically every audio transmission system throughout the world: FM, AM, HD-Radio, DAB, DRM, television, multicasting, podcasting, netcasting, satcasting – about every form of 'casting you can name.

Getting quality sound, especially at low bitrates, requires a comprehensive understanding of the coded system, as well as knowing what must be applied, prior to coding the content, to insure consistent sound performance. It is more than just plugging sound gear together, configuring the applications, and – sha-zzam! – great sound appears. It takes investigation into what transpires within the coded transmission system. It takes innovative signal conditioning and processing.

For the codec naysayers out there, if you feel that Life gave us lemons, well, we are about to make lemonade!

ANALYZING THE PROBLEM

This material grew out of efforts to seek improved performance of coded audio at lower bitrates (24 kbps - 48 kbps). So, what are the critical elements that set apart great sounding digital channels or streams especially at lower bitrates?

By undertaking a detailed and comprehensive review of the causes of perceptible problems in audio coding, we will see how we can avoid the problems, and how we can develop methods that improve the sound quality of our coded audio.

Critical listening to the performance of a new conditioning algorithm, designed to improve vocal intelligibility, revealed two significant results:

1. Voice reproduction was noticeably improved due to the new algorithm.

2. The enhanced midrange uncovered and/or disclosed negative aural discolorations in the presence and high frequency range.

MOVING TARGETS

Since the early 1990's, audio coding has been around the professional sound industry. Codec developers have been on a fast track, and they continue to be so. Audio quality, once judged by MPEG (Motion Picture Experts Group) to be "excellent" at 256 kbps and 128 kbps, is now receiving the same judgment at bitrates much lower.

As codecs improve payload efficiency, it becomes possible to add more transmission channels to the existing infrastructure. It is much easier to improve the data payload, as compared to expanding the pipe. This is how program services are able to expand their range of content offerings with additional channels.

However, there is a great potential for degradation of audio performance. While advancement of codec design has allowed lower bitrates to be employed, and most codecs do sound *decent* at these rates, they are much more fragile with regards to distortion and are susceptible to artifacts.

Due to the various types of codecs and lower bitrates, getting a handle on the issues that generate the problems can be difficult – a moving target, so to speak. Our goal is seek out those gremlins, then offer ways and means to avoid them.

IT'S ALWAYS SOMETHING

All transmission systems suffer from some constaints, one way or another; it does not matter if the system is linear or not. Suffice it to say that all of them have something to overcome. The simple phrase *no free lunch* applies.

As mentioned before, the key to improving audio quality through a coded system is in understanding where the challenges are located and what can be done to avoid causing them. Performance advancements in prior transmission methods came about due to investigating what caused the ills in each particular method.

For example, consider the FM-Stereo system: High frequency distortion and peak-level overshoots were very common in early FM-Stereo generators. Both the preemphasis boost and sharp cutoff of the required low-pass filters caused severe problems within the system.

In-depth analysis of the system and then utilizing the gathered information led to the development of new means to overcome the challenges. Embedded preemphasis management and non-overshooting low pass filters dramatically improved FM-Stereo performance. The same approach applies to coded audio systems, too.

SONIC ARTIFACTS

While the concern with FM-Stereo was distortion and overshoot, coded audio suffers from what are referred to as *sonic artifacts*. These are the perceptible annoyances that bother the listener.

Most sound anomalies are categorized as one form of distortion or another. Most common are harmonic distortion (THD) and intermodulation distortion (IMD). Coding artifacts are neither. When they are perceived, they occur due to inadequacies of the coding algorithm.

Basically, this is the point where the coder runs out of capability to reduce the audio data without the process of data reduction being heard. While there have not been specific technical terms assigned to describe these artifacts, they can be referred to as *swishy-swirly, underwater-like, gurgle-like*, and sometimes *synthetic-metallic*. All of these characteristics degrade sound quality, and reduce intelligibility.

LIMITED SUCCESS

Dynamic signal processing does provide benefits to coded audio. Dedicated audio processors that utilize look-ahead limiting and bandwidth control do improve sound performance. But they still do not reduce artifacts enough at low bitrates – especially below 48 kbps. HD-Radio, satcasters, podcasters, and netcasters employ bitrates at 24 kbps, and lower, in some instances.

Reducing artifacts at these low rates usually requires severe bandwidth reduction, which in turn dulls the sound quality.

ANOTHER ISSUE TO CONSIDER

Additional, careful listening to lower bitrate coded audio revealed another underlying discoloration of the signal. It was not necessarily artifact-like – and not really distortion – but the audio quality within the presence range sounds like there is some type of degrading *ghost-like product* being carried along with the signal.

Attempts to remove it via signal processing only seem to increase this characteristic. Careful listening to the output of the audio processor, prior to the encode/decode section sounded very clean. Upon adding the codec to the scenario, this annoyance returned. (Note: this problem was observed with use of a common known codec for HD Radio and various audio processors of different designers/companies were used. All of them produced the same results.)

A clue to the problem was revealed when the timing in one of the audio processors was modified to reduce the amount of fast-limiting applied to presence and high frequencies. (This did not remove the limiting in this spectra, but changed the manner in which the limiter's timing responded to transient signals.) The audio immediately opened up, along with clarity in the presence and high frequency range. The ghost-like products were gone. So what was going on?

SCOPING OUT TRANSIENT IMD

Since it was the modification to the timing of the audio processor that led to the change in sound, consideration was given to the effect of processor-induced IMD within the codec. The following simple test was crafted to observe the effects of IMD through a codec.

Figure 1 illustrates the test setup. A multi-tone sine wave generator creates 400 Hz and 11.5 kHz source signals to stress the audio processor and codec. The output from the audio processor was routed in two directions: to the input of a multi-channel spectrum analyzer and to the input of an HD Radio encoder. The encoder was routed directly to a corresponding decoder, and its output was connected to the other input of the spectrum analyzer.

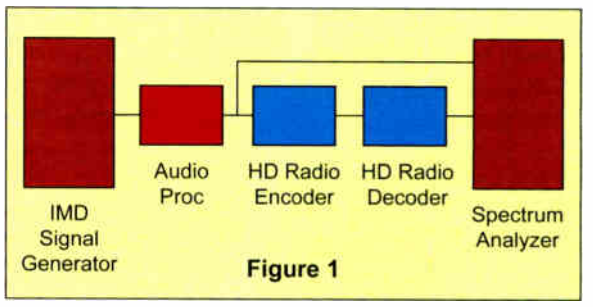


Figure 1

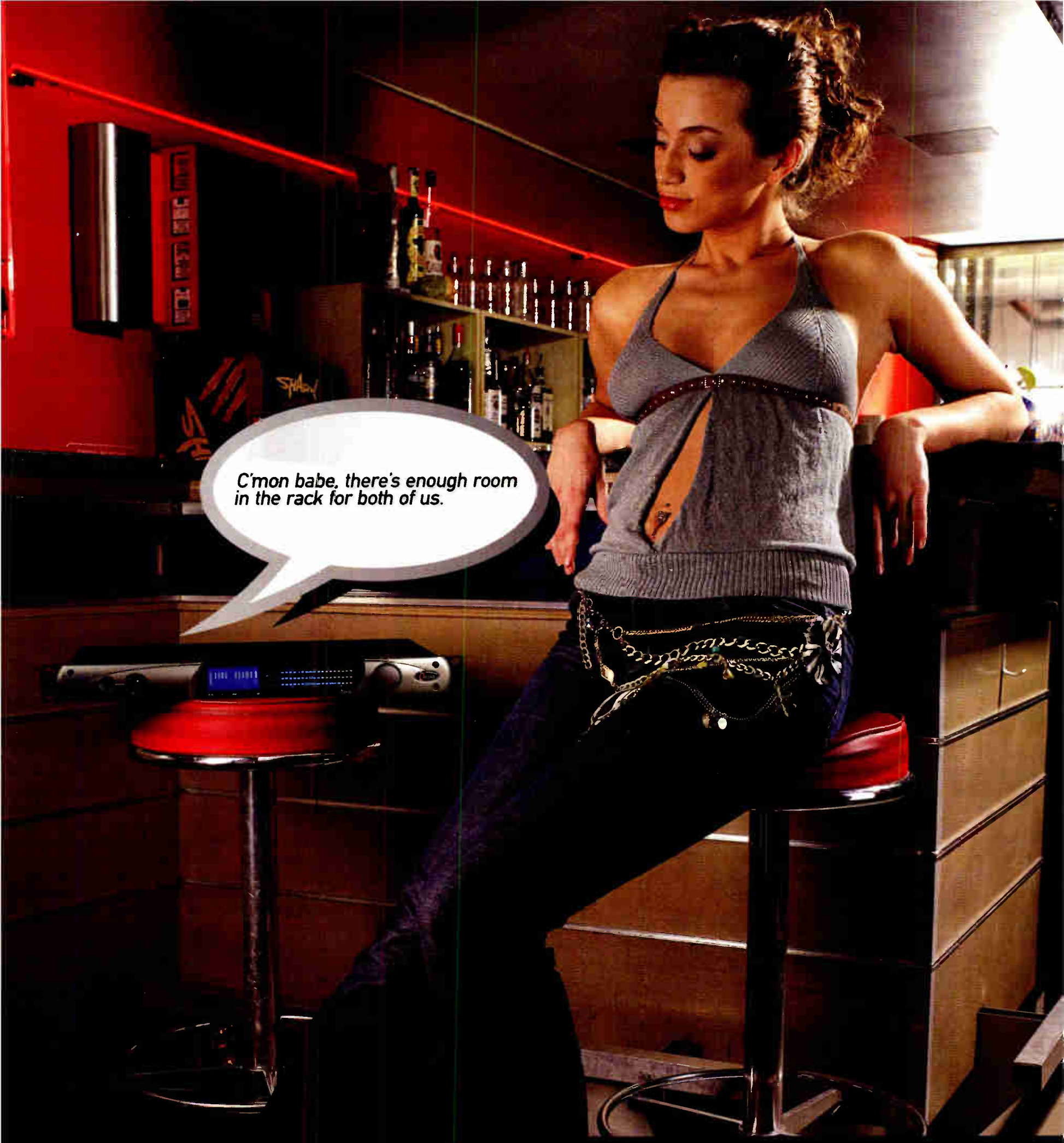
The objective of this test is to observe whether or not any part of the dynamics function will generate distortion via the codec. The audio processor employed for the test is designed to condition audio in a coded environment. The back-end processing utilizes look-ahead limiting, in place of hard limiting/clipping. This reduces THD components in the codec and eliminates aliasing in the system.

TONE BURSTS

Bursts of the twin tones were used, as this would simulate the effects of transient activity in the source signal, as well as activate the fast-limiting functions in the audio processor.

Figure 2 is the spectral illustration of the tone bursts at the output of the audio processor. The twin-tones appear as would be expected. This is also the result when observed at the output of the codec encoder when the steady-state tones are passed through the processor and codec together.

(Continued on Page 26)



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Continued From Page 24

A Sonic Tonic for Audio Coding

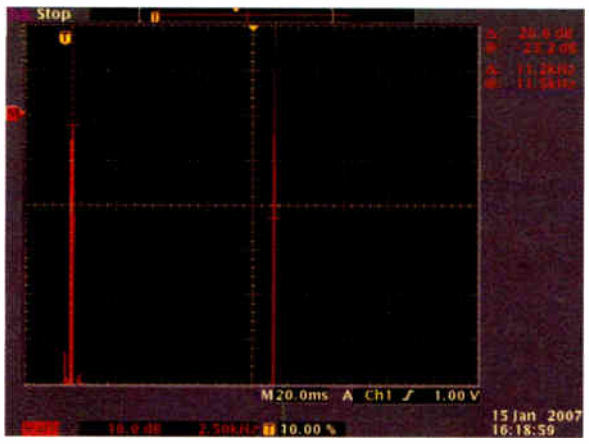

Figure 2

Figure 3 illustrates the output of the codec's decoder. And, look! "Houston, we've got a problem!" Notice the significant spectra around the upper frequency of 11.5 kHz.

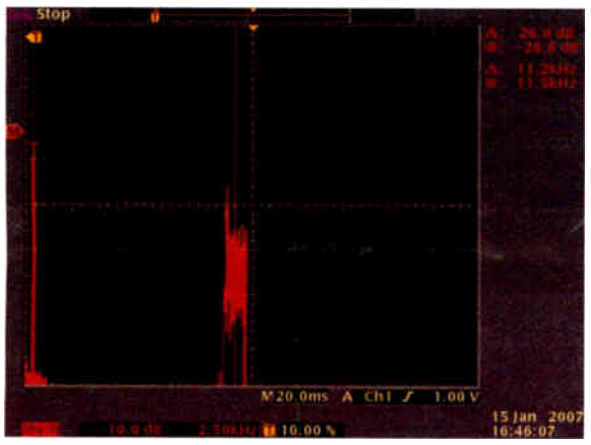

Figure 3

Further investigation of the situation revealed that the transient activity upset the encoder and caused added modulation in the upper frequency domain. This is what was causing the added ghost-like product heard prior. Just as a hunch: this might possibly be the effect of the SBR function becoming upset at transient information.

The rigor of this test exhibits what appears to be severe IMD in the signal. While broadcast source material does not contain transient twin-tones, it does contain plenty of dynamically transient signals within this frequency range. The extent of this added IMD is dependent upon the transients embedded in the source material. Additionally, fast-limiting time constants in the audio processor are capable of exaggerating, and/or creating this problem.

LoIMD

Fortunately, there is solution to this problem.

In this case, further study of the presence and high-frequency limiting algorithms yielded a method to reduce processor induced IMD. Utilizing a proprietary new function known as *LoIMD*, the algorithm is capable of providing fast-limiting to control transients, yet without agitating the encoder and causing the afore mentioned IMD. When normal source content material is applied, the audio through the entire coded system is devoid of the ghost-like annoyances that were mentioned earlier.

The LoIMD function modifies the control function within a dynamics algorithm. Through internal analysis of the incoming dynamics, and IMD characteristics, the architecture of the control method is rearranged to provide a control signal that reduces – and sometimes eliminates – IMD in the processed signal. The sonic result is cleaner sound for a given amount of gain control.

While the LoIMD function answers the issue regarding coding artifacts tied to induced IMD, another critical issue is achieving improved voice intelligibility. For low bitrate applications, this is vital.

CODEC PROVISIONING

Traditional dynamics processors are designed to fulfill the requirements of a medium where the functions are *static*, such as precision peak control and bandwidth limiting for conventional broadcasting or the normalization needed for recording and mastering. Each of these functions is a known static entity. They are singular, one-dimensional functions where the target is known and the audio processor is designed to accommodate this.

The audio codec, on the other hand, is a moving target. No two codecs are alike nor do they sound the same. They vary in sonic quality based upon bitrate – and more importantly – they vary within the same architecture based upon audio content. This is where conventional audio processors fall short when used in a coding environment.

Up to this point, dynamics processing has been able to address *some* of the hurdles and artifacts generated by audio coding. The codec has the ability to adapt and modify its algorithm internally, in order to provide maximum throughput, and this alters the sonic artifacts created by the coding process.

Unless an audio processor can do the same, it will *hit and miss* regarding how well it provisions the audio to avoid artifacts. Sometimes coded audio sounds acceptable – and sometimes it does not. Conventional processors play games with HF limiters and static low-pass filtering to minimize coding anomalies.

In order to condition audio in hopes of artifact avoidance, the processing will over-compensate audio bandwidth and dynamics. The result is dull, lifeless sounding audio that still contains audible gremlins.

SENSUS EXPLAINED

Sensus technology takes dynamics processing into a new realm. Instead of two-dimensional static architecture and functionality, Sensus adds a third domain where it modifies processing algorithms, architecture, and functions based upon conditions that are understood by the system. There are numerous derivatives to this innovative tech, and it can be scaled to many different applications.

Simply stated, Sensus has the ability to sense what must be done to a signal, and then "rearrange the furniture" to accomplish its goal. This new process generates clean, smooth, intelligible, and clear audio that is consistent sounding no matter the content.

The Sensus algorithm detects troublesome content for a codec, modifies the processor's architecture, and then makes the appropriate changes. These could be dynamics, bandwidth adjustment, a combination of both, or the elimination of a not-needed function.

The result is consistent quality through the coded transmission system, even at low bitrates; i.e. 18 kbps - 21 kbps. Voice for example, especially without any other accompaniment, is very difficult to code at low bitrates without the quality and intelligibility suffering.

HEADROOM CONSIDERATIONS

Another important factor regarding coded systems is headroom.

Digital systems have an absolute maximum ceiling of 0 dBfs. Theoretically, audio levels for transmission should be able to be set right up to this level. But, depending upon the encode/decode implementation, overshoots may occur. This is not consistent from codec to codec, but is due more so to the specific implementation of the codec by various manufacturers.

Additional input low-pass filters in the encoder may cause headroom difficulties. A well-designed encoder will ensure that any added input filter possesses the same headroom as the system, along without generating overshot that reduces headroom. (Note: most filter overshot is of the 2 to 3 dB magnitude, but can exceed this amount depending upon filter characteristics.)

It would be wise to test any codecs within a specified infrastructure to make sure that 0 dBfs is attainable without system overload or clipping. For this reason, setting the absolute peak level 2 to 3 dB below 0 dBfs, offers insurance against clipping.

PROCESSING FOR DIGITAL STREAMS

The advent of HD Radio has introduced the capability to broadcast multiple content streams within the 96 kbps digital channel.

To facilitate multicasting requires the use of lower bitrate audio coding. The broadcaster can choose the bitrate for each content channel, as well as the number of desired channels, with a maximum limit of seven. Therefore it is possible that extremely low bitrate audio channels will exist, and those will require dynamics processing capable of consistent sound quality that yields low, or no, sonic artifacts.

Research has yielded a new audio processor for multicast An innovative codec provisioning algorithm – using Sensus Technology and LoIMD limiters, yields consistent audio quality that contains little, if any, coding artifacts. Yet, audio quality does not suffer the dull or muffled quality due to extreme bandwidth reduction that would normally be employed to mask codec "nasties."

Now it is possible for lower bitrate channels to offer high quality and clear intelligibility through the use of a dedicated processor that employs the means to understand and handle the challenges of the coded audio path.

THE SONIC TONIC

For those who wish to tweak on their own, with existing processing equipment, the following should be observed:

1. Avoid dense processing that contains fast limiting time constants. Try to reduce the attack time on functions when 5 dB (or more) depth of compression is desired. This will reduce upper frequency processor induced IMD.

2. Make sure that the coding system provides full headroom. If the system clips on its own before 0 dBfs, then reset the maximum input level to avoid system headroom problems.

3. Low bitrates will benefit from bandwidth control. A static low-pass filter will reduce artifacts. The tradeoff will be perceived high frequencies vs. quality. A specialized processor for coded audio will offer some dynamic method to accomplish this.

4. Do not use any final limiter that contains a clipper. The THD generated by the clipping function will cause more trouble than it is worth. However, precision peak control is needed in the coded system. As mentioned before, specialized processing for this medium will provide a look-ahead limiter to accomplish this task.

If the above four items are followed, improved coded audio will result.

CODECS AND CLIPPING

It is worth taking a moment to share some further insight as to why application of a hard-limiter/clipper is a bad thing for coded audio.

(Continued on Page 28)

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Continued From Page 26

A Sonic Tonic for Audio Coding

Sound mediums require peak control to avoid the loss of headroom and eventual system distortion. Precision peak limiting is employed to accomplish this. Hard limiting, or peak clipping, is used in conventional broadcasting and it works quite well; proper use does not degrade an analog system.

Overuse of final limiting is a subjective adjustment, but most will agree too much limiting can degrade performance. Suffice it to say that hard limiting does work as a precision peak controller within standard FM-Stereo and AM transmissions.

The coded path offers a different set of challenges. We have already noted that it is not possible to overmodulate the digital system – there is a precise peak ceiling of 0 dBfs. Sorry, +6 dBfs is not possible! (This last statement provided for our Programming brethren.) But precision peak control is required.

Therefore, we can see how a conventional method of clipping creates systemic problems, occurring as aliasing products within the encoder. **Figure 4** is an example of what happens to a 2 kHz tone when:

- It is clipped.
- A 15 kHz low-pass filtered in a conventional audio processor used for FM-Stereo.
- It is passed through the HD Radio codec.

This problem is consistent with other codecs too.

The cluster of energy that appears around 15 kHz is from aliasing components. These were caused by the 2 kHz clipped signal from a conventional audio processor, as the hard-limited signal was routed to the codec.

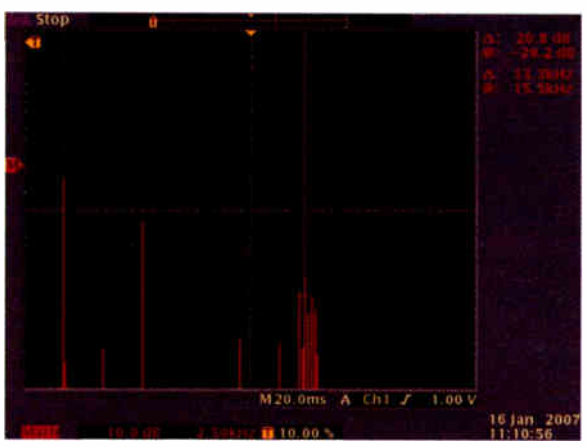


Figure 4

This is proof that all peak limiting for coded audio must employ a limiting means that is devoid of THD content. Clipped waveforms are exceedingly high in THD. This is why the use of look-ahead limiting is the preferred limiting mechanism for coders. This style of limiter yields very low THD and will not alias the system.

For reference purposes, **Figure 5** is the same signal, prior to the codec. Notice how the odd harmonics line up as would be expected from a clipped waveform. The added strange content that appears around 15 kHz in **Figure 4** is what exaggerates coding artifacts when conventional style processing is applied to coded audio.

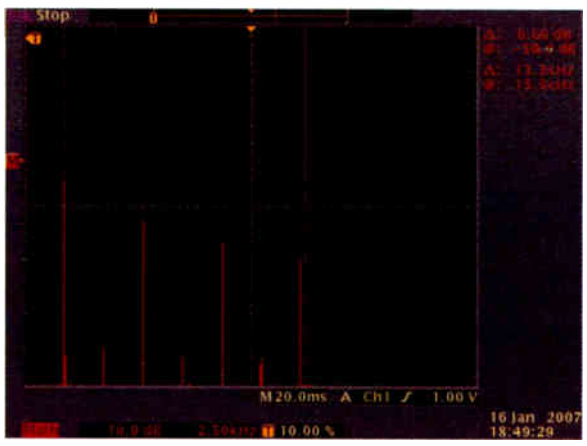


Figure 5

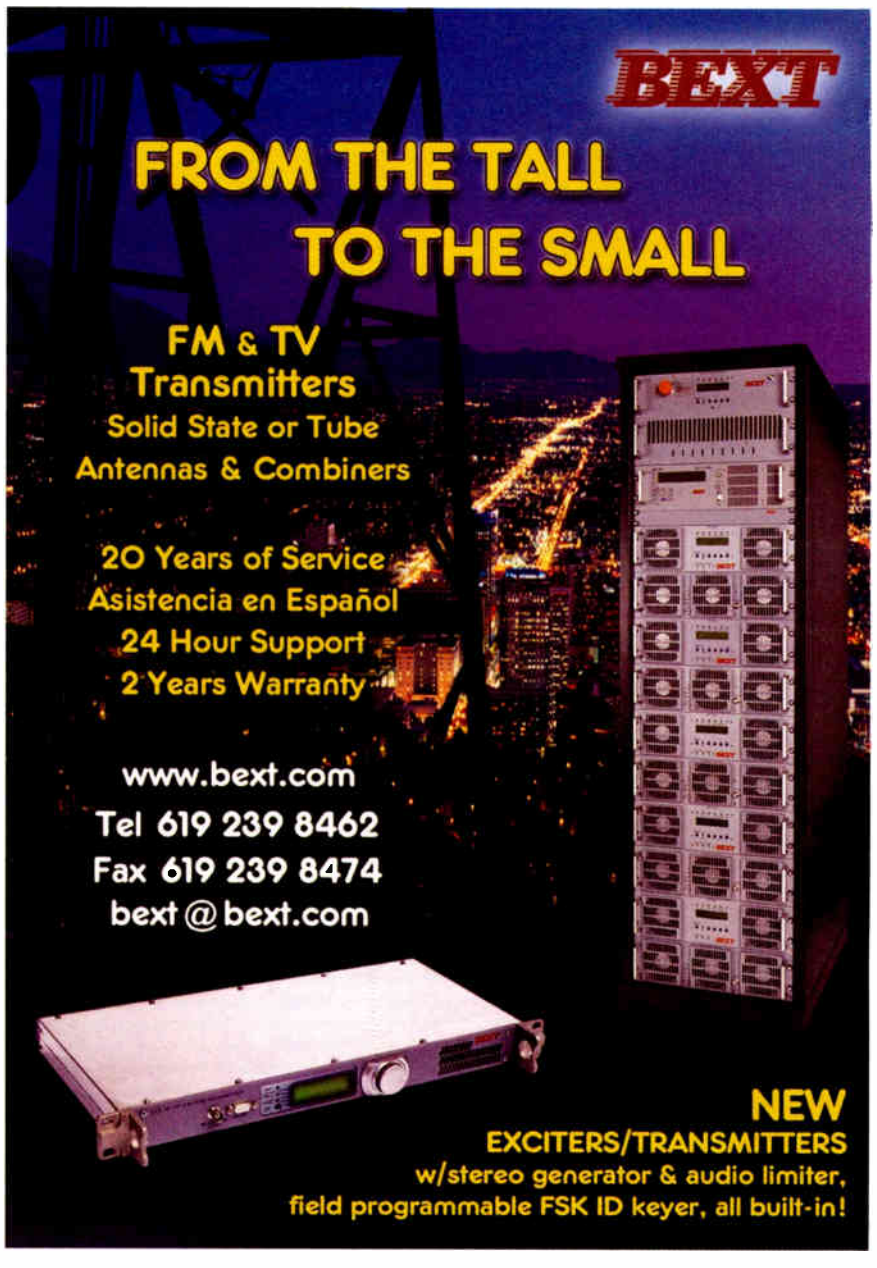
KNOWLEDGE BRINGS BETTER AUDIO

Research, testing, development, and the (hopefully) sound reasoning offered here have offered an explanation as to why coded audio performs as it does. With this knowledge, various signal processing and conditioning means can be used to bring to life coded sound.

The test results illustrated here reveal that conventional compressors and limiters exaggerate artifacts. While signal processing, conditioning and peak limiting are required for coded audio, the processing must employ methods that do not contribute additional distortion aspects, as this is what degrades clarity and quality at low bitrates – and sometimes even at moderate to higher rates.

Indeed, if handled carefully, digital audio can be produced and processed in a manner pleasing to the majority of listeners, whether on broadcast stations, web streams, or other any other medium.

Frank Foti is the man behind the Omnia audio processors, and has spent a lot of time dealing with the issues digital audio presents to broadcasters. Foti can be reached at padrino@telos-systems.com



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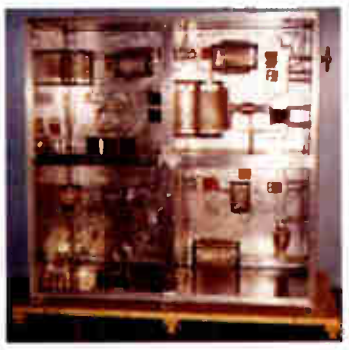

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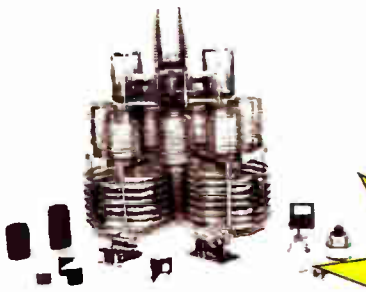

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SINCE 1963

Tech Tip

by Tom Taggart

StarGuide Clinic

Recently, San Diego-based X-Digital announced the purchase of certain intellectual property and licenses for the patents used in the manufacture of DG FastChannel's StarGuide satellite receivers. This, in turn, is causing some changes out in the field.

MULTIPLE RECEIVER TYPES

Instead of racks of similar receivers, many stations may likely be using a mixture of satellite receivers. X-Digital now is making their own receiver, and ABC is already shipping these new XDS-PRO receivers to their ESPN affiliates.

Meanwhile dozens of independent networks will continue to use the StarGuide receivers, at least for now, from NASCAR and Salem to the Moon Landrieu show. Premier Radio Networks has not officially announced a change yet, either. But the sale of these patents does not bode well for future support of these receivers.

At the moment, StarGuide Repair is still in business at the DG-FastChannel Tech Center, 3465 Technology Drive, Plano, TX 75704. Phone: (214) 440-1234. You will need an RMA before sending a unit in: contact Dwilcox@dgfastchannel.com.

REPAIR IN THE FIELD

During the transition period ahead, it is good to know that you can cure a number of problems in the field.

For example: the StarGuide is designed to power your LNB through the coaxial cable. If you suddenly lose signal, check for about 18 Volts from the center conductor to ground. If you have more then one receiver, I would suggest purchasing a separate LNB supply from a satellite equipment supplier such as DAWNco. Or build your own, with an 18 Volt, 3-pin regulator (e.g. 7818), DC block, and splitter.

The receivers can be persnickety at times and cables can go bad. Buy good quality splitters (rated for up to 2 GHz), and make sure outside connections are weatherproofed.

DIAGNOSTIC TIPS

The front panel display can be a useful diagnostic tool, especially if you have kept records of the readings. The EB number indicates received signal quality; a sudden drop indicates problems in dish alignment, cabling, or even terrestrial interference.

The AGC number is also useful. A high number (above 130) may indicate a weak signal, but low AGC numbers also may mean trouble: strong signals can overload the receiver, causing dropouts, or other sporadic problems. Try an in-line pad; you can find them at Radio Shack.

A word on those annoying dropouts: If the audio sputters or vanishes momentarily but the front panel display does not change – it could well be the network feed. Many networks use landline connections to feed the uplink. You may be simply hearing a flaky T-1.

FAN AND POWER SUPPLY

If the receiver dies completely, or boots up but never acquires a signal, check the fan and the power supply. Both are mounted on the right hand side of the receiver.

The fan is a Sunon model KDO506PHB3. Allied stocked this fan at one time as their part number 997-0073, but a recent check indicates they no longer carry it. This is a small 5 Volt DC ball-bearing fan, 60 mm square and 15 mm deep (depth is not critical). Any similar fan with 15 CFM or better should work. The Sunon fan plugs directly into the motherboard, but you can always splice into the leads of the old fan if you cannot find an exact replacement.

The power supply is an Astec LPT63, Newark part no. 62K3455 (about $60.00). The supply should provide +5 volts at around 7 amps, +15 at around 3 amps, and -15 at around an amp. If the voltages are off, or if they drift by several volts, the supply is bad.

The supply mounts on four standoffs on the side of the receiver. AC in and DC output connections are plug-in connectors. The tricky part of changing a supply is removing the four Phillips head screws that hold it in place. You will need to remove the receiver card so you can reach the bottom screws. Three screws hold this card in place, but there is also a multi-pin header plugged into the motherboard beneath this card. *Be careful not to bend these pins!*

AUDIO AND RELAY CARDS

Personally, I have rarely had problems with either audio cards or relay boards. The biggest hassle most people find is damage resulting from lightning strike surges.

In addition to the StarGuide Repair option, Charlie Wooten at Clear Channel in Panama City, FL can fix common audio board problems and replace the surface mount IC chips. You may contact him at: charliewooten@clearchannel.com.

Missed triggers? You might want to check to make sure all of the pins from the relay card are mated properly to the audio card and are neither bent nor misaligned.

If you are troubleshooting audio problems or missed triggers, perhaps by swapping cards, here are two important cautions:

- Never remove nor plug in either card while the receiver is "hot." At best, you will dump the receiver, at worst, you may damage the card.
- Remember that the relay card is mated to the audio card with a multi-pin header. *Both cards must come out at the same time or damage can easily occur.*

Tom Taggart is part-owner of two FM stations in West Virginia. He can be reached at (304) 684-3400 or tpt@Eurekanet.com

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In the Field

Recent Updates for BE FM Transmitters

Users of the Broadcast Electronics digital broadcast gear may find it useful to check out the following recent updates that have been released from the factory.

SOFTWARE AND FIRMWARE UPDATES

At the end of May, Broadcast Electronics Customer Service released software and firmware updates for all FM 10S, 20S, FMi 703 and FMi 1405 transmitters as well as an additional firmware update for FMi 703 and FMi 1405 transmitters using the FXi 250 exciter.

• For FM 10S and FMi 703 transmitters, version 1.0.51 of Smartcore Board software was released in conjunction with version 1.09 of U7 and U107 Module Control Board firmware.

• For FM 20S and FMi 1405 transmitters, version 2.1.20 of Smartcore Board software was released in conjunction with version 1.09 of U7 and U107 Module Control Board firmware.

IMPROVED IBOC OPERATION

The software/firmware update is designed to implement a soft-start functionality so as to avoid potential overdrive conditions that may result in premature PA module failure in the "IBOC Only" and "FM & IBOC" modes of operation.

BE indicates that it is necessary for the software and firmware to be upgraded simultaneously. This update is required for all FM 10S and FMi 703 transmitters as well as all FM 20S and FMi 1405 transmitters.

Important note: The FM 10S/FMi 703 or FM 20S /FMi 1405 Smartcore Board software update requires the use of a Serial Interface Board (SIB) programmer to upload the software to the transmitter. If you do not already own an SIB programmer, it may be purchased from BE for a nominal fee or borrowed on a loaner basis.

To get one of the SIB programmers, you can contact the RF Service department by phone at 217-224-9617 or by e-mail at rfservice@bdcast.com to request the appropriate kit(s). Have ready the "ship-to" address, contact name, phone number, model number of transmitter (FM 10S, 20S, FMi 703, or FMi 1405) and the quantity of kits required. Also, it would be a good idea to make clear whether you wish to purchase or borrow the SIB programmer.

EXCITER UPDATE

Additionally, version 2.0 of U41 FXi 250 Exciter firmware was released.

This firmware update provides improved spectral performance in all HD modes of operation at reduced transmitter PAV Voltage levels, yielding improved efficiency and reliability of PA modules.

• This firmware is *only* required for the FXi 250 Exciter when installed in an FMi 703 transmitter or an FMi 1405 transmitter.

Again, the BE RF Service department has the appropriate update kits, which can be requested at: 217-224-9617 or e-mail at: rfservice@bdcast.com.

Additional information can be found through the Broadcast Electronics website www.bdcast.com

The Worst I've Ever Seen

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

When Good Wires Go Bad
The Attack of the Monster Yellow Spaghetti

Rewiring a studio or complex has always been a time and labor intensive project – and that is before you even get around to making sure the documentation is in order.

In fact, as the project progresses, it may well seem that no matter how fast or how long you work on them the wires almost come alive and multiply right before your eyes – taking over the facility much like the sorcerer's broomsticks did in *Fantasia* and seeking out their own sockets.

One thing is for sure: there is no time to slow down – the wires might just catch up with you!

When dealing with a large pile of wires, resistance might be futile.

In this picture, courtesy of Brent Hall, Jerrick Mitchell, Audio Maintenance Engineer at the LDS Conference Center in Salt Lake City, certainly appears to be fully consumed in one of his current projects. Late word is that he survived intact and has tamed the spaghetti monster – at least until the next time the wires need to be reworked.

They sure seem to have a lot of that yellow spaghetti in Salt Lake City! Please share with us your pictures of the strange things that go on out your way. Send them to editor@radio-guide.com

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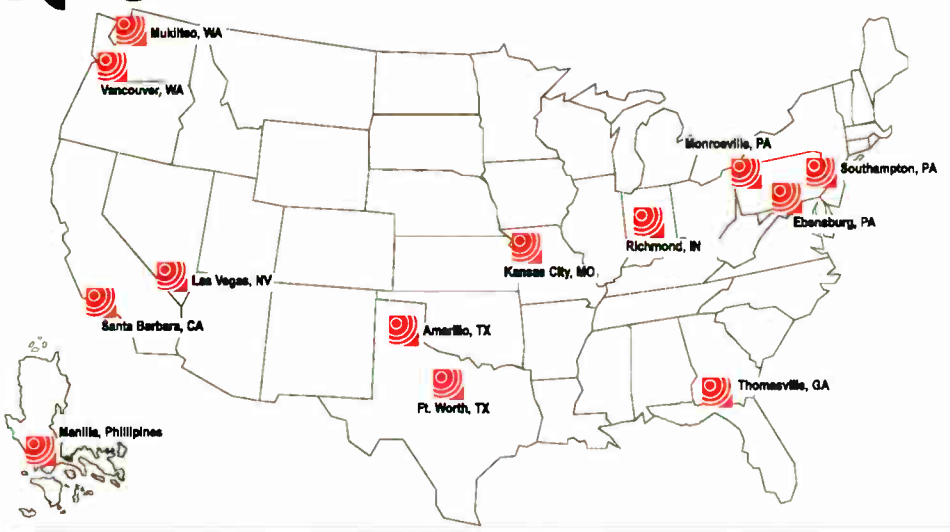

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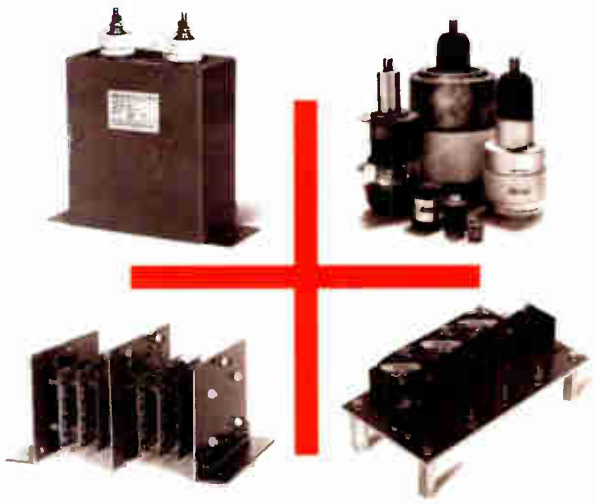

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Tool Guide

Test, Tools, Tips and Applications

A Desktop Mailing Solution from Dymo

Communication via email has become a large part of our lives in recent years. However, there still are many reasons we may need to send out materials in standard envelopes, resulting in a need for an easy way to label and get the right postage for the envelope or package.

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At the same time, desk space is always at a premium and, all too often, it seems like the wrong roll of labels is always in the machine, slowing you down just when you need to get something out the door quickly. Finding the right desktop solution is not always easy.

The DYMO Desktop Mailing Solution™ may be just the right solution for your office and/or the front office. While the word "mailing" might make you think it is a product limited to a few uses, this is a versatile labeler, available in two versions depending upon whether or not you want to print postage.

TWIN TURBO, PLUS

The Desktop Mailing Solution consists of a DYMO LabelWriter™ Twin Turbo matched with a five-pound scale and software. Together you can print over 40 sizes and styles of labels, often without having to change the rolls in the machine.

The DYMO LabelWriter™ Twin Turbo prints up to 55 labels per minute on up to a four-line address label, and requires no ink or toner.

The DYMO Desktop Mailing Solution

Since it is a dual unit, you set up the two sizes of labels you use most frequently and can print on either (or both) with just a single click. Changing labels is quick and easy, using the release lever. New label rolls immediately line up and are ready for action. If you have changed size or shape, a drop-down menu quickly adjusts the printer output.

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At the core of DYMO Desktop Mailing Solution is DYMO Stamps™, the Internet postage service that eliminates unnecessary trips to the Post Office by letting users print postage from home or office.

DYMO Stamps prints U.S. postage for First Class, flat rate Priority Mail, international (1 oz.) and postcard mail pieces, including those 2-cent stamps you need now to match with the old First Class stamps you still have in the drawer, and the new lower-rate "additional ounce" stamps.

The DYMO weighing and stamping software also features their Address Fixer, which automatically checks any U.S. address against the USPS database to ensure more accurate mail delivery. It will even print bar codes on the label, to further ensure a quick, accurate transit through the Post Office's sorting machines.

Another nice touch is that you do not have to go to the Post Office for stamps. Powered by Endicia™, a leading Internet postage provider, users simply sign up for an Endicia account via a link in the DYMO software installation CD. There are no monthly fees or long-term service commitments required by Endicia.

IT'S A POSTAGE MACHINE, IT'S A LABELER

While the front desk will definitely want the postage capability, back in the shop you might need just the labeling function. DYMO sells the Twin Turbo and labeling software separately, without the scale, for just such applications. Programming, Sales and Engineering can use whatever labels fit their needs.

PC and Mac compatible, the Twin Turbo or the full DYMO Desktop Mailing Solution is available at OfficeMax as well as direct from DYMO at www.dymo.com. Further information about DYMO products is also available on their web page. – *Radio Guide* –

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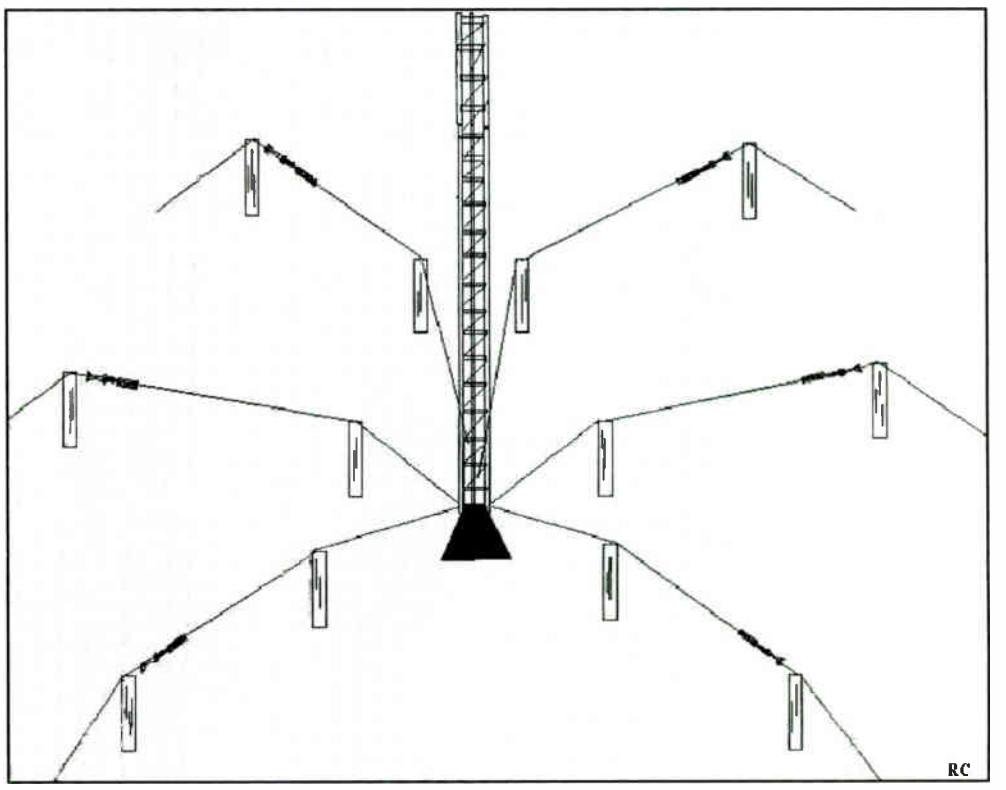

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Heavy Metal

by Stanley Adams

Part 3 – General Electric Starts Turning Up the Power

The Heavy Metal series is a look back at the technology, engineers, and manufacturers who brought broadcasting from a tiny voice to booming transmitters that covered dozens of states. In this installment, Stan Adams not only masters the spelling of "Schenectady," but details how General Electric was a driving force in the development of broadcast transmission systems.

From the early Fessenden alternators designed in 1901-1903 by Dr. Charles Steinmetz (chief among chiefs at the General Electric Research Lab), to the 1906 breakthroughs by Dr. Ernst Alexanderson, GE was the only source of usable mechanical alternators – the only known method of transmitting a fully undamped wave up until that time.

These large alternators provided the ability to modulate voice and music to the world. The largest units – capable of running at a level of 200 kilowatts – were numbered One through Twenty (the last two being shipped to Poland). A working museum in Grimeton, Sweden displays the remaining units, one of them kept operational and being used occasionally for station SAQ. Yet their gigantic presence in the spotlight of communications essentially lasted one short decade.

THE KEY TO POWER

Communications systems were then about to undergo a great and majestic transformation using a little invention credited to Dr. Lee de Forest. However, by the time this came about, the work of Dr. Irving Langmuir began to overshadow the mechanical designs with the electrical designs for a fully functional transmission and reception system.

Dr. Irving Langmuir

Dr. Langmuir was the General Electric Company's version of Dr. H.D. Arnold over at Western Electric. Both men worked cooperatively and independently on the de Forest Audion tube. Quickly they realized a number of things:

(1) The tube contained gas and was not a hard vacuum.

(2) There had been very little study of the operational characteristics of the tube – none of those common Grid Eg/Plate Ip curves existed to explain the operation of the tube.

(3) The tube could do a lot more than had been thought about up until that time.

It did not take an appreciable amount of time to find out some of those very fundamental answers. Whether it was Western Electric or the General Electric Company (and Westinghouse, too), progress was rapid and it was reflexive. By that last term, we mean that the work that occurred would lead to more and more successful applications.

THE VACUUM TUBE

If one but looks into the work of Dr. Langmuir one would see the path of the development of the tube from a fundamental five watt output level, then to a 50, 250, 1,000, 20,000, and finally a 100,000 watt tube.

By 1921, the UV-204 (250 watt capacity) was ready to go into one of first commercial products, and the UV-208 (a 5 kW bulb) was ready for sale the following year. With the development of these tubes, it became pretty evident that limits had been reached for the full development of air-cooled tubes at that time.

The beginnings of true high-power tube capacity were to be found in the initial design of the UV-207, a 20 kW water-cooled tube, which later developed into the famous GL-862 (a 100 kW tube), the highest-powered tube ever made by General Electric.

Power tubes like the 207 and the 862 gave broadcasters a much "bigger voice."

GE's work on water-cooled tubes came out of the development work and experimentation at WGY radio. Using the processes pioneered by AT&T, an 862 type tube eventually was used in the WLW high power transmitter as well as other stations, including all of the high power RCA rigs (the 50 kW series), Western Electric, and at Radio Central.

> According to John Lyles, the Bell System Technical Journal for January 1930 presented evidence that it was Western Electric that had created the first successful high power tube which had integral water cooling.
>
> Up to that time, General Electric and Westinghouse had been unable to make seals that could go between glass and metal (anode) of tubes and still hold a good vacuum. Then, a guy named Housekeeper at AT&T/WE figured out the process in 1922.
>
> The switch to using the long water-cooled 862 tubes brought on a rapid increase in transmitter power levels in the 1920s, and the 50 kW rigs came about from this design. Once WE accomplished this, GE, RCA, Westinghouse, etc. also began to build 100 kW tubes and larger.
>
> The Housekeeper seal is still an important part of tubes that use metal to glass or metal to ceramic. A few are still being made.

Additionally, there were the special tubes such as the Thyratron (a tube based switch), x-ray, video and numerous others that came from the hands of the department supporting the work of Dr. Langmuir. Again, it was the principle of successive "firsts" that allowed communications to stand on the shoulders of those GE giants.

CROSS-POLLINATION

We would do well to look for a moment at the participants of the developing world of early broadcast, ship to shore, aircraft, and other special service radios. Technical direction in these early years was led by Dr. A. F. Van Dyck for receivers and Dr. Walter R. G. Baker as the group lead for transmission tubes and sets.

In 1927, Dr. Baker took over as the development lead in both divisions. In 1930 he became a Vice President over Engineering at RCA when the "crank-up" of actual manufacturing was about to begin at RCA for the very first time.

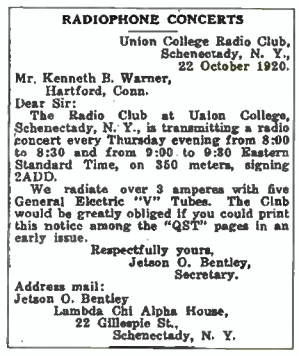
Many of us who have worked on the RCA line of transmitters might be surprised to learn that, up to about the mid-1930's, *all* of the early transmitters which carried an RCA logo were built by General Electric. (We will discuss more about this relationship as we go along.)

By 1935 when General Electric was allowed to resume manufacturing for itself (after the limits of the consent decree), Dr. Baker returned to become Mr. TV for GE. Over the years, he lent a very significant hand serving every facet of TV developmental work.

GE TUBES REACH OUT

During and after the close of World War I, GE built transmitters for the Navy and some later for the United Fruit Companies network of spark stations throughout the southern hemisphere. Much of this developmental work was being carried on during the manufacturing of the Alexanderson Alternator.

Around this time, we find what is claimed to be the very first "outside" use of GE transmitter tubes and information. This claim is held by amateur station 2ADD, the transmitting station of Union College (Department of Electrical Engineering) in Schenectady, NY. Dr. Charles Steinmetz was instrumental in supporting the youth of this nearby college.



RADIOPHONE CONCERTS

Union College Radio Club,
Schenectady, N. Y.,
22 October 1920.

Mr. Kenneth B. Warner,
Hartford, Conn.

Dear Sir:

The Radio Club at Union College, Schenectady, N. Y., is transmitting a radio concert every Thursday evening from 8:00 to 8:30 and from 9:00 to 9:30 Eastern Standard Time, on 360 meters, signing 2ADD.

We radiate over 3 amperes with five General Electric "V" Tubes. The Club would be greatly obliged if you could print this notice among the "QST" pages in an early issue.

Respectfully yours,
Jetson O. Bentley,
Secretary.

Address mail:
Jetson O. Bentley
Lambda Chi Alpha House,
22 Gillespie St.,
Schenectady, N. Y.

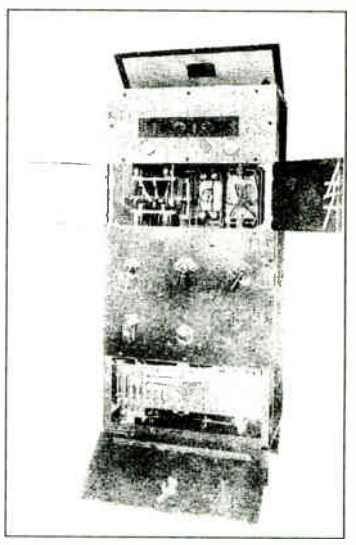
An item from QST detailing the use of GE tubes to increase transmission power. *From QST, December, 1920, Page 64.*

According to Gerald F. J. Tyne's *Saga of the Vacuum Tube*, the Type V was in the range of 25-50 Watts and was experimental. Therefore, we can assume the transmitter operated with an input power in the range of 100-200 Watts.

This station was built entirely of GE parts and under the sponsorship of the Professor of Electricity and of the fine Doctors of Engineering from GE. These GE research leaders often spent their time in lectures and experiments with the students so as to encourage those young students to press toward their goals in life by participating in the grand industrial and technical period of which GE commanded the leading position.

DEVELOPING A COMMERCIAL PRODUCT

Coming from this sort of background, many of the General Electric Company transmission products started to take their place in the commercial world.



One of the earliest GE transmitters, a 500 Watt model AT-702

One of the very first transmitters that were designed for commercial service was known as the AT-702, a one kilowatt radio transmitter that could use UV-204 or UV-206 output tubes. The photograph of this transmitter came from the mid-1921 period of time.

(Continued on Page 40)

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- VU + PPM meter/monitor
- 1/3 octave spectrum analyzer
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The AL1 Acoustilyzer is the newest member of the Minstruments family, featuring extensive acoustical measurement capabilities as well as core analog audio electrical measurements such as level, frequency and THD+N. With both true RTA and high resolution FFT capability, the AL1 also measures delay and reverberation times. With the optional STI-PA Speech Intelligibility function, rapid and convenient standardized "one-number" intelligibility measurements may be made on all types of sound systems, from venue sound reinforcement to regulated "life and safety" audio systems.

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- 1/2" precision measurement microphone
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- Omni-directional reference microphone for acoustical measurements
- Required for the Acoustilyzer; optional for the Minilyzer

MiniLink USB interface
and PC software

Add the MiniLINK USB interface and Windows software to any ML1 or DL1 analyzer to add both display and storage of measurement results to the PC and control from the PC. Individual measurements and sweeps are captured and stored on the instrument and may be uploaded to the PC. When connected to the PC the analyzer is powered via the USB interface to conserve battery power. Another feature of MiniLINK is instant online firmware updates and feature additions from the NTI web site via the USB interface and your internet-connected PC.

- USB interface fits any ML1 or DL1
- Powers analyzer via USB when connected
- Enables data storage in analyzer for later upload to PC
- Display real time measurements and plots on the PC
- Control the analyzer from the PC
- Firmware updates via PC
- MiniLINK USB interface is standard on AL1 Acoustilyzer

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Heavy Metal

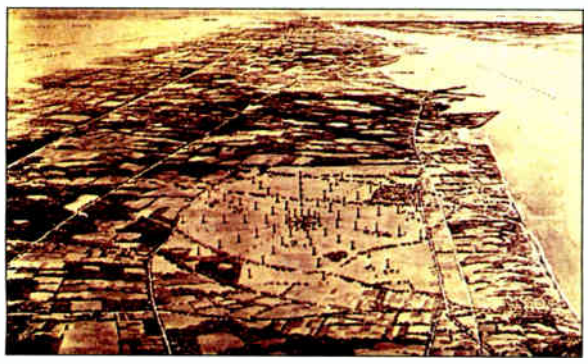
Continued From Page 38

Part 3 – General Electric Starts Turning Up the Power

TRANSMITTER DEVELOPMENT RACES AHEAD

In our last installment, we spent some time in describing some of the work by GE at the RCA Radio Central at Riverhead, Long Island. (This was a former Marconi station, taken over after WWI.) General Electric developed several transmitters for RCA during this early period.

As a demonstration of how fast the new tubes were being fitted into larger and larger transmitters, a sort of "friendly competition" developed between GE and AT&T. During the summer of 1922, work began at New Brunswick and, not far away, the Telephone Company was working on the development of their high-powered tube-type transmitters.



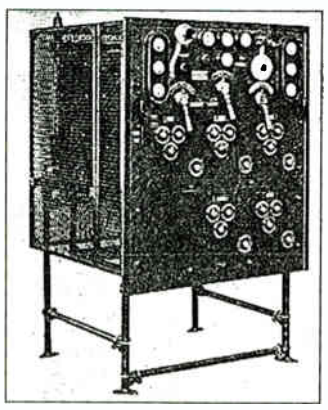
An aerial view of RCA Radio Central in the early 1920s.

The competition concluded with a slight win by GE (they cheated a bit by reverting to an alternator instead of the specified oscillator sections, so they could get done in time), using twelve 207 tubes. Placing these in parallel, it had taken them months to rid the tubes of parasitics, which came to be called the "Rocky Point effect."

A goodly amount of knowledge about power tubes was learned by using the 207 in this application, as well as by its use in tests at WGY. It quickly became apparent, for example that the maximum operating frequency of this tube was in the neighborhood of 1600 to 1800 kHz.

GE BRINGS SPORTING EVENTS TO LISTENERS

Probably the most well-known early broadcast in which General Electric participated with RCA (RCA sold the transmitter to the Navy) was the "Battle of the Century" that involved the great American heavy weight Jack Dempsey and the Frenchman, Georges Carpentier.



GE made this transmitter that carried the Dempsey/Carpentier "Battle of the Century"

On a Hoboken, NJ lot of some thirty acres, some 90,000 people saw both the fight and the broadcast. Using what was considered as the highest-powered, self-contained tube transmitter of that time, hundreds of thousands heard the fight. Here is a report, from *The Wireless Age*, August, 1921, page 11-21.

> *"No untoward incidents occurred on the long-awaited day which followed. . . . There are, literally, a thousand and one angles from which to view the achievement, but space limitations prevent their recording in this article.*
>
> *"So, turning to the next feature of primary interest, the powerful radiophone that did the job at Hoboken, it may be of interest that this transmitter, built by the General Electric Company and installed by the Radio Corporation of America, employed six 250-watt Radiotrons [type 204's], three used as oscillators and three as modulators, when on telephone or buzzer modulated output. For straight continuous wave telegraphy, all six Radiotrons were used as oscillators."*

GE called this early transmitter an "SCR 1.5 kW set."

At that time, a true broadcasting service began to emerge as an outgrowth of amateur experimentation. For example, 8MK became WWJ, and Dr. Frank Conrad of Westinghouse and station 8ZZ turned into KDKA. Other stations popped up on the air with GE, de Forest, and Western Electric transmitters.

For those at General Electric, it was the "wake up" call – and a needed one. It was a call that forced them to begin broadcasting on their own station, something that would furnish two functions:

1. An actual service to the people of Schenectady.

2. A developmental "bed" to try out the latest circuit designs, power tests and other ideas of those who worked with Dr. Baker and friends.

WGY

In late 1922 a large number of GE engineers began to assemble a broadcast transmitter, antennas and studio equipment. (Experiments leading toward this broadcasting project were started during the preceding year of 1921.)

The March 1st 1922 *Radio Service Bulletin* first lists the approval of WGY for broadcasting, and the first evening of broadcasting was February 20th, 1922. The transmitter would supply a total of 1500 watts input power,

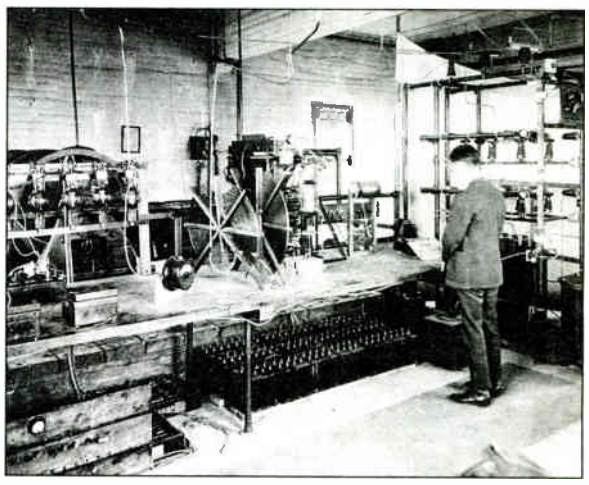
In learning about the first station to be built and operated by the General Electric Company, we would like to give credit to a wonderful article from the 1992 volume of the *Antique Wireless Association (AWA)*. The article, by an unknown author, was found in the Schenectady Hall of History.

The *AWA* article contains a condensed history of the growth of WGY and of the transmitter department, along with a number of pictures. Included is material that discusses the growth of General Electric's work in broadcasting through a successive series of "firsts":

- Vacuum tubes
- Power increases
- Modulation systems
- Over-all transmitter design
- Fidelity
- Frequency control
- Power supply
- Antenna designs
- Studio equipment
- Wire-line collection of broadcast material.

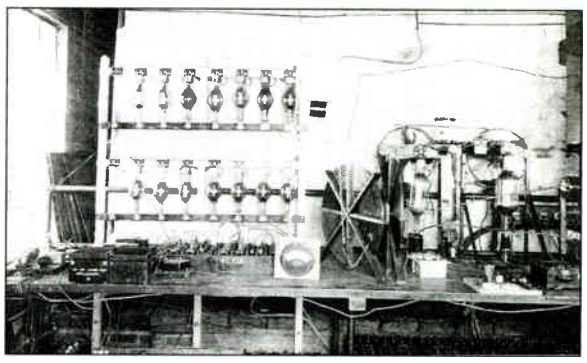
SETTING THE POWER RECORDS

The first transmitter at WGY was a glass-tubed rig, managing approximately 1.5 kW.



The original WGY transmitter.

As development progressed, the power output was slowly but steadily increased by adjusting the high voltage and drive power. The transmitter utilized six high-vacuum rectifiers (UV-218 tubes); the power stage was modulated using the constant current method by a bank of six of the 1 kW, 206 tubes. It was during the latter part of 1922 that the tube complement was increased to two 5 kW tubes in the modulator stage. Power output was now about 5 kW.



Using "improved" modulators and oscillators, WGY increased output to 5 kW.

Adding further prestige to the station, Guglielmo Marconi visited WGY in the summer of 1922, during a visit to America, David Sarnoff, and the RCA Radio Central works. In July, he spoke over WGY radio and thanked GE for expanding the efforts he was proud to have started years before.

Vacuum tube development was very important to GE as by this time they had become the largest supplier of tubes not only to RCA, but also to the Navy and to amateurs. Moreover, as mentioned earlier, Drs. Langmuir, Baker, and the entire radio research lab allowed no grass to grow under their shoes as far as power development.

THE DUAL PURPOSE STATION MAKES WAVES

As we noted, station WGY was designed not only for the public consumption of news and entertainment but also as the actual "on-the-air" test bed for the GE engineers. (Way out west, in Denver, GE set up another such station, KOA.) Gleason Archer wrote that the station could be picked up from coast to coast, in Alaska, and in England.

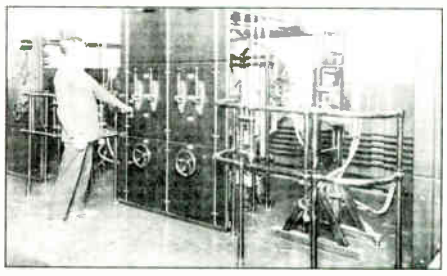
(Continued on Page 42)

Heavy Metal

Continued From Page 40

The push for higher power levels was established early, and WGY is recorded as being the first station in the nation to operate at the different higher power levels – at least until WLW unleashed its 500 kW monster transmitter on the airwaves.

In early 1925, two high power, water-cooled tubes were installed, one as an oscillator and one as a modulator; the output was raised to about 10 kW. However, in the later months of 1925, a factory-built transmitter replaced the original breadboard approach and was used for experimentation.



Moving from prototypes to its first commercial production transmitter, GE used WGY as its test site in developing ever more powerful models.

1925 was an extremely busy year for the WGY engineers. The old transmitter was changed to the MOPA (master oscillator-power amplifier) type of circuit. Power was raised to 15 kW. And WGY was developing a site on the South Side of Schenectady for a superpower transmitter facility.

The South Schenectady Radio Laboratory coordinated its experimentation with the operational hours of WGY. Ultimately, a 50 kW plant was to be constructed. Early power levels varied between 30 and 50 kW, in accordance with the experimental license and new Federal Radio Rules that set 30 or 40 kW as the maximum permissible broadcast power at the time. But even 50 kW was not the limit for GE's engineers.

Please join us next month as we follow WGY to superpower, show you some of these transmitters, and discuss some of the challenges the GE engineers overcame in the process, as well as how RCA benefited from the GE's engineering department achievements.

The author would like to thank Barry Mishkind, John Lyles, John Byrnes, Jeff Glass, and long-time (but now retired) KFI engineer Mr. Newcomb Weisenberger for all their conversations and correspondence over the past many months. All have contributed to the research into the history and engineering that went into the broadcast transmitters over the years.

It is worth noting that a lot of the information in these articles can be found in the standard books on the history of broadcasting, research on various Internet sites, and from reading old IRE and General Electric Review publications.

For those interested in the Antique Wireless Association (AWA), information can be found on their website: www.antiquewireless.org

Additionally, CD scans of all published QST issues are for sale through various groups including the American Radio Relay League (ARRL). Further information can be found on their website, www.arrl.org

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Stan Adams' family has been involved in broadcasting since the 1940s. He currently works at Sprint's Memphis RF Engineering department. If you have information on the men and manufacturers who produced the "heavy metal" or questions on this series, Stan would love to hear from you. Email him at: stanleyadams@yahoo.com

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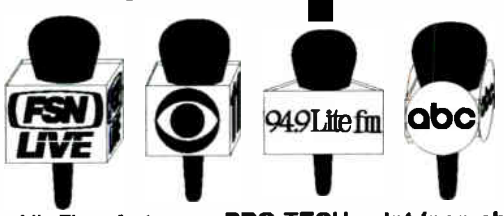

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www.tab.org/convention.php

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September 26-28, 2007
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www.nabradioshow.com

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

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

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October 10-11, 2007
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www.sbe20.org

35th Annual SBE22 Broadcast/Technology Expo
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www.sbe22expo.org

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