Radio Guide

Radio Technology for Engineers and Managers

March 2006

High Power Transmitters
Reduced Size – Increased Efficiency

The Nautel XR50 Installed at KDIS

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A Cool, Efficient 50 kW Transmitter

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Cover Photo: The Nautel XR50 installation at KDIS, Los Angeles. Courtesy Chris Hays.

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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

NAB – A Good Time to Be There

The attendance at the spring NAB show had been hampered in recent years by a combination of things.

Consolidation and corporate policies made it harder for engineers to travel, even if there was money; several corporations severed their relationship with the NAB; and with station acquisition being top priority, reduced capex budgets made it less important to managers to send their engineers to Las Vegas.

In 2005, money really started flowing for digital transmission systems, including large grants from the CPB. Some companies went on a veritable "crash program" to install digital gear as fast as possible.

However, not everyone had the required test gear and expertise on the iBiquity system, so some engineers have been kept quite busy installing and aligning digital systems. Others remain somewhat mystified by the process, even after their own station was up and running.

Things are different this year. More and more engineers have experience with the technology. Digital transmission test gear is coming on line. There is a lot to learn.

Given the concentrated knowledge and experience available, it should be clear this is a good year to be at the NAB Spring Show. ***And don't forget the Tuesday Lunch Gathering!*** If you still hesitate due to cost issues, check out our ideas on how to moderate those costs on page 40.

Nevertheless, whether you finally decide you are able to make it to Las Vegas or not, your digital education will be enhanced by reading Jeff Welton's *Digital Crash Course*, continuing on page 10, and Kyle Evan's discussion of the issue of analog versus digital coverage on page 8. At the very least, they will provide you with the vocabulary you need to understand the technology. – *Radio Guide* –

A Cool, Efficient 50 kW Transmitter

The Nautel XR50

by Chris Hays

There was a time when you could open a door and actually walk into a 50 kW transmitter – along with several other people. Now, 75 years after 50 kW transmitters became common, advancements have brought the size down dramatically.

HEAVY METAL

The first really big rig I ever saw was a GE 50 kW monster, newly installed at KNX in Los Angeles. It was state of the art – air cooled and plate modulated. It was the early 60's and I was just a high school kid. My father worked for CBS and arranged for a tour of the new building. I was pretty impressed!

I worked with even older transmitters when I was part-time at KRLA in the early 70's. KRLA had been under interim operating authority for a number of years; this might explain why KRLA had the two oldest rigs in the market: a 1943 vintage 10 kW Western Electric, and a 50 kW Continental which, if it was not the first 50 kW Doherty they built, it was a very early unit.

Both KRLA transmitters were water-cooled. The Continental took up about half of a good-sized transmitter building; it was very much the all-tube transmitter. The final amplifier ran 12 kV at about 7 amps resting, for 50 kW of carrier power. That is not even 60 percent PA efficiency and does not count all the kilowatts of filaments, plate losses in the driver stages, and the big heat exchanger and pump.

HIGH EFFICIENCY

Now fast-forward to my latest transmitter encounter: the new Nautel XR50 – the new Main Transmitter at KDIS, the Radio Disney station in Los Angeles.

Replacing a Continental 317-C2 with a PA plate efficiency of around 76 percent, the XR50 trumps that with an 84 percent over-all efficiency – and I think that number is probably conservative. The XR50's power modules are based on the proven design of the XL60, with most changes making things smaller and more efficient due to improved components.

The project to install the XR50 was driven by the desire of ABC (and parent Walt Disney Company) to begin HD Radio™ (IBOC) transmissions. ABC is migrating all their stations to HD-Radio but KDIS, Radio Disney, was to be the first conversion.

OUT WITH THE OLD, IN WITH THE NEW

Initially, I was apprehensive when Chief Engineer Norm Avery told me we would be installing a transmitter that was a "serial number one" unit.

However, in the end it was a very smooth install and the transmitter is performing very well. Installation was fairly straightforward, although there were a couple of interesting things worth noting.

For example, the knockout for the power entry on the transmitter was discovered to be too small for the existing power wiring. This is not too surprising as the Continental it replaced had a 225-ampere service. The XR50 does not require nearly that much power. A fused 150-amp service fit fine and allowed for some headroom.

Another point of interest is the wiring between the HD Radio generator (mounted separately in the audio racks) and the transmitter exciter is CAT-5. This is becoming the standard method for connecting digital devices. The BNC connections on the digital "exciter" are for monitoring.

Most of the heavy work was in dismantling the old 317-C2 transmitter and moving it out of the way. There was also a fairly large gap in the wall that needed filling, as the XR50 is only slightly larger than just one of the three cabinets of the old transmitter had formerly sat in that space.

HEY, LOOK ME OVER!

The XR50 is one cabinet (72.4 x 52.8 x 41 inches). As you look at the front you see essentially three sections. The bottom section is a blank, removable panel that provides access to the power supply and RF Driver distribution area.

The KDIS XR50, Phasor and Control Rack.

The middle section of the cabinet houses the eight power modules. These modules can be removed even while the transmitter is operating. The small button on the front of the module allows you to "trip" the associated module so that it can be removed safely with the transmitter on the air.

There are four individual RF banks in each module. Any of these can go to "fault" condtion without the transmitter leaving the air; you simply lose the power generated by that bank. If an entire module trips, you lose the power generated by that module. At 50 kW output, each of the eight power modules provides 6,250 watts with each bank within a module providing about 1,560 watts.

KEEPING COOL

The XR50 temperature rise is extremely modest.

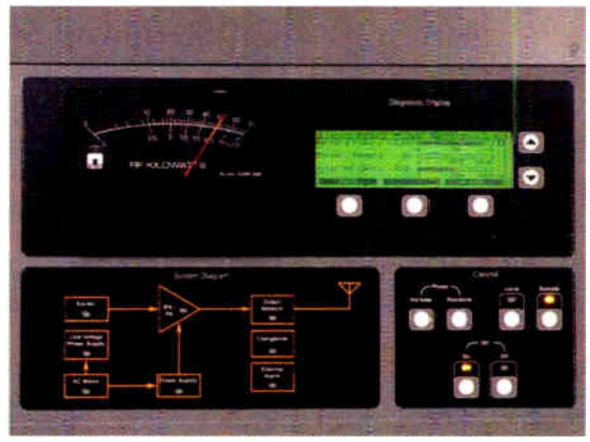
The KDIS site is on an old landfill and the building requires positive air pressure to prevent the ingress of methane gas. The old transmitter exhausted 5,000 CFM through the roof, so there had to be that much makeup air plus a little more.

With the XR50, we were able to reduce that air requirement substantially. The XR50 vents into the room and air conditioning removes the heat; it does not have to work hard – the output temperature is under 90 degrees.

We kept the old exhaust fan only as a backup in case we lose air conditioning.

The upper part of the cabinet is sparse, and contains a relatively small control panel. In an era when everyone is trying to out-glitter everyone else with color computer screens and such, Nautel has given us a "best of the old and best of the new" approach.

The left side contains a conventional analog meter, which has only one function: it tells you how much power the transmitter is putting out. It is large enough to be seen from across a room, which is very nice. To the right is a backlit LCD "Diagnostic Display."



The XR50 Control Panel

This display is multifunction, and its mode is selected via the three buttons below. These buttons are "soft" buttons, as their function depends on the display mode (the display also tells you what each button does). The two buttons at the side are for scrolling the display. The top function displays forward power, reflected power, and total DC supply current on three bar graphs. Other functions are accessed via a menu.

MULTI-MODE OPERATION

The XR50 operates with presets. If you are a station with multiple operating modes, you will definitely use this function.

You can set different power levels on each preset, as well as change exciters. In our case, KDIS runs 50 kW daytime, 20 kW at night, and we also switch to the "B" exciter at night, so we can use processing without the 5 kHz bandwidth restriction that IBOC imposes when operating during the day.

The presets can be selected via the remote control interface as well as from the Diagnostic Display. I would caution users that although setting up presets is not difficult, I found it a little counter-intuitive and it was easy to accidentally tell the transmitter you want it to put out zero watts – and it will happily oblige!

DIAGNOSTICS AND LOGS

There is an event log that can be accessed via the LCD screen. Any change in status of the transmitter or its alarms is accumulated in a running log which has a date and time stamp on the entry (assuming you have set the internal clock). The memory is backed up with a standard button battery, so logs and status are retained even if the main power goes off.

Event Log on the Diagnostic Display

Below the meter and display are "system diagram" and "control" sections. The control panel contains only three functions: on/off, remote/local, and power raise/lower.

(Continued on Page 6)

A Cool, Efficient 50 kW Transmitter

The Nautel XR50

Continued From Page 4

To the left is the "system diagram" which is really a nicely laid out fault tally display. The display has a "no news is good news" approach, and the normal condition is all of the led lamps are extinguished. If a fault occurs, the appropriate lamp will light giving a quick indication of where the fault occurred. The "external alarm" lamp lights whenever the carrier-squelch is asserted via the remote control interface.

The software that runs this panel is in flash memory, so if updates are needed all that is required is a serial cable and a computer.

OVERALL EVALUATION

Nautel was on site to assist with the transmitter and IBOC generator start-up and proofing.

While many (if not most) stations will need some antenna treatment when they migrate to HD Radio, this site – built in 1986 when the station was KRLA – was designed with a broad-banded antenna. However, even though the antenna is quite broad by 1986 standards, nobody was thinking about the kind of bandwidth the IBOC system requires going into the adjacent channels on either side today. As it turned out, we were fortunate not to have to place any correction into the system.

Overall, this was a very smooth installation; the transmitter continues to perform well and we really have found nothing at all to complain about.

I would like to close with a word about safety: anyone working with these transmitters who is used to older solid-state technology should know that high-voltages are back! Not the kilovolt variety, but the power FETs in these high-efficiency designs do run with several hundred volts.

These voltages are dangerous and can be lethal, so remember the old rules: always turn the power off and ensure that capacitors are discharged with a grounding stick before working on these rigs. If you must work inside energized equipment, keep one hand in your pocket and never work alone!

The XR50 uses LEDs to monitor each 60 Amp fuse on the power input. The window on the back of the transmitter instantly shows the power input status.

Chris Hays, Manager of RF Systems for ABC Radio in Los Angeles, has been working on high power transmitters for over 35 years. He can be reached at chris@chrishays.com

– Techie Stats –

Natuel XR50 features at a glance:

1. Maximum RF Power Output: 60 kW
2. RF Power Range: 10-60 kW. Six programmable pre-sets, local or remote.
3. Efficiency: 84%
4. Frequency Range: 531 kHz to 1,610 kHz
5. Modulation Capability: 140% positive at 50 kW and 120% positive at 60 kW.
6. Dual DDS exciters and dual hot-pluggable power modules and redundant standby modules.
7. Compatible with NE IBOC (HD Radio™) signal generator.
8. Audio Input: 600 ohms balanced.
9. Frequency Response: +0.2dB/-0.8dB, 30 Hz to 10 kHz.
10. THD: Better than 0.8%, 30 Hz to 10 kHz.
11. Hum and Noise: -65 dB or better at 50 kW, 100% modulation.
12. AC Input: 350-510 VAC, three-phase.
13. Power Factor: 0.95
14. Power Consumption: 59.9 kW at 50 kW, 0% modulation; 89.3 kW at 50 kW, 100% modulation.
15. Operating Altitude: 0-13,000 feet.
16. Cooling: 1,600 CFM
17. Size: 53" wide x 72.5" tall x 41" deep.
18. Weight: 1,950 lbs.

by Kyle Evans, NPR Labs

Comparing Digital to Analog Coverage Contours

Part 1 – Gathering the Data

The brave new world of HD Radio is fundamentally changing terrestrial broadcasting for all parties involved. The technology opens up new possibilities for broadcasters, allowing stations a home for new content offerings, CD-quality sound, and the promise of a variety of ancillary data services to come.

But with these new opportunities come new concerns that need to be taken into consideration when designing and calibrating implementation schemes. Specifically, coverage issues have been oft-mentioned concerns.

REAL WORLD STUDY

To tackle this issue, National Public Radio Labs embarked on a year-long project to collect data from actual operating stations and form a propagation model for digital radio.

In this two-part article, we will summarize the study, discuss the conclusions, and address future work that needs to be done to improve the model.

Before any conversation about HD Radio propagation issues and concerns, we need to first address the basics of RF propagation models and discuss what they are designed to compute.

RF MODELING

An RF propagation model is designed to compute the loss in mean signal strength over a geographic area. Loss in mean signal strength is typically caused by three levels of additive phenomena:

• Large-Scale (path loss) – Path loss is a gradual drop in received power due to the distance from the transmitter

• Mid-Scale (shadowing) – Shadowing is caused by obstacles in the vicinity of the antenna that cause a temporarily diffracted wave.

• Small-Scale (multipath) – Multipath is a short decrease in signal strength caused by phase cancellation between the multiple delayed versions of a signal simultaneously arriving at an antenna due to local clutter.

Several types of RF propagation models have been designed over the years to approximate the loss of signal strength. The Longley-Rice (LR) propagation algorithm (an Irregular Terrain Model) has emerged over time as an industry standard tool for predicting signal strength loss based on its better sensitivity to terrain elevation changes.

In addition to utilizing a terrain elevation database and a wide range of antenna and environmental factors, LR includes time and location variability in its calculation, allowing for a better statistical interpretation of signal loss. For example, a region calculated as having 60 dBu predicted signal level with Longley-Rice set at 50/50 time/location variability equates to 50% of the people, 50% of the time receiving a 60 dBu signal in the calculated region.

However, the advent of HD Radio broadcasting is changing this world of RF propagation modeling at its base level – HD Radio coverage simply cannot be predicted accurately with old FCC contour methodology. A more comprehensive model needed to be developed and to generate this model data had to be collected from practical implementations of HD Radio across the country.

NPR Labs set out to do precisely that with its HD Radio Coverage Measurement Initiative.

THE LOGGING PROJECT

NPR Labs' HD Radio Coverage Measurement Initiative set out to collect data from NPR member stations across the country which are broadcasting digitally.

As our database of information grew, we could successively refine our model, gradually arriving at a reasonable approximation of HD Radio signal propagation and defining causal factors in DAB broadcast success. But to collect this data we needed a suitable measuring device.

After examining a variety of industry solutions – none of which completely met our needs at the time – we decided to design and produce our own measuring unit. We integrated a Kenwood KTC-HR100 HD Radio Tuner, a Kenwood EZ500 radio, and a GPS unit into a case and connected the input to a 32-inch vertically polarized mag-mount antenna.

The NPR Labs' HD test and logging unit.

The information gathered was logged four times per second onto 16 MB MultiMediaCards (MMC), which allowed approximately 20 hours of recording per card. The self-contained unit required no external computer or controls, so users simply laid the logger on a car seat, connected the GPS unit, connected the antenna, tuned in the desired station and pressed "record."

GATHERING DATA

After the logging unit had been designed and constructed, we presented it at the Public Radio Engineering Conference (PREC) at NAB 2005.

We were warmly received by engineers keen to understand their new coverage concerns and collected a long list of people eager to collect data in their markets. From this list, we selected candidate stations that represented as broad of a cross-section of public radio stations as possible; we were interested in getting a variety and the stations finally selected ended up running the gamut in terms of class, morphology, and overall market size.

Over a period of seven months logging units were shuffled around from station to station. Each station drove their broadcast area, paying attention to a few particular concerns:

• Diversity of road types – highways allowed the coverage area to be driven quickly, but often provided inflated data, as they are elevated and generally free from obstruction. We requested data be collected on a variety of roads, from city streets to small state roads.

• Diversity of HD reception – driving half a mile from an antenna told us little about a station's HD signal, because there was always enough HD signal for the receiver to "lock." Data collected from fringe areas provided us much better data.

• Diversity of existing conditions – data from known problem-areas was encouraged, especially areas with adjacency concerns.

After data was collected from each market, the MMC cards were mailed back to NPR Labs, where we added the information to our growing archive.

PROCESSING THE DATA

The logger collected samples approximately four times per second – a rate equivalent to one sample every 6.7 meters at highway speed.

While this high sampling rate was more than enough to provide an accurate depiction of the drive-test, the combination of an abundance of information and a rapid signal fluctuation of the mobile test environment caused the data to falsely exhibit excessive jitter.

To compensate for this jitter, a windowed average of the data was taken. Each sample was represented by the arithmetic mean of itself and the nine previous samples. These small corrections drastically improved the continuity of the data, allowing the drive-test to be broadly characterized.

UNDERSTANDING THE DATA

As the data came in, we gradually developed theories about how a large variety of factors was affecting the digital signal. As we received more information, some theories started looking more and more accurate, while others were discarded or were modified.

One of the participating local data collection vehicles.

For example, we started noticing trends in the data, specifically non-correlation between predicted and measured signal levels, which we determined was caused by morphology effects. We observed in our predictions that, because the terrain elevation utilized by the algorithm represented "bare earth" conditions, Longley-Rice tended to consistently overestimate signal strengths.

While a single adjustment to path loss would improve the correlation between actual measured and predicted signal levels, a further improvement with Land Use Land Cover (LULC) adjustment factors was deemed necessary. Our LULC database classifies land cover in an array of 1/4 mile grid points into 32 different categories. A global adjustment of LULC factors was not serving our needs well – so we needed to develop a computational technique to generate LULC adjustments on a market-by-market basis.

We computed adjustments by linking an LULC database and a bare-earth Longley Rice propagation model prediction. Each drive-test point was compared to a corresponding bare-earth predicted signal, with the difference between measured and predicted noted. Then, each point was matched with its corresponding LULC type and the collected differences between measured and received signal level were averaged.

These LULC averages were then used as local land type adjustments in a second Longley-Rice prediction model, in a sense keying the model with its own data. This allowed the drive-test data to be viewed in a market-by-market context, and drastically improved the accuracy of the predictions.

BUILDING A VISUAL REPRESENTATION

The refined Longley-Rice prediction model was then imported into MapInfo, an industry-standard Geographic Information System program used to manipulate and map multiple layers of geo-information. Using Vertical Mapper, a suite of MapInfo tools, the Longley-Rice data was interpolated using an Inverse Distance Weighting scheme and rendered in iso-contour regions of 50-60 dBu, 60-70 dBu, 70-80 dBu and 80-120 dBu at 2 meters above ground level.

In order to represent a large amount of data efficiently and practically, drive-test data was aggregated into bins of at least 100 samples. Each of these aggregated bins represented the average received signal level and HD status of all drive-test samples within a specified distance of the bin's center. This "binning" allowed the large amounts of data collected by each station to be viewable on a large scale map and offered viewers of the maps a better characterization of regional service.

From this data, two maps were then created. On the first, each drive-test bin was colored according to its average received signal level to match Longley-Rice contour intervals, making a Received Signal Level map. On the second map each drive-test bin was shaded to represent a percentage range of HD Reception, making an HD Receive Status map.

We will continue with this next month and discuss the findings and what this means for the digital broadcast community.

Kyle Evans is an Engineering Technology Research Associate at NPR Labs in Washington, DC. Kyle can be contacted at kevans@npr.org

Digital Guide

by Jeff Welton, Nautel, Ltd.

Digital Radio Crash Course

Part 4 – Terminology

As with any new technology, implementation of HD Radio™ will require learning some new technical terms. Jeff Welton continues his Digital Radio Crash Course with a dictionary of the terminology frequently needed for communicating on this topic.

Following on from our discussion about what hardware we need to get HD transmissions going – and keep it going – this might be a good time to review some of the new words and/or phrases that we will need to help us understand one another as we discuss ways to optimize the performance of our new system.

I am presenting these terms as sort of a "dictionary," keeping it in alphabetical order as much as possible. I will try not to get too technical on anything – so let us call it a "Layman's Lexicon of HD."

TERMS OF ENDEARMENT

ADC – Analog to Digital Converter. The ADC is a device used to take conventional left and right channel analog audio and convert it to a digital data stream. For broadcasting purposes this data stream is in the AES/EBU format and for HD Radio purposes the sample rate, if adjustable, should be set to 44.1 kHz (*see sample rate*).

AES/EBU – American Engineering Society/European Broadcast Union. This is a standardized format adopted for the transmission of analog audio in a digital form over 110 ohm shielded twisted-pair cable.

AES/EBU transmission has the advantage of not being as subject to line noise or distortion as analog paths, so it results in a much cleaner signal at the other end of the transmission chain. Note that AES/EBU does not necessarily refer only to the digital audio signal in a system broadcasting with HD Radio technology – the analog audio could just as easily be in AES/EBU format.

Various sampling frequencies are possible, but the standard for systems using HD Radio technology is 44.1 kHz. For the most part, all audio transmitted through a system using HD Radio technology will be in AES/EBU format, whether it is part of the analog audio path or the digital. However, many exciters, including the Nautel M50, are capable of using composite analog baseband for the analog carrier modulation in HD hybrid mode.

Artifacts – a type of digital noise that can result from many causes. Artifacts typically manifest themselves as a "flanging" or metallic sound on the broadcast audio and can be quite irritating to the listener.

Two of the primary causes of artifacts are multiple sample-rate conversions through an AES/EBU audio chain – where the signal bandwidth on the input is greater than the Nyquist limitation on the outgoing sample rate (see SRC) – and "dueling algorithms" – an effect seen when AES audio is passed through multiple lossy-codecs to the point where essential information begins to disappear or is improperly reconstructed at the receiver end.

The problem is that cascaded lossy-codecs often end up with artifacts that are worse than the sums of the individual codecs. This is important to note because the digital component of your HD signal is compressed through a lossy-codec in the Importer, Exporter and/or HD Generator – additional compression in outboard equipment may cause undesirable artifacts.

That is why I have recommended processing on the HD audio should be kept fairly light, to help prevent these anomalies. Actually, anything that causes the audio to go through an unnecessary codec should be avoided.

Indeed, the light processing – and subsequent increase in dynamic range – is one of the primary factors for the improved sound of the HD signal. Most of the major audio processor manufacturers have very good information regarding processing your HD signals on their websites.

Audio – this is the station modulating information – in short, the signal from the studio which is meant to be broadcast to the speakers on the receiving end. Audio is transmitted in two forms.

Analog: The audio information that is used to modulate the analog AM or FM carrier. The audio information itself may be in analog or digital (AES/EBU) format, but we are referring specifically to the signal being conventionally modulated on the analog carrier.

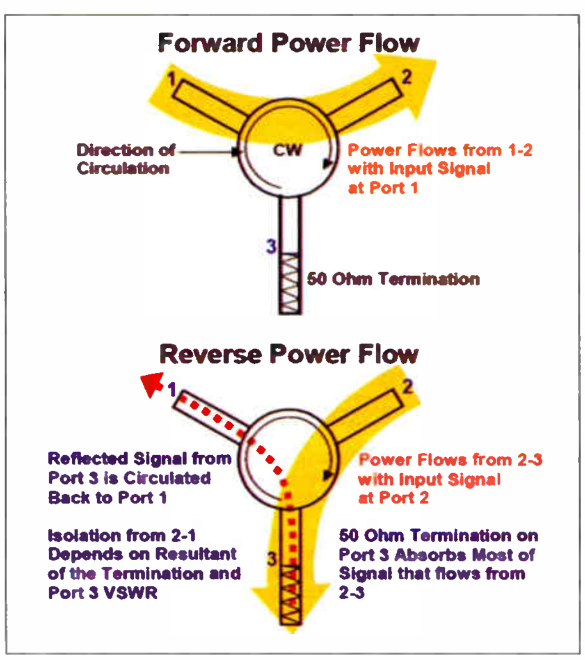
Digital: The audio information that is carried by the digitally modulated OFDM carriers. This audio signal will always be in AES/EBU format and should be sampled at 44.1 kHz, to prevent artifacts from repeated sample rate conversions (*see artifacts and SRC*).

BER – Bit Error Rate. The BER effectively determines whether or not a digitally transmitted audio signal can be reconstructed on the receive end.

The receiver takes all of the bits received and rebuilds the audio signal from them. If some bits are lost or corrupted during transmission, the receiver will not have information to fill in the blanks and artifacts can occur. In an HD transmission, if enough bits are lost or corrupted, the receiver will not be able to reconstruct the audio signal at all and will either mute or blend to analog.

Blending – the ability of a signal broadcast using HD Radio technology to switch from digital to analog in the event that insufficient digital information is available to accurately reconstruct the audio signal.

Blending should be reasonably seamless and will usually only be noticeable if the analog and digital audio signals are processed much differently or if the analog delay is not properly set (*see delay*).



A Lump Constant Circulator

Circulator – a circulator is basically a "one way street" for RF signals. RF energy entering the input port of the circulator is fed to the output port; however, reflected energy or back-fed energy from a downstream device – such as analog energy being fed back from a high level combiner – is absorbed and dissipated as heat.

A circulator isolates the HD transmitter more completely from the analog transmitter and prevents possible intermodulation products or damage that could result from excessive energy entering into the output of the HD transmitter (*see isolator*).

Delay – because it takes some time – nominally seven to eight seconds – for the digital audio to be processed through the system, analog audio must be delayed by a similar amount to allow the same information to be received at any given time.

This is usually done during the installation by viewing digital audio on one channel of an oscilloscope and analog audio on the other, with the scope set to view a Lissajous pattern. When the display is a flat diagonal line, the delay is properly set. Alternately, it can be done by ear, but this may depend on the ability of the receiver to switch between digital and analog modes – and it will not be as accurate as a scope display (*see blending*).

Exgine – this component resides in the FM exciter. It accepts coded audio and data from the Exporter and converts it to a set of subcarriers in a digital format. The digitized subcarriers are mixed with the analog MPS and frequency shifted to the station carrier frequency in the FM exciter (hybrid or low level combine). The Exgine is connected to the Exporter over a LAN.

Exporter – PC based equipment that codes Main Program Service (MPS) audio using proprietary software from iBiquity Digital. The coded audio is transported over a LAN to an HD modulator (i.e. Exgine) that converts it to a set of subcarriers in a digital format.

The Exporter will accept Program Associated Data (PAD) for the main program audio and it will accept Coded Secondary Program audio (SPS) and/or Advanced Application Service (AAS) data from an Importer (transported via LAN). The Exporter accepts the MPS in AES/EBU format, rate converted to 44.1 kHz where the 44.1 kHz is frequency locked to a timing reference from a GPS receiver. The sample rate converter and GPS receiver are contained in a support device supplied with an Exporter.

HD Generator – this device combines the functionality of the Exporter and Exgine and represents the 2nd generation HD system (Exporter and Exgine are 3rd generation). Due to the type of signaling between the HD generator and FM exciter, the HD generator had to be located at the transmitter site. Separating the HD generator into Exporter and Exgine means that the Exporter can be at the studio and the Exgine is in the FM exciter at the transmitter site.

HD Radio – a technology under license from iBiquity Corporation that allows radio stations to simultaneously broadcast conventional analog as well as digital audio signals and data.

For AM radio, these signals are simulcast (the digital audio is the same as the analog). For FM stations, the analog and the digital MPS are simulcast, but the option exists to allow additional program feeds on the digital signal.

In addition, both AM and FM offer Program Associated Data (PAD) and station identification as well as leaving room for advanced data applications.

High Level – an RF combining method where the analog and digital transmission signals are combined at the outputs of the two transmitters (*see injector*).

iBiquity – the corporation primarily responsible for developing and licensing HD Radio technology. For more information see www.ibiquity.com

IBOC – In Band On Channel. Used to refer to a method of broadcast transmission whereby analog and digital information are transmitted simultaneously on the same channel using conventional broadcast frequencies and maintaining the signal within existing bandwidth limitations.

The standard for this is defined in NRSC-5, available at http://www.nrscstandards.org/Standards.asp

Importer – PC based equipment that takes multiple audio feeds to be broadcast in conjunction with the main program audio. These multiple feeds (secondary program audio) are coded and transported to an Exporter over a LAN. The Importer will also accept PAD for the secondary program audio and other data services for broadcast.

(Continued on Page 12)


Design » Build » Installation
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by Jeff Welton, Nautel, Ltd.

Digital Radio Crash Course

Continued From Page 10

Injector – frequently referred to (and essentially the same) as a combiner or coupler, this is the unit that receives the output from the digital transmitter and adds it to the signal from the analog transmitter in a high level combined system.

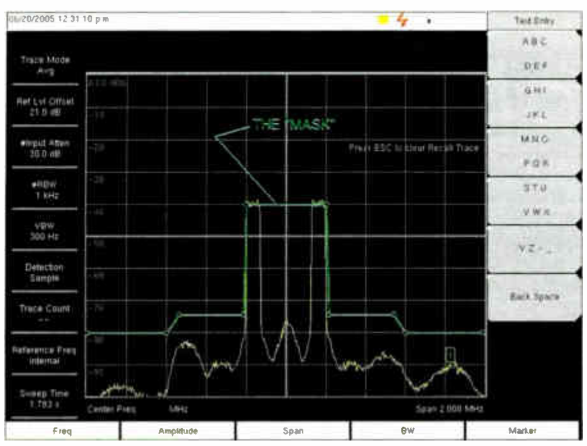
Isolator – an isolator is a circulator with a matched load port. Energy entering one port is permitted to pass through the port immediately adjacent to it, but not through the port in the other direction.

In this manner, the HD signal can be passed through to be combined with the analog signal, but any signal fed back to the isolator from the high level combiner will be passed to a dummy (reject) load rather than being fed into the output of the HD transmitter.

In areas with high power analog signals being high level combined with HD, this gives good isolation from any combiner leakage and prevents possible intermodulation products as a result of interference signal.

Low Level – a system of transmitting using HD Radio technology where the digital and analog signals are mixed prior to the exciter stage and fed through an exciter and transmitter capable of hybrid mode operation.

Mask – the boundaries set to limit the emissions from a transmission system. Frequently displayed on a spectrum analyzer to provide an immediate visual reference as to whether or not a system is in compliance.



The Mask for a high level combined FM system.

MPS – Main Program Service. For stations broadcasting with HD Radio technology, this refers to the primary digital audio stream – a simulcast of the analog audio program.

Multicasting – the ability to broadcast multiple audio feeds simultaneously. The Main Program Service (MPS) will be a simulcast of the analog audio feed. Additional Supplementary Program Services (SPS) can be added as desired.

Keep in mind that every SPS added will require a reduction of the bit rate available for the Main Program Service. There was an article on multicasting in the January 2006 issue of ***Radio Guide***.

PAD – Program Associated Data. As the name implies, this is data associated with the program information, such as artist, song title, album, etc.

PAD can also be used to convey station information, call sign, frequency and the like. PAD is transmitted in conjunction with the Main Program Service and does not require an Importer.

RBW – Resolution Bandwidth. A spectrum analyzer must have sufficient RBW capabilities in order to properly measure an HD Radio signal. For AM broadcast a resolution bandwidth of 300 Hz is required; for FM it must be 1 kHz.

Sample Rate – the rate at which a (digital audio) signal is sampled. While most equipment can accommodate various sample rates, ranging from 22-96 kHz, the standard chosen for HD Radio is 44.1 kHz. (*see AES/EBU and SRC*)

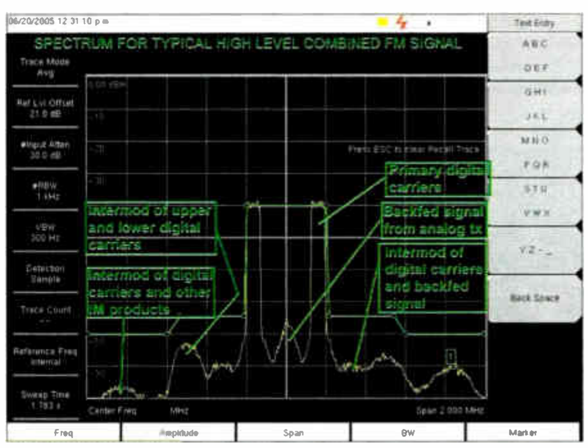
Sidebands – the portions of the broadcast signal that appear on either side of the conventionally modulated carrier when viewed with a spectrum analyzer. Sidebands for HD Radio information are divided into several blocks, with the three most commonly mentioned being:

1. *Primary:* the portion of the digital sidebands residing from 10 to 15 kHz above and below the carrier for AM and from 130 kHz to 200 kHz for FM. The primary sidebands contain the core digital audio information. Theoretically, the digital signal is decodable at the receive end if only one of the digital sidebands is received.

2. *Secondary:* the portion of the digital sidebands residing from 5 to 10 kHz above and below the carrier frequency for AM. The secondary sidebands, in conjunction with the tertiary sidebands, contain the information necessary for the receiver to decode the enhanced mode signal.

Secondary digital sidebands are not used for the transitional hybrid mode of FM IBOC, but are planned to replace the analog carrier at some point in the future, extending from the carrier frequency to ± 100 kHz.

3. *Tertiary:* the portion of the digital sidebands residing from 0 to 5 kHz above and below the carrier for AM – again, these are not used in FM. Tertiary sidebands contain some of the information required to provide the enhanced quality signal for AM IBOC.



The basic parts making up an FM HD signal.

In the picture above, we have an example of the basic parts of an FM HD signal, where you can note an example of backfeed from the analog transmitter – this can often be reduced by installing an isolator.

The first problem that can occur is when the intermodulation products from the backfed FM signal mix with the amplifier output and result in unacceptable out-of-band emissions. Keep in mind, however, that for the backfed analog signal to have a detrimental effect on the HD signal it would need to be significantly higher in level – therefore it would be useful to take a look at spurious and harmonic output outside the normal span that would be viewed when analyzing the mask.

When signals mix, the result is F1+F2 and F1-F2. If you do the math on the digital carriers and backfed analog, the products would not be in-band. The actual mixing occurring is 3rd order (2F2 +/- F1) and 5th order (3F2 +/- 2F1) intermodulation.

In addition, backfed analog could conceivably exceed the SWR threshold of the HD transmitter, causing power limiting and affecting the power ratio between the analog and digital transmitters.

Considering that the HD transmitter in a high level system is operating at 10% of the power of the analog (with 90% of that being dumped in the combiner), then for a 20 kW system, we would have a 2,000 W HD transmitter. This means that for some models of transmitter as little as 40 W of backfed power (-17 dB relative to the digital transmitter's forward power) from the analog could cause SWR limiting of the HD transmitter's forward power.

In a Nautel system, the SWR threshold is 1.5:1 (which would equate to 80 W of backfed power in the above example), but this may not be true in all cases – check with your equipment manufacturer

Space Combined – A combining method where the analog and digital transmission paths are totally independent, using separate antennas, and the signals are combined in free space after leaving the antennas

Split Level – A combining method where one transmitter operates in modified hybrid mode, providing all of the digital and some of the analog power and the other transmitter operates only in analog mode.

SPS – Supplemental Program Service. Additional audio stream(s) that can be added to your HD signal for multicasting (SPSA). This can also include data services (SPSD) (*see Exporter, Importer, MPS and Multicasting*).

SRC – Sample Rate Converter. Used to convert a digital audio signal from one sample rate to another. Note that repeated sample rate conversions can cause distortion of the digital audio signal (*see artifacts*). This is usually only a problem when sample rate is decreased from one point to the next.

The sample rate used throughout the HD Radio technology system developed by iBiquity is 44.1 kHz. As much as possible, this rate should be maintained through the entire audio chain.

FROM GLOSSARY TO REALITY

Okay, so now you know how to "talk the talk." Next month we will learn how to "walk the walk," with an overview of things you need to look out for during the installation phase and some general tips and tricks picked up during a few of these installs.

You will note that most of my information will almost certainly be geared toward Nautel equipment (you are surprised?), but as the software platform is pretty much standard among all manufacturers, a lot of it should apply regardless of what name is on the boxes.

At that point, unless somebody comes up with any suggestions for a future article in this series, I will probably be ready to say: "class closed, go forth and multiply your program streams."

A CORRECTION OR TWO

A couple of errors appeared on page 8 in January's article.

A minor error was in the "Calculating the Losses" paragraph, I erroneously stated that for 20 kW of analog power into the antenna, we would require 22 kW from the transmitter. Sharp-eyed readers will know this should actually be 22.2 kW. This increases the reject load requirement to just over 4 kW: (22.2 kW x 10%) + (2000 W x 90%) = 4.022 kW).

A more significant error was in the last paragraph of the section entitled "Multicast Summary." The second sentence indicates that some digital exciters can take data directly from the Importer, negating the need for the Exporter and the HD generator. With currently existing configurations, this is wrong.

Digital exciters containing the Exgine revision can take data directly from the Exporter and do not require a separate outboard HD generator. However, even then the Exporter is still quite necessary.

Even though he speaks Canadian at home, Jeff Welton has helped many understand the terminology of digital radio. If you have any questions, feel free to contact Jeff at jwelton@nautel.com. Good day, eh?

FCC Focus

by Bruce Eisen

Zoning and Your Station

A number of tough questions surround the issue of FCC preemption of state and local law. Although subject to significant regulation from the federal government, radio stations must also answer to local authorities.

What happens in those infrequent, but nevertheless very real, situations where state or local regulations conflict with FCC Rules or policy?

Is there an easy way out of the puzzle of cross-regulation? Can a broadcaster be punished twice for the same purported infraction? Does the federal government not always prove sovereign to the detriment of the local authorities?

PRIMARY JURISDICTION

There is a doctrine of law which is known as "primary jurisdiction." That is dry legalese which describes a situation where a court holds that a lawsuit requires an administrative agency (like the FCC) to decide the questions raised even though a federal, state, or local court may have jurisdiction over the matter.

In effect, the court finds a matter is best resolved by the FCC or some other administrative agency because it has the unique expertise to resolve the matter or the exclusive statutory authority to consider the facts.

In these rare cases, courts will simply defer all action on the case and send it to the agency for a decision.

AUTHORIZING AUTHORITY

A few years ago, the FCC traced certain radio transmissions to a pirate broadcaster, ultimately attempting to fine him for operating an unlicensed, low power radio station. The individual argued to the FCC that such an action by the agency was unconstitutional, citing First Amendment and other "rights."

When the FCC attempted to go to a federal district court to enjoin the allegedly illegal operation, the court stayed the action under the doctrine of primary jurisdiction and referred the matter back to the FCC so that it could address the constitutional arguments that had been made. In the end, the FCC found the constitutional arguments were un-persuasive and then slammed the pirate with a monetary forfeiture.

An appellate court held that the Communications Act requires that anyone who wants to broadcast has to first be authorized by the FCC. It agreed with the district court that the doctrine of primary jurisdiction had been correctly applied and the case had to be adjudicated only by the FCC.

There are, of course, other and far more ordinary actions which broadcasters frequently confront that cause courts to look to the FCC's expertise for the correct resolution of questions.

THE LOCAL ZONING BOARD

Questions of zoning often arise with regard to "due diligence" in original tower construction. With the FCC now taking a tough stance on extensions of time for construction permits, it behooves a broadcaster to apply to its planning or zoning board as soon as reasonably possible in order to construct FCC authorized facilities .

Do not rely upon local planning and zoning board difficulties to justify an extension of a permit. It will not work.

Local governments have various kinds of regulations regarding the construction of broadcast towers. Some use simple and well established zoning laws, but many have particularized rules when it comes to tower locations and aesthetics. These are matters which have to be carefully addressed locally and which may be best handled by a skilled real estate lawyer.

One thing is certain: The FCC does not regulate radio and/or television towers and the agency has never tried to control where towers may be located nor what the allowable height of such structures should be. The agency, instead, defers to local authorities and in the past has rejected claims that local government restrictions on broadcast facility locations should be pre-empted.

"FACTS" AND ZONING BOARDS

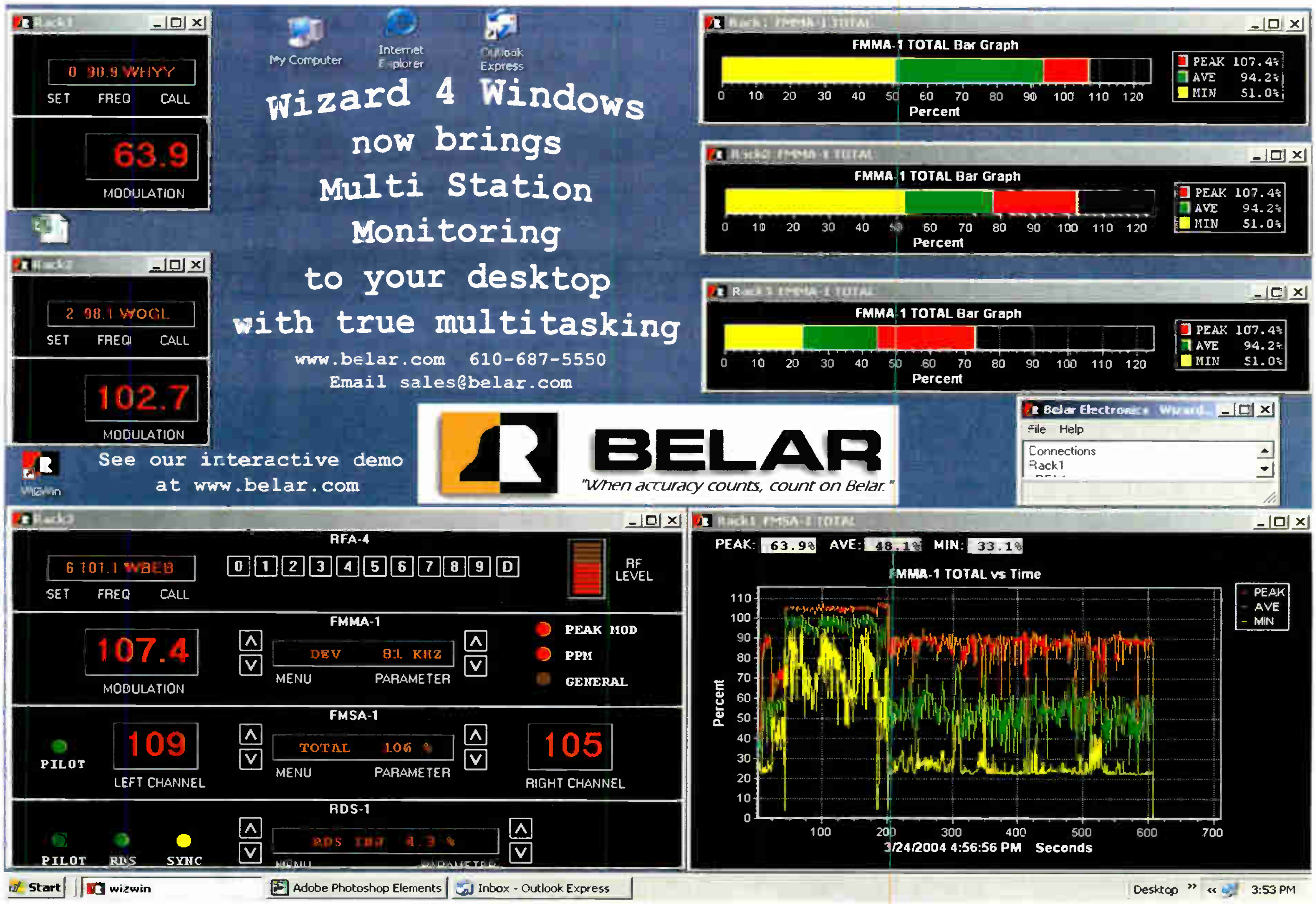
Some years ago, I represented a broadcaster who sought to move his tower to a superior location for coverage. The location met all FCC spacing requirements, but the owner was forced to go before the local zoning board. He asked me to address the board and to explain the benefits to both the board and the community that would result from the station's increased coverage.

I spent thirty uncomfortable minutes listening to questions from the board that could have been raised in 17th century Salem. The proposed tower was to be located about 600 feet from a motel. The motel owner showed up at the hearing, as did a number of concerned citizens who wanted to voice their own opinions.

Basically, the zoning board was presented with two kinds of opposition from these folks: first, the "fact" that the new tower would "likely" knock out all television reception in the motel, thus depreciating the motel's value and its attractiveness to visitors; and secondly, the tower had the potential to cause dangerous radiation to town residents that could result in all kinds of maladies from cancer to infertility. Incredible!

Not only did the tower comply with all RF regulations, but the proposed site was a significant distance from the closest residential area. There was no scientific or medical evidence offered by the opponents.

(Continued on Page 16)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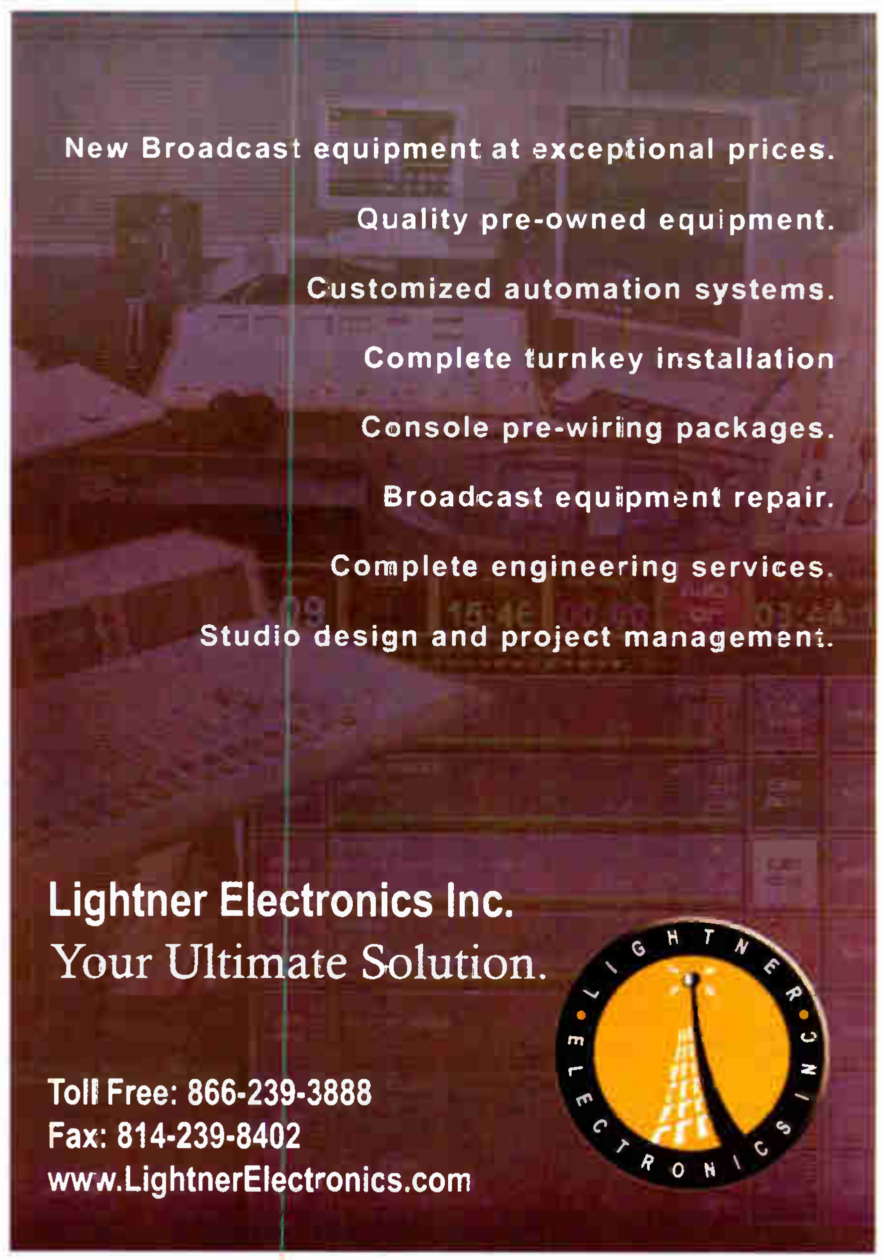
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FCC Focus

by Bruce Eisen

Continued from Page 14

It did not matter. The zoning board turned down the request. In so doing, it rejected the legal and engineering arguments presented and placed the broadcaster at a terrific competitive disadvantage in the market. Only after months of further negotiations with the board and town citizens was the station able to satisfactorily relocate its tower.

LOCAL OR FEDERAL CONTROL?

Any broadcaster seeking to relocate an existing tower or construct a new tower for initial broadcasting must consider local zoning policy before applying to the Commission for an appropriate construction permit.

Remember, we are not discussing FAA restrictions, radiation factors or technical elements of coverage, all of which are proper federal considerations. Local zoning turndowns are not supposed to result from the effects of radiation, so my ancient case was a real anomaly.

In 2000, the FCC issued a "Local Government Guide" intended to assist communities in understanding RF safety, as well as FCC Rules and procedures. And, of course, the agency alone regulates interference questions. But the FCC has no authority to pass judgment on the adequacy or reasonableness of local zoning regulations because its members are not appointed to make local land use decisions.

So, it is entirely correct to say that the power over local land use rests exclusively with state and local governments and is not a federal power which courts would ordinarily pass on to the FCC for a decision under primary jurisdiction. If a community has a tower moratorium, the FCC is not the correct forum to bring a fight.

SPECIAL CIRCUMSTANCES

It is important not to confuse FCC Regulations concerning broadcast towers with other evolving communications technologies.

For example, Congress has given the FCC exclusive regulatory jurisdiction and authority with regard to "direct-to-home" satellite services and MMDS – including the right to issue regulations to prohibit restrictions that impede viewers from using necessary devices. Sometimes, this can result in the alteration of property rights created under state law.

It is more than interesting to note that the National Association of Broadcasters asked the FCC to initiate a Rulemaking in 1997 (MM 97-182) to pre-empt certain local zoning of radio, TV and cellular towers.

However, there is still a grey area concerning the zoning of broadcast towers because the FCC never resolved that Rulemaking to adopt Rules that would have limited local authorities to regulate the construction of broadcast towers or the tower modifications required to implement digital broadcasting.

REPLACEMENT ISSUES

This question of conflict between local and federal authorities becomes more and more critical as last-generation transmission facilities begin to fail, bringing a potential end to tower life. Finding out after an issue arises is the wrong time.

What happens if an existing broadcast licensee must replace an aging tower – or one damaged by a storm or plane accident – with a new one at the same location, but with the fearful understanding that the local authority does not permit replacement construction?

While the FCC probably would not intervene, it is likely that the severity of the situation would allow the agency to at least extend a construction permit for a short period of time.

PUSHING THE ENVELOPE

A few years ago, a broadcast permittee in New England came face-to-face with a local ordinance that prohibited the construction of "any broadcast tower that exceeded 42 feet." The FCC's Construction Permit had authorized a 50,000 watt daytime, 500 watt nighttime signal through the use of four 266-foot towers in an area previously zoned for industrial use.

The local authority zealously opposed the towers. Years of litigation followed, but ultimately the broadcaster won on appeal when the court ruled the local ordinance prohibiting the tower at 266 feet wrongly defeated the FCC Rule requiring a tower of that height for a station to operate on the frequency (720 kHz).

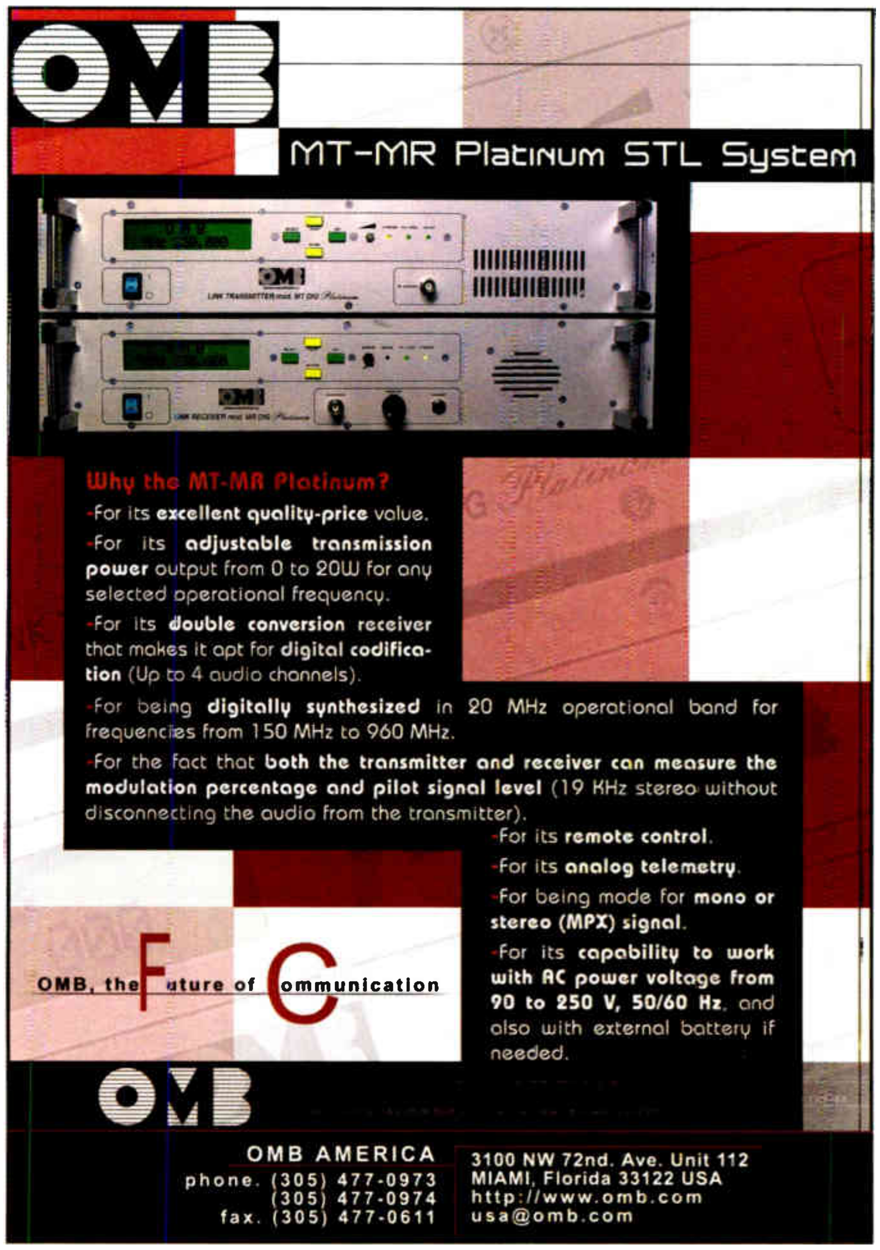
In short, the broadcaster beat the locals by arguing that the FCC's exclusive jurisdiction over technical radio matters trumped local land use provisions because the United States Constitution establishes that federal statutes are "the supreme law of the land."

Perhaps this logic can be used in the future at state and local levels to help secure necessary tower replacement.

Of course, the best result is not to have to confront the authorities at all, but to educate them as to the special needs of broadcasters who, after all, are constrained by both the laws of physics and by the Regulations of the FCC.

There is a need for a continuing dialogue between broadcasters and local governments so unfamiliar technical questions can be equitably handled by zoning boards and planning commissions. For starters, it might be wise for broadcasters to provide the FCC Guide on RF to the authorities so they may be correctly informed about such matters.

Bruce Eisen, of Kaye, Scholer, has been a communications attorney for some 20 years. If you have a question regarding the FCC Rules and Regulations, send it to Bruce at beisen@kayescholer.com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by Goran Tomas

Streaming Audio

Part 2 – The Opticodec

Last month we took a look back into the history and problems with early streaming, and introduced you to aacPlus – the codec that makes all the difference. Now it is time to show you how easy it is to start streaming high quality audio on the Internet (and to mobile devices) with Orban Opticodec software.

ORIGINS

Greg Ogonowski, Orban's Vice President for New Product Development, recognized the quality of the aacPlus codec early in the game. After developing the PC-1100 (an Optimod processor on a PCI card) it seemed obvious to offer users a complete streaming solution.

Orban saw great potential in the new codec, licensed it from Coding Technologies, and was the first on the market with AAC/aacPlus streaming encoder – officially called the Opticodec-PC1010.

A first version was introduced in 2004 and it supported AAC, aacPlus v1 and aacPlus v2. Last year at NAB version 2 was presented, featuring a number of improvements including 3GPP streaming to mobile devices, support for more streaming servers, saveable configurations, packet optimization, embedded song titling, etc.

MULTIPLE VERSIONS

Opticodec runs on Windows 2000/XP/Server 2003 and is available in three versions: LE, SE and PE.

The Light Edition will encode a single stream with a maximum bit-rate of 32 kbps and accepts audio from any standard audio card. The Standard edition allows for four different streams with bit-rates up to 320 kbps, also working with any sound card.

The Professional Edition comes exclusively with the Optimod PC-1100 sound/dynamics-processing card. It can encode any bit-rate and as many streams as your computer can handle. Only this version supports encoding of 3GPP streams for streaming to UMTS/3G mobile phones and it will not work without the PC-1100 card with which it comes bundled.

INSTALLATION

The installation of Opticodec software is very simple and straightforward. The PE version requires just a bit more time because of the hardware installation of the PCI card, but that is just a minor issue.

The PC-1100 is a self-contained audio processor that we will take a closer look at in my next article, after the long-anticipated version 2 software comes out. I will just mention here that it offers a complete set of audio inputs and outputs (including WAVE drivers for the operating system) and full-blown Optimod processing – a 2-band AGC followed by a 2 or 5-band dynamic processing section with final look-ahead limiting. Essentially, it is an Orban 6200S packaged conveniently on a PCI card.

Since broadcast-grade dynamic audio processing is essential for your streams to sound as good as your on-air broadcast, the PC-1100 is therefore a wise addition to both LE and SE Opticodec versions. Alternatively, you could use the HD output of your HD-enabled broadcast processor if that is available to you.

Since quality processing designed for bit-reduced audio will not only greatly improve your presentation in terms of level and dynamic control, but it will also increase codec efficiency and reduce artifacts.

FLEXIBLE AND CONFIGURABLE

Opticodec can be started either manually or via command line scripts. The latter is useful if you want to have multiple streams with different bitrates; you can save individual settings for each stream (they are called "profiles") and easily create an automatic start-up batch file.

Unlike some other encoding software applications, running multiple instances is not a problem as the Opticodec is very CPU efficient. We have set up streaming computers running a dozen Opticodec streams alongside other encoding software apps without a hiccup. Greg Ogonowski reports running as much as 16 instances at the same time.

The Opticodec in Action

THE STREAMING SERVER

Along with the codec, a streaming server is necessary to reach listeners. There are several options to choose from.

You can do "in-house" serving if you have enough upload bandwidth to support the maximum expected number of current listeners. Although a separate computer usually performs the server function, you can install the streaming server software on the same computer on which you are running the Opticodec.

The creation of a separate stream (connection) for each listener just described is called a "unicast." A more effective and bandwidth efficient way to serve streams is to multicast, where a listener just hooks up on the stream much like you tune into radio station. This requires that ISPs have multicast enabled servers, although not many do.

A third, and easier, option is to use the ISP's own server. All you have to do is enter the data (such as IP address, port number, password and type of server and protocol used) your service provider gives you, check that you have allowed traffic on that port on your firewall/router/gateway, and off you go.

Another option is to build your own server and place it at the ISP's location, connecting directly to their backbone; this is called "co-location." It requires a dedicated, reliable, full-time connection between you and the ISP. Basically you send source streams to the server and there they are multiplied, based on the number of listeners requesting feeds.

Since somebody else takes care of the server set-up, maintenance and administration, this comes with a certain cost but on the other hand is the most convenient. Service providers such as Streamguys and Abacast readily support Opticodec/aacPlus streams.

SERVE AND PLAY

Opticodec can talk to various streaming servers, including SHOUTcast, IceCast, Ultravox, and Apple Darwin servers – all of which are free. However, if you will be doing serving yourself, setting up some of these servers can be a bit tricky if you are not computer/network savvy.

The Opticodec manual is of great help here as installation of each server is explained step by step and in detail. Depending upon the server, you can use different transmission protocols. HTTP/ICY protocol (which generally gets through routers and firewalls) is supported, as well as RTSP and RTP (which are more efficient).

We found a combination of IceCast and Darwin Streaming Server works well as it covers both HTTP/ICY and RTP/RTSP protocols, supports all platforms and players and streams to 3G mobile devices as well.

LISTENING

On the user's (listener's) side, all that is required is a compatible player. Most popular and free players are supported including WinAmp, Real Player and QuickTime, so practically anyone on any system will be able to listen to your stream(s). All they have to do is download the free player, if they do not already have it.

At the moment WinAmp supports all aacPlus versions, while Real is limited to aacPlus v1 and QuickTime to AAC, but this is expected to change in future versions.

It is unfortunate that Windows Media Player happens to be integrated with every Windows operating system but does not yet support AAC/aacPlus. Gary Blau of Boomer Radio hopes that in the future Microsoft will "support complete MPEG-4 standard (which includes aacPlus) into their Windows Media Server and Player. Their attempt to force their proprietary media system by exclusion is not serving the interests of millions of potential worldwide customers."

Many webcasters and broadcasters have recognized the advantages of aacPlus codec and the quality and reliability of Opticodec software. There are already 120 stations streaming with Opticodec as listed on the Tuner2 portal (www.tuner2.com).

RADIO ON THE GO

Apart from web streaming over the Internet, a significant driving force behind aacPlus seems to be streaming to mobile phones.

Most of the big mobile phone manufacturers (like Nokia and Samsung) have licensed use of aacPlus in their mobile phones. Some of them are already on the market, with many more announced to come in 2006. Apart from the manufacturers, independent experts on the mobile phone market also agree that audio and video streaming might very well be a "killer application" for 3G.

Though bandwidth in 3G networks is not a problem, traffic is much more expensive than in fixed or wireless Internet connections. Using aacPlus allows using low bitrates without sacrificing quality.

We could not agree more with Greg Ogonowski that "rather than viewing this as more competition against radio, broadcasters can embrace this technology and use it to their advantage." By purchasing and installing Opticodec PE, every station can start streaming processed, high quality audio over the Internet at a reasonable price and expand streaming to 3G mobile phones without any further cost!

Streaming to Internet and mobile devices makes it possible for anyone, anywhere in the world to listen to your station. Whether mobile/smart phones, wireless handheld device or PDA, wireless or fixed access notebook or desktop PC, your listeners do not have to stop listening to your station if they go on a trip to another state or country and anybody around the globe can become your valued listener.

New 3G phones such as Nokia N70 are already aacPlus v2 compatible.

It very much looks like the line between broadcasting and streaming might easily blur in the future, making streaming just another word for broadcasting through the various digital mediums.

Goran Tomas is a radio engineer and audio consultant based in Zagreb, Croatia. His passion is audio processing. You can contact Goran at goran.tomas@post.htnet.hr

– Techie Stats –

- Professional MPEG-4 AAC/aacPlus/aacPlus v2 streaming encoder.
- 3 versions to choose from: LE for $99, SE for $199 and PE for $1999 (or $499 if you have a PC-1100 card).
- 3GPP support for mobile devices (PE version).
- Optimized and robust network transmission.
- Talks to Apple Darwin Streaming Server, IceCast, SHOUTcast, Real Helix Mobile and Ultravox servers.
- Compatible with WinAmp, Real Player and QuickTime players.
- Saveable configurations.
- Launch via command line or batch file.
- Various metadata (song titling) options.

Radio.edu

A Non-Comm View

by John Devecka

Helping Streaming Listeners Connect

Once you have your station set up to stream on the Internet, the challenge is for listeners to get it and have a good listening experience. This month, John Devecka offers suggestions to use – both to help your listeners, but also to anticipate problems before they happen.

OK, so how *do* we get people to connect and stay connected? Let us look at the individual programs and put together some simple connection issues and solutions for them.

WINDOWS MEDIA PLAYER

Using WMP version 9 (and many others), you start by clicking Tools and Options which will bring up a configuration board with many things to adjust. There are some things that the average user may want to adjust (buffer size) and some they probably should not touch (port use).

It is up to you which options you put out there, but I would start with showing them how to adjust the buffer size, since that is the *#1 problem* we have had with listeners getting rebuffer delays. So, since you have this screen open, click on the "Performance" tab to open the settings we need to tweak.

First of all, they should have the setting for "Connection Speed" set for the "detect connection speed (recommended)" rather than to a specific speed. This helps to cover them during drops in bandwidth; even if they have a T1, they could have all sorts of limitations on that connection.

BUFFERING

Secondly, they probably need to change the "Network Buffering" settings. Instead of default buffering, have them set the buffer to 30 or 60 seconds based on their connection experience.

I have some users who need 60 seconds for their connections to stay solid and some who require only a couple of seconds. I normally would suggest they set it for 30 seconds to start as 60 seconds might tax their patience on startup.

Once they have made these two changes they can hit the "Apply" button on the panel and make these changes stick.

PORTS

You *could* also have them set their ports to match your streaming ports, but that is a bit more risky. There are a lot of streamers out there; however they do not all use port 8000 or 7000. So, you may get them to set it to your preference and then find out they have lost connectivity to some other site – which, on a mercenary level is OK, might not win you any friends).

If you want to do that, they need to click on the "Network" tab and select the port range that they want to use. Once they are done with this, have them hit "Apply," close the window, and they should be optimized for your streams.

With these settings, they can either click on a premade button on your site to listen now or they can click File, then Open URL and type or paste your stream URL into the form to open it. At that point, they should be up and running.

QUICKTIME

When using Quicktime – whether on a Windows or a Macintosh system – you have a lot of setting controls; they just do not make themselves apparent.

In Quicktime 6.5 for Windows, you click Edit, then Preferences, then Quicktime Preferences to reach the setup options. The drop-down menu will provide a zillion setting options, including MIME settings and more. We will start with that.

Click the dropdown and select "Browser Plug-In" then click the MIME settings button at the bottom of the board. Now, this is a bit of a mine field, so tread lightly. Assuming your listener is typical, they will have more than one media player on their machine. Try to only suggest changes specific to your streams so as to avoid conflicts with other settings in their system.

For example, if you run a Shoutcast MP3 stream you want them to put a check next to "MP3 – MPEG layer III movies and streams" – this will make MP3 streams and playlists trigger Quicktime. You might also suggest that they click the boxes for "MPEG – MPEG system, video, and audio files" as well as "Audio – Audio only file formats" if they plan to use Quicktime as their main player.

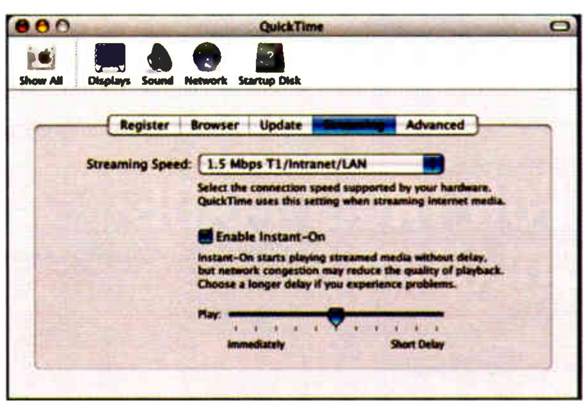
Once you have made these changes, and hit "Apply," go to the drop-down menu again and select "File Type Associations" and select the same items again. While you have them here, I would suggest that they also check the box to be notified if another program tries to change the associations.

TAILORING CONNECTION SPEED

Quicktime does not allow buffer-specific size settings, but it does allow instant-on and delay controls based on your connection speed.

Under the drop-down "Connection Speed" the listener can select the appropriate setting for their system; it offers a range, rather than a specific single type. They should also uncheck the setting to "Allow Multiple Simultaneous Streams" as this will only cause chaos.

If they have a connection of 112k or higher, they can change to the "Instant-On" drop-down and select the delay for their playback. I believe this setting is in seconds (0-100) but, regardless, increasing the delay should be the equivalent of increasing the buffer setting in other programs.



Setting the connection speed in Quicktime.

As with WMP, you can have them set the streaming connections and the port information if you want, and as before, it does entail some risk. If you want to have your listeners do it, select "Streaming Transport" in the drop-down menu and direct them to the appropriate port choice.

The typical HTTP default is port 80, but you can also fill in the box. My suggestion would be to have them leave it set for "Automatically determine the best protocol and port ID." With that, you are done for Quicktime.

WINAMP

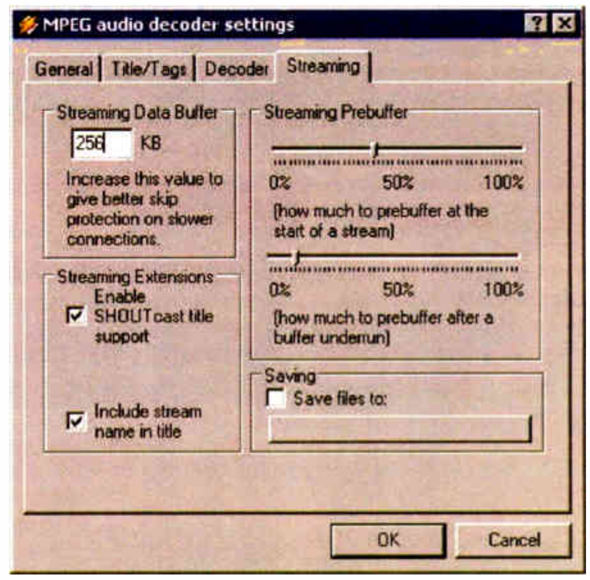
There are quite a few versions of Winamp around; I use an old one (5.07) but you can use any one of them the same way.

To get to the controls, you need to click the upper left corner and get the drop-down menu, click Options then Preferences (or just hit Control P). Click general Preferences and select the type of connection being used (always on or dial up). Under File Types you can select the audio file types needed for your streams (.m3u, .pls, .mp3, etc.) so that they will trigger Winamp to run. Pretty simple; maybe that is why I like Winamp.

You can give the user ways to adjust the reading and display of metadata (also an option in WMP) so that you can stream song titles to them as well. This is an option you can decide on your own whether or not to use.

BUFFER

To adjust the buffer size you need to go to the Plug-ins menu which is part of the above Preferences menu. Click "Input" under "Plug-ins." In the right part of the window click "Nullsoft MPEG(Layer1-3/CT AAC+/ Dolby AAC) Audio Decoder 3.08 (in_mp3.dll)" and then click the "Configure" button. This will bring up the decoder settings.



WinAmp buffer settings.

Click the Streaming tab and set the Streaming Data Buffer as high as you need to get a good stream. Click "OK" and then stop and start your stream to be sure your settings take effect. Be aware that the higher the buffer, the more delay you will have between the actual live broadcast and what comes out of your speakers.

REAL PLAYER

For a virus, RealPlayer sounds pretty good. The AAC codecs added in version 10 really make a nice change, even at low sampling rates, so it is worth considering using their Helix/Producer programs to stream in their .RAM format.

However, I have seen a steady decline in users connecting with Real and also connecting to our Real server. So much so that it is currently offline and we have had no complaints. I will probably bring it back on as a Darwin or Quicktime server, or maybe load up the new Orban 1100 sound card and see how it runs; more on that distraction another day.

There are a lot of versions of Real Player out there too. At some point the BBC got Real to make one that was less loaded with junk and made it available for their on-line listeners. You can still download a version on the BBC Radio website for free: http://www.bbc.co.uk/radio/audiohelp_install.shtml although I do not know if it is any different than the standard version of Real One since it now directs you to a download site at Real Networks.

REAL CONFIGURATION

The latest versions of Real have automatic cache/buffering as a feature (optimistically called "Perfect Play") but they still allow you to adjust the settings for more coverage of "difficult to receive" streams.

Under Tools, click Preferences to bring up the appropriate selections. Under the category "General," select "Playback Settings," and set the buffer setting near the bottom to 30 seconds. If you still have problems with this, increase the number to 45 or 60 seconds – remembering that the buffer will have to load before playback begins, so there will be a lag when starting streams the first time.

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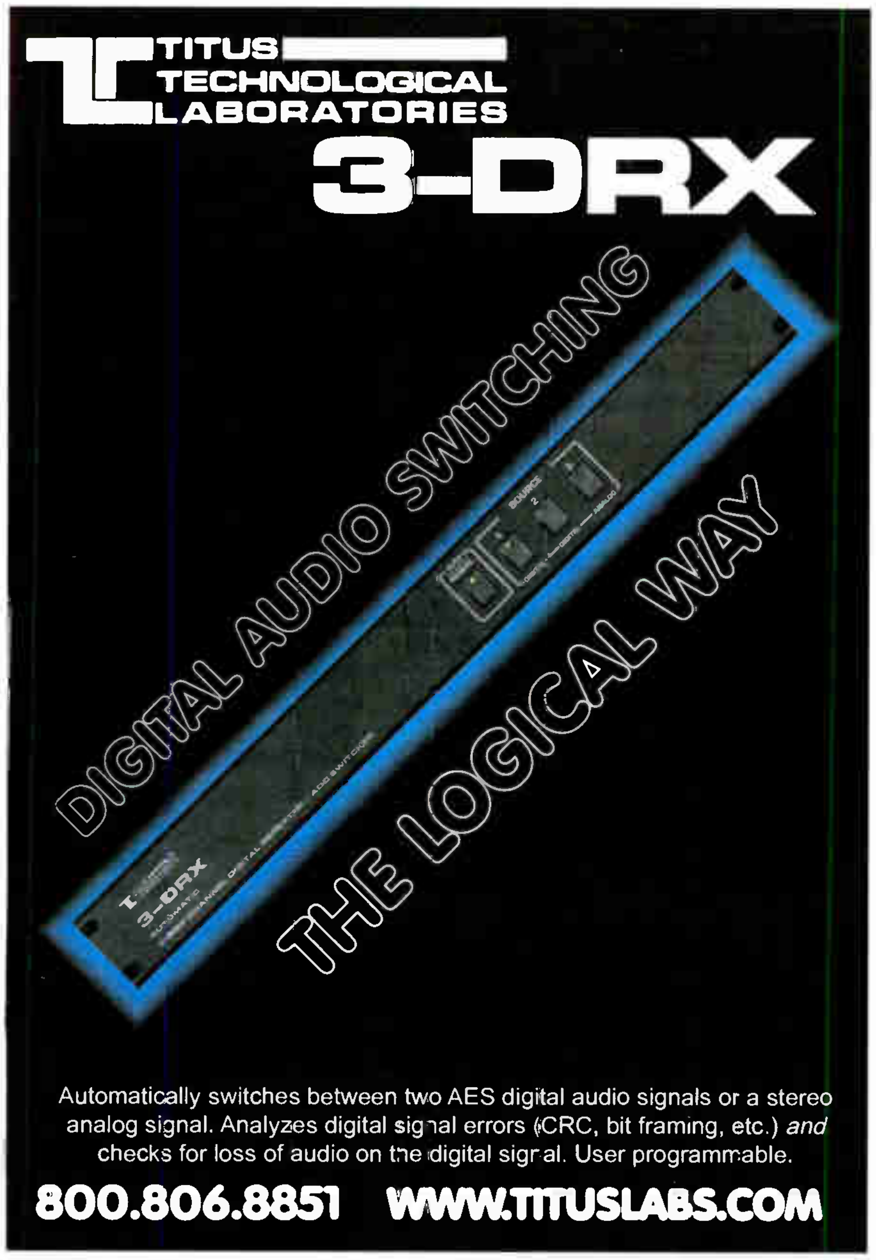
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A Non-Comm View

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XMMS

For those Linux users out there, the #1 audio tool is XMMS, and it looks a *lot* like Winamp. It even functions mostly the same, but was written from scratch to run in Linux.

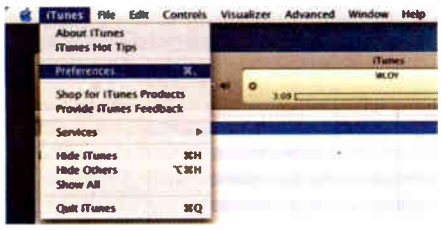
It is probably a safe bet that any listener using it is way more into computer geekdom than you (certainly than I!) and will be able to make their own setting controls without your help. Just in case though, hit Control P and pull up the "Input Plug-Ins," click the "MPEG Layer 1/2/3 Player" plug in and the streaming tab.

In the streaming tab you can choose a "Buffer size" from 4 to 4,096 kbps and set it at whatever you want. Using the "Pre-buffer" value allows control of the initial buffer (0%-90%) before starting to play the stream. Over all, pretty simple.

iTUNES

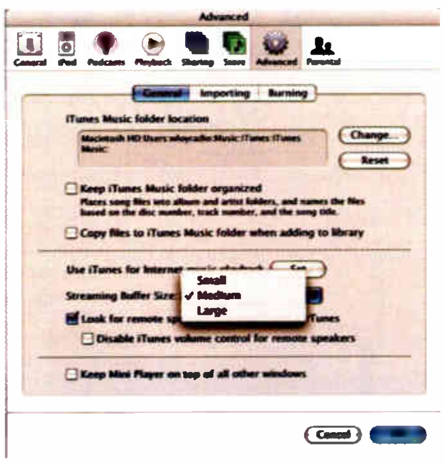
The massive use of iTunes for music downloads, podcasting, etc. has also made it a common sight on streams and one that you need to make sure your users can configure.

Once again, the things you need to adjust are pretty simple - you just have to look in the right place. Under "iTunes" on the top menu bar, select Preferences.



iTunes path to the Advanced settings.

Then select the "Advanced" settings from the top of the menu in the new window. Click "General" and, in the center of that menu, you can adjust the "Streaming Buffer Size," to Medium (or Large) and that should cover most connection issues.



iTunes Advanced Menu

This should be a good start for most station's webstreams and their listeners' needs. Keep in mind, however, that there are always more players out there for people to listen to your streams – Rhapsody, MusicMatch, etc., so keep your eyes on the web and your ears to the listener and add more players and information as you find them.

Overall, it never hurts to have as many different players listed and you may find it helps keep a few more listeners in touch.

STREAM RIPPERS

Just as a side note, there is a function of some programs – and more and more programs will be adding it – called "stream ripping." It allows a listener to connect and grab your audio stream, read the metadata and split it into individual songs in their system.

You will see them in your logs with things like "iRadio," "JetRadio," "sr-POSIX," and others. Essentially, they are a way for people to "steal music" using your stream and it is, of course, the sort of thing that makes the RIAA huddle in the fetal position and shake uncontrollably. Frankly, I would be flattered that a listener liked what we were playing enough to grab it, but a lot of people are working to ban rippers from their streams.

Since most of your streams will include crossfades and talkovers, they will likely rip your streams as full shows. Do not forget that some of these players are used as players by the listener and not rippers, so you have to think about the damage you could do by banning their connections.

If you really want to keep them out, you can find a number of downloadable scripts on the Internet that will help you do that. Just make sure you also put up a form to allow the "legitimate" listener to appeal their banning so you do not lose anyone that you should not!

So, there you have it – a few easy ways to give your listeners a better experience, more understanding of their own software, and increase their staying time on your webstreams. Feel free to modify these ideas into a FAQ for your own page (you can even, as a thank you, put a link to www.wloy.org on your page somewhere) or just get a PDF of this article from ***Radio Guide*** to put on your page as a quick "Help Guide" for your listeners.

John Devecka, Operations Manager of WLOY, hopes this material will help you help your listeners as it has his listeners. Now, if only he could get some more buffer time in his day, so he can get his other work done. Contact him at john@radioedu.com

All talk and no action? That certainly doesn't describe any radio station we've ever seen. With guest interviews, news and traffic feeds, live reports and listener calls to juggle, a talk studio is one of the most active places on the planet. Seconds count, and there's no room for mistakes.

That's why we created Status Symbols® for the Telos TWOx12 Talkshow System. Instead of flashing lights to decipher, there's easy-to-understand picture icons that give talk pros the information they need with just a glance. What caller's next? Who's screened, and who's just holding? With Status Symbols, you'll know instantly. And only Telos has them.

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12 lines, two digital hybrids, and superior audio performance. Desktop Director controller features handset, speakerphone and headset jack. Drop-in controls available for popular consoles.

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Assistant Producer enables talk show production via LAN or WAN. Status Symbols, Caller ID support, instant messaging and caller database are just a few benefits. Supports touchscreens, too.

Practical Engineering

by Bill Croghan

Preparing for the Heat

Last fall, Dave Dunsmoor wrote a great practical engineering article on preparing yourself for winter, so as we head toward the summer, Bill Croghan offers his knowledge and experiences with the other extreme.

Most of you think you know about hot weather from the beach, but you may not know how to work in conditions that are easily fatal if not taken seriously.

LOVE THE DESERT, WARY OF THE HEAT

I was raised in New York but I much prefer the desert southwest. After 18 years in southern Arizona and eight years here in Las Vegas I have learned what hot weather is all about. Summer temperatures here routinely run near 120 degrees.

These years of experience have taught me a few things. I am an active ground Search and Rescue person with Civil Air Patrol and have found too many illegal aliens dead of dehydration in the Arizona border country to ever take the hot weather lightly.

Let me share with you some of what I have learned, so that you do not become a statistic. As Dave pointed out in his article, planning ahead not only counts – it is essential. I have a canoe paddle over my desk to remind me never to be up the creek without one.

THE RULE OF THREES

In search and rescue, we teach the Rule of Threes. Three minutes without air, three hours without shelter, three days without water, and you are in pretty bad shape – or dead.

Shelter starts with clothing. I have seen a lot of folks who think the way to dress is shorts, flip-flops, tee shirts, and no hat. While I enjoy that in the lady tourists walking along on the Las Vegas strip, it is not the way to survive in the desert.

Think of the classic Arab dress. These guys live in the hottest climate in the world. They are covered head to toe and can survive for long periods. I recommend long sleeve, loose cotton shirts, long pants, and a hat that gives you at least eye shade.

Having lost some good friends to Melanomas over the years, I wear a broad brim hat at all times to keep the sun off my ears and neck. I personally prefer the crushable Indiana Jones-style felt hats for the absorption of sweat, but the cheap straw planters or cowboy type also work as well. Just make sure it has an absorbent inner hatband for cooling.

KEEPING YOUR COOL

Anything that keeps the sun off your bare body, provides for evaporative cooling, and is comfortable enough to permit free air flow is good. However, nylon, polyester, or most artificial fabrics do not absorb water and are not much good for cooling. Cotton shirts and pants are good at absorbing sweat and then evaporating, providing an efficient cooling process.

Preventing overheating also means staying out of the sun. A cheap plastic tarp thrown over the ATU unit while working in it will give you shade, keep the metal from getting too hot, and protect you from the sun.

If you are working out of a car at a stationary point, put the tarp over the windshield to cut down on the green house effect. Silver would be best for sun reflection – camouflage tarps are suicide if you need to be spotted by rescuers.

SUFFICIENT WATER

You might survive for three days without taking in water, but you would be uncomfortable after a few hours, in trouble after twelve, and may have permanent brain damage after a day or two.

The rule I follow is: Carry at least two quarts of water at all times, four quarts during the summer and more if you might be away from a source of refill for any serious time. *Do not make the mistake of thinking there is a substitute for water.*

I have seen some folks show up with a couple of liters of Coca Cola, large thermos of coffee, or some other drink. Any drink that contains *caffeine is a diuretic*; that means it causes your body to use water *faster*. Some teach that it takes two measures of water for every single measure of a caffeinated drink – coffee, Coke, etc. – just to break even.

An old rule of thumb is that if you are not urinating once every two hours, you are not drinking enough water. Cold water is nice, but any water is good. I carry a couple GI quart canteens and a lot of 16 ounce bottled water bottles. That way if one of the small bottles breaks, I do not lose all my water. Sometimes I will freeze a couple of those 16 ounce bottles, refilled about halfway, and then have cool water while it lasts.

UNEXPECTED STUFF HAPPENS

So there I was, cruising along in my well-equipped SUV, headed for the transmitter site at 7:00 AM to get a jump on the hot day. The air conditioner was running already because here in the desert it does not take long to get over 90.

About ten miles past the last ranch house, down a dirt road rarely used by anyone, the SUV made a horrible sound and stopped running. It takes very little time for that SUV to turn into a green house without the air conditioner running and with no wind coming through the windows.

I grabbed the cell phone to call for help, no coverage. My ham VHF/UHF rig was of no more help since I was on the wrong side of the mountain for the repeaters. I very rarely have the HF in the SUV when I am going to be going up rough mountain roads. So there I sat.

Fortunately before I left I made sure that a couple of responsible people at the radio station knew where I was going, the route I was taking, and when I would return. If I waited long enough, they would send someone to find me.

PREPARED FOR THE UNEXPECTED

As the sun rose, the prediction was for another balmy Nevada desert day with temperatures in the low three digits.

In the back of the SUV was my emergency kit. I had, as usual, double-checked its contents within the last month. First, I rolled down the windows, opened all the doors, and put a blanket or tarp over the windshield. That helped keep the SUV cool.

Alternatively, I could have gotten out and sat on the shady side of the vehicle, using a tool box or back seat to sit upon, since it is five or ten degrees cooler if you are up off the hot ground.

I checked my water, found I had plenty, and drank a bit when I got thirsty. People have been found dead of dehydration with water still in their canteens; if I am thirsty, it is my body telling me that I need water. The best place to store water is in the body. Sip it – do *not* chug it. Use your water carefully.

It was a long walk back to the last ranch house. If necessary, I would have waited until dark and taken plenty of water during the walk out along with a two-cell flashlight I carry, stored with one of the cells turned around to prevent accidental battery drainage.

During a less stressful time, Bill Croghan and Jim Owen (r) check out some of the survival tools carried on the truck.

In the meantime, I exerted myself no more than absolutely necessary. It is always smarter to stay in place and await rescue.

STAY IN SIGHT

If I had been stuck there longer, one of the best ways to let searchers find me would be to make myself bigger. What this means is to make sure you can be seen easily from the air or from a distance.

One trick is to take a bunch of those CDs I keep in the truck and spread them around, shiny side up. They are great reflectors. One can be used to signal to any low flying aircraft or helicopters that pass. With a little practice, a CD makes a great signal mirror; when a searcher comes near you can flash the mirror at them.

Other options include throwing hands-full of sand into the air to make large dust clouds. Wearing bright clothing works as well. That Space Blanket from the winter kit is bright aluminum colored and easily seen. Or perhaps one could start a small fire with stuff that will smoke to get attention.

If the situation became really desperate, one could burn the spare tire. It will smoke like crazy and get attention – but only as a last resort, because it will not last long.

CARRY THE RIGHT FOOD

I also keep some food in the emergency kit; foods that keep well, require no preparation, do not use water, and can be eaten easily.

Years ago I used to carry little cans of cocktail sausages until I noticed the sodium content. Sodium = Salt = Need for more water. Now I carry power bars, military MREs, and hard candy – stuff I do not normally like so I will not be tempted to snack on it when it is not needed.

Since I am a diabetic, my kit is stocked with food to take account of my specific needs. I have checked with my diabetic dieticians and doctors about what is good for just this situation – your needs may be different.

RESCUE!

Sure enough, my assistance noticed that I had not checked in from the transmitter site. Around four hours later the welcome sight of his vehicle was raising dust along the road. Right behind him was the tow truck. The transmitter visit would wait for another day.

Time and experience prove that even with the best of plans, it is always possible to end up "out there" for extended periods of time. You can survive and work comfortably for a long time in the desert if you just use some common sense and listen to what your body is telling you.

Active for many years in radio engineering, ham activities, Civil Air Patrol, and Search and Rescue volunteering, Bill Croghan is the Engineering Manager for Lotus Broadcasting in Las Vegas. Contact Bill at loteng@lvradio.com

"Some people don't like change. Change doesn't much care."

"I guess being the very first station to use Ethernet for audio routing has made WEGL a little famous! Someone's always on the phone: 'Tell me about your Axia system. What's the real story?'

"The real story is that two years ago, when our our old analog consoles began to fall apart, we put in an Axia IP-Audio network and SmartSurface. And I've never had a single reason to regret that decision.

"Sure, I was skeptical at first. But audio-over-Ethernet technology is compelling! Other companies just use CAT-5 to carry audio using proprietary protocols. Axia uses standard Ethernet to build a true network with uncompressed digital streams *plus* machine logic and program-associated data. No one else does that! I was a little concerned about dropouts and QoS problems, so we went to the Axia factory and assembled a network ourselves. It was easy to do, and it just *worked*. We were sold.

"The jocks took to the new board like fish to water. Show Profiles are their favorite part, since they can all have custom board setups. Some like their headphone levels blasting, some don't. Some like the mic on the left side, others on the right. I've got one guy who brings in his vinyl records every week for an oldies show; he's the only one who uses the turntables but when he loads his profile, they're ready to go.

"There were a few little bugs, but we had the very first surface! Axia support gave us new software right away and our problems were solved. Two years later, I'm more impressed than ever. I recommend Axia one-hundred percent.

"Since the first studio was installed, we've added a new production and interview studio, and we plan on building three more studios. It'll be all Axia — all the way to the transmitter."

— Marc Johnson, Chief Engineer, WEGL-FM
Auburn University, Auburn, Alabama

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Tech Tip

by David Hershberger
Principal Engineer, Axcera

Finding Cable Breaks the Easy Way

You Might Have Everything You Need for a TDR

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

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

TDR IN THE SHOP

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

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

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

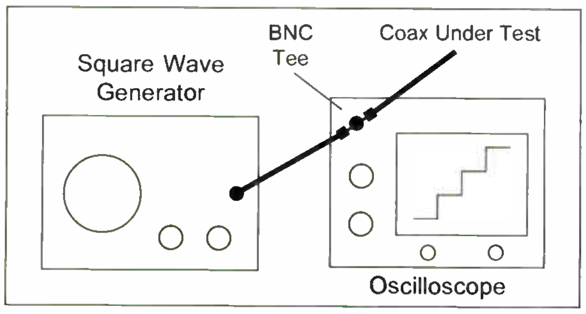

Fig 1 – An improvised Time Delay Reflectometer.

MEASURING THE CHARGE TIME

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

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

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

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

MEASURING CONSTANTS

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

I physically measured the coax and found that it was 140.5 feet long.

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

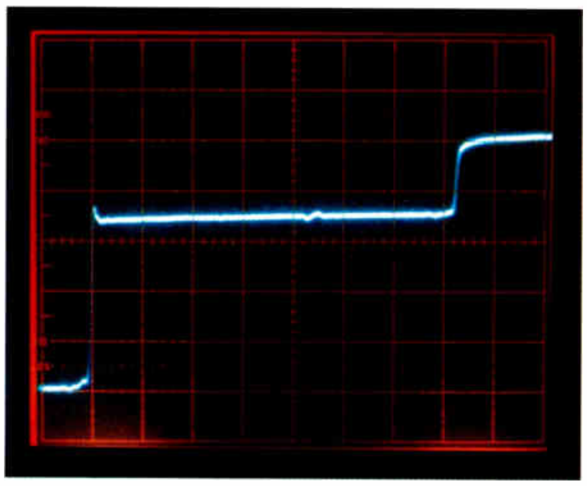

Fig 2 - Measuring the velocity factor of RG/6.

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

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

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

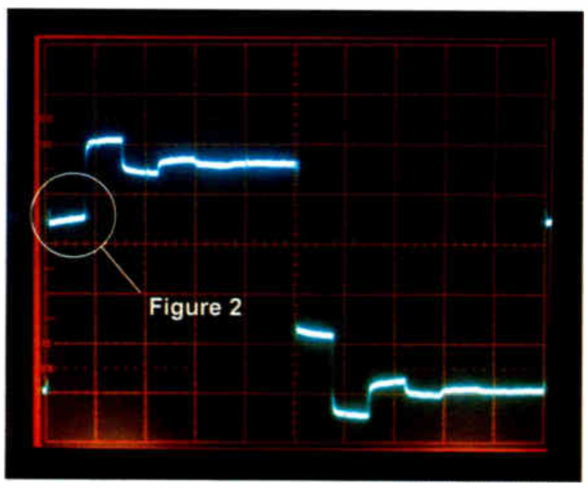

Fig 3 - Allowing reflections to dampen out (0.5 microseconds/div.).

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

LOCATING THE PROBLEM

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

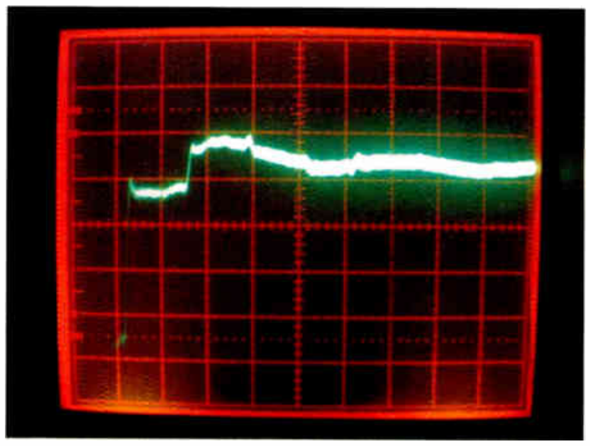

Fig 4 - The display showing the distance to the DirecTV coax break (50 nsec/div).

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

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

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

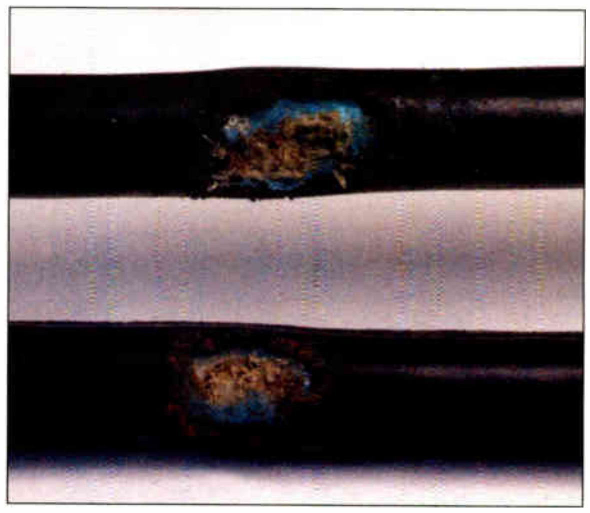

Fig 5 - Varmint-induced impedance discontinuities

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

LEARNING FROM THE PROCESS

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

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

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

Dave Hershberger is the Principal Engineer at Axcera. A longtime design engineer in both radio and television. Dave can be reached at dhershberger@axcera.com

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SS 16.4

The 16.4 provides matrix audio switching of 16 stereo inputs to 4 stereo plus 4 monaural outputs. Matrix switching allows any/or all inputs to be assigned to any/or all outputs. The SS 16.4 may be controlled via front panel switches, contact closures, 5-volt TTL/CMOS logic and/or the multi-drop RS-232 or RS-485 serial port along with 24 GPIO's and input expansion port. Installation is simplified with plug-in euroblock screw terminals.

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The ACS 8.2 provides matrix audio switching of 8 stereo inputs to 2 stereo plus 2 mono outputs. Any input assigned to output one has fading capabilities. Matrix switching allows any/or all inputs to be assigned to any/or all outputs. The ACS 8.2 may be controlled via front panel switches, contact closures, 5-volt TTL/CMOS logic and/or the multi-drop RS-232 serial port along with 16 GPI's, eight relays, eight open collector outputs, and input expansion port. Installation is simplified with plug-in euroblock screw terminals.

SS 4.2

The SS 4.2 provides matrix audio switching of 4 stereo inputs to 2 stereo plus 2 mono outputs. Matrix switching allows any/or all inputs to be assigned to any/or all outputs. The SS 4.2 may be controlled via front panel switches, contact closures, 5-volt TTL/CMOS logic and/or the multi-drop RS-232 serial port along with 16 GPI's, eight GPO's, and input expansion port. Installation is simplified with plug-in euroblock screw terminals.

SS 8.2

The SS 8.2 provides crosspoint switching/routing with 8 stereo inputs, 2 stereo plus 2 mono outputs, 3 switching modes, I/O trimmers, internal silence sensor, selectable headphone and powered speaker level controls and outputs. LED VU meters, 16 GPI's, eight relays and eight open collector outputs. Multi-drop RS-232 and RS-485 serial ports, plug-in euroblock screw terminals and input expansion port .

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Radio War Stories

by Phil Alexander CSRE, AMD

Adventures in the AM Field

(Confessions of an AMD in the Trenches)

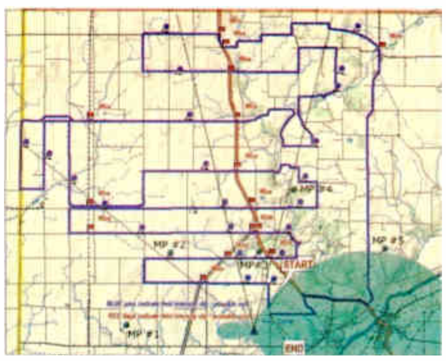
Part 3 – Explaining it all to the GM

Phil continues to insist there is no one station that fits this account – but it is also true that the things he describes are seen far more commonly than we would like to think.

We had spent the morning driving around, measuring the pattern of a station with a history of sliding in and out of compliance. By the time we had stopped for lunch, we had a very nice map of pins and flags for the nighttime pattern.

Most of the blue pins – which marked what appeared to be pattern nulls – lined up pretty well, so drawing a straight line through the majority missed very few.

At the same time, as we expected, the red flags (apparent nulls that seemed "wrong") were more or less random although some appeared to line up with roads where we had seen utility lines across our path.



This route was designed to find the station's nulls.

After lunch, we spent the afternoon retracing our route and made the same measurements for the day pattern. Here, our analysis also indicated a distorted pattern in need of a proper re-alignment.

REPORTING TIME

Once again we cleaned our footwear and returned to the studios for a debriefing session with "Mr. Carpet." This time we waited with his receptionist while he finished a meeting with someone from sales who either had a hot project or was in hot water.

When we were seated in his office he gave us a short, "Cut to the chase, let me hear it." Then he folded his hands and leaned back in his chair to listen.

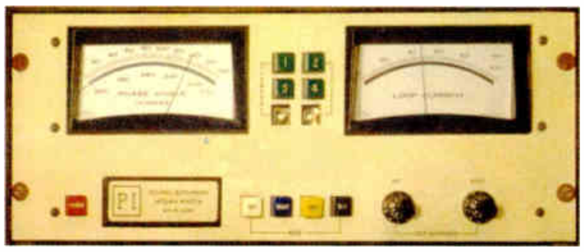
I pulled my notebook computer from my bag and graphically showed him the results of our survey, saying, "This is what we have, and this is what we should have. They are similar but that doesn't put the pattern within limits. There are problems."

"Time or money?" he asked. I said "both" and, as his grimace became progressively more pronounced, began to enumerate them.

A FEW THINGS TO FIX

First and foremost, the phase monitor was rather clearly out of calibration – if indeed this unit, built for another station, was ever "in" calibration – and needed a trip to the factory. Without this tool, any adjustments to the phasor were just "guesses."

Unfortunately, given the age and condition of the phase sampling loops, accurate use of the phase monitor after re-calibration was doubtful.



This Antenna Monitor apparently came from a station with more towers.

The station could operate without a phase monitor for up to 120 days, provided the pattern was held in compliance with frequent monitor point checks. However the nighttime power would have to remain between 700 and 800 watts unless we could "talk it in" to licensed limits using field intensity meters.

Since the towers were slightly less than 90°, I recommended removing the phase sampling loops and replacing them with toroid current sampling coils at the feed lines to their bases. That would eliminate a potential source of reliability problems and also remove the isolation coils from the circuit.

REALIGNING THE SYSTEM

I also explained that our test adjustments of the phasor had not been an easy process, indicating the possibility of other problems.

My recommendation was re-measurement and resetting of the antenna coupling units and a full inspection of the phasor with the station off the air. That would probably take three or four nights, but we should plan for five to be safe.

Before we could start, we also needed to measure each tower's base impedance while the plant was oper-

(Continued on Page 30)

Radio War Stories

by Phil Alexander CSRE, AMD

Continued from Page 28

ating at design conditions so we would need to wait about four to six weeks for the phase monitor calibration before we could begin. I concluded by saying we would send complete details in a written report.

Clearly, waiting was not something the manager wanted to hear about. I could tell something was bothering him so I asked if any of this was a problem. He did not answer directly but invited the CE and my assistant to go over to the motel and have a good dinner on him, while asking me to stay for a few minutes.

After they left, he asked if I had plans for the evening. I chuckled and said the next thing on my agenda was returning home in the morning. He smiled, picked up the phone, and made reservations for dinner at his club.

It was a typical small-city country club with casual dress. The food was OK and I knew he wanted to talk about something. After the general pleasantries and a discussion of business, he asked me what I thought about the station and its problems.

SO, TELL ME THE *REAL* STORY

I gave him more or less the same information as earlier, including my observations during the brief inspection the day before. Then he asked my opinion of his CE.

I explained that while he seemed to pick up knowledge quickly and easily he could use more experience; he almost seemed to have more than he could handle alone. Pointing out the number of stations and studios, and the traveling he had to do to cover all of them, I frankly suggested the engineer needed an assistant if bringing the facilities back to good reliable condition was the goal.

The GM reflected on that and asked if perhaps he should look for a more talented engineer.

"Well, that is a question of money," I said, explaining this young man was intelligent, talented and energetic; if the GM was paying a typical small market wage, he was getting a bargain.

THE LIGHT FINALLY GOES ON

The manager still pressed the same issue: considering all the AM problems over the past two years, could this fellow handle the job?

It appeared he really did not understand what I had said, so I asked him if the problems started before or after his present CE arrived on the scene. He thought a moment and finally saw the point: the problems had started long before this CE began working at the station. I think he now also understood they had been compounded by the way he, not the CE, had been dealing with them via "Joe Blowhard," the self-proclaimed consultant and pattern "cranker."

"OK," he said, "we have the right guy and I need to see about getting him some help at least part time." I agreed that would be a good start, but he needed a budget for replacing some of the older equipment.

Yes, he could do that and there would be tax write-off advantages; but he remained concerned about the AM station. He asked if I could come once a year or perhaps at six-month intervals, review the operation, and correct problems. I told him we could do that if he wanted; it would be a good learning experience for his chief and we could work out a flat rate for a one-day inspection.

WHEN MINDS MEET

We finished our dessert, after dinner drinks, and had coffee while he introduced me to a few friends who passed our table as his "consultant from Indianapolis." The evening was nearly over when he asked if I could do anything to expedite the time to return the phase monitor. I agreed to look into it but could not make a firm promise.

Altogether, not a bad evening. We had a new client, the CE's job appeared to be getting easier, I had a good dinner, and Mr. Carpet turned out to be a pleasant dinner companion. Plus he was picking up the tab. Life could be worse.

Before leaving the next morning, I was able to arrange for the loan of a calibrated phase monitor. A brief chat with Mr. Carpet explaining the conditions – what he would have to do as his part of the deal: the security deposit, agreement to return in the same condition or pay for refurbishing, etc.

He said he would do it that day and let me know the day the monitor arrived, so we could get back on the job as quickly as possible. I reminded him of the need for four toroid coils for phase and current sampling and he said he would get them as soon as I sent him the ordering information.

We were beginning to see light in the tunnel, but was it daylight or a locomotive headlight? Only time would tell.

Will Phil actually solve the station's issues or are the problems he found only the tip of the iceberg? Stay tuned.

A contract engineer specializing in RF transmission and AM directional stations, Phil Alexander is based in Indianapolis, IN. He can be contacted at dynotherm@earthlink.net

Processing Guide

by Cornelius Gould

Audio Processing for HD Radio

Getting the best out of bit-rate reduced transmission systems.

Part 1 – Changes

2005 will be remembered as the year digital transmission exploded onto the scene. Many engineers worked tight schedules modifying existing transmitter sites or, in some cases, completely rebuilding them in order implement this new technology.

As with any new enhancement to the broadcast service, there is always some learning curve to overcome to get the most reliable results from this new service.

With HD Radio™ technology, this learning curve is pretty intense as it involves a completely separate transmission system which makes completely separate radio waves that exist around your main AM or FM signal.

SOMETHING TO LEARN

Unlike previous advancements to the broadcast medium, this time around we are faced with a brand new technology whose inner workings are shrouded in mystery and some broadcast engineers are faced with a scenario where their best efforts fall short due to some mysterious process within their digital transmitters – and the resulting audio might not be very nice sounding.

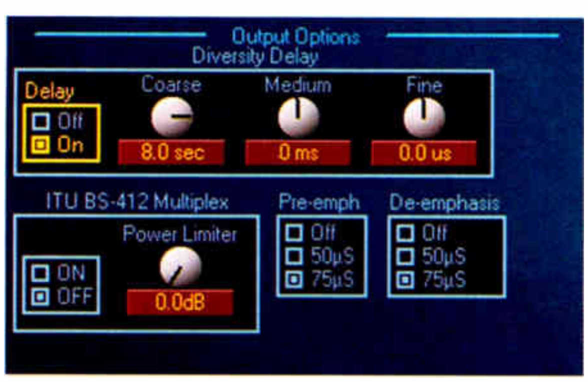
Others are following the guidelines presented by audio processing manufacturers and are having good results, but they still want to have a better grasp as to what is going on "under the hood" to better understand the HD Radio beast they have to handle.

While driving around my section of the country with an HD Radio receiver, I find it interesting to listen to how HD Radio is being implemented by broadcasters. One thing that jumps out at me is how many systems still need work in many basic areas.

THE OTHER DELAY

The most common problem is a lack of diversity delay on the analog channel. This is most apparent when a listener with an HD Radio drives in and out of the optimum reception conditions for the digital carriers.

Essentially what happens is they find themselves jumping back by as much as eight seconds in time when the HD carriers are decoded, only to shoot ahead as many seconds when the radio rolls back to analog service. As a result the listener can miss entire sentences in a conversation.



The diversity delay should be "on" and set to blend cleanly between digital and analog.
Courtesy: Telos-Omnia

Other issues involve audio quality and consistency.

I have heard stations with as much as a 12 dB level difference between the digital and analog services. Another annoyance comes from stations whose digital transmitters are fed with the clipped, pre-emphasized FM analog processed audio.

Even if the de-emphasis is turned on (to make it flat again), the resulting audio heard from the digital service can still be very unpleasant to the ear.

FOCUS ON THE AUDIO

The above examples show there is a lot that needs to be learned by the broadcast engineering community about this technology. If this system is to be successful, proper adjustment and implementation is essential.

Of course, I am aware there are many people out there who feel HD Radio should not have been allowed to be used due to its use of the spectrum within what has been traditionally considered the "guard bands" of AM and FM signals. While there is considerable debate as to the validity of many aspects of this new service, I will not be addressing these issues.

The point of this series is not to convince anyone to change their opinions on the validity of this system one way or another, but rather to help point broadcasters in the right direction to get the best audio performance from what we have to work with today. Since my specialty is audio processing, naturally my focus is in that area.

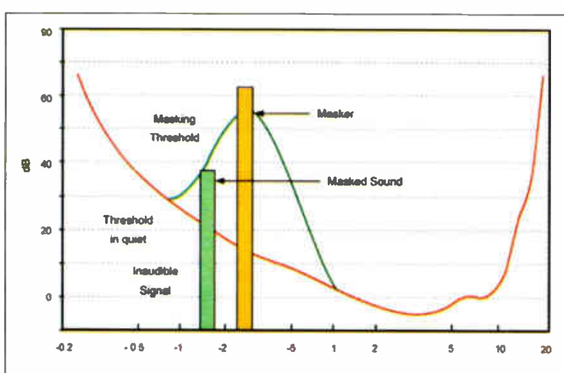
I will pick apart what is going on (as best as anyone outside the iron gates of iBiquity can) and with these tips my hope is that you will be able to get the best audio performance on your digital transmission system from understanding both the audio processing and the system in general.

NOW FOR SOMETHING COMPLETELY DIFFERENT

Broadcasting with HD Radio technology is an entirely different beast. From a technology point of view, it shares almost nothing in common with the legacy broadcasting technology with which we have become accustomed.

The biggest difference – and the hardest concept for many broadcasters to grasp – is that HD Radio is not a "linear" transmission system.

Analog broadcasting can be thought of as a linear process. That is, every sound that leaves the audio processor and enters the transmitter will be sent over the air with very little change.



The acoustic masking principle in the frequency domain. Here the masker at 300 Hz causes the 150 Hz signal to be inaudible.

The 150 Hz tone is deemed "inaudible" under the 300 Hz tone and is simply dropped under Perceptual Coding.

On the other hand, HD Radio is not a linear process. Only a portion of the audio you feed into the HD Radio system actually makes it to your listeners. The art of deleting large amounts of audio data while preventing the human ear from "hearing" it – for the most part – is called "Perceptual Coding."

In fact, most of the audio data is thrown away and, through some neat ear trickery and the proper use of technology, very few people will ever know!

LINEAR AUDIO

What we are describing here is not a difference between digital audio and analog audio. Digital audio can be linear too.

Analog audio is given its name because the entire process by which it works is by literally electrically copying sound waveforms onto some medium, making a literal copy of the sound image onto the medium of choice.

For our discussion here, this medium is a radio wave. As the sounds from the mouths of your announcers strike a microphone, their voices are instantly turned into electrical signals which travel through your audio chain to change the radio signal directly in proportion to the sounds at the studio microphones.

In the case of digital audio, the sounds of your announcers are still picked up by microphones and the electrical signals are turned into digital data. This is done in a device known as an Analog to Digital converter. (The reverse happens in a Digital to Analog converter.)

BIG BANDWIDTH

There is one major problem with the basic concept of such a linear digital transmission system: assuming the process is meant to be of "CD Quality" – whatever that is – we find the system takes an enormous amount of data to accomplish its task when compared to the analog system.

By way of comparison, the analog system can create the same sound quality of digital with only twenty thousand Hertz of electrical space. Digital, on the other hand, requires almost 1.5 *million* Hertz of electrical bandwidth per second to reproduce the same kind of audio. (While this watered down explanation is not entirely technically accurate, it is meant to get the point across to as many readers as possible.)

If the quality is the same, and digital is not as efficient as analog, why even bother with digital?

WHY DIGITAL

The advantage digital audio has over analog is that the process of converting audio into digital bits is inherently immune to noises present in any transmission or storage medium. In other words, for all its disadvantages, the main thing you gain is the ability to make endless copies of the data and still have it sound as good as the original.

Please note that this benefit assumes you are not changing the data in any way during the copying process. This is an important factor to remember for reasons that will become apparent very soon.

There is no way to broadcast full linear CD Quality audio to listeners with the transmission systems in use for the past 80 or 90 years. Remember: it takes about 1.5 *million* Hertz of electrical space to reproduce linear digital audio; the most electrical bandwidth any Digital Audio Broadcast (DAB) service in existence has to work with is about 256 *thousand* Hertz of space.

For broadcasters using IBOC (HD Radio), the space available is even less: about 96 thousand Hertz of space. And this is assuming there is only one digital program service; there is even less space available if secondary (or tertiary) channels are used in "Multicasting."

So, how do you squeeze 1.5 million Hertz of data into 96 thousand Hertz of space?

PUTTING 1.5 MILLION HERTZ IN A 96 THOUSAND HERTZ BAG

Digital Audio Broadcast services have to use methods to permanently, and destructively, discard most of the digital audio data in order to make it all "fit" within the tight spectrum constraints.

The method of throwing away this "excess" data is commonly called "bit reduction" – where varying amounts of digital bits of data are discarded to make what is left fit within signal bandwidth constraints.

(Continued on Page 34)

Processing Guide

by Cornelius Gould

Continued from Page 32

Now, remember what I said before: Perfect copies of digital audio data contain no noise nor errors so long as there is no change in the digital data across many copies. Bit-reduced audio involves major changes to the digital data right from the first copy and, as a result, the decoded audio has very little resemblance to the original source.

The trick is for the decoded bit-reduced audio to be *perceived* to be a "good enough" (if not close to a perfect) copy of the original. Audio processing becomes extremely important in this area as having optimum audio performance can enhance what is left of the audio and can even make or break the entire process.

SPECIAL PROCESSING NEEDS

Over the past nine or so years, this is the area in which I have been working. How can an audio processor enhance this process for the better? What new processes can be developed specifically for this new technology?

As my wife and friends can tell you, I am obsessed with these questions. What I could not have realized back then is how much of what I learned over the years of doing this is paying off now in such a major way.

I got involved with mixing audio processing with bit-rate-reduced perceptual coding technology back in 1996 when a friend and I decided to start up a 24/7 Internet radio station. Of course, the big thing that stuck out at me was the quality of the coded audio.

It was not good, of course, and I set out to see just how far I could take improving audio quality. What started out sounding like a gravely telephone-grade programming rapidly evolved into something that sounded more like AM radio broadcasts within a month of intense audio processing work.

INTO THE CODEC JUNGLE

Along the way I became intrigued by these perceptual audio codecs and how you can use audio processing to get the most out of their performance.

It also did not hurt that this interest took hold when I started to work for Telos Systems – one of the leaders in the handling of coded audio for broadcast applications. If I ever need to know why certain codecs behaved the way they did, the answers were in a thick deep technical reference book somewhere in their library!

Since that time, with every new codec that is released, I anxiously jump on board to see what it can do – and then immediately after that, what I could do with it audio performance-wise.

NEW CONCEPTS

I had not done much research work with AM or FM audio processing in quite some time. With my normal day job and dealings with small non-commercial stations I still spend lots of time adjusting what I call "legacy broadcast audio processing" on a regular basis.

But, by far, most of my research fun comes from learning how I can make perceptual codecs "play" at peak performance through the use of external audio processing. To make bit-rate reduced perceptual codecs work at their best level, I find it necessary to research as much as possible about the technology in question.

This is also the same sort of information the broadcast engineer in the field needs to understand to make HD Radio technology play at its best.

After all, just how good would your ability be to adjust your legacy AM or FM station to sound its best if you did not understand certain fundamental things such as the internal design of the transmitter, the choice of the transmission line and antenna, and the way all of that can have an effect on your audio processing efforts?

HELP ON HAND

The major audio processing manufacturers have been doing a great job at staying ahead of the curve for you. Each of them have come up with decent presets that will work acceptably right out of the box, but you and I know that the best results come from hand-tailoring your processing to your facility and market.

Doing this with bit-reduction codecs requires some knowledge of what is going on under the digital radio transmitter hood. As this series progresses, my goal is to shed some light on this and point you in the right direction to learn more as you need it.

For example, while the exact nature of the codec used for HD Radio is a complete mystery to anyone outside iBiquity corporate circles, a reasonable guess by many (including me) is that it is either the HE-AAC codec or some derivative closely related to it.

WHERE WE ARE HEADED

During my audio processing experimentation with both the HE-AAC/aacplus technology and HD Radio, I find the results to be extremely similar – close enough that I can test ideas at home in my workshop using aacplus and implement them the next day through the HD Radio system with virtually identical results.

With that correlation in mind, I plan to base our discussions around making HE-AAC/aacplus sound its best with audio processing. To start this series, we need to look at how the HE-AAC bit reducing codec operates.

In a previous article (***Radio Guide**, September 2003*), I have already touched upon the basics of perceptual coding, although it was somewhat outside the scope of that series of articles. However, if you want to go back into the archives, the article was titled "*The Rock and The Pin.*" It is a simplified discussion on perceptual audio coding, but will make a nice foundation as we start this series.

Cornelius Gould is the Senior Staff Engineer at CBS in Cleveland and has helped station throughout the region implement digital transmissions. He is also a proud new father. Questions, comments, and congratulations for Corny and Karoline can reach him at cg@cgould.com

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Tool Guide

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Consultant Guide

Radio Consulting Engineers

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National & SBE • Regional & State • FCC Applications & Deadlines

OAB Convention & Engineering Conference
March 31- April 1, 2006
Sheraton Hotel, Oklahoma City, OK
www.oabok.org

NAB 2006
April 22-27, 2006
Las Vegas, Nevada
www.nabshow.com

Broadcast Electronics HD Radio Seminar
April 23, 2006 – Las Vegas Convention Center
2:00-4:00 PM, Room N-114
www.bdcast.com

SCMS Communications Conference
June 1, 2006
Charlotte, North Carolina
SCMSConference@laurenoriginals.com

Mid-Atlantic Broadcasters Conference
June 5-6, 2006
Atlantic City, New Jersey
www.njba.com

AM/FM License Expiration Dates
August 1, 2006
Delaware & Pennsylvania
/www.fcc.gov/mb/audio/renewal/index.html

Email your dates to: radio@rconnect.com

NAB 2006 Radio Show
September 20-22, 2006
Dallas, Texas
www.nab.org/conventions/radioshow/2006/

34th Annual SBE22 Broadcast & Technology Expo
SBE 2006 National Meeting
September 26-27, 2006
Verona, New York • www.sbe22.org

3rd Annual Broadcast Engineering Expo
October 2006
Dallas/Fort Worth, Texas
www.www.bee2005.org

2006 Broadcasters Clinic
October 24-26, 2006
Madison, Wisconsin
www.wi-broadcasters.org

BOS-CON 2006 Boston SBE Regional Convention
October 25-26, 2006
Marlborough, MA
www.bos-con.com

SBE Certification Exam Dates

Exam Dates	Location	App. Deadline
June 2-12	Local Chapters	April 21, 2006
August 11-21	Local Chapters	June 9, 2006
November 10-20	Local Chapters	Sep. 22, 2006

NAB 2006

by Barry Mishkind

Celebrating Spring in the Desert

If the projections from the National Association of Broadcasters are accurate, more than 100,000 attendees from 130 countries will descend upon Las Vegas in April for the 2006 Annual NAB Convention.

DIGITAL IS STILL THE WORD

As it was last year, a lot of the interest and activity on the Radio floor in the North Hall will be focused on the continuing transition to digital audio and transmission systems.

In addition to a lot more experience with the equipment installation, industry leaders have formed an "Alliance" to encourage a variety of programming formats in digital mode within each market. The group also hopes to encourage receiver manufacturers to increase their offerings and reduce pricing, the recent price reduction by Boston Acoustics being seen as good sign.

Combined with sessions that will offer technical training and discuss real world problems and solutions in implementing the digital audio services, there should be plenty to attract many of the folks who have not attended the spring show in recent years.

NOT TOO LATE TO GO

Even if you had not planned to make the trip out to Las Vegas this year, it is not too late to find reasonable travel and hotel plans. Many of the airlines and hotels even have special packages where you can save a lot of money. A call to your travel agent, or a few minutes on the Internet, and you might easily find something that does not drain your budget.

A good place to get answers.

You can get a free floor pass courtesy of ***Radio Guide Magazine***. Log on to www.nabshow.com, select "*Register Now*," then select "*VIP Exhibits Pass*," and enter the source code: **RC2166**. For those interested in attending the various sessions, both NAB and SBE members get a discount on the "full registration." An alternative would be to buy the recording of the "Proceedings" – some of which even come with the PowerPoint files used by the presenters.

Not everything happens during the show. In fact, if you can get to Las Vegas a day early, Nautel and BE are holding their special tech sessions, with specific information on their products; questions and answers are part of the sessions – contact Nautel or BE for free reservations.

Getting around Las Vegas, at least in the areas near the convention, is not too hard. There will be shuttle buses to many of the hotels on the Strip, as well as a few others. And the monorail is running; it is cheaper and faster than a cab – although a single ride is now $5.00.

EAT WELL

If you have not been to Las Vegas in a few years, unfortunately it is no longer the home of cheap food everywhere. However, there are a lot of modestly priced alternatives, including buffets, some even close to the Convention Center. (At the other end of the spectrum, there are also some buffets at $35 per head!)

Of course, we hope you will set aside some time at Noon on Tuesday (April 25th) for my Annual Lunch Gathering. Planned again for the Riviera Hotel Buffet Restaurant, it is a chance to get away from the show floor and convention center food, and meet up with many of the folks who come by to chat.

You might also bag yourself some of the great door prizes that have been arranged, from useful tools to software. In any event, the short walk back and forth will erase any calories you might have gained from lunch. At least that is the "official line."

TALK TO US

Sometime during the show we sure hope you will accept our invitation to visit us in the ***Radio Guide*** booth, number **N4015**. Come over, sit down for a while, and relax – rest your tired feet for a moment.

We would especially appreciate it if you would take a moment to tell us what impresses you at the show so we can be sure to arrange for future articles in the magazine and share the information with everyone. Also, we are glad to get your suggestions regarding what else we can do to better help you on the job.

We look forward to seeing you at NAB 2006!


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Gear Guide:

March – Consoles, Mixers, Routers, Mics, Furniture

Monthly Gear Guide Categories

- **January** - AM-FM Transmitters, Exciters, IBOC
- **February** - Telco, Remote Audio, Codecs, Wireless
- **March** - Consoles, Mixers, Routers, Mics, Furniture
- **April** - Towers, Antennas, Phasors, RF Products
- **May** - Test Equipment, AM-FM-HD Monitors
- **June** - Automation, Digital Storage, Workstations

Audio Technologies

NANOAMP – Audio Mixers

www.atiaudio.com • 800-922-8001

The **NANOAMP** Stereo Input and Output Mixers by ATI are the perfect choice for any location. These mixers are compact, convenient and rugged with low cost mixers and utility amplifiers featuring professional XLR type connectors; high performance; low noise circuitry and UL and CE approved remote power modules. Use them free standing, stack them, or rack them.

The ATI NANOAMP

The ATI models consist of: three-channel mono mixers such as MX100, MX101, and MX100C; three-channel stereo mixers such as MX200 and MXS100; the four-channel stereo XPS100 Input Expander and the two-channel stereo XPS200 Input Expander. All mixers feature VCA master gain, headphone controls, and require 24VDC power. Replaceable and rechargeable battery packs, and DC converters for belt packs are available.

Autogram Corp.

MiniMix 8 & 12 – Broadcast Audio Consoles

www.autogramcorp.com • 972-424-8585

The **Mini-Mix 8 and 12** Consoles are fully-functioned professional Broadcast Audio Consoles. Space and cost saving measures have yielded a small package along with attractive price for today's Broadcast Studios.

The Pacemaker "Classic" consoles are available in 6, 8, 10-pot configurations. All connections are made using miniature screw-type for easy installation. Mix-Minus is assignable on front panel. Four independent microphone preamps w/ balanced inputs and outputs may be patched to any channel. The Pacemaker 11k uses a bi-module concept – front panel module and a card module that plugs into the mother board. Up to 15 modules (PM 218) and 25 modules (PM 228) are available for customer's option. The Autoclock features Time, Count-Up, and Temperature and is available in console-mount or stand-alone desk cabinet.

Broadcast Devices

UTA-200 – Audio Interface and Distribution

www.broadcast-devices.com • 914-737-5032

The **UTA-200** Series is a versatile interface and distribution solution that allows various combinations in a common frame. It offers four different plug-in modules which allow for microphone, line level, and AES3 digital input. Using these standard building block modules it can help you create a system of up to twelve interfaces in any combination of consumer-to-pro/pro-to-consumer interfaces in one compact frame. The UTA-200 is also offered in distribution configurations.

The UTA-200

DA ins and outs can be set up to accept consumer or pro interfaces making the UTA-200 one of the most versatile interface systems available. Stereo DA configurations include 1-1x12, 2-1x5, 3-1x3. Visit www.broadcast-devices.com and download a complete 12 page catalog of information about the UTA-200 system or call them to inquire about standard and custom configurations.

Broadcast Tools

SS 16.16 – Distribution Amplifier Replacement

www.broadcasttools.com • 360-854-9559

The Broadcast Tools® **SS 16.16** provides audio routing of 16 stereo inputs to 16 stereo outputs, allowing any one stereo input to be assigned to any or all stereo outputs. The SS 16.16 may be controlled via front panel encoder controls and/or multi-drop RS-232 serial port.

A 40x4 LCD back lit display provides for input descriptions and macro setup. A 16x16 GPIO port is provide when used with automation systems. Free MS Windows NetSwitch/II remote control software is available.

Installation is simplified with plug-in euroblock removable screw terminals.

Additional features include; Headphone amplifier with front panel 1/4-inch jack and level control; Front panel monitor speaker with mute switch and level control; Internal audio activity/silence sensor monitors output channel sixteen; Two front panel encoder controls are provided; Power-up selection of channel configuration, mute or last source selected; Sixteen user configured macros; Electronically balanced stereo inputs and outputs.

Henry Engineering

USB Matchbox – USB to XLR Interface

www.henryeng.com • 626-355-3656

Henry Engineering's new **USB Matchbox** and **USB Match Plus** units are professional quality USB-to-XLR interfaces that replace computer "sound cards." They eliminate the hum, noise, and interface difficulties caused by in-the-computer sound cards, and provide audiophile-quality performance with the convenience of a simple USB connection to any PC or laptop. Both are USB-powered external units that can be rack-mounted.

The USB Matchbox is a basic USB (digital) to XLR (analog) interface that provides stereo inputs and outputs at professional levels on XLR connectors. The USB Match Plus is similar; it also includes LED peak level meters to accurately monitor input and output levels, and a high-performance headphone amplifier for critical aural monitoring. Both units also include a Speaker output to feed a monitor speaker system, and a Mute control port to mute the Speakers with an external contact closure.

Klotz Digital

AEON – Digital Audio Console

www.klotzdigital.com • 678-966-9900

Klotz Digital has introduced the new cost-effective **AEON Digital Audio Console** which comes together with an integrated state of the art router.

AEON Digital Audio Console

AEON is based on the company's ultra slim console modules (1 inch thick) allowing flexibility in console layouts and studio set up. AEON is available with 8, 12 and 16-fader control surfaces with professional features like 100mm faders, alphanumeric displays with 16 characters in two lines per channel, large ON/OFF buttons, CUE/PFL, programmable TalkBack functions, freely assignable routing and function key and status indication LEDs for the most important parameters and functions.

The "AEON Setup Tool" software is included and enables users to set the configuration of the system exactly according to one's personal requirements.

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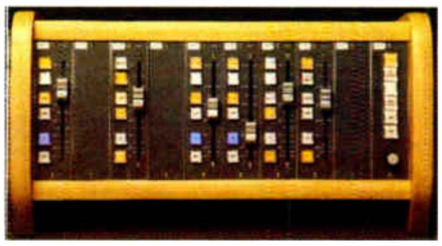
- **August** - Telco, Remote Audio, Codecs, Wireless
- **September** - Audio Processing, Interface Boxes
- **October** - Towers, Antennas, Phasors, RF Products
- **November** - RPU, STL, Remote Control, Satellite
- **December** - Automation, Digital Storage, Workstations

Sierra Automated Systems

Rubi-T – Mini Console Control Surface

www.sasaudio.com • 818-840-6749



The new **Rubi-T** Mini Rubicon broadcast console is ideal for voice tracking rooms, news booths, edit booths, announce booths, effects mixing in on-air studios, and lots more.

The TP-L4 input module features a full-length 100mm P&G fader, channel ON/OFF, and four programmable source select or bus assignment buttons. It's just 6" high, and can be configured with any number of input modules, monitor, talkback, remote control, clock/timer, and meter modules. SAS can supply Rubi-T in a table-top wood cabinet (as shown), or you can build Rubi-T into your studio furniture.

Like its bigger brothers Rubicon and Rubicon-SL, Rubi-T is a control panel that connects via RS485 serial to the SAS 32KD Digital Router/Mixer or the SAS RIOLink Mixer/Router/Remote IO chassis. It can share sources and outputs with the larger SAS system, or stand alone using the RIOLink as a 32x32 mixer/router.

Sine Systems

ACU-1 – Audio Mixer and Switcher

www.sinesystems.com • 615-228-3500

The ACU-1 is an audio mixer and switcher with eight balanced stereo inputs and one balanced stereo output that is controlled by commands over an RS232 serial link. Input selection can be programmed to interlock or mix. The system also incorporates left and right channel silence sensors, parallel logic inputs, multiplex outputs, control relays, a clock/calendar and an optional temperature sensor.

While channel selection can be operated manually, the maximum power and flexibility is achieved by connecting one or more ACU-1's to a single serial data port of a host computer. The simple ASCII command structure allows for rapid development of very powerful "one-off" customized automation systems.

Front panel indicators include left and right VU meters, channel selection indicators and left and right silence alarm status indicators. Rear panel screw terminals are mounted on removable connector boards.

Tieline

i-Mix G3 – Mixer and Codec

www.tieline.com • 800-780-4750

The Tieline **i-Mix G3** platform, the world's most advanced radio and television codec, commentary, communications and control interface, is now able to deliver FM-quality mono and stereo audio for remote broadcasts over the Internet utilizing DSL, LAN or wireless connections.

The new IP software has been integrated into the i-Mix G3 which is already being described by talk show, sports, music and live event broadcasters as a "dream machine." i-Mix G3 combines six essential live remote broadcast products into one box weighing just four pounds and offers broadcasters 20 kHz uncompressed linear stereo audio over IP networks.

Connections in the field are mostly automatic for talent and the codec can also be pre-figured by the studio engineer. It can even be fully remote controlled. The i-Mix G3 was designed by live sports radio and television event broadcasting specialists and was employed at the 2006 Torino Winter Games.

Radio Systems

Millenium Digital – Broadcast Audio Console

www.radiosystems.com • 856-467-8000

The Millenium Digital Console

The tradition of the Millennium Console continues with a complete digital transformation. The **Millennium Digital** is now 100% AES/EBU capable on every input and output. In addition, performance has been enhanced with 10 fully programmable mix-minus outputs and a serial interface to third party equipment.

Major features of the **"Millennium-D"** include; AES-EBU or analog on every input, full analog and digital outputs – with 10 fully programmable mix-outputs, serial interface and a PC GUI for every input function.

One truly unique aspect to this console is that it continues Radio Systems' commitment to allowing customers to upgrade their existing analog Millennium and RS-series consoles. Any of the existing 4000+ console owners can simply change out the audio input and output motherboards in the field (or have the factory perform the upgrade) and enjoy all the benefits of the new digital circuitry for a fraction of the cost of a new console.

Telos-Axia

Element – Broadcast Control Surface

www.telos-systems.com • 216-241-7225

Introducing **Element**, the new modular broadcast control surface from Axia Audio. With configurations as small as 4 faders and as large as 40, Element is versatile enough for all your air, production, news and edit applications.

Element is designed to fully exploit the benefits of the Axia IP-Audio network. Share live audio between studios, eliminate PC soundcards, and instantly reconfigure shows and setups, all using standard Ethernet. Element provides flexibility and features not found in control surfaces costing three times as much.

Configuration and management can be done remotely from any PC browser – even from off-site. As part of the Axia system, Element allows you to network all of your facilities' audio peripherals for greater efficiency. And you can finally enable communication between computer-based studio applications – playout and traffic systems, logging applications and much more.

Telos-Axia

Router Selector Node – Audio Router

www.telos-systems.com • 216-241-7225

Axia's modular approach gives you significant advantages over traditional wiring and routing systems. Installation time is slashed from weeks to days, smaller amounts of cable make it easy and cost-efficient to move your Axia system to a new location. The router is just one of the audio adapter nodes from the Axia family helping to interface and manage conventional audio equipment.

The **Router Selector** node resembles the X-Y controllers used with expensive cross-point audio switchers. The LCD screen lists available sources, which can be browsed and selected with the scroll wheel; eight "radio buttons" provide instant access for your frequently-used sources.

Unlike an X-Y controller, however, the Router Selector node has audio output direct to headphones, and analog and AES3 outputs. It even provides a convenient analog and AES3 input, making it ideal for production or news studios where operators typically create and play audio streams.

Service Guide: Radio Equipment Products and Services

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SCMS Announces Communications Conference Focusing on Digital Radio

SCMS, premier distributor of radio products to the radio broadcast industry, announces a Communications Conference to be held on June 1, 2006 in Charlotte, NC. The focus of the conference will be on digital radio. Because of the rapid changes occurring in the marketplace, SCMS has decided to support the industry with this opportunity.

Current plans include both an engineering track and a management/PD track for attendees. Broadcasters can come and enjoy the day learning about the latest happenings with digital radio and also have time with their peers. Later announcements will be made as speakers and seminars are added. Registration for broadcast company staff is *free*.

In addition to the educational seminars, vendors will be well represented with a showroom area dedicated to displaying the most up-to-date radio products on the market. Companies currently slated to participate include:

- **AEQ Broadcast**
- **Audemat-Aztec**
- **Audio Processing Technology (APT)**
- **Broadcast Electronics**
- **Davicom, a division of Comlab**
- **Dielectric**
- **OMT**
- **Orban**
- **Radio Systems**
- **TWR Lighting, Inc.**
- **Wheatstone Corporation**

For more information on the SCMS Conference, email: SCMSConference@laurenoriginals.com.

SCMS
Phone: 800-438-6040
Web: www.scmsinc.com

Broadcast Electronics to Introduce 25kW 4MX Transmitter at NAB 2006

Broadcast Electronics (BE) will return to the NAB convention this spring with a 25kW transmitter based on its breakthrough, patent-pending 4MX medium-wave digital transmission technology.

BE's new 4MX 25kW transmitter is the second in a line of medium-wave transmitters based on 4M Modulation™, Broadcast Electronic's patent-pending method of modulating the duty cycle of the radio frequency directly to produce a more linear output waveform.

BE introduced its 4MX 50 kW transmitter more than a year ago, setting a new benchmark in AM efficiency and power-performance to meet today's HD Radio™ and Digital Radio Mondiale (DRM) requirements. With the introduction of its 4MX 25kW transmitter this NAB convention, the company is extending the benefits of 4MX technology to stations requiring up to 25kW power outputs.

"The overwhelming interest in 4MX as the preferred modulation method for HD Radio and DRM really pushed us to produce a 25kW version so soon after introducing the 50 kW 4MX," stated Tim Bealor, BE Vice President, RF Systems.

The patent-pending 4M Modulation scheme uses a breakthrough technique to apply signal to all PA modules in parallel, resulting in a transmitter that outperforms other transmitters in its class by several percentage points in terms of audio quality and efficiency. Among other benefits, this design maintains audio quality and efficiency during both full power daytime and reduced power nighttime modes.

DRM-compatible and capable of linear audio reproduction, the transmitter comes with separate audio input in order to pass the full frequency range possible of digital transmission.

Broadcast Electronics is at NAB2006, booth N1808.

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