Radio Guide

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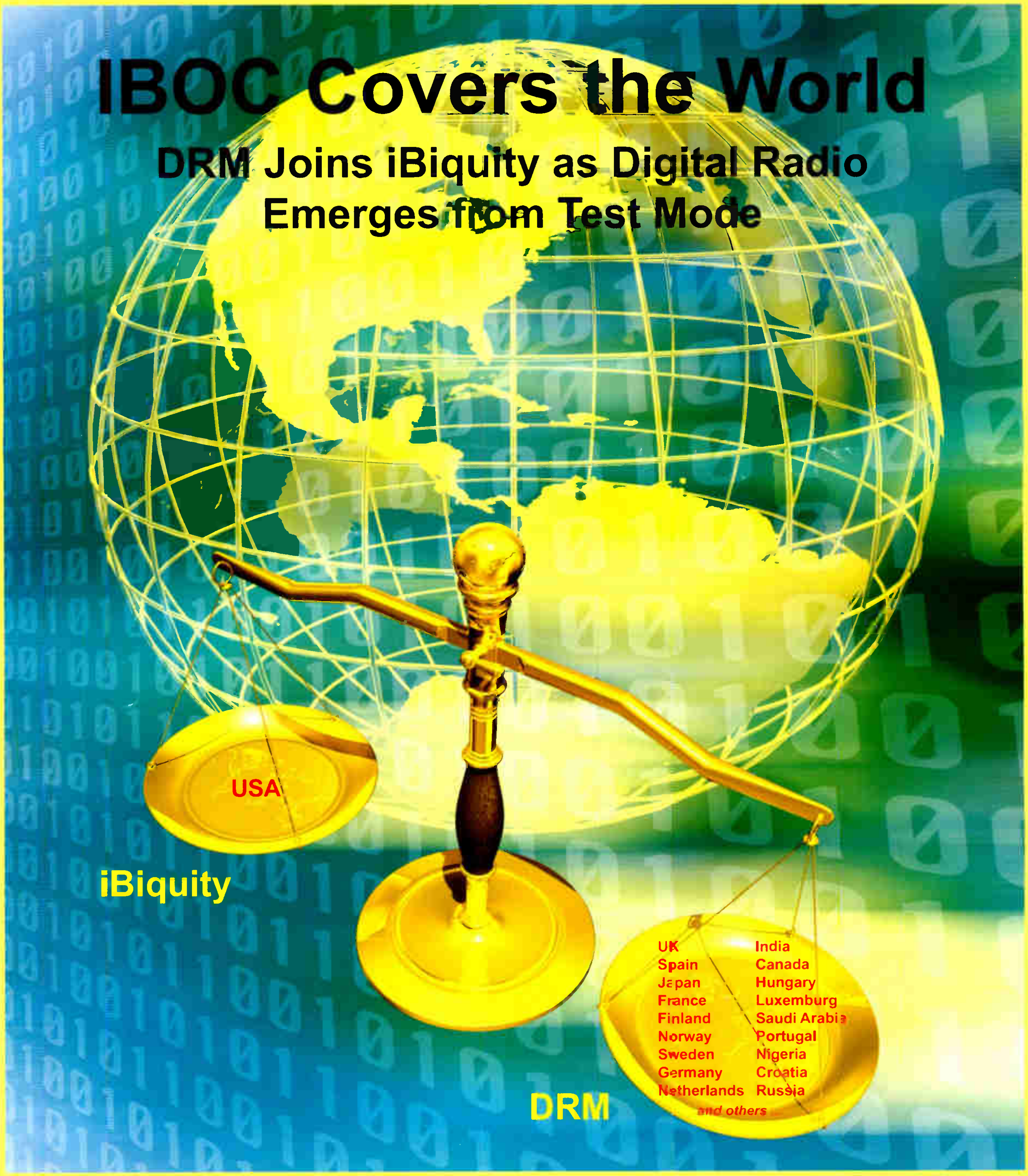
Including Radio Shopper

June 2003
Volume 11 Issue 6

IBOC Covers the World

DRM Joins iBiquity as Digital Radio Emerges from Test Mode



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A Primer on DRM™ Digital AM Radio

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Digital Takes The Stage

With the ramping up of IBOC systems in the USA, as well as the inauguration of regular DRM programming in a large part of the rest of the world, that would be enough to put "Digital Radio" on the minds and lips of the industry.

Add to that the recent call from NRSC, unhappy with some of the algorithms, as well as the unfortunate difficulties AM IBOC is having, especially at night. From the perspective of some, this not only has not helped AM, but actually enlarged the gap between AM and FM at a time when AM was looking for some assistance toward parity.

DRM appears to be tested and ready to go: The June 16th rollout of the system is coordinated with the World Radio Congress. In this issue of **Radio Guide**, you will find information to help you understand the technology. Proponents point out that DRM does not create a "buzz-saw" sound on the sidebands as US systems do, and will indeed operate comfortably within the "NRSC mask."

And recently, Leonard Kahn has tossed his CAM-D™ digital broadcast system into the mix. Certainly this will give the FCC and NRSC something think about, and whether DRM and/or CAM-D™ will have an opportunity to be tried in the US.

Did you make it past the **Radio Guide** booth at NAB? A special feature: There was a drawing from among those who signed up for a super gift from Jensen Tools – a toolkit worth well over $350. We are happy to announce that the winner of this toolkit is: **Ralph Chambers, of the Spanish Broadcasting System, Coral Gables, Florida.**

Our sincere thanks to all of you who stopped by.

A Primer on DRM™ Digital AM Radio

by Peter Jackson

[With the introduction of regular DRM broadcasting on June 16th, here are the basics that you need to know about this NRSC compatible system that has been tested and implemented in a large part of the world. Ed.]

[PARIS, France - June 2003] DRM (Digital Radio Mondiale™) consists of a number of organisations involved in the broadcast industry (broadcasters, manufacturers, research institutes etc.). They came together in 1998 to set up the consortium to develop and launch a digital transmission system for the AM broadcast bands (LW, MW and SW) below 30 MHz. Starting with 20 founder Members, the consortium has grown today to around 80 Members from all parts of the world (see http://www.drm.org/).

The reason behind the consortium's formation was an appreciation that listening to AM broadcasts was declining in the face of competition from FM and, latterly, digital radio broadcasts. There was also a feeling that devising a digital system that would work in the AM bands was becoming possible due to the coincidence of a number of technological advances: namely cheaper, faster DSP chips using less energy and the ability to provide good quality digital audio at very low bit rates.

This meant receivers would be affordable both in purchase and running costs and the digital signals could provide good quality audio whilst retaining high spectrum efficiency. This decision to develop a system was also partly in response to an ITU request (Question 217-1/10) for digital systems to be proposed which could operate worldwide in the AM broadcast bands.

DEVELOPMENT AND TESTING

Having formed the DRM consortium, work began on the technical development of a suitable system. The technical work was split into a number of working groups, which could concentrate on the component parts of the system, e.g. modulation system, audio coding etc. An additional working group took responsibility for the testing and validation of the system as it was developed. As the consortium is not a conventional commercial organisation, the development and testing work was carried out by Members organisations with the relevant expertise in the required technologies needed to build the system.

Each organisation directly involved in the development process contributed engineering time and effort from its own resources, the expectation being that any return on this investment would come from equipment manufacturing or supply of services when DRM services were implemented in the future.

Building on existing expertise in digital broadcasting within the Member organisations, it was possible to develop, field test and standardise the DRM system within a very short period so that earlier this year the system achieved IEC recognition under IEC 62272-1 Ed.1 [Digital Radio Mondiale (DRM) - Part 1: System Specification]. This recognition is important as it was always considered vital by consortium Members that the DRM system should be *open and non-proprietary*, so any manufacturer could build equipment, using the standard, on equitable terms.

There has also been an attempt to use existing international standards (for example MPEG-4 for the audio coding) wherever possible. This is one of the ways in which the DRM system differs from Ibiquity®, as that currently remains a proprietary system.

Testing of the DRM system has taken place both, in the early stages, in the laboratory and, extensively, in the field. It was possible to field test the system from an early stage due to the fact that existing modern analogue AM transmitters could be adapted to transmit the DRM signals. This has been a particularly encouraging part of the development work because tight spectrum occupancy constraints, placed on the digital signal, must be achieved if both digital and analogue signals are to co-exist within the same spectrum during the change-over period.

THE SYSTEM

The basis of the transmission system is the use of multi-carrier COFDM (Coded Orthogonal Frequency Division Multiplex) modulation. The basic idea behind COFDM is to spread the transmitted data across a large number of carriers. Each of these carries only a small part of the total data to be transmitted. Furthermore, the data stream is shuffled in time before being spread across the carriers. A significant amount of additional error checking and correcting data is added to the original data before transmission.

This means loss of the data from a few carriers for a short period does not prevent the original data being correctly reconstructed after reception, as there is sufficient redundancy to allow the errors to be detected and reconstructed. Where errors are too great for correct reconstruction, error concealment is used for the audio data. In this way the system can provide essentially error free audio at an error rate of 1 in 10^4 bits.

The DRM system must be able to cope with a number of different types of propagation from day-time MW ground-wave, where the main problem is electrical noise, to night-time MW sky-wave, where there are multi-path effects on the signal itself, plus incoming interference from adjacent and co-channel signals from other stations, as well as electrical noise.

In the case of SW there will always be similar problems, as propagation is always by sky-wave, but in many cases they are more severe, as the signal may have reached the receiver via several hops. In the case of near vertical incidence signals (NVIS), sometimes used for SW domestic broadcasting, the multiple reflections can severely distort the received signal.

To cope with these variations in propagation the DRM system provides for 4 different transmission modes with different numbers of carriers, spacing and guard interval. Mode A has the highest carrier density for least difficult conditions whilst Mode D has the least and caters for the most severe propagation (e.g. NVIS). Within these modes, the modulation of the main service channel, which carries the majority of data, can be changed between 64 and 16 QAM, and the coding rate of the data can be changed, allowing more or less capacity to be reserved for error correction bits. In addition, the time interleaving of the data can be either 0.4 sec. or 2.0 sec. to cater for different fade conditions. This provides to large number of possible transmission parameter combinations.

However, one further parameter can be varied: the *spectrum occupancy* of the DRM signal. The minimum bandwidth option is 4.5 kHz and this can be increased through 5, 9, 10, 18 and 20 kHz options. This caters for the different channel bandwidths available in today's AM broadcast bands (9 kHz for LW and MW in ITU Regions 1 and 3, 10 kHz in Region 2 and 10 kHz world-wide in the SW bands). In the future it may be possible to introduce services using the wider 18 and 20 kHz bandwidths.

Of course varying the bandwidth used also varies the maximum data rate available for the audio and therefore the quality. A DRM signal can also be inserted in either next adjacent channel (at a level which causes minimal disturbance to the analogue signal's reception) to an existing analogue signal so the two signals could together occupy 18 or 20 kHz of bandwidth, where spectrum planning allows this to be done.

At the heart of the DRM transmission system is a data multiplex. This multiplex is made up of three basic components.

• The Fast Access Channel (FAC), which has a low data rate and uses 4 QAM modulation for highest robustness, uses no data interleaving so that decoding is fast. This contains data, which allows the receiver to find services and start decoding the multiplex.

• The Service Description Channel (SDC), which also has a relatively low data rate, can use either 4 QAM or 16 QAM modulation. This provides information needed to decode the services contained in the multiplex.

• The Main Service Channel (MSC), which carries the bulk of the data in the multiplex such as audio or "pure" data services. This can use either 16 or 64 QAM modulation.

Between one and four services can be carried within the MSC multiplex. These services can contain digital audio or pure data services. In the case of a digital audio service, three different audio coding algorithms are available, all of which are contained within the MPEG-4 standard. These algorithms consist of Advanced Audio Coding (AAC), for coding of high quality mixed programme material (i.e. speech and music), and two speech coders, CELP and HVXC. HVXC allows the coding of intelligible speech down to 2 kb/s.

In addition Spectral Band Replication (SBR) coding may be used to extend the audio bandwidth of the AAC audio for the expenditure of around 2 kb/s of data and this is particularly effective at low bit rates (e.g. 20-30 kb/s). The use of SBR with AAC coding allows a 15 kHz audio bandwidth to be supported at a data rate of around 20 kb/s and low complexity stereo from around 25 kb/s.

The latest work from CTS, the DRM Member that developed SBR, has demonstrated parametric stereo with AAC+SBR at 20 kb/s and significant improvements to both CELP and HVXC quality with the addition of SBR. SBR coding is in the process of being incorporated into the MPEG4 standard.

For those readers familiar with the AM version of the Ibiquity® IBOC system, it can be seen there are a number of major differences between it and the DRM system. The DRM specification provides a toolbox of system options, allowing it to function within all the different AM planning parameters and bands in use across the world. The only common technology is the use of COFDM in both systems, although the parameter sets are quite different.

INAUGURATION

DRM inaugural services will begin during the upcoming World Radio Congress (WRC 2003) in June 2003. A number of broadcasters are already running trial services, and have committed to starting these services by or on June 16th 2003. However, as is so often the case with new broadcast services, there will be relatively few receivers available initially. A list of transmissions to which broadcasters have already made commitments may be found on **Table 1**, however for up-to-date information on DRM transmissions go to http://www.rnw.nl/realradio/html/drm_latest.html

(Continued on page 6)

A Primer on DRM™ Digital AM Radio

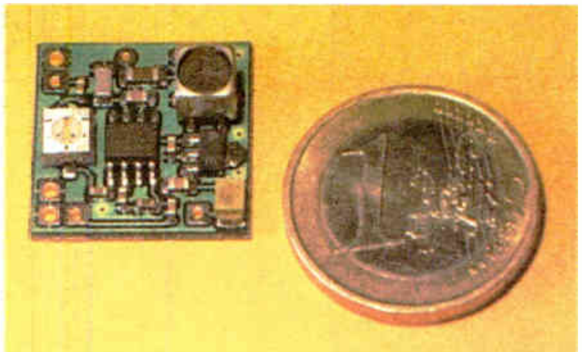
Continued from page 4.

RECEIVER DEVELOPMENTS

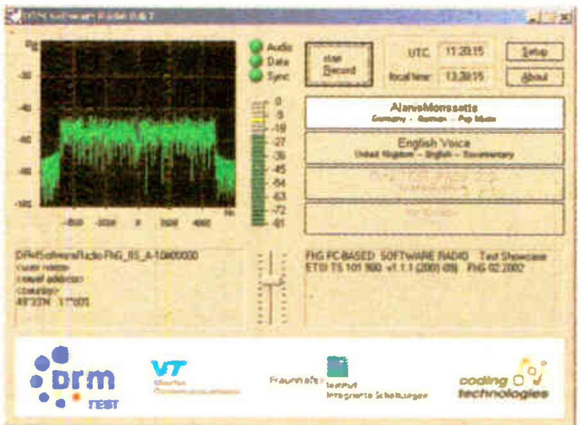
The first consumer receivers are expected to reach the market during 2004 when the first chip sets become available. These receivers will continue to provide for the reception of analogue services, both AM and FM, as there will be relatively few services initially on air using DRM transmission. A typical DRM chip topology is likely to be similar to that being developed in the DIAM project. A prototype portable DRM radio has been produced by DRM Member Coding Technology (CTS). This has been built into a standard consumer radio case, although the power consumption is too great for standard internal batteries.

The illustration above shows the radio and the internal DSP board, which provides for the demodulation, demultiplexing and audio decoding of the DRM signal. An additional board (not shown outside the radio) provides the front end tuning and selectivity. The radio can be tuned with the standard push buttons and the LCD display will display the station name and any text message embedded in the audio service.

Another way in which DRM signals can currently be listened to is by use of a suitable modified AM receiver (which is used for the front end tuning), a small IF down-converter PCB (around $30 from http://www.sat-schneider.de/), which changes the signal frequency to 12 kHz, and a suitable PC, running the DRM software receiver application (around $65 for the licence from http://www.drmrx.org/).

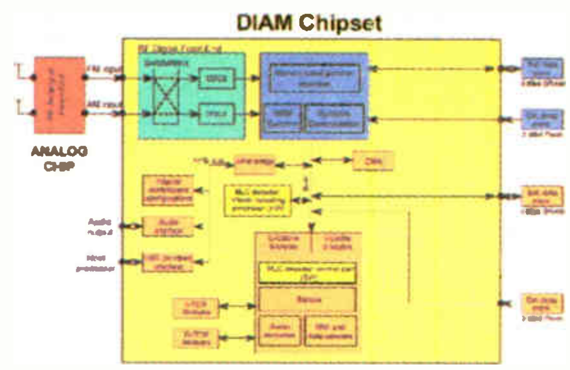


Working examples of receivers already found suitable for modification and the minimum specification for the PC can also be found on the drmrx site, together with a users forum. An example of the software receiver screen is shown, illustrating the



DRM signal spectrum displayed screen-left with other information about the received signal displayed to the right.

Receivers in use so far are not directly intended for the consumer market but the code, which is running on the PC version, can be exported to other platforms, which could include DSPs aimed at the consumer radio market. At the same time, a project is running, which is due to complete late this year, to develop a consumer DRM enabled chip set. This currently runs under the project name of DIAM and the architecture of the chip is illustrated alongside. It is intended that such a chip would be incorporated in DRM capable radios from 2004 onwards.



DRM AND THE FUTURE

Most of the building blocks are in place or close to being in place – system specification, DRM capable transmitters, consumer chips and receivers – so the inaugural broadcasts starting from June this year will show whether the acceptance of the system is sufficient in rapidity and size to produce a self-sustaining market. Success will be vital if broadcasters want to retain the unique properties of the AM broadcast spectrum so they can continue to reach their listeners to entertain and inform them in the coming decades.

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

DRM Inaugural Services World-Wide — **Table 1**

Time (UTC)	Days	kHz	Beam	Target	Av/ DRM Pwr (kW)	Programme	Site
0300-0400	daily	11955	285	W & C No. America	70	BBC WS	Sackville
0430-0530	Sat/Sun	15400	230	NZ + SEAustralia	10	RNW English	Bonaire
0900-1500	daily	7320	105	W & C Europe	30	BBC WS	Rampisham
0930-1200	daily	15440	040	W & C Europe	80	DW English	Sines
1000-1100	daily	6140	120	W & C Europe	40	DW English	Jülich
1000-1100	Mon.	9590		W Europe	30	CV English	Rampisham
1100-1200	daily	6140	120	W & C Europe	40	DW German	Jülich
1200-1300	daily	6140	120	W & C Europe	40	DW English	Jülich
1305-1455	daily	5975	290 or 060°	W Europe	40	Multimedia T-System	Jülich
1600-1700	daily	6140	ND	W & C Europe	40	DW English	Jülich
1700-1800	daily	6140	ND	W & C Europe	40	DW German	Jülich
1800-1900	daily	6140	ND	W & C Europe	40	DW English	Jülich
2300-2400	daily	9795	268	E No. America	70	BBC WS	Sackville
2330-0030	daily	15525	350	NE USA &NE Canada	10	RNW English	Bonaire
0930-1230	daily	9590	172	S & C Europe	40	RNW English	Flevo
Tba	daily	tba		NE USA &Canada	70	Radio Sweden	Sackville
TBA	daily	1296		W & C Europe	60	BBC WS	Orfordness

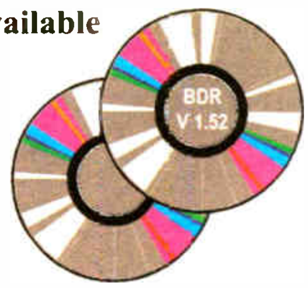
CV = Christian Vision, RNW = Radio Netherlands International, DW = Deutsche Welle

Bonaire – Netherlands Antilles, Flevo – Netherlands, Jülich – Germany, Orfordness – UK,

Sackville – Canada, Sines – Portugal, Rampisham - UK

Do You Have the BDR on *Your* Desktop?

Version 1.52 of the BDR Now Available



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

Among the resources already available, you'll find: Barry's Radio Utilities, The Continental Electronics E-Slide, RF Specialties Toolkit, Tom Osenkowsky's Toolkit, Bob Carpenter's AM and FM/TV database viewer, Top Ten Lists, EAS paper sources, some project schematics, several files and pictures of broadcast history.

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

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

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

We are suggesting something in the range of $15-$20 (or more, if you really want to support the Oldradio Project).

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Thanks for your support of OLDRADIO.COM – Barry M.

Choosing an Automation System for Radio

by Allen Sherrill

[TUCSON, Arizona - June 2003] Sitting down to write this article, I realized the term "automation" really bothers me as a shorthand way of referring to the systems we will talk about. Automation is really only part of their capability in the radio plant, and besides, "automation" has very negative connotations to some of the radio station staff – namely air talent, who tend to associate "automation" with pink slips.

It would be so much better if we had a better descriptive term for these systems, aside from the really generic sounding "music-on-hard-drive." Maybe a catchy acronym, like POTS or CODEC. Something like the Audio Storage System, which reduces to the easily-remembered acronym of ...

On second thought, I guess "automation" will have to do for now.

I have been evaluating and maintaining computer-based radio automation systems for over ten years now. My first experience was with one of the very early versions of Broadcast Electronics' Audio Vault while CE of a Midwestern radio group.

In the early 1990s, it seemed every small broadcast manufacturer and his brother had an automation system operating on stand-alone desktop computers, most using some flavor of DOS. The Audio Vault was a little different – it was one of the first systems designed specifically to run on Windows 3.1. It had a central control and audio storage unit (hence the "Vault" name), which could accommodate up to four workstation PCs. That, and the fact it was produced by a "name" manufacturer of broadcast equipment, sold us on the system. After evaluating the system with our key people, we made the purchase.

EARLY LIMITATIONS

Very quickly, we discovered the early Audio Vault's shortcomings. Installation was fairly labor-intensive. And each workstation was connected to the controller with a lengthy multi-pair cable, which we later found was an ideal path for lightning surges to find their way into the controller.

The ownership rules began to be relaxed as we took delivery of our system, so our local AM-FM operation soon had an additional AM signal to program. In a radio duopoly environment, the four-user limit became a real handicap, especially since one of the AMs was a news-talk operation with several satellite sources, some of which needed to be recorded for later broadcast. A trip back to

the well for more hardware so the automation could meet our requirements did not please the management.

Another problem: The rather small storage drives got full very quickly. In those days, we only had space for commercials, liners, and other short audio bits, and as the drives filled up, the system got less stable. At times, the controller would lock up and have to be reset, or even worse, data on one of the drives would get corrupted and everything on it would have to be re-recorded.

Fortunately, our relationship with BE allowed us to upgrade to the new, improved Audio Vault product a couple of years later at minimal cost to us. The new system was a huge improvement; it could expand to meet our growing need for additional workstations and storage space (no more four-user limit), and reliability was vastly better. The system networked in a peer-to-peer configuration using Windows for Workgroups, which was more flexible than the old workstation-controller arrangement.

After a few years and station acquisitions, we outgrew that system and upgraded to an even larger system, with dual-redundant servers and over a dozen workstations. We were irrevocably committed to the concept of computer automation, although sometimes when we were having problems it was not unusual for the operations manager to express the desire to "rip everything out and go back to carts." Fat chance!

Nevertheless, my facility was faced with some important decisions and choices. Our automation system is several years old, and will only work with legacy audio cards and operating systems. It lacks some of the latest features, such as the ability to quickly import audio files from external sources. We are nearing the point where the system will have to be replaced in order to keep our radio stations on a competitive footing.

With upgrading the current system not an option, our choices were to buy the latest version of the current system or go with a completely different system. As one might imagine, there have been some pretty passionate conversations about this subject. Although our system has had its troubles, a few "power users" are dead set against going with a different system. But we owed it to ourselves to look around and see if there might be something better.

A COMPANY PROJECT

When it comes to deciding on a system, I have always tried to involve a reasonable number of station people in the process, so as many potential end-users as possible could make their needs known. When possible, I have arranged demonstrations of different systems, so they could personally get a "hands-on feel" for how they worked.

Choosing an automation system is somewhat easier than ten years ago, if only because the sheer number of players has declined. It was hard then to tell if the system you were evaluating would work for your facility, or if the company stood a chance of being around to support the product.

(Some companies did inadvertently make the decision easier for me. I remember watching a video of one system in action, audibly upcutting songs during segues; another system crashed repeatedly as I watched it at NAB. Those experiences made it easier to decide to go with a system from a proven, reputable broadcast equipment manufacturer.)

The size of the facility often will narrow the choice of systems somewhat. For instance, some systems are tailored for smaller operations with a few studios, and work best in that configuration. Other systems are intended to be easily "scaled-up" to fit into larger, multi-studio facilities, possibly working across a wide-area-network.

The formats and programming of the various radio stations in a given cluster also may dictate which system works best. The automation we currently use in our Tucson facility works very nicely in a live-assist or voice-tracked situation, which is great for our three music-intensive FM signals.

However, it is not as effective for complex satellite automation. It takes a lot of effort to make the system operate our AM sports-talk format smoothly. The next system we buy will have to handle that. Another requirement is a good segue editor.

Some other important features not widely available when our current system was purchased include "rippers" and remote control. We broadcast a lot of syndicated programming, so the capability to rapidly "rip" these shows into the automation storage needs to replace laboriously recording programs in real time. And, since there are times when our stations run unattended, we need a secure way to control our system while off-premises.

Sometimes the system architecture will determine whether it is a good fit in a particular radio facility. Some systems generate playback audio from a central server and constantly stream audio over the Ethernet network to each studio workstation; other systems store and play audio at the workstation, and the server is simply a repository which occasionally forwards new audio files to the workstations. In the latter case, audio files recorded in one part of the station may not be immediately available in another studio, until the forwarding process is complete. This might be a problem where a newscast is recorded in one studio and needs to be on air from another studio within seconds.

Investigating how different systems offer data backup

Credit: Scott Studios

can be an important factor in the decision. It is critical to back up crucial audio and/or database files on a spare drive to protect the radio station's business. Larger system budgets can include redundant servers and backup workstations. In fact, redundancy is a subject that really deserves its own article.

TRAINING AND SUPPORT

Technical support is also crucial. My experiences, and those of others, suggest factory installation and training is well worth the extra money. Check out the quality of after-hours tech support, because Mr. Murphy dictates you will need technical help at the worst possible times (6:00 p.m. on Friday of a three-day weekend). Try to get a feel for the technical savvy and attitude of the support staff by asking questions, such as regarding software modifications to fit your application. If the response to such a question is not, "Sure, we can do that" but instead "Why would you want to do that?," watch out!

Corporate policy may dictate all the stations in a national chain standardize on the same automation system for consistency and to facilitate audio file exchanges between commonly-owned stations. This is, in fact, the situation we face in our Tucson facility. Later this year we will replace our aging automation hardware with a completely new system from a domestic manufacturer as part of a corporate automation make-over.

We are already past the decision-making phase, now our challenge will be to sell the benefits of the new system as we help our staff make the transition. Even though we like to think of ourselves as "change-embracers" at Journal, ripping out an established platform and replacing it with something substantially different is never easy.

However, we are fortunate to be working with an automation provider who "gets" the business of radio. We have been working with the software writers to create a system our people can live with, and we think we have a great chance for a relatively smooth transition and a reasonably short learning curve. Our staff will be watching closely to make sure the provider adapts the system to fit our various needs, and deal with any technical "glitches" in our installation. When the dust settles, we expect an automation system with all our desired features, running on all-new hardware, and helping our people do great radio.

If all goes well, we plan to have our new system in service by fall, and hope to report back late in the year as to how the installation went and how good the tech support was in ironing out those last minute "glitches," as well as DJ reactions to the system.

Allen Sherrill is a North Carolina redneck who woke up one day in the desert. He is Chief Engineer for the Journal Broadcast stations in Tucson, AZ. His contact address is sherrill@journalbroadcastgroup.com


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Audio Processing From the Ground Up

by Cornelius Gould

Part 6 – FM Stereo

Cornelius has been discussing the internal workings of a typical audio processor, section by section, from a designer's point of view: the compromises necessary to make an audio processor work, and the balance between legal operation vs. the demands of the programming department. This installment looks at the final stage of processing. [Ed.]

[CLEVELAND, Ohio - June 2003] For Stereo radio stations, the end of the audio path is the Stereo Encoder. We will concentrate mostly on the FM Stereo system, since that is one of the few areas where the stereo encoder is typically "wrapped" inside an audio processor for better performance.

As a kid, I often wondered how a radio station got a "left" channel and a "right" channel into *one* radio signal; it seems this question started me on my path of learning all about the odd world of Audio Processing. I did not actively pursue the answer until years later, when I had my nifty neighborhood FM radio station. Tired of being in mono, I picked up a copy of the Code of Federal Regulations (CFR) at the library to leaf through the FCC Rules for answers. (Yes – I was a young GEEK!)

Anyway, in the CFR I learned about what you have to do to broadcast FM Stereo: There is this thing called the 19 kHz pilot tone that is sent at about 10% modulation on your program signal, as a reference for your radio. When present, it triggers an FM Stereo radio into "FM Stereo mode." I also learned that the "stereo" signal comes in the form of a 38 kHz sub-carrier. So, off to the basement I went to build a 19 kHz oscillator for my first experiment. I mixed it into the program feed to my transmitter and – viola! – the FM stereo light came on in my studio radio. Of course, the audio was still mono.

STEREO AUDIO

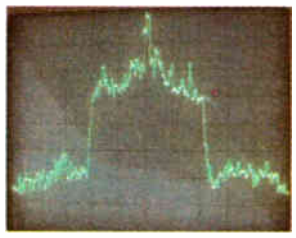
The CFR went on to describe the process of encoding audio for FM Stereo. First, a component called L+R feeds the main channel. This L+R signal is created by adding the left channel (L) to the right channel (R), hence L+R. The result was Mono. Easy enough, I had already broadcast that.

Then I read on, and saw talk about L-R, as in Left *minus* Right. Now that was a head-scratcher for me, but eventually I figured out how to subtract the right channel from the left channel. What you get is a signal that contains material *only* appearing on the left or right channel, and nothing from "center." This basically nulls out any mono material, while anything panned even the slightest bit left or right is very noticeable.

As an example, the L-R signal from a typical rock song will usually contain the stereo reverb effects placed on vocals and the drum kits, but no actual vocal material (or any other sound "in the middle"). In essence, this is how a lot of boom boxes perform the "karaoke" function on normal CD's.

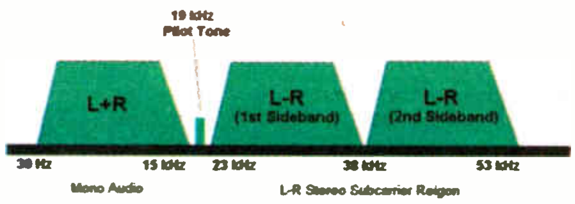
The next challenge was to figure out how to make a sub-carrier. This is needed because the L-R audio signal has to be encoded onto a modified AM sub-carrier. (A sub-carrier is basically a radio signal created at a frequency outside our range of hearing, which is still embedded inside of the main radio signal.) The FM Stereo sub-carrier is centered at 38 kHz, compared to the "golden ear" whose hearing tops out at about 20 kHz.

Actually, the 38 kHz sub-carrier is modified in that the AM carrier is removed from the modulation, leaving only the "modulation pieces." Technically speaking, this "Modified AM signal" is called Double Sideband Suppressed Carrier (DSSC). AM signals, such as good 'ol AM broadcasts, have two sidebands whenever audio is being transmitted over the air, one above and one below your main frequency. If you were to look at an AM signal (as you can with a spectrum analyzer) you will see the main carrier, and some "stuff" moving around to either side of it, "growing" up and down with program audio.



That "stuff" is the two sidebands. (You can also do AM effectively by removing one of the sidebands, but that is an entirely different subject.) When there is no modulation, the AM signal will only consist of the carrier, and *no* sidebands.

With DSSC, the main carrier part is removed, leaving only the two smaller sideband signals. This saves the FM stereo station from having to reduce modulation to fit the carrier in the signal. Another benefit is when there is no L-R audio (whenever there is pure mono audio, e.g. a DJ talking on the air without a music bed behind him), there is no signal to be found in the 38 kHz sub-carrier area. The DSSC sub-carrier method makes more efficient use of the FM signal, and eliminates the need to turn down modulation substantially for FM stereo operation, so FM Stereo stations can basically remain as loud as mono ones.



The components that make up FM Stereo.

FOLLOW THE SIGNAL

The 38 kHz DSSC AM sub-carrier is mixed on top of the L+R (mono) signal along with the 19 kHz pilot, and it is all fed as one signal into an FM transmitter, which goes over the air to FM stereo radios all over the city. Now, how does the radio get stereo from this?

In a classic FM Stereo radio, the 19 kHz tone is not only used to turn on the FM stereo indicator, but is also used to synchronize the decoder for the sub-carrier, keeping it in "sync" with your audio processor's stereo encoder. This 19 kHz tone is doubled to create a 38 kHz signal, and the FM stereo decoder uses it to rebuild the main carrier part of the DSSC signal, creating a standard AM signal to properly to recover the L-R audio.

The recovered L-R audio signal is then used to recreate stereo by taking the L-R and adding it to the L+R signal. Remember from the old algebra classes that "L-R" actually means "+L *and* -R", and "L+R" actually means "+L *and* +R."

Thus, when you add "L-R" to "L+R" what happens is the "R's" cancel each other out, and you get "2L," which in English means "all that remains is audio from the left channel," and the sound is sent to your left speaker.

The decoder then flips the "L-R" signal so that it is now "R-L" (+R and -L), and adds this to the "L+R" signal. When this happens, the Left channel signal cancels, and leaves you "2R", or in English "all that remains is audio from the right channel." The right channel audio is then passed on to your right speaker.

In a simplified nutshell, that is how FM stereo works. (It will be obvious shortly why we had to explain all this in such detail!)

The FM Audio processor, as (explained in the previous article) has to apply filtering to the processed program audio to make sure it doesn't exceed much beyond 15 kHz to prevent interference to the 19 kHz pilot tone. If that were to happen, the radio could temporarily "lock onto" the audio material, and momentarily decode "stereo noise" as a result. Now, remember that the 38 kHz sideband energy is also controlled by the 15 kHz filtering, so if the filters are ineffective, or not there, the interference could also come down from the 38 kHz L-R sideband energy too, in effect a "double whammy."

MORE CONTROL

A very popular (and sometimes controversial) processing tool used on the encoded stereo signal is the composite clipper. I alluded to it in an earlier article, and the time has come to talk about it!

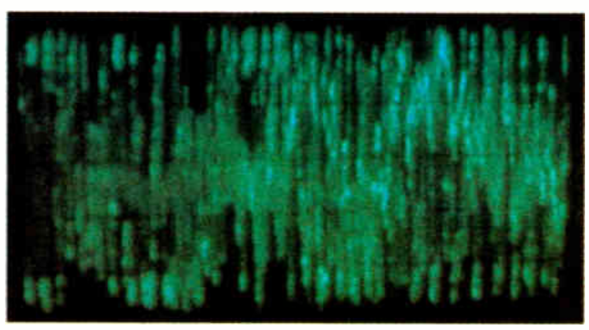
What the composite clipper does is to take the L+R signal and its superimposed 38 kHz L-R sub-carrier and feed it into a clipper stage (typically the 19 kHz pilot tone is *not* sent through the clipper – it is either extracted, and added back in after clipping, or added later).

This extra clipping stage allows several more dB's of clipping (read – loudness) than L/R clipping, without the nasty distortion. Well, at least not "normal nasty distortion."

The kind of distortion you get is not very audible at first, as it is distributed about in a not immediately detectable way. To hear this distortion, all you have to do is to remove program audio to, say, the right channel of the processor. If you listen to the (silent) right channel, you will hear "crashing" noises whenever there is high frequency energy in the left channel. As the clipping (loudness) is increased, the crashing gets worse. Plugging the right channel back in covers up the crashing noises with normal right channel audio.

When composite clipping is at its most extreme, you also run the risk of clipping harmonics falling into the 19 kHz pilot region, as well as above the 53 kHz limit of FM stereo. When the pilot area becomes contaminated, the same problem you would get from not using 15 kHz filters happens; with harmonics above 53 kHz, any sub-carriers you may be renting to clients (67 kHz, for example) will be contaminated by this "crashing" noise, too.

This effect constitutes a good part of the controversy over using composite clipping for loudness. Supporters of composite clipping will say much of the audible side effects are negated by the fact that 90% of your listeners are never in a position to have reception good enough to make a difference, but the loudness gained comes through regardless of location. Which stance is the correct one? It depends on what is important to your radio station.



What composite clipping looks like.

As far as the negative effects of composite clipping go, the latest generation of DSP processors all address some of these issues in clever ways, including special filtering to remove most of the spectral "garbage" created by composite clipping. Despite the controversy, we will probably never see composite clipping go away. That is, unless the day comes where radio programmers stop caring about being loud.

Yeah ... right!

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

RADIO.EDU

"College Radio CAN be Fun"

by John Devecka

[BALTIMORE, MD - June 2003] I remember this: The sounds of new music, excited voices, first shows, small concerts – the whole thrill of discovery that cajoled most, if not all, of us to stay in radio. This is college radio! So, while the "real world" has a playlist of 300 songs at best, we have nearly 10,000 in our server and nearly 1,000 CDs in our new library!

OK, it may not be the "real world" experience of being stuffed into a restrictive format, kowtowing to commercial sponsors, promoting lousy bands, and having to voicetrack a station in Iowa from your local Georgia studio, but what the heck, this is fun!

Yeah, this might generate some letters, I usually do. But, consider this – if you had not had that first amazing experience in radio, whether it was getting a phone call from a real listener, or causing arcs in the transmitter, you would not be reading this right now. Think of me as the smiling recruiter; it is never like you are promised in the real world. I am now giving students a chance to experience all the jobs, from DJ to PD, with less hassle and headache; and they even get to play what *they* want and not what The Consultant said would fit best with their 18-34 female, truck driving, pro-war, anti-troops, average 8 minute listener at 3:45 p.m.

But, I am on the third paragraph and way off track. Please give me a moment to explain how this all happened. [SFX: Cue swirly music and wavy visuals] Let me take you back to what seems like a time long ago: March 2000. I was at another college radio conference – I do three or four a year. As usual, I ended up chatting with lots of people after sessions, trying to help them with planning and tech issues for their stations. I had spent a dozen years as the sales manager and low power "go-to" guy at LPB Communications. I had designed, supplied, installed – or messed up in some way – about a thousand educational stations from licensed FMs to carrier current AMs.

A NEW DIRECTION

I started talking with a fellow from Loyola College in Maryland about their idea to resurrect the defunct college station as a real cornerstone for their Communications Department. The station was the kind many of us remember – behind the stairs, under a leaky drain line, and perpetually under-funded and understaffed. They wanted to get past this and had hired someone to pump up their Radio and TV courses and facilities. The Budget: Well, they were "working on that" and needed some real numbers. I suggested it would take a couple of hundred thousand if they were serious or maybe 20K if not. Those numbers usually send college folks scurrying.

One day he called and said they had a 30' by 60' weight room, that could be used for the station. He asked for a proposed studio layout, so I went to the campus, looked at the space and drew up some basic ideas, not really expecting it to amount to much (I routinely did dozens of proposals for every one that came to fruition). But, then I got a call asking if I could come to meet with the architects, to discuss their ideas on adjusting my drawings. You can imagine my surprise: "Huh?! You mean you got funding? That much! Wow!" It was time to look at this whole station thing in a new light.

We sat down and began to rework the old free weight room into a radio station. It happened to be the ground floor of a dorm, so it had great student traffic, but also had students above it with basketballs! We started with the dream of all rooms being isolated, soundproofed and interconnected. We considered blowing the side out of the building to reconfigure the windows and doors that were not in line with the radio model. Finally, we had plans for usage in each of the rooms, but quickly discovered we would blow the whole budget just on the construction of our dream space – and Fisher Price radios would not cut it for equipment. Rats!

FROM PLAN TO REALITY

To keep costs under control, the College moved the construction in-house. Initially, this was a concern as most college physical plant folks do not do a lot of sound-critical work. Well, high praise for these guys and my apology for underestimating them! They brought the whole construction package in early and way under budget! It all works, looks great and sounds great. No doubt the detail level of the architects' planning helped, as did the acoustical consultant, but if you are facing a tight construction budget, see if the "local" folks can help.

Careful reworking allowed us to create four rooms, isolated from above and below, with interconnecting windows and sound locks to keep the main room at bay. These four became On Air, Recording A, Production and Recording B, each independent but interconnected.

Isolating the rooms was only part of the battle as we still had to leave room for all the wiring snakes to get from their Engineering home run location to each, without compromising the acoustics. After several meetings on interconnection issues, we found a way to radius pipe into the space above each of the rooms and down inside their walls, giving us good paths and maintaining sound isolation.

In addition to the four studios, the main lobby area doubles as a classroom and triples as a set of three news gathering and production desks.

Budget compromises forced us to leave this space less sound-isolated, so sometimes you hear the water from upstairs pipes (or feel it!), but that only happened twice. A music library space was included to make sure there was a secure location for all the CDs and other operational staff. And an Engineering office was added at the end of the space. It would include all the power panels for the room, home runs for audio, servers and processing. It would also be long and narrow, but that came after the equipment went in.

So, we had worked out the basic concepts and structures, but had not gotten to the gear and operational functionality of the startup space. They wanted to be able to teach Radio Production and several other classes, in addition to having the students run the station as a club. This meant we had to have a lot of workstations for the class, but also a lot of flexibility in the space to keep classes from interfering with radio operations.

Because of the flexibility demands, all of the studios really needed to be capable of running as On Air in a pinch. Because we had a pretty tight budget for four studios, Engineering, three news desks, and Library, it forced some compromises in equipment choices, but not in functionality. Where the budget did not allow for a bunch of SAS routers, we had to make other ideas work.

A quick tour of the gear selected will show, to many folks surprise, you do not have to have a killer budget to get all this stuff and have it installed. But that list is a whole 'nuther column.

ON THE "AIR"

WLOY does not have a license. Yes, we are small time. But we do everything else. A 100 mW AM transmitter (the first of many) is up and running about a 1/4 mile radius under Part 15. Channel 71 on the campus cable system carries the audio and our own funky PowerPoint show. And, of course, we have two beefy servers for streaming Real Audio and Shoutcast.

Why am I still here? Well, when we finished building the station, they offered. Then they offered again, and finally they sent in Don Corleone (yes, it was an offer I could not refuse!). I must admit, attending NAB and not having to deal with a booth was pretty cool. And going from an hour plus commute to five minutes is pretty neat. But what really makes it worth doing is the students. The first time they hear themselves on the air, the first time they see their own channel on the cable system, the first time the hear the streams, or get a caller on their show – to steal a bit from a commercial: Priceless!

We still have a few things to work out, like schedules, programming, DJs, music, PSAs, underwriting, remotes, money, and all sorts of other insignificant bits. But, a mere two weeks after we went live we held a concert. We have 22 DJ shows, and another dozen in the works. True, we rely on automation more than I would like, but we are growing and we are always "on."

I hope through this column to explore issues in educational radio as well as low power broadcasting. Maybe, just maybe, I will strike a chord and one of you will find this interesting, or educational. We will not know until we try!

John Devecka is the Operations Manager for WLOY at Loyola College in Maryland. He previously spent 12 years as Sales Manager for LPB Communications, Inc. and has traveled extensively to develop and install low power broadcasting systems worldwide. He may be reached at wloy@loyola.edu or 410-617-5349.

DA Low-Down

So You Want a DA? – Part 2

by Wayne S. Reese

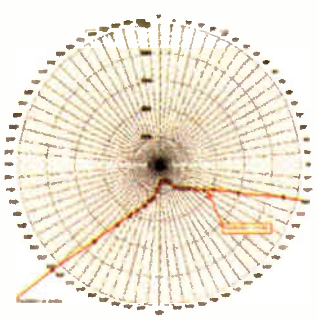
[COLDWATER, Michigan - June 2003] Perhaps you have decided a directional array (DA) might allow your AM station to make significant improvements. But how do you know what pattern to use? How many towers will it take? How much land will you need? These and other unknowns may be sending your head into a tailspin, but they do not have to! Here is some background information about how broadcast consultants answer these questions.

The first step in planning your DA is determining the limits of radiation in each direction. This is done with the aid of specialized software. Depending on the software package, information may be available in a tabulation, a graphical plot, or both. The tabulation usually lists a series of azimuths, normally 0° to 355° in 5° increments. For each azimuth, the maximum radiation that avoids prohibited overlap will be shown. These radiation values are given in units of mV/m@km (millivolts per meter at one kilometer). This is a universal designation used by engineers to compare antenna systems.

THE KEYHOLE

The radiation limits are then transferred to polar graph paper to form boundaries that must contain the final directional pattern. Depending on the allocation and the scale of the plot, these boundaries may appear along only a portion of the graph, or they may surround the diagram.

The polar plot formed by this process is often called a "keyhole" because the limits often tend to look like a keyhole – at least in the mysterious mind of an engineer! An experienced engineer can look at this "keyhole" and start to visualize the shape of a workable pattern.



Radiation Keyhole Plot

Since he or she will be working with theoretically maximum limits, even in a best case scenario you should not expect a practical directional pattern to fill all areas of this "keyhole." At this point, the engineer is simply trying to find the most efficient use of the available spectrum.

Before proceeding further, we need to discuss the factors influencing pattern formation. Basically, three items influence the coverage you receive from a directional antenna system: tower heights, array geometry and the current in each tower. During the design stage, all of these factors can be varied – within practical limits.

Once an array is built, however, the number of variable options diminishes. Clients sometimes ask us if we cannot simply adjust the phasor to put more signal over some nearby (or even distant) community. Although it may seem like engineers can work magic with the phasor controls, there really is not a separate control for each community within or adjacent to your coverage area!

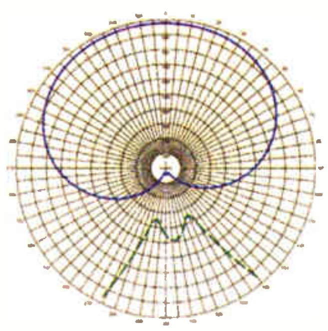
• **Tower Heights** - For daytime arrays, the heights of the towers affect the efficiency of the pattern. However, for nighttime arrays, the height of the towers also affects the vertical radiation pattern and therefore the skywave signal generated by the array. Changing the heights of nighttime towers may have a significant effect on the amount of power that can be achieved before interference is caused. Other factors influencing tower heights include air space issues, zoning ordinances, and cost of materials.

• **Array Geometry** - The spacing and orientation of the towers will have a great effect on the pattern that is generated. A skillful engineer can use these factors to minimize the number of towers needed to fill the available "keyhole." It is important to note the orientations for directional arrays are always given in degrees True. This refers to True North – not Magnetic North.

It is imperative the surveyor who lays out your array understands this. The difference may not seem like much, but more than one array has had to move towers to make the pattern work because the wrong reference was used when the array was constructed!

• **Current in Each Tower** - Along with the array geometry, the relative magnitude and phase of the current in each tower controls the location and depth of the pattern minima. Mimima, or nulls, are the areas of the pattern with minimum radiation. Of the factors controlling pattern formation, only the relative magnitude and phase will be adjustable once the array is built. And even this factor will have practical limits on the range of adjustments that can be made.

Obviously, all of these factors must be brought together to achieve the final design. If you are aware of limitations imposed by local conditions, such as airspace problems or the amount of available land, you need to provide this information to your technical consultant-before he or she completes the design!



2-Tower AM Directional Pattern

How does your consultant use these factors to fill your "keyhole?" The simplest array consists of only two towers. This allows for a mathematically uncomplicated solution. In its basic form, the tower spacing will affect the shape of the pattern. The phase of the tower currents will control the location of the minima. And the ratio of the tower currents will control the depth of the minima.

MORE COMPLEX PATTERNS

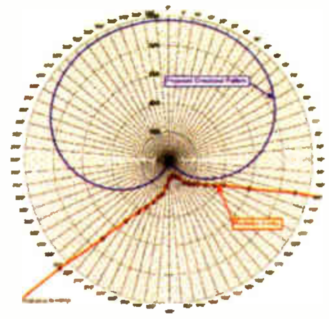
From this simple beginning, increasingly complex arrays can be made by adding more pairs of towers. Adding an additional pair of towers will create the classic parallelogram. This increases the number of pattern minima and gives more control, yet it is still easy to predict mathematically.

You can even close the angles on the parallelogram until the towers all end up in a line. Doing this will turn a four tower parallelogram into a three tower inline array. (The center tower takes the place of two of the parallelogram towers.) This saves the purchase of an additional tower, but all of the pattern minima will be symmetrical around the line of towers. For some allocations, this provides a cost efficient solution, but for others, it may not fill the "keyhole" efficiently. The combinations of pairs can be extended to produce large and complex arrays.

For the design engineer, the advantage of basing the array on pairs is predictability. He or she can sit down with a calculator and an allocation study and determine the exact phases needed to place the pattern minima at the desired angles.

In fact, an experienced design engineer will often be able to look at a "keyhole" and predict a good starting point using a simple parallelogram or inline array. This "starter" design is then refined and expanded as necessary to achieve the desired protection, power and/or coverage.

It is also possible to design directional patterns without using pairs. These are called vector arrays, and sometimes "doglegs" when the towers are not in straight lines. In fact, some computer programs have been written to attempt these kinds of designs. However, the gain in flexibility is offset by a loss in mathematical predictability. That may seem like a small price to pay – unless you are the poor field engineer who has to make it work after it is constructed! These patterns may look good in theory, but can be extremely difficult, if not impossible, to implement in the real world.



Directional Pattern & Keyhole Plot

Here are a few other factors to consider in formulating the final array design:

• **Location** - The shape of the "keyhole" and resulting pattern will usually determine where a directional array needs to be located. Ideally, the major lobe should be pointed toward the desired population center(s). Thus, if the available pattern has a large lobe to the north, the array needs to be located south of the area to be covered. Depending on the power and the pattern, this can be a critical issue.

Oddly enough, it is often more critical for daytime arrays than it is for nighttime arrays. Daytime allocations are based on groundwave contour locations. Depending on where the ground conductivity changes occur, the contours can generally be expected to move about the same amount as the site. If the protected and interference contours in the allocation are close, you may not have many options for a site location.

Nighttime allocations are more dependent on skywave interference from distant stations. Thus, modest changes in site location will be minimal compared to the overall distance to the interference protection.

• **Land** - Directional arrays take land – in some cases, lots of land! The spacing between towers in directional arrays is measured in electrical degrees. Here is a simple procedure to help you relate this to more familiar measurement units. Divide 984 by the frequency of your station in MHz. (Remember, 1230 kHz is 1.23 MHz.) This will give you the number of feet in a wavelength. Since there are 360 degrees in a wavelength, divide the first answer by 360 to get the number of feet in a degree at your frequency.

If your station operates on 600 kHz, you should get 4.56 feet per degree. If you operate on 1600 kHz, you should get 1.71 feet. Typical distances between adjacent towers will range from 70 to 180 electrical degrees – although you can certainly find existing arrays with spacing outside this range. In addition, you should plan for an additional 90 electrical degrees around the base of each tower for a ground system. (This normally consists of 120 wires, 90 electrical degrees in length, fanned out from the base of each tower.)

Once your consultant has completed the design of the array, he or she can provide you with the dimensions of the property required to construct the array. But remember, it is not just the total number of acres that matters, the property must also be the *right shape* to hold the tower geometry and ground system.

• Power - Discuss this issue very carefully with your consultant. Everyone's first inclination is to want as much power as possible. Power often makes the station a more marketable commodity for the sales force. However, it can be a two-edged sword. Although it normally is desirable to get as much power as possible, there are times when reducing the power allows a simplification of the array and/or a more desirable location.

We have tried to provide some basic concepts to help you get started. There is no substitute for a good working relationship with your technical consultant and your communications attorney. These professionals may seem expensive, but it is normally money well spent. Their advice can help you avoid unforeseen problems and guide your project through the bureaucratic process from concept to licensed facility!

Wayne S. Reese is President of Munn-Reese, Inc, a Broadcast Engineering Consultant firm in Coldwater, MI. You can contact him at wayne@munn-reese.com

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Tower Topics

So You Have a New Neighbor - Part 2

by Bix Bixby

[LYKENS, Pennsylvania - June 2003] In the first installment, we looked at the FCC Rules and policies that apply when a cellular operator builds a tower in proximity to an AM antenna system. Of course, the object of the Rules is to avoid situations in which the cellular tower causes a "...disturbance of the AM station pattern which causes operation outside of the radiation parameters specified by the FCC for the AM station..." (Section 22.371).

The specific culprit is a phenomenon called "reradiation," that is, parasitic radiation of a radio station's signal by an object or structure which is externally excited. In this article, we will focus on cellular towers, but almost any conducting object may be a re-radiator. AM station re-radiators may include water tanks, silos, high tension power line towers, light standards, and even steel frame buildings.

Parasitic radiation is not always unintentional. Yagi arrays, for example, typically comprise one driven or internally excited element and as many as a dozen or more parasitic elements. Even though they are not driven directly, RF current flows on each parasitic element and each contributes to the final pattern of the array. By custom, reradiation generally refers to unintended radiation from objects that are usually, but not always, external to the station's array.

Cellular towers and other external re-radiators are a problem for several reasons. First, they are not under the AM station's control. They may be erected, modified, or dismantled in locations and on schedules that often seem to be designed to be as troublesome as possible for nearby AM stations. Typically, they range in height from 100' to 200', a significant portion of a wavelength for most AM stations, except for the very lowest in frequency.

The effect a cellular tower may have on a nearby AM station depends on factors relating to the tower and its location with respect to the AM station's pattern. It will also depend on the AM station's pattern. Directional stations with very deep nulls are more susceptible to the effects of reradiation than are non-directional stations.

CELLULAR TOWER EFFECTS

The structure height above ground and its grounding are the principal characteristics of interest. With very few exceptions, cellular towers are well grounded for lightning protection; so for this series, we will assume grounded structures. And we will not spend much time on very short towers. Towers that are short with respect to a wavelength, say 1/8 wavelength (45°) or less, cannot intercept much energy from the nearby AM station and cannot efficiently radiate the small amount of energy they do intercept. Therefore, they rarely present a problem for nearby AM stations. On the other hand, towers that are approximately 1/4 or 3/4 wavelength in apparent electrical height are the worst offenders.

Figure 1 shows three computer model studies (we used EZNEC 3.0.5, copyright 2000 by Roy Lewallen). *Figure 1a* is a typical three tower in-line array and its pattern. The pattern nulls are deep but not unusually so. And, as we would expect, the pattern is symmetrical about the line of towers. In *Figure 1b*, a fourth tower of about 123 feet (1/8 wavelength at 1000 kHz.) has been added to the southwest. The station's directional pattern is essentially unchanged. In fact, the changes are so small as to be difficult to measure in the field.

But we cannot make the same claim for the situation of *Figure 1c*. For this example, the height of the added tower was increased to 250 feet, about 1/4 wavelength, resulting in severe distortion of the station's pattern.


Figure 1a

Typical cellular towers have one or more antenna mounting platforms which have the effect of top-loading the towers, making them somewhat taller electrically than their physical height would suggest.

Similarly, large self-supporting towers appear to have a little more electrical height than a monopole of similar physical height. With that in mind, any nearby cell tower approaching 1/8 wavelength at your frequency should be regarded with suspicion. And, if its overall height is 65° or more, it warrants serious study.

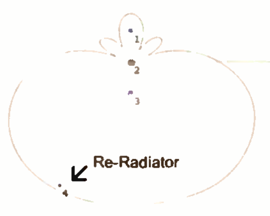


Figure 1b

EXCITATION EXAMPLES

Reradiation from any structure requires a source of excitation – the nearby AM station. In turn, the magnitude of the excitation is determined by the distance from the transmitter site, and the field strength directed toward the structure from the station. Stated simply, towers close to the array are a bigger problem than those farther away. And towers located in the station's major lobe are a bigger problem than those in the pattern nulls.

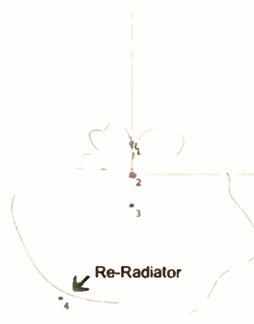


Figure 1c

Stations often complain the cellular folks "...put the silly thing right in the middle of our deepest null." But the fact is, because of the lower excitation, you are probably better off with the tower in your null than in the major lobe.

In *Figure 2a*, the cell tower is still in the major lobe, but we have reduced the height to 175 feet, about 65° in electrical height. Note that the distortion of the pattern, while reduced from *Figure 1c*, is still quite evident.

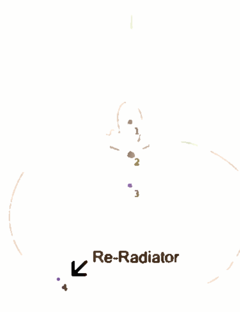


Figure 2a

For *Figure 2b*, we moved the same 175 foot tower to the north, locating it at the same distance, but now in the null rather than the major lobe. The pattern is essentially normal despite the cellular tower in the vicinity.

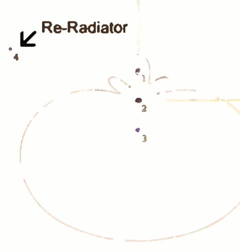


Figure 2b

By moving the tower from the major lobe into the null, we reduced the field incident on the tower, thereby reducing the reradiation in direct proportion to the reduction in excitation, in this case nearly 20 dB.

Putting the cell tower in the pattern nulls is not a cure-all, though. In this case, if the cell tower were taller, it would have an impact on the AM station, although less than if the same tower were located in the major lobe. The considerable distortion shown in *Figure 1c* resulted from a 90° tower in the major lobe. *Figure 2c* shows that placing the tower in the null reduces the distortion, but does not always eliminate it.

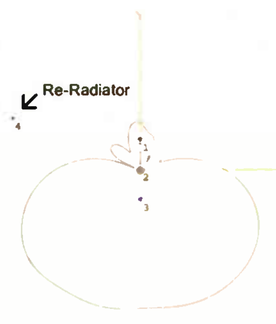


Figure 2c

We often focus on the station's directional pattern(s) when considering reradiation issues, but this can be a mousetrap. Our office recently evaluated a site for a new directional station. There are a couple of re-radiators located on the adjoining property. They are in the proposed null structure and would not be significantly illuminated. Therefore, their effect on the directional pattern will be negligible.

The non-directional pattern will excite the re-radiators, however, and the resulting pattern distortion will be on the order of ±1.5 dB. Since this will be a new station, they will rely on non-directional measurements for the proof of performance. Existing stations may encounter similar problems doing a partial proof. This particular set of circumstances is probably unusual, but the effect on the station's non-directional pattern should be considered in evaluating a reradiation situation.

PATTERN CONSIDERATIONS

Directional patterns with high forward lobe gain and deep nulls are much more likely to be distorted by a re-radiator than those which are almost non-directional. Directional antenna patterns are shaped by the vector addition of the field contributions of each tower in the array. In the major lobes, the vectors add more or less in phase to produce a large resultant. In the nulls, the vectors are out of phase and combine to produce a small resultant.

The effect of any re-radiator is to add an additional vector, usually small, to the calculation. Let us assume a tower capable of reradiating an inverse distance field of approximately 5 mV/m at 1 kilometer. If the station's deepest null has an inverse distance field of 100 mV/m @ 1 km, then the maximum effect the re-radiator can have is 5% or about 0.5 dB. But, if the field in station's deepest null is only 10 mV/m @ 1 km, the likely change is 50% or about 6 dB. The first case would be difficult to measure precisely given the normal uncertainties of field measurement techniques. The second case would be hard to miss.

CONCLUSION

The effect of a cellular tower (or any other structure) on a nearby station depends on the magnitude of the field impinging on the tower, the ability of the tower to intercept and reradiate the station's signal, and the susceptibility of the pattern to reradiation. The ability of the tower to reradiate is principally a function of its electrical height, that is, its height in wavelengths at the AM stations frequency.

The magnitude of the field to which the tower is exposed is determined by its location with respect to the station's pattern. Obviously, towers that are closer intercept more energy than they would if they were farther away. And, a tower in the major lobe receives a lot more excitation than a similar tower in the pattern null would.

Finally, the shape of the station's pattern itself often determines whether a particular tower might be a problem. Stations operating with multiple patterns should look at the effect of the reradiation on each.

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

Networking 101

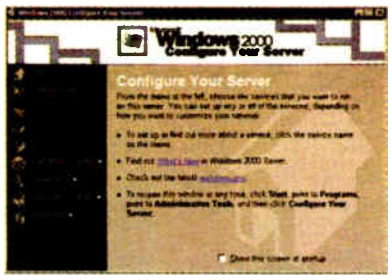
by Tren P. Barnett

Part 5: Managing Windows 2000 Server Getting to Know the User Interface

[TUCSON, Arizona - June 2003] The Microsoft Management Console (MMC) is the common interface for most all of the task of managing a server. With Windows 2000, server management changed its interface notably. In an attempt to make all administrative tasks work in a similar fashion, the MMC was created. Before we get to managing some of our server settings though, let us get familiar with Windows 2000.

As we become more familiar with navigating in Windows 2000 a lot of our frustrations will disappear. After all, there is nothing more frustrating when configuring our server then to have to refer to a document each time to get to the appropriate tool.

When we first started the process of setting up Windows 2000 server, we had a window pop up to assist us in managing our server. Initially I suggested we learn to manage our server without reliance on this tool. That does not mean using this tool will cause you problems, but it is limited in what it will do for you. Knowing the different ways to configure the server allows more confidence in doing so. Case in point, in the *Configure Your Server* window, what will you do when, sooner or later, someone clicks on the *Show this screen at start-up* and removes the check mark?



If this is all you are familiar with then you will be stuck until you get this window back. However if you have become familiar with the Windows management tools, you will know both how to get the window back and how to do all that it offers.

As Windows has gone through its changes, Microsoft has created many different ways to adjust and change settings. That also means there are many ways to break settings that we rely on if we are not familiar with Windows. We have been going to *Start, Programs, Administrative Tools*, to change settings. What if *Administrative Tools* is not there? You can easily get it back. Right click on the task bar and choose *Properties* from the pop-up menu. Select the *Advanced* tab. Here we can select the choice of what will be displayed on the *Start* menu.

At the top of the list is *Display Administrative Tools*.

Another selection that is very useful is the choice to *Display Logoff*. This puts the *Log Off* menu choice on the *Start* menu.

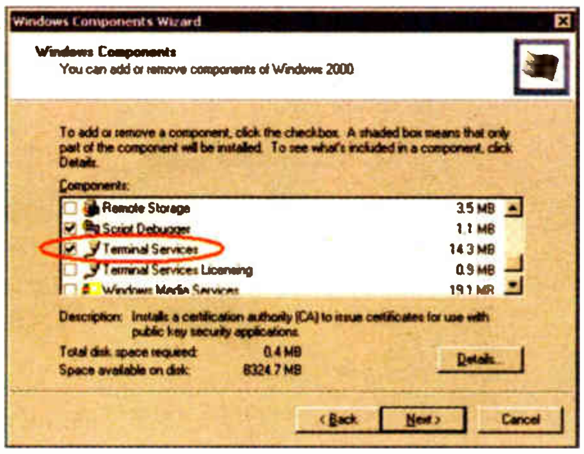
The benefits of having *Log Off* on the menu is choosing *Start, Shut Down* brings up the last "shut down" choice which may or may not be Log Off. No big deal you may think, but if your last choice was *Restart*, not *Logoff*, and you are not paying close enough attention, then guess what happens? Your server restarts and all your users are dropped off-line! Not fun.

There are many different ways to accomplish our goals in Windows. You can also get to the administrative tools through the control panel.

Differences In Management

With previous versions of NT, Microsoft made tools for managing servers from workstations. While some of the old tools will continue to work, Microsoft did provide us with an even easier means to manage our servers remotely.

When setting up the server, we passed by some of the options for configuring our server. These options can be installed at any time. How? By going to the control panel and selecting *Add / Remove Programs* then selecting *Add Remove Windows Components*. If we want to add DNS, DHCP, or other server features, this is where we would go. So let us go there now.



The feature we are after is *Terminals Services*. Since we are adding Terminal services for administrative purposes only, we do not need *Terminal Services Licensing*.

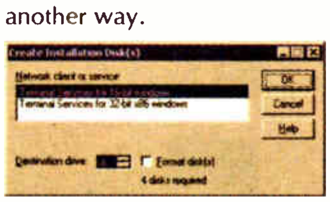
What is Terminal Services, and what does it do for us?

Windows 2000 server's *Terminal Services* gives us a means to have the remote server's desktop on our local computer through a terminal service client. This virtually brings the screen, keyboard and mouse to you, instead of you having to go to the server. Except for a few minor configuration settings such as creating Ports using DLC *(a protocol for networked HP printers)*, you can fully configure and manage your server.

To install the *Terminal Services Client*, after installing Terminal Services, go to *Start, Programs, Administrative Tools*, or a similar path from the control panel, and select *Terminal Services Client Creator*.

If you have four floppy disks ready, you are in business.

The point of these articles is to get us familiar with the Windows 2000 server. If we have been going through the steps so far covered, we are on a network with our server. Assuming we are connected to a functioning network, let us get to know Windows 2000 better and do this installation another way.



To install the client go to your Windows System directory on the server and there you will find a Clients folder i.e. *\WINNT\system32\clients\tsclient*. How do we get there? This time go to *Start, Run* at the command line type \\Server\c$ where Server = your server name, and c$ is the drive letter of the Windows directory. The $ brings up a hidden share that is created by default on Windows 2000. The operating system uses the $ shares for internal purposes. This share will exist unless you have taken steps to lock down your server.

At the following location, you will find a compatible client for most all version of windows: *\\Server\c$\\WINNT\system32\clients\tsclient*. Windows XP however does not need a client installed. The remote desktop connection found in *Start, Programs, Accessories, Communication* works just fine, in fact better, as a terminal client.

As a last note on *Terminal Services* setup, each time you return to add features or remove them form your server, the Terminal Services setup is going to pop up and ask you about your configuration. This is just one of those things. Just leave the settings the same and all will be fine.

Using the Remote Desktop Connection or Terminal Client

To use the client or remote desktop, launch the program. The *Terminal Services Client* will be located on the Start menu under programs, and as mention earlier the *Remote Desktop Connection* is under *Accessories, Communications*. Launching either one of the applications gives us a standard Windows logon screen in the client Window.

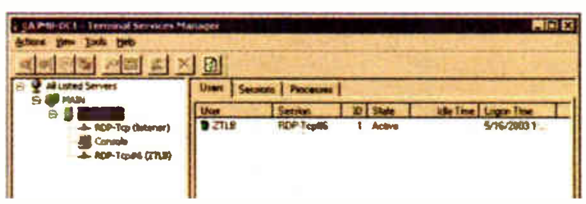
Once we are connected, there are just a few other things to keep in mind. One is the difference between a logoff and the closing of the Window. When you logoff, the server goes through the usual steps and logs you off. Closing the Window however brings up a Dialog Box that says "This will disconnect your Windows session. Your programs will continue to run while you are disconnected. You can reconnect to this session later by logging on again."

What this means is that we can start a program running on a server such as a virus scan, disconnect and shutdown your workstation with out the scan being interrupted. When we close the Window or disconnect, the session continues, without logging us off. This is like doing a *Control Alt Delete* and selecting *Lock Computer* while standing at the server.

When using the *Terminal Services Client*, only two connections will be allowed at the same time. This is probably just as well since it isn't a good idea to have two different users administrating the same server at the same time. But then how would we know this if this *was* happening?

Terminal Services Manager

How can we know who is currently connected to the server? We can use the *Terminal Services Manager* an MMC.



With this we can see all current connected sessions and users. We can also view the processes (programs) that they are currently running. In this window we also can discontinue another user's session.

Now that we are configured to remotely work on and manage our server, we are in a good position to continue to get to know Windows management. In the next article we will use other MMC's and do some more configuring of our server.

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

Free Subscriptions at: http://www.radio-guide.com/subform.html

Answers to Your Questions on EAS

EAS Q&A

by Clay Freinwald with Barry Mishkind

[SEATTLE, Washington - June 2003] Last month's discussion of Relay Networks brought some comments and questions. Clay and Barry find there is more to say on the subject.

Barry - Previously, we discussed how a State Relay Network (SRN) can distribute EAS messages from state governments to Broadcasters within a state. However, there seems to be considerable difficulty in some states as regards making existing communications resources available for use with EAS. What can be done to facilitate this?

Clay - In some states, this has been a problem. Thankfully, Washington is not in this group. Perhaps we can start by reviewing some of the possible alternatives:

- In most cases, it is far easier to utilize existing communications resources for EAS. Not only is it cheaper than creating something from scratch, but it is usually faster to implement.
- Those existing communications users need to understand the very small amount of air-time EAS requires. When you are talking with a state government entity about using their existing statewide microwave system, they immediately visualize your use patterns being similar to theirs. In reality, it takes about a minute to distribute an EAS message, and the frequency of use is very low.
- In some cases, state governments need to understand the value of EAS before they are going to even entertain letting some of their communications infrastructure be "taken over" by EAS. This is normally a job for the existing state emergency management department to handle. But in some cases, concerned citizens may well have to play the "political card" and take the issue to lawmakers.
- Since each state is different, before embarking on building a state EAS distribution system, utilizing existing facilities, it is a good idea to gain a rather complete understanding of what's out there as the first step.

Barry - Are there alternatives to using existing state communications systems for EAS?

Clay - Yes. The private sector has been watching this situation and has come up with several very interesting solutions.

Barry - Perhaps you could offer an example of a private sector solution?

Clay - One system that has gained some users recently is a system called EMnet developed by Comlabs. Much like the name of their product, EMnet is a system whose mission is to "connect" emergency management (hence the name EM) to a network that performs the function of distributing public warning messages, EAS etc, to a great number of locations at the same time.

Barry - Does EMnet utilize existing state communications systems?

Clay - No, it does not. Comlabs has developed a rather sophisticated system using privately owned satellite technology, secured servers, etc.

Barry - How would a state use a system like this to perform the function of a SRN?

Clay - A typical state has an emergency management facility. This facility, often called an EOC (Emergency Operations Center), would be linked, via an up-link, to the EMnet system. At various locations around the state, there would be other satellite terminals to receive the state message and distribute it.

Barry - Would these regional or local satellite stations be connected to existing EAS networks?

Clay - The answer is – yes, they could be. Let me explain. Just how a given state would utilize the EMnet system is somewhat up to the state using the system. In other words, it can be customized to fit the application. For example, these outlying satellite terminals could be connected to existing LP stations, Local Relay Networks (LRN), or be installed at individual stations.

Barry - This sounds like a solid system. Are there any states using this system now?

Clay - Yes. The one that comes to mind is Pennsylvania. That state recently installed the system, with the first phase linking their DEM folks with a number of key broadcast stations around the state. Their goal is to have *all* broadcast stations connected in the future.

Barry - Are there other states using or ready to use this system?

Clay - Yes, Delaware, Illinois and Florida are gearing up to use the system, meanwhile several other states are strongly considering it, they include Maryland, Virginia, Washington DC and Washington State.

Barry - You said that the EMnet system works with satellites. Does this not make the system vulnerable to a single point of failure?

Clay - It appears they have thought this one out; the system can also connect to its users via land line based communications systems.

Barry - Suppose part of the system did fail. How would the state know everyone got the message?

Clay - This is one unique feature of this system. Most EAS distribution systems are "one-way." EMnet returns a "message received" acknowledgment. Unlike broadcast program circuits that rely on someone calling to report they are no longer getting the feed, this system is automatic and built-in. Pretty cool!

Barry - Yes, I agree. How can one find out more about this system?

Clay - Anyone interested should contact Comlabs directly at 207-594-7777. Ask for Roland Lussier at Ext. 300. Their videotape presentation answers many of these questions.

Barry - All this redundancy and two-way communication – this sounds expensive. Is it?

Clay - I really have no idea of what this costs. Certainly, considering the various states and how their applications could vary, this is a question that can only be answered after the exact application and level of implementation is known.

Barry - You mentioned that your state, Washington, was considering this. I thought you already had a SRN in place?

Clay - According to Don Miller of Washington EMD, he is looking at EMnet as a means of improving what we already have.

Barry - What sort of improvements?

Clay - We have been operating a pilot project here in Seattle involving NWS, whereby all our EAS messages are also automatically transmitted via NOAA Weather Radio. Currently, this involves only 1 of the 4 forecast offices serving the state. Don sees a first phase with EMnet connecting the State EOC to all 4 of these facilities, providing instant access to all the NWS transmitters covering most of our state.

Barry - This is what you meant earlier by "customizing?"

Clay - Exactly. How you use a system like this depends on a lot of factors, what you have now, what you would like to improve etc.

Barry - I have to ask again: what about costs? Is this expensive? And, who pays?

Clay - As noted, this depends on how its done. In Pennsylvania, they realized they needed a statewide public warning system. I understand the state is paying for a big chunk of the system. The PA Broadcasters Association ought to have more information, as they have been a leading participant in this effort.

Barry - You know the first question in many a GM's mind is "will the broadcaster be asked to pay for all or a part of this?"

Clay - Without advance knowledge of how a system like this might be installed in a given state, let me hedge a bit and answer with a "yes, perhaps." But again this depends on how the system is implemented.

Barry - Going back to the problem many states have with money these days, would not making use of existing communications systems make more sense in terms of cost?

Clay - I would think so. For instance, if a state has a microwave backbone and a bunch of radio sites linking an existing non Public Safety (DOT, etc) communications network willing to share some air time, then it would seem this would be a more economical route. Again this is something that should be seriously studied in great detail.

Barry - OK, let us say a state needs an SRN or EAS message distribution system, who then should be involved in getting this system off the ground?

Clay - Whoa! There are lots of variables here. I would say State Emergency Management should take the lead, as these systems will become *their* tool. A great place to start would be for DEM and the state broadcasters association, along with EAS leaders to set down and first determine the needs of that state.

Barry - The commercial aspects of this come to mind. If what Comlabs has come up with is so good, is it not reasonable to assume that other firms will produce something working just as well, or better?

Clay - While EMnet is already in the market, it is not the only option, nor am I advocating their product above others. And there are others working on this right now. I received a call the other day from a fellow in Vancouver BC (Canada) who is doing just that. I would welcome information about competitors so I can mention them in a future column.

Barry - Let us change the subject a bit and deal with some other questions we have received. What can you say about IBOC or HD radio? Is EAS different with these new systems?

Clay - To the best of my knowledge, the FCC has not said anything about HDR and EAS. Remember, HDR broadcasts the same program stream as the host station. Therefore, I would conclude Broadcasters would automatically be running EAS on both Analog and Digital. Remember the mission of EAS is Public Warning. Hopefully, the public will be listening via their new HD Radio receivers and receive warnings just as they do now, although perhaps the audio will sound better.

Barry - This message asks: "We have been considering replacing our existing EAS box with a different brand, can you recommend one? Do I have to notify the FCC?"

Clay - I probably could, but had better not! (Now, is that being evasive?) Let me put it this way. If you have already decided to replace your existing unit, it means there was some basis for your decision. Perhaps there was something about the existing unit you did not like, or features that you now want or need that the previous unit did not deliver.

Most stations do not view their EAS equipment like they do other things; they bought one, and that is it! I like to think of EAS boxes like Audio Processors, i.e. there always seems like a better mouse-trap coming along. Just about every station has gone through that drill. Of course, when the original EAS units came along, no one had any experience with them and it was very difficult for some to determine what type/brand of unit to purchase.

Now that we all have a greater understanding of how EAS works, the changes that have been made, and changes likely to be made, we have likely formed different opinions about this equipment. Obviously there are both sophisticated units and some rather simplistic ones; as with audio processing, not everyone needs the fancy one. As when buying other pieces of equipment, ask other stations or post a question to the BROADCAST mailing list (www.broadcast.net/mailman/listinfo/broadcast). You will likely get a lot of help.

In answer to the second part of your question. No you do not have to notify the FCC when you change EAS Boxes. However, be aware you *must* log the removal of the device from service, and log when it went back in service. This is detailed in Part 11 of the Rules. I hope this helps.

Clay Freinwald, Senior Facilities Engineer for Entercom in Seattle, is Chairman of the SBE's EAS Committee as well as chair of the Washington State SECC. Barry just likes to ask him questions. Please feel free to address your questions about EAS to Clay at k7cr@wolfenet.com

FCC Focus

The Public File - Part 2

by Ken Benner, NCE

[TUCSON, Arizona - June 2003] Once we understand what goes into the Public File, it becomes less a mystery and more a straightforward procedure to maintain it in a way that will easily pass inspection. By way of a quick review, in last month's installment we covered the first four categories in a suggested "model" Public File:

- **WELCOME TO OUR PUBLIC FILE** (A recommended information sheet to assist the station staff and a member of the public in obtaining and understanding the public file purpose and process.)
- **APPLICATIONS**
- **AUTHORIZATIONS**
- **CITIZEN AGREEMENTS**

As we move ahead, please note that all the requirements for the Public File are in the FCC Rules and Regulations. Therefore, it is highly beneficial to make a periodic review of those Public File Regulations (73.3526 for commercial stations and 73.3627 for noncommercial stations). With that starting point in mind, let us wrap things up with the final twelve recommended folders:

CONTOUR MAPS: All that is required here is a coverage map of the station's city grade signal. This is simply the 5 mv/m (millivolts per meter) contour for an AM station and 3.16 mv/m (70 dBu) contour for FM stations. Most stations will find this map in the engineering section of the last 301 or 302 application made to the FCC; your consulting engineer will like be able to provide this for you as well.

And there are several software packages and database firms capable of producing such maps quickly and at nominal cost. On the other hand, *do not* file your sales manager's somewhat exaggerated map implying prime coverage for North and South America, Eastern and Western Europe with secondary coverage for Africa and the Antarctic!

OWNERSHIP REPORTS: Unless there is any change from year to year, this file contains the FCC Ownership Report Form (323) together with any supplemental ownership reports including all exhibits, letters and other documents associated with this file (see 73.3615). Your legal counsel likely will prompt you to keep this file up-to-date in most cases. Items 20 through 23 in the FCC Self Inspection Checklist address this file very simply.

POLITICAL: This folder contains nothing older than two years. The double-sided NAB Form PB-15 Candidates (Item #4046A), properly completed with each request from a candidate for air-time, will satisfy this requirement. Please note the file requires a complete record of *all* requests for time made by or on behalf of candidates *whether they purchase time or do not do so*. Again, these items are retained for only two years from the date of the last broadcast

NON-CANDIDATE/ISSUE ADVERTISEMENTS: While yet to be addressed in the current FCC checklists this folder involves single-sided NAB Form PB-15 Issues (item #4046A) properly completed for each non-candidate issue request for air-time. Since the procedure is yet to be officially defined, it is assumed these items are also held two years.

EEO FILE: Please note that new rules for the contents of this file became effective March 10, 2003. Records of activities undertaken prior to this date are not required.

Please note that personal identification of employee applicants, current employees and employee evaluations are not required and should *never* be placed in this public file folder. For this folder the following items are to be maintained:

1. Job Titles of all full time hires;
2. Name, address, contact person and phone number of each recruitment source, (i.e., schools, broadcaster's associations, professional organizations, etc.), that have been used to fill each vacancy. Be sure to include those organizations entitled to automatic notifications.
3. The recruitment source that referred each full-time person hired.
4. Total number of persons interviewed for each full-time vacancy.
5. Number of persons interviewed referred by each recruitment source.
6. A list and description of all outreach initiatives undertaken (job fairs, etc.) during the past year.

These items are to be retained until grant of the next renewal or license agreement

(All stations are encouraged to obtain a primer on the current, non-public file, EEO/FCC requirements that involve initiatives, notifications, recruitment policies and other areas. One such excellent primer is available at www.wcsr.com entitled "EEO Regulations for Broadcasters – A Primer on Current FCC Requirements")

PUBLIC AND BROADCASTING: This booklet is available from www.fcc.gov and it is a very good idea to have some additional copies available on site for those without Internet access, and that the public be advised how they may pull a copy from the FCC web site.

LETTERS FROM THE PUBLIC: This file includes written comments and suggestions including mail, e-mail and faxes unless the writer requests it not be made public or the licensee feels it should be excluded because of the nature of its content, such as defamation or obscenity. Common sense also would exclude comments from people whose items could cause them embarrassment; for example, threatening or love letters addressed to talent and incoherent or nonsensical rambling letters. Few letter writers are aware their items could be made public via the station's public file, therefore the FCC understands discretion is advisable.

(Continued on page 22)

FCC Focus

Continued from page 21.

INVESTIGATIVE MATERIAL: Rarely will any station have material of this nature. It consists of items having a substantial bearing on a matter which is the subject of an FCC investigation or complaint to the FCC of which the licensee has been advised. Notices of violations from the FCC are typical of what belong here. These are kept until the licensee is notified in writing that the material may be discarded

ISSUES-PROGRAM LISTS: The question generally asked is how many issues are we to cover during a quarter? While not defined, most legal counsels have advised twelve are reasonable. Each issue described should include the following:

- *Issue Description: Example: New Dog Lease Law*
- *Program Segment: Example: Ken's 7:00AM Newscast*
- *Date/Time: Example: 7/4/03 - 7:00AM*
- *Duration: Example: 45 Seconds*
- *Description of Segment: Taped Actuality: Mayor Jones Urges Council to Pass Law*

Issues/ program lists are retained for the term of license. You can find a sample form at: **www.radio-guide.com/pubfile.html**

DONOR LISTS: At commercial stations, this file will contain one of those sheets stating; "This Public File Folder Is Not Applicable To This Station At This Time."

Noncommercial stations should note this list of donors includes only those supporting specific programs. Thus, since most noncommercial stations accept only donations or grants that are not program specific, most such stations list no donors and instead include the "Not Applicable" notice. If some of their donors contribute contingent upon the station carrying a specific program, such a listing is required. Such donor lists are retained for two years.

TIME BROKERAGE AGREEMENTS: This folder contains a copy of any agreement involving time brokerage of the licensee's station or of another station by the licensee. Time Brokerage and Local Marketing agreements are the same and are retained for two years.

LOCAL ANNOUNCEMENTS: These are simply the pre- and post-filing of license application and renewal announcements and are retained until final action is taken on the application to which they refer.

That about sums up the requirements for the entire Public File. Following these tips will likely get you though an inspection without any problems. Of course, please remember the preceding is a good faith set of suggestions based upon the author's 43 years experience in broadcasting, and includes suggestions from past experience with FCC professionals, legal counsels and experienced colleagues. It is not to be construed as professional legal advice.

A special note of appreciation to staffer, Ron Ramage – of the Kansas City FCC Office – whose extraordinary professional dedication has long been an inspiration for the rest of us.

Next time, we will visit a typical studio and transmitter site, and offer some comments on what should, and what should not, be found in those locations.

As a parting note, many folks were glad to learn the FCC recently released information regarding any violations that might be noted during a voluntary inspection and corrected. The FCC stated these are not considered when a station applies for a license renewal. The question on the renewal form relating to violations brought to the attention of the licensee apply only to those from an *actual* FCC inspector, who would issue a NOV (Notice of Violation).

Ken Benner, a retired broadcast engineer, resides in Tucson, Arizona. He continues to perform Alternative FCC Inspection Certifications for hundreds of stations under several state broadcaster association sponsored programs. He can be reached at bennerassociates@aol.com

Public File sample forms & info located at:
www.radio-guide.com/pubfile.html

"Field Notes"

*[It sure is gratifying to hear from those of you who enjoy **Radio Guide**. Your comments are always welcome, as well as suggestions for future articles and topics. What do you need to know? Please let us know at editor@radio-guide.com Ed.]*

From: Margaret Bryant, Dallas, TX

I just got my latest issue. I have to tell you that you guys have a great little newspaper here. I always thought it had grown into a useful newspaper, but since you arrived Barry, it's the greatest! It's the one trade I always look forward to reading. Tell your advertisers I am one of, I'm sure, many devoted fans. And [our company] is usually good for several hundred thousands of dollars a year in capital expenditures! And we're reading their ads! Of course the editorial content can't be beat!

Keep up the great work!

From: Dave Kobe, Harris Corp, Quincy, IL

I have been a long time subscriber to Radio Guide. It really is an excellent publication. The articles on Networking are great! Tren Barnett is doing a tremendous job of explaining Networking for broadcasters.

I have a request. I have lost my Feb & Mar issues (after reading the issues I leave them out for fellow staffers). I believe these contained Parts 1 and 2 of Networking 101. Is there any way of obtaining those 2 articles? It would be greatly appreciated.

Thank you for your help.

[RG replies: Thanks for the kind words, Dave. The requested articles are on their way! Ed.]

From: Maynard Meyer, GM - KLQP-FM, Madison-Dawson, MN

I enjoyed [Paul Brown's] article in Radio Guide. I once owned an IGM automation with the noisy Scully machines and a couple of 48-tray Instacarts. I also worked with carousels and a Sono Mag system at another station. The station we put on the air 20 years ago here in Madison, Minnesota (pop 1,767) is dependent on a Smartcaster.

How times change! I didn't think much of automation when I started as an announcer many years ago ... but as an owner/manager I love it now!!

From: Frank Pingree, WJSK Radio

Great story – History by the Bay. I enjoyed it immensely. The front cover is a treasure. I think I'll cut it out and frame it.

Have you considered stories on the synchronized stations of old? Here in New England many years ago WBZ-1030 kHz Boston (50kW) was synced with WBZA (1kW) in Springfield (MA) about 100 miles west of Boston. Also in MA was WLLH in Lowell synced w/a transmitter in Lawrence. (1kW each) I don't believe they operate synced anymore. I'm sure there are many stories on the methods used to sync the sites.

Also found Donna Halper's article on automation systems very helpful, as I am conducting a search for programming software. I look forward to Radio Guide's arrival every month. Keep up the good work.

[RG replies: We're glad you enjoyed the articles. And thanks very much for the suggestion! Ed.]

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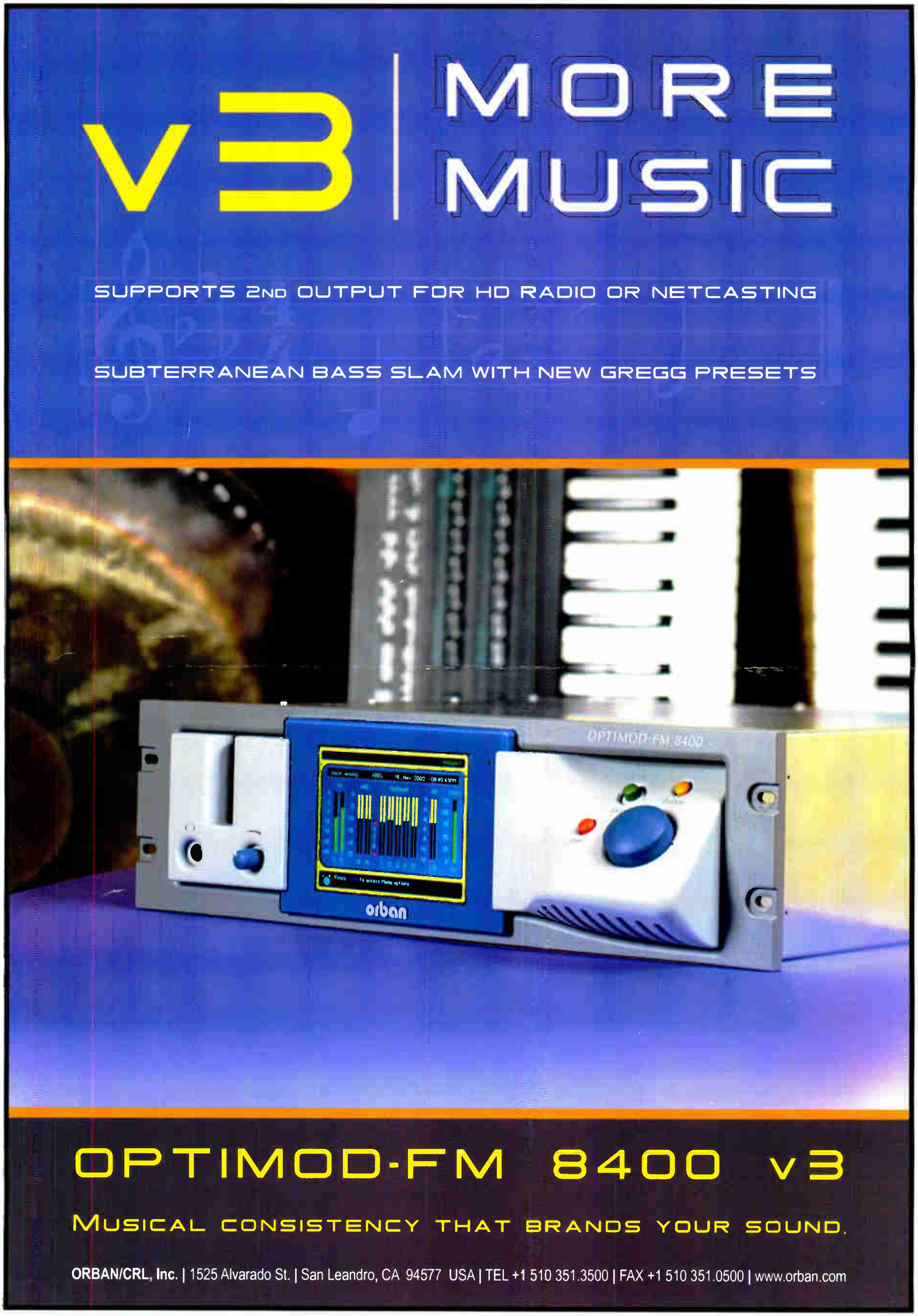

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