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April 1999
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- Streaming Audio
- The Web for Profit
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- Digital Exciters
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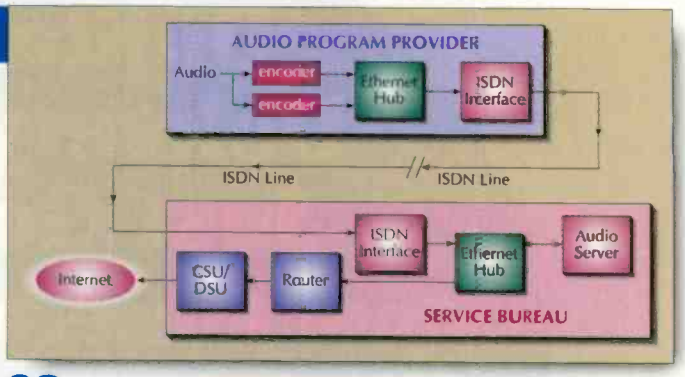
Contents

BE Radio
www.beradio.com
April 1999
Volume 5, Number 4

FEATURES



08

12

DEPARTMENTS

62

CURRENTS

ONLINE AT WWW.BERADIO.COM

RADIO SOUND NETWORK Online

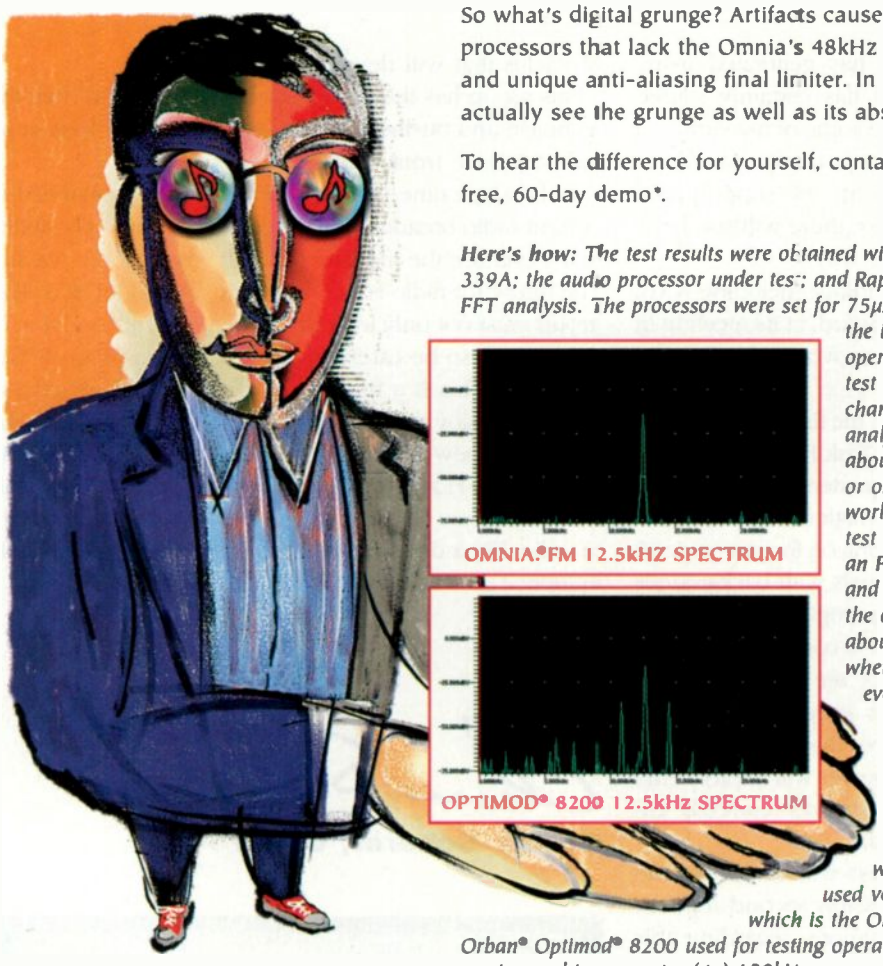
ON THE COVER: Since its inception, radio has undergone many transitions. Perhaps the most substantial and lasting change will prove to be the move to webcasting. Cover design by Michael J. Knust.

LISTEN

When you hear the Omnia®.fm, you'll know why broadcasters the world over choose it: Sound that's as smooth and fluid as analog, with absolutely none of the digital grunge you hear in other digital processors.

So what's digital grunge? Artifacts caused by aliasing distortion in yesterday's processors that lack the Omnia's 48kHz sampling, 192kHz virtual upsampling and unique anti-aliasing final limiter. In the FFT analyses shown below, you can actually see the grunge as well as its absence in the Omnia.

To hear the difference for yourself, contact your Omnia dealer and get your risk-free, 60-day demo*.



OMNIA.®FM 12.5kHZ SPECTRUM

OPTIMOD® 8200 12.5kHz SPECTRUM

Here's how: *The test results were obtained with a Hewlett-Packard Audio Test Set, Model 339A; the audio processor under test; and Rapid Systems R1200 Data Acquisition System for FFT analysis. The processors were set for 75µs pre-emphasis, and were carefully adjusted so the input levels were within the normal range of operation. The unit under test was fed a 12.5kHz test tone using the analog inputs. The discrete left channel analog output was connected to the FFT analyzer input. That's it. No tricks, no disclaimers about the test working only in our trade show booth or only in our lab, under the most arcane, non-real-world test conditions. In fact, you can duplicate the test results yourself in your own shop. Don't have an FFT analyzer? No problem. Just use an oscillator and your ears–you can clearly hear the birdies in the old processor! But this isn't about test tones; it's about music. And Fourier theory says that music–whether it's rap, oldies, urban, country, and yes, even grunge–is represented as a combination of sine waves. Imagine what this kind of aliasing distortion can do to complex musical signals!*

Here's why: *The Omnia.fm utilizes 48kHz sampling for dynamics processing and virtual upsampling at 192kHz for the final limiter, which is a unique, anti-aliasing design. The test used version 1.02 software and the 'Cranked' preset, which is the Omnia's most aggressive stock setting. The Orban® Optimod® 8200 used for testing operates at 32kHz sampling for the dynamics processing and incorporates (4x) 128kHz upsampling for the clipping/low-pass filtering function. The test used version 3.0 software and the 'Urban/Rap-Dense' preset, which is the Optimod's most aggressive stock setting. Aliasing will occur with input signals above 5kHz in 32kHz FM broadcast audio processors unless mechanisms that cause aliasing are eliminated.*

For a complete technical report, call us for a copy of our paper entitled "Omnia.fm: An Engineering Study." Or visit our web site at: www.nogrunge.com.

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To the future

The recent LPFM NPRM stir has generated many NPRM reply comments and has certainly started many conversations. I offered some of my views on this topic last month. This NPRM is just one example of a proposed change that has plenty of support and opposition. As this business evolves, there will surely be more proposed changes along the way.

Many groups file comments to NPRMs, including NAB, SBE and group owners. The NAB Board, at its meeting in January, formed a new committee to work with the FCC to improve radio broadcasting.

In mid-March, the first meeting of the Radio Integrity Task Force was held at the NAB headquarters. Bruce Reese of Bonneville International chairs the task force. Also serving on the group are 15 radio professionals with backgrounds in management, engineering and programming. (For a complete list of the group members, see Currents, p. 90.) The goal of this assembly is to ensure that new services the FCC creates will not harm, but rather will improve, the quality of radio service currently enjoyed by the public — a noble goal.

I'm sure the first order of business will be LPFM. The proposal suggests that third and possibly second adjacent limitations can be lifted. The opinions regarding this portion of the proposal are varied. One shortcoming is that it applies to the current analog system we use. With so much effort going into IBOC research and testing, changes such as these may further retard the progress of DAB in the U.S. Just as one phase of testing is completed, the rules could change, and half of the data gathered may be worthless. There reply-comment deadline has already been extended so that additional research can be done.

There have been other FCC efforts that also fit into the group's charter, whether they concern the AM and FM bands directly or affect auxiliary services, like the Little LEOs in the 455MHz band and some of the application streamlining procedures.

The formation of this technology watchdog is good in that it is a body *of* broadcasters working *for* broadcasters. With all the attention being given to DTV, it is encouraging that the NAB is still looking after the well being of radio, and I applaud the effort. The work of this task force may help prevent IBOC from becoming a debacle like AM stereo and may also watch out for other potential obstacles that will develop in the future.

This group has the background to understand both the technical and business aspects of radio. It can look at an industry issue from all sides.

At the same time, because this group is so attached to current radio broadcasting, there is always the possibility that it will see the industry through rose-colored glasses. The future for radio is still unknown and undecided. This group must not only look out for the current condition of radio, but also be careful not to impede its progress and evolution. This is a fine line to navigate. It is easy to sit back and enjoy the surroundings, ignoring or dismissing something new because it may threaten the near-future profitability. However, I don't think the group will do this.

The members of this committee carry substantial weight in radio. Their decisions and recommendations will likely influence the FCC and possibly other groups.

Chriss Scherer, editor

On the road:

Chriss will be presenting at the Broadcast Engineering conference at NAB99 with the Ennes/SBE sessions.

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Streaming audio primer

By Chriss Scherer, editor

Radio is an aural medium. Well-produced commercials, promos and radio plays can paint a mental picture for the listener. Live music can transport the listener to the concert hall. Whether you use the Web as a source of entertainment or information, you have no doubt at some time listened to a streamed audio file.

Going online

To send an uncompressed audio file of any significant length, a three-minute song for instance, will take several minutes before it downloads, stores and then begins playing. If you don't like the song, you have just wasted considerable time. By streaming the audio file, you can begin playing it before the entire file is sent.

These long downloading times prompted the development of streaming audio technologies on the Internet. In a streaming audio system, the audio is played back as the data is received by the client. The user does not have to wait for an entire audio file to download before playback can begin. RealAudio was one of the first streaming audio systems available. Other companies, such as Xing Technology, Macromedia and Telos, have also developed streaming systems. Each has its own codec and client-sever interaction protocols.

Streaming audio provides audio playback almost instantly at many levels of quality. Since Internet users can be connected at rates from as low as 14.4kb/s to full T1 speeds, the quality of the audio stream can be adjusted to fit into the available bandwidth. Figure 1 shows the basic hardware configuration for a streaming audio server.

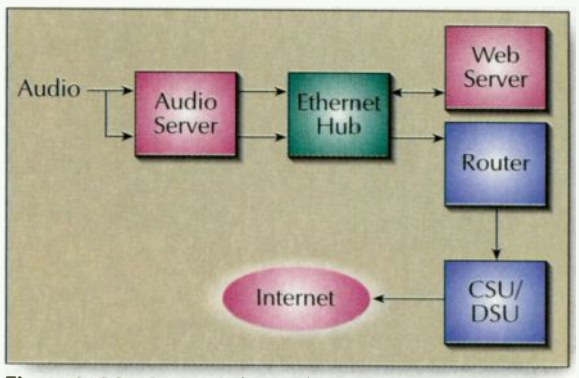


Figure 1. A basic streaming audio hardware configuration.

Because of the disparity in connections, some streaming audio sites will make several different streams available to online listeners, using different sampling rates or variations in the coding algorithm to vary the required bit rates. For some content, such as talk radio, the artifacts of data reduction are not as objectionable, since the audio frequency range can be reduced to 7kHz to 10kHz. For music streaming, anything less than full 20kHz bandwidth will be noticeable. The fastest connections will deliver the highest quality of full-frequency audio.

To actually stream a file, the initial data that the client receives is placed into a buffer area. After this buffer stores a certain amount of data, the older data (the beginning of the sound file) begins to play back. At the same time, additional data is being received and stored for later playback. The level of data in the buffer may vary, but there is always enough in reserve to play back the sound without interruption.

Depending upon the connection speed and the size of the file, there may be a delay before streaming begins, because streaming won't begin until the computer detects that there is enough data stored to play the stream without interruption.

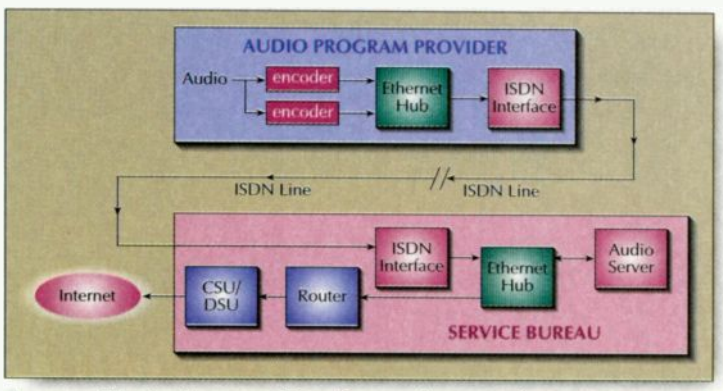
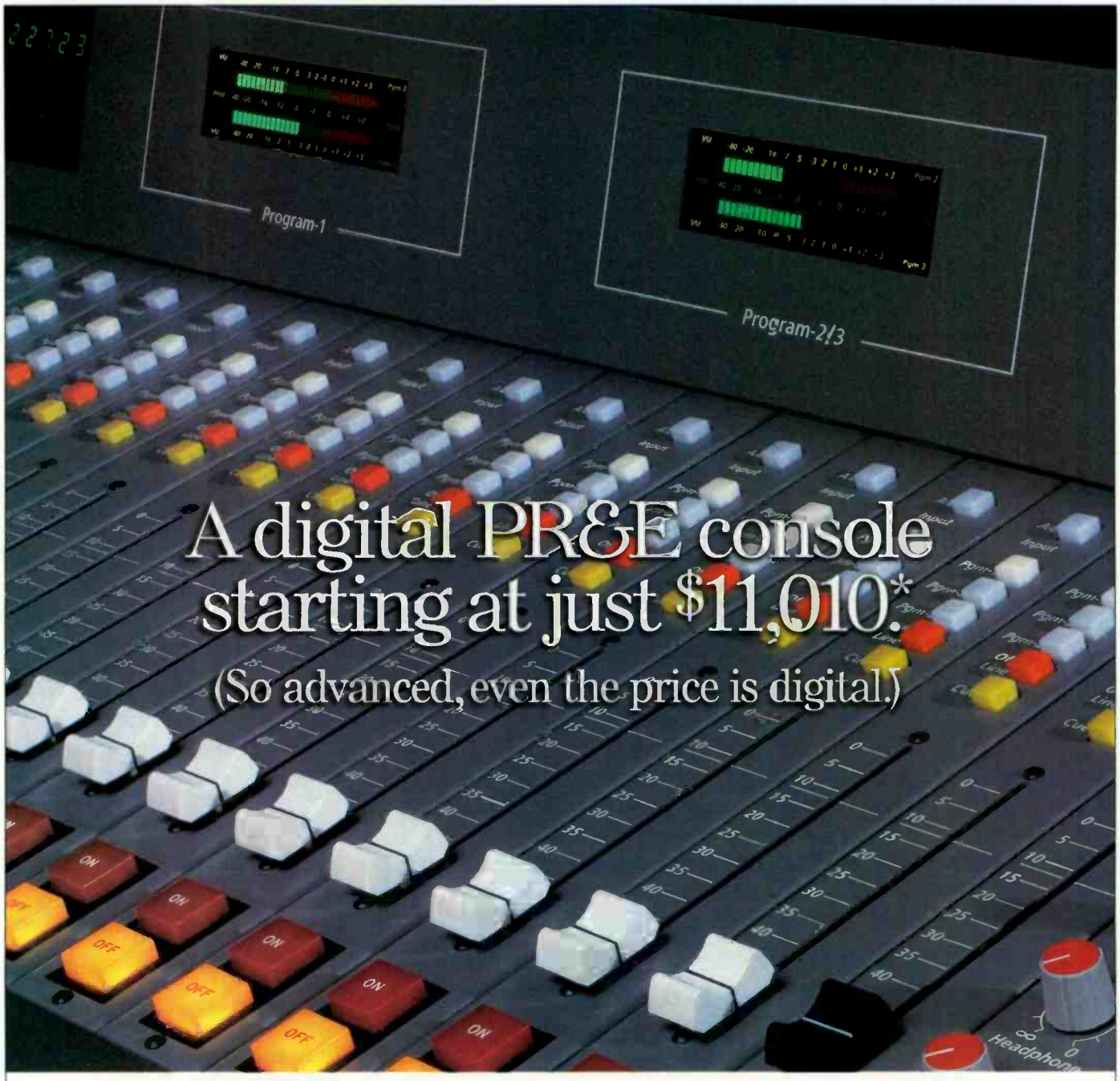


Figure 2. The hardware configuration to stream audio with a dedicated audio path from the audio provider to the service provider.

Convergence

Faster connection speeds are being made available to the public constantly, fueled by price reductions in technology or availability of enhanced services. Add to this the improvements being made in audio codecs. We have recently seen the availability of newer versions of streaming audio encoders, players and formats that rival true CD-quality sound.

Although the RealAudio format has been around for some time, the MPEG Layer 3 format has also become popular. These files, carrying an MP3 extension, are also causing some headaches for the record companies as bootleg recordings make their way around the Internet.



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Hardware configurations

Streaming audio requires a server, like any other online content. Audio is converted to the streaming format and either stored for on-call retrieval or buffered and transmitted for real-time listening, as is the case for a live concert or radio show. In some ways this is just like an over-the-air system, but instead of a transmitter tied to an antenna, you have a server tied to the Internet.

Getting audio to the server can be done in many different ways. If the server is located in the same building as the station, connection is easy. Simply run a wire. If the server is located elsewhere, it may be necessary to send the audio via a leased line or possibly *Intracity link* (ICL). For applications that only stream occasionally, an ISDN circuit can also be used (see Figure 2). Another possibility is to send the audio via the Internet itself, as is shown in Figure 3. A dedicated path is obviously more robust, but it may not be feasible for some stations.

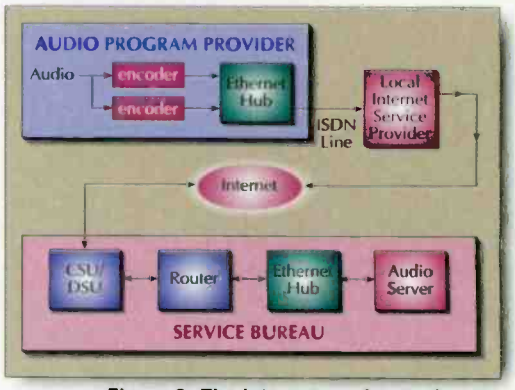

Figure 3. The Internet can be used as the link between the audio provider and the service provider.

On the receiving end, a listener's machine will need the proper decoder, typically called a player, installed. In most cases these are software decoders, but they could also be separate hardware-based decoders. Basic versions of most popular audio players are available for free from the technology developer. Many of these companies also offer players for purchase that have additional features and functions.

The next step

With standard IP datastreams, each client calls the server for the desired information. There is a unique signal path created for each requester. A single copy of that data is sent out to each requester as well. This system of *IP unicast* is fine for text, graphics and very small media files.

IP multicast opens the way to many simultaneous users. Instead of a single stream being sent to a single client, a single stream is sent to a router that then replicates the stream as needed. As more requests are made to the router, more copies are created. For IP multicast to function, every step along the way — every router, switch and hub — must be IP multicast capable. For some additional information on IP multicast, see Next Wave, p. 24 in the February 1998 issue of *BE Radio*.

Diagram concepts courtesy of Telos.

Voice Over America

With today's ISDN linkups, you can easily produce voice-overs from anywhere in the world – even from the comfort of your own home studio. Think about it...the spot you cut this afternoon could be uplinked by satellite this evening for global broadcast. Now that you know who's listening, shouldn't you insist on a microphone that will let you sound as good as you are?
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The Web for profit

By John Caracciolo

A short time ago, all that was needed to convert a radio station to digital was a new CD player; a Class A FM station was only 3000W; the only real computers in the radio station were in the business office; and the Internet was an information BBS that engineers would only occasionally mention in passing. Then, seemingly overnight, the Internet became part of our daily lives. We began using words like Web, Net, dot-com and homepage.

The World Wide Web is growing so ferociously that it is devouring everyone and everything in its path. The few individuals who used to say, "I'm not into computers or the Net," have been forced to either get onboard or be eaten alive.

In 1998, 966 radio stations added audio on the Internet. Country is the number-one format on the Web, with a total of 94 stations. News, talk and sports formats combined account for 153 stations, or 19 percent of all commercial webcasters.

Get an intern

When the Web first appeared, Jarad Broadcasting, like most radio stations around the country, quickly got onboard for promotional and imaging reasons. Like most other stations, we assigned the task of creating our homepage to a computer savvy intern and our promotions department. We thought pictures of our DJs, a copy of our promotional calendar and our current playlist would be great novelties. But the novelty quickly wore off. Updating the site became a full-time job. The information on our site quickly became outdated — our online concert schedule lagged a month behind. Furthermore, the competition's site blew ours away.

We had to turn this novelty into a revenue-generating department contained within our station infrastructure. However, doing so was not that easy. The cost of consolidation has created unbearable revenue pressure for radio stations. More and more stations caught in the consolidation revenue crunch have fallen into the trap of increasing their spot loads or raising their rates as quick, easy fixes. Unfortunately, these measures are not long-term solutions. With the dual concerns of fixing our website and constantly striving to increase revenue, we knew it was necessary to turn the Internet into a nontraditional source of income.

Webcasting can be lucrative, but turning your site into a sucessful marketing tool will require time and effort.

A case study

Jarad Broadcastings radio properties — WLIR-FM, WDRE-FM and WXXP-FM — are young, aggressive, street-level radio stations that target listeners from 18 to 34 years of age. Arbitron's Scarborough Data determined that this was the age bracket of the Internet user. We felt the radio stations had a large opportunity to use the Internet to generate sales programs tied into each station. We had the research we needed to go to our local advertisers and show them the integration between radio and the Web, and how webcasting could generate sales. Radio and the Internet are the only two mediums that have this formidable bond: You can't read the newspaper and surf the Net; you can't read a magazine or watch television while you surf. But you can listen to the radio while you browse.

We felt the Web gave us the answer to all of the objections we had gotten from advertisers when they compared WLIR-FM, WDRE-FM or WXXP-FM with newspaper advertising. This comparison proved that the stations could support the product: They can deliver added information or they can coupon; they can offer advertisers added value on the Net by offering listeners the opportunity to go to our website to obtain more information on an advertiser's product.

Once we had the vehicle, we needed the department and staff to implement our plan. In 1995, we created Jarad Syndication and the Web Radio Network. We wanted to

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find a unique way to introduce the Internet to our current radio advertisers. We felt the best way to implement this plan were to create a 60-second commercial feature to run on all of our stations to promote the Internet and to create a sponsorship opportunity for local clients as well as nationally based advertisers. The sponsorship opportunities would include adjacent spot placement to the radio feature as well as webpage placement. If the program worked well locally, our plan was to syndicate the feature free of charge to other radio stations through our newly formed syndication company. Thus, the Techno-File was born.

How it works

The Techno-File is a daily, 60-second feature that informs listeners about the new media revolution, the Internet. The spot is hosted by a 10-year Internet veteran who reports on computers, websites, software and telecommunications in a fun and informative way. This feature is produced by the staff of WLIR-FM and Jarad Syndication. The commentary is personality-driven and includes interviews with industry executives, editors and computer professionals. Each day this 60-second feature runs on all three of our stations with a national sponsor and is followed by a local 60-second commercial. We created a website for each station and a Techno-File page (www.lazlow.com — named after the host). The package includes a small amount of radio inventory and banner ads on the webpages.

The Techno-File and the webpage sponsorship are a targeted advertising package. The client knows that the listeners and (obviously) Net surfers are computer users. The ads can effectively target these listeners/surfers and not waste ad dollars.

We also came up with added-value promotions for each advertiser. Clients can hotlink the station's webpage to their site. Client product giveaway promotions and special sale prices can be made available to users or browsers. Also, traffic can be driven to the site through the radio on-air promotion. It is a tidy package that takes the fear out of Internet advertising for those who are familiar and comfortable with radio advertising, and it provides a good way to train account executives to sell a new product. Instead of pitching a new medium, we pitch a *companion* medium.

Increased bottom line

So far, the results have been fantastic. With such great results locally, we took the package to the next level. Jarad Syndication began offering the Techno-File program to

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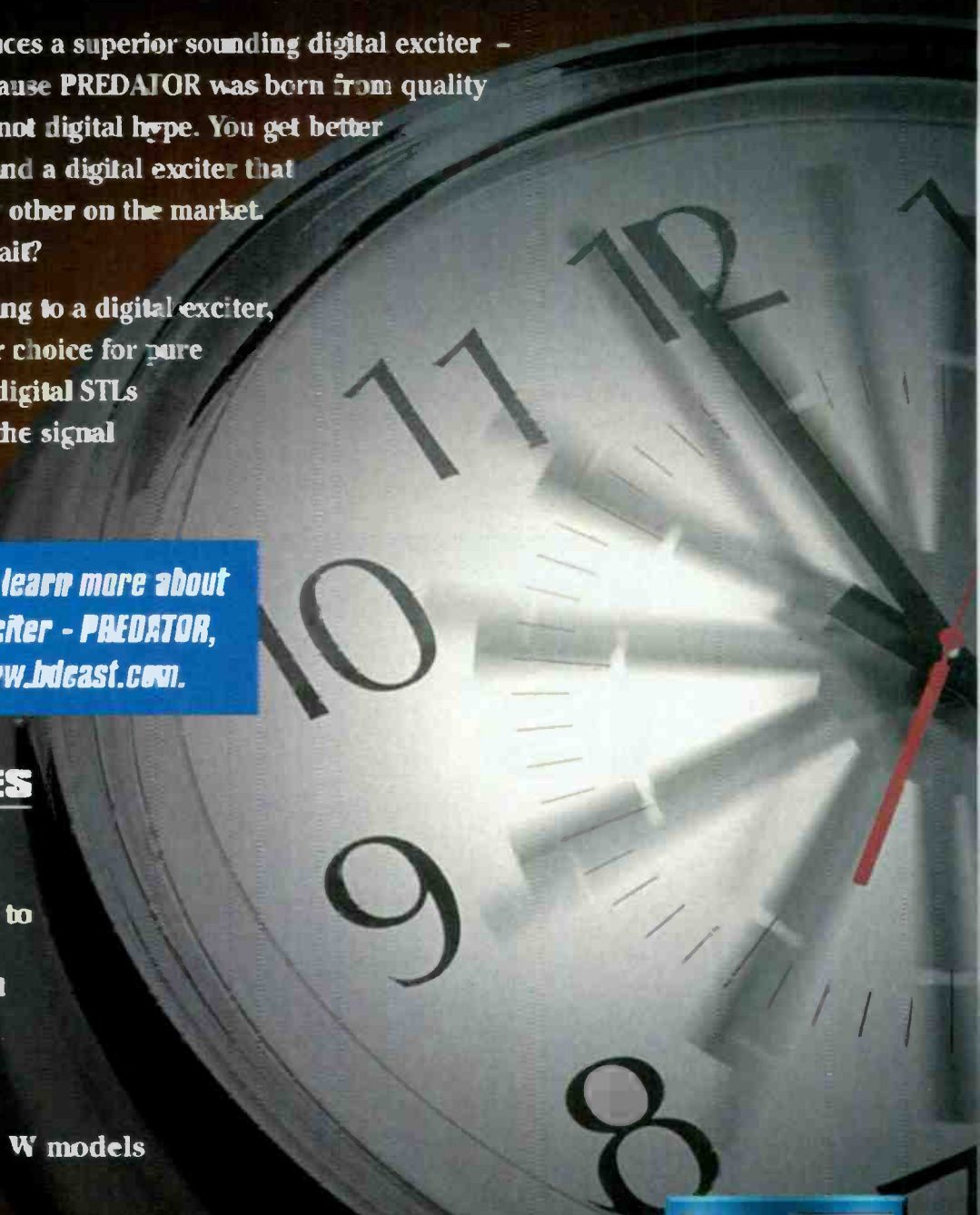

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stations outside the market — for free. Since its inception four years ago, the Techno-File has grown. It is heard on 98 stations throughout the U.S. Radio can finally achieve what print has done for so long.

This combination has enabled us to charge advertisers based upon the response to their ads. We have a new medium to provide our clients ways to integrate with our listeners and more ways to increase the bottom line of our radio properties. If you have 10 advertisers a week at $500 for a banner ad on the station homepage, and one sponsorship of the program per day for a week, you will increase your annual bottom line by $260,000. As the medium's popularity increases, you'll reap a much bigger return, and you'll never touch your commercial load because the sponsorship can be a five 10 to 15 second intro or outro to the feature.

It does not cost much for a station to implement a package like this if it already has a website. The salespeople can add it to their list of features they sell every day, and they'll get buys that they were unable to get in the past. Computer stores, audio/video stores, record stores, Internet providers, colleges and schools are just a few of the sponsor categories attracted to an Internet package.

It's your turn

Turning the station's Web presence into something more than a novelty is not difficult. Use the Internet to supplement what you already have. Radio has firmly established itself as a provider of content. Use this to your advantage to make your website an asset and not a financial drain. Look for other ways to tie your existing product into this new revenue partner.

Let's face it, the Web and webcasting will never fully replace conventional radio. AM/FM offers much more appeal to the average person. The radio is just too convenient and easy to turn on. Web browsing and webcasting require a computer and Internet connectivity. Both mediums can survive and even prosper together.

John Caracciolo is vice president and general manager of Jarad Broadcasting WLIR-FM, WDRE-FM, and WXXP-FM, Garden City, NY. For information on the Techno-File, call 516-222-1466.

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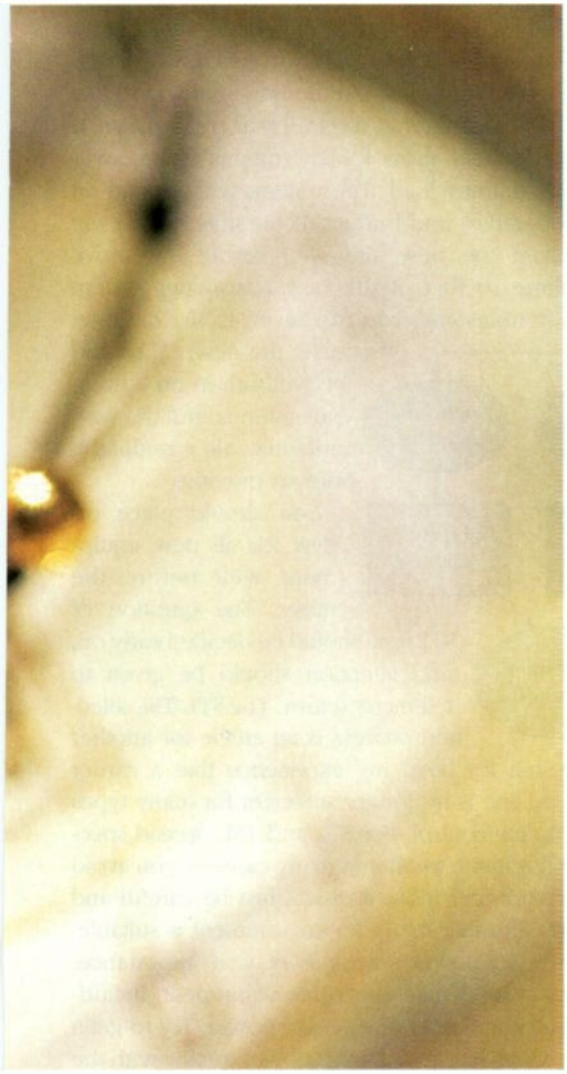

The technology is so reliable you can set your clock by the Harris DX transmitter line with power ranges from 10kW to 2MW that have 110% sine wave modulation, hour after hour.

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Moving your transmitter site

John Battison, P.E., technical editor, RF

When the word comes from on high that the transmitter must be moved, the whole load falls on the chief engineer. Presumably, the engineer has worked with the consulting engineer during the preparation of Form 301 (Form 340 for noncommercial stations) and knows where the new site is — in fact, he probably found it. So now the physical job of getting the new site on the air must be undertaken, which can be tricky.

The worst case is when there is a definite cutoff date for clearing the old site. In this case, you'll have to work back from that date in your planning. Perhaps the situation may arise when an old, valuable downtown site has been sold for a new mall, or perhaps *eminent domain* has condemned the site so that a friend of a local politician can build on it. In either case, the first step is to prepare a list of jobs to be done.

Getting started

The first item on the list should be finding out whether management has done any work you're not aware of toward obtaining the necessary building permits. The specifics of permits differs in almost every case. In many parts of the country, it is necessary to file for county zoning and even state airspace approval. In most cases, FAA approval will take care of state requirements, but sometimes filings are needed to meet state self-importance.

Once the site has been selected, management and the consulting engineer should confirm that approval *will be* given for tower construction. Don't take this step for granted. Many a chief engineer has happily commenced construction only to find that the essential permits were not obtained. This permit concern also extends to the type of building to be constructed. A cement block building that will simply house the transmitter and other equipment, with a convenient tree outside, will usually require a permit that is easier to obtain than will a building that houses a staff and requires a well and sewage system.

Take the time necessary to get this paperwork taken care of up front and avoid wasted time and energy later. Figure 1 outlines the entire transition process.

Leave enough room in the new building to use the old transmitter as a standby after the move. If possible, also allow for an antenna changeover switch and dummy load. These items will depend on your operation and budget. If possible, go on the air from the new site well before the move deadline so that, if the new transmitter system proves troublesome, you can revert to the old one. Of course, the new TX should be well run-in on a dummy antenna and the new antenna, after midnight, prior to moving.

You should place orders for all new equipment well before the move. The question of STL type should be decided early on, and attention should be given to telemetry return. The STL/TSL selection process is an article for another time, but it's been my experience that a carrier phone line is no longer sufficient for many types of remote control. For STL and TSL, spread spectrum has much to offer in many cases — you avoid paperwork and more licenses. Just be careful and make sure that the radio environment is suitable.

Your AC power source is of vital importance. Today's solid-state electronic equipment, including transmitters, requires *clean* power. Try to get a single user line and discuss power quality with the power company's engineering staff. Ask for a supply that can come from two different sources to reduce the chance of complete cutoff.

Never accept a line that has heavy pumping or nonconstant loads on it. I once had what I thought was a beautiful line with only our TV transmitter on it and another plant 20 miles away. However, after we got on the air, I found that the plant was a helium compressor, and it had a two-cycle load that changed the line input voltage by 5 percent every half second. You could watch the voltmeter swing.

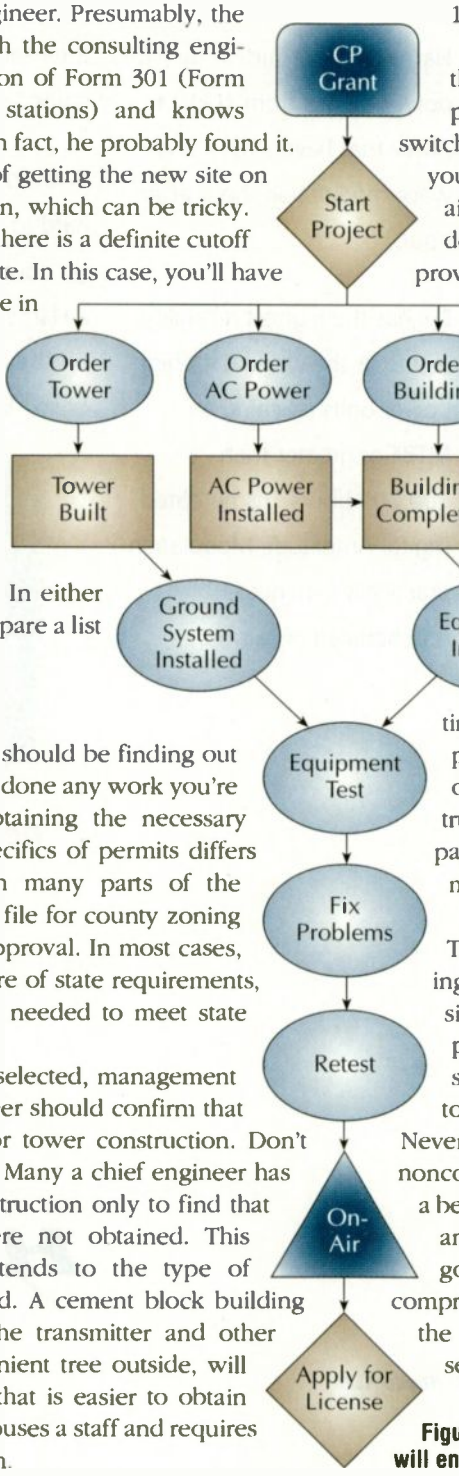

Figure 1. A basic flow chart, like this one for an AM station, will ensure a smooth project without unforeseen omissions.

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RF Engineering

If you are going to have an emergency generator, make a careful choice between diesel, gasoline, bottled gas or natural gas. A gas line is the best bet. Gas lines rarely go down in a storm. Sometimes local zoning and environmental law as well as factors like fuel storage limits can affect the choice of propulsion.

Solid ground

If you are moving an FM transmitter, your new tower *must* be properly grounded. A few copper ground rods won't do the job. Try for a ground system that has a low resistance and is adequate for the local weather. With dry, sandy soil, consider chemical grounds. Even with a chemical ground, consider a small ground system similar to that for an AM transmitter. Use 4-inch copper strap for all ground connections inside and outside the transmitter building.

For AM, a 4-inch copper strap should run in the trench to the tower base with the coax, which should be jacketed. The copper strap should be hard-soldered to the ground system. Putting the coax in conduit can be helpful should it have to be replaced in the future, but conduits are expensive. Don't install the ground system until all construction is completed.

As with any project, a transmitter site move should be planned as thoroughly as possible. Simple items like an ice bridge are common oversights.

A nondirectional AM antenna often has an ATU cabinet mounted on metal legs in the open air at the base of the tower. I recommend spending a few dollars to build a small doghouse. In the depth of winter, after midnight, you will appreciate it. Also, run AC power and the capability for a telephone line out to the doghouse. I often use a multipair cable.

Ice shields should be installed on the building and on the line to the tower if the budget allows, especially if the transmitter is located close to the tower base.

All phone, power and other lines should come in underground. The power transformer may or may not be paid for by your company. In some cases it is good to own — if you own it you can keep other users from deteriorating your supply. But from the transformer to the "shack," keep the line underground.

E-mail John at: batcom@bright.net.

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The Broadcast Wave Format

By Kevin McNamara, CNE

The lack of a standardized digital format that would enable the seamless transfer of digital audio between a variety of broadcast environments and/or the equipment of various manufacturers has been a pet peeve for many engineers. Unless you end up selecting all of your digital audio equipment from a common manufacturer, you can assume that the native audio formats will be incompatible. Of course, many of these companies now provide a method to import and export a common digital format, typically the WAVE (.wav) file. There are two problems with this method:

1) The process of exporting/importing requires an additional and unnecessary step; and 2) the WAVE format was not created to handle the additional information broadcast application require. A standard known as the *open media framework,* or OMF, has been created to handle the problem for radio and TV facilities that need to move files between different platforms. However, the OMF has seen little use in radio at this point.

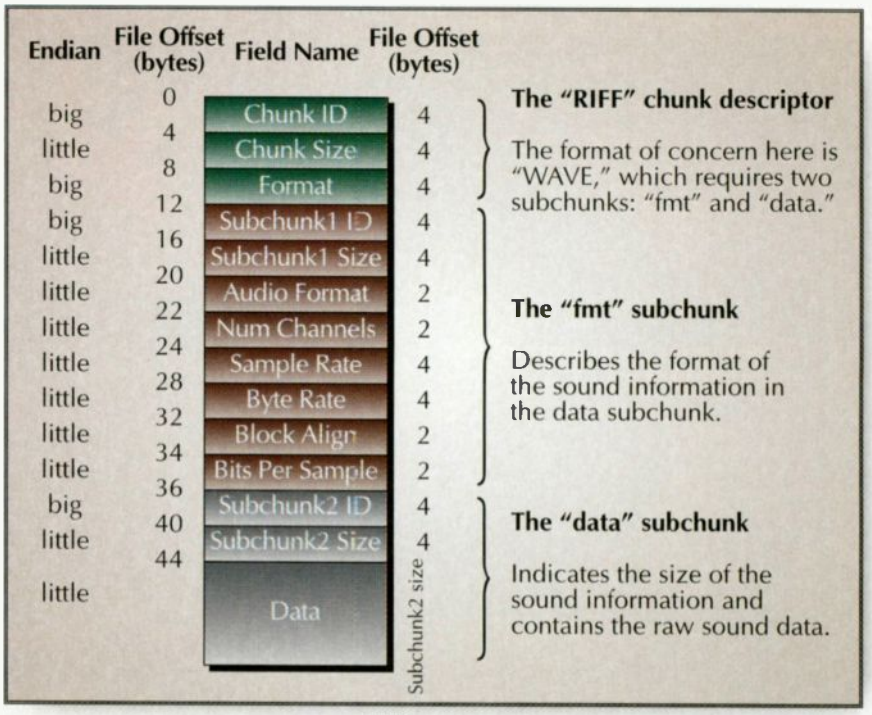
The European Broadcast Union (EBU), faced with a similar dilemma, recently moved to create a standardized, broadcast-specific audio exchange format based on the existing .wav specification, called the *Broadcast Wave Format,* or BWF. Presently, the EBU, along with the AES and several manufacturers, is working on a final version of this specification.

History of the WAVE file

Microsoft defines the waveform data file in the *Resource Interchange File Format,* or RIFF, as a means of storing digital audio files. WAVE files can support *pulse code modulated* (PCM) uncompressed audio or other compressed encoding schemes (e.g., MPEG, ADPCM or G.721). The RIFF does not specify any new methods of storing data. Rather, it defines a structured framework that may contain other existing data formats. These formats are typically related, but not limited, to the storage and delivery of digital multimedia files. Examples of existing file formats that are stored within the RIFF framework include audio-visual interleaved data (.avi), MIDI information (.rmi), animated cursor (.ani) and waveform data (.wav).

The RIFF structure

Technically, the RIFF is a binary file format containing multiple nested data structures. Each of the data structures within a RIFF file is called a *chunk.* Each chunk can define specific information about the datastream, such as its structure or the actual contents, or it could possibly contain another chunk called a *subchunk.*



The data string of the canonical WAVE format can be broken down into its various components.

A RIFF file starts out with a single file header, or *form-type,* that describes the overall file contents. A WAVE file is generally a RIFF file with a single WAVE chunk comprised of two subchunks: the *fmt chunk,* which describes the sample rate, sample width, etc., and the *data chunk,* which contains the actual data. Although not required, other chunks can be used that define other items, such as the author's name or copyright date.

RIFF can also use several other types of chunks specifically designed for the storage of other types of multimedia specific data, such as video or animation.

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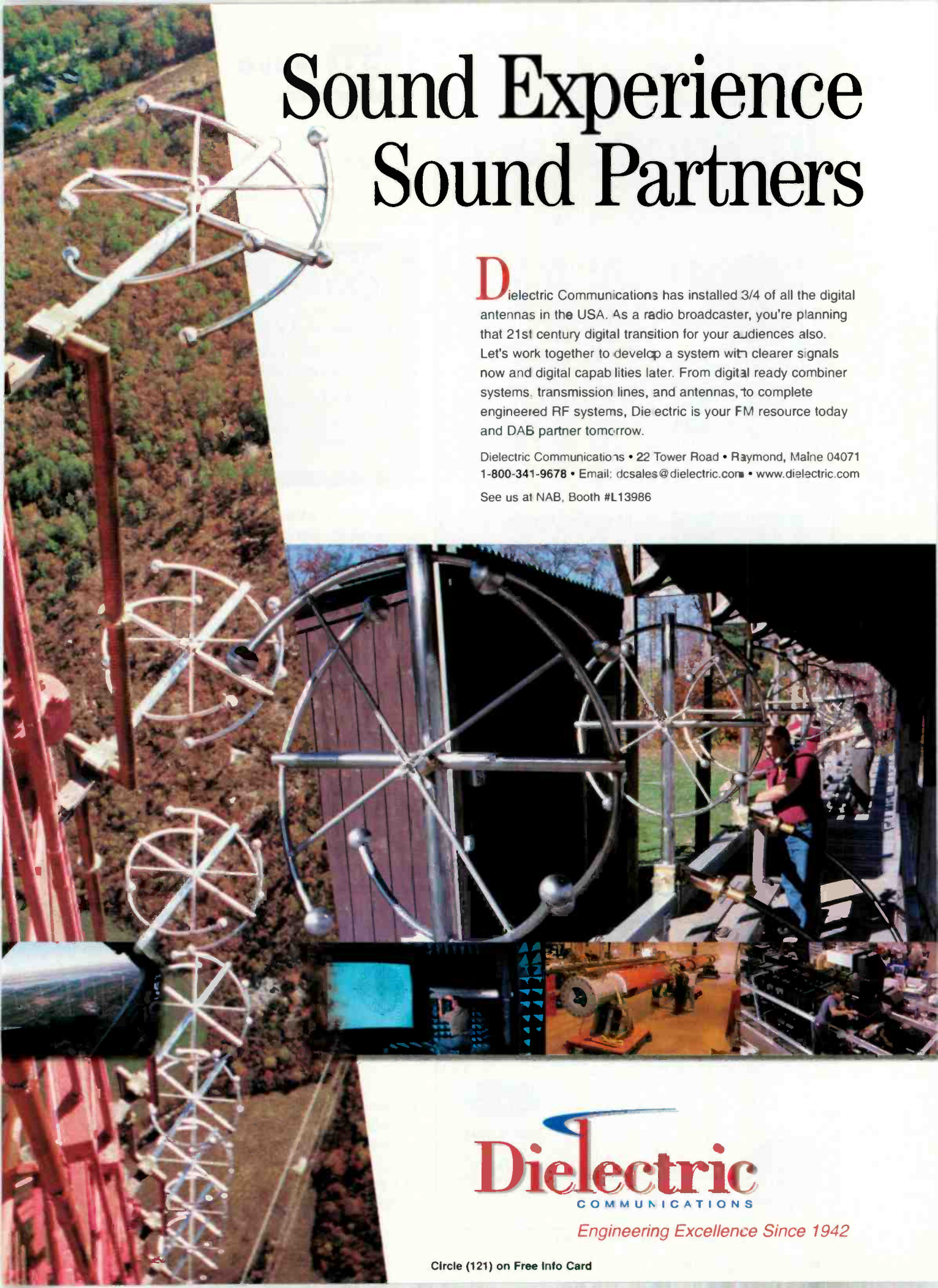

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Next Wave

Broadcast needs

The BWF is intended to work entirely within the framework of the existing RIFF/WAVE formats. It does this by applying some restrictions to the original WAVE format and adding additional chunks that are used to provide specific information required in professional audio production environments.

Online resources

General BWF information
EBU Broadcast Wave Format site
www.ebu.ch/pmc_bwf.html

BWF decoder and sample files
Swedish Radio
www.sr.se/utveckling/tu/bwf

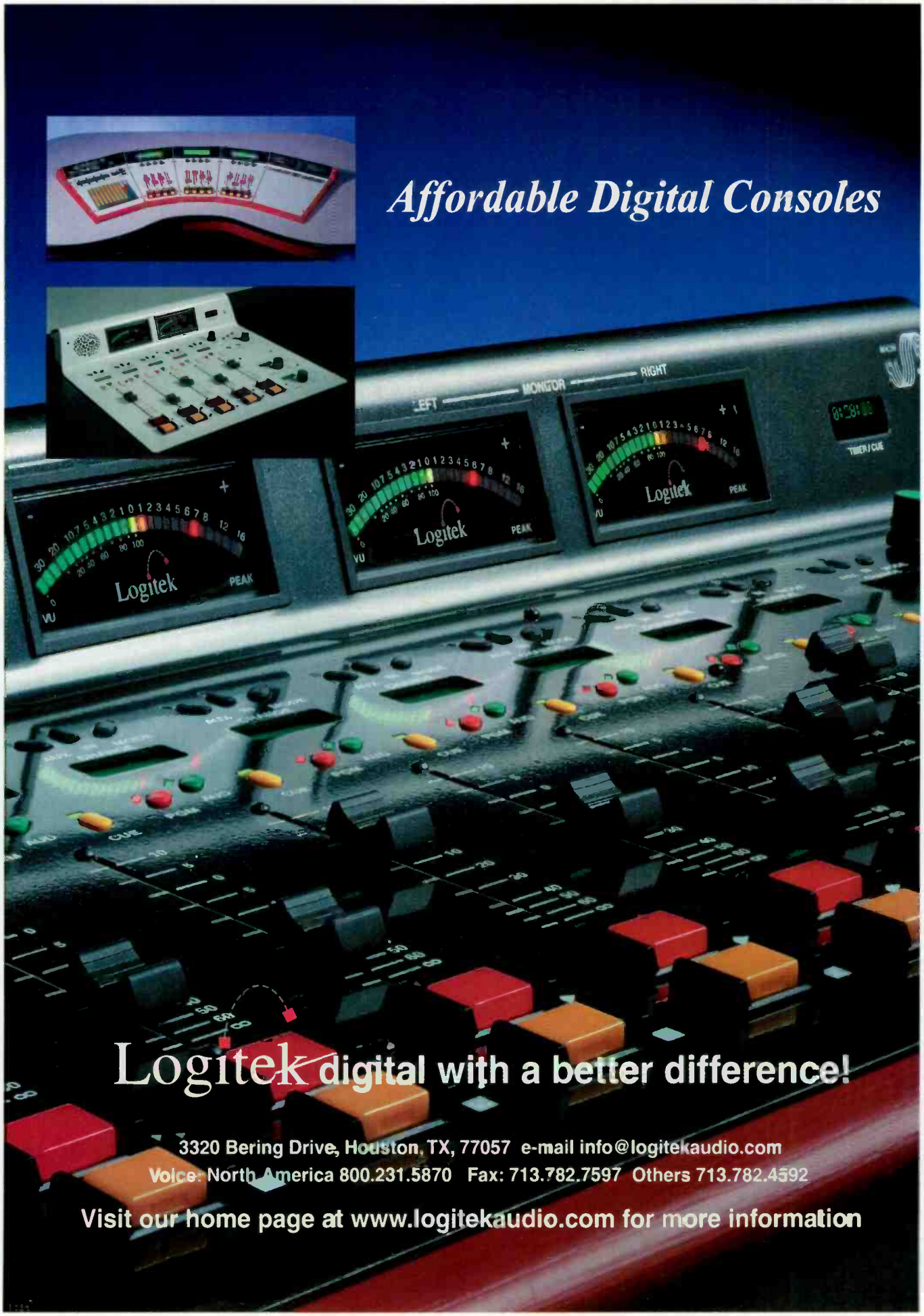
The primary addition is the *broadcast Audio Extension chunk*, which contains information used in all professional audio productions applications, such as the following:

- *Description*. Description of the sequence
- *Originator*. Name of the originator of the file
- *Originator organization*. Additional Reference field
- *Origination date*. Date of creation
- *Origination time*. Time of creation
- *Time reference*. Time-code information
- *Version*. Version information
- *Reserved*. Future usage
- *Coding history*. Type of coding used (PCM or MPEG), mono or stereo, sample rates, bit rates, etc.

In the case of MPEG coded data, two additional chucks are used. The *fact chunk* stores information relative to the contents of the WAVE file (e.g., the length of the sampled files). The *MPEG Audio Extension chunk* is used to further define MPEG coding options. The information within this specification includes the following:

- *Sound information*. Homogeneous or nonhomogeneous sound data and related information
- *Frame size*. Used to define frame size when using homogeneous files
- *Ancillary data length*. Sets the available space within a sound file reserved for ancillary data use
- *Ancillary data definition*. Specifies the type of ancillary data.

One advantage of applications designed to read RIFF formats is that they will ignore unrecognized chunks. Manufacturers designing applications that use the BWF can still maintain any information they feel is proprietary within a particular chunk while maintaining a high level of interoperability using other chunks. The ability to add additional chunks has further uses for radio.



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Next Wave

Further development

Audio files used in most on-air playback systems have additional data that is kept with the file including run dates and kill dates. By imbedding this required information into the audio file, the complete audio file can be created on the editing system and then tagged before leaving the editor. The file is then ready for air with another step eliminated.

Several manufacturers are working on this technology. This additional effort will help to further reduce the unnecessary steps that must be taken, further streamlining the production and commercial traffic process.

Kevin McNamara, CNE, BE Radio's consultant on computer technology, is president of EXEgesis Technologies, a consulting firm in New Market, MD. He can be reached at (888) EXE-GESIS or exegesis@unidial.com.

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LPFM spectrum availability program

By Harry Martin

The FCC has made available to the public the spectrum availability analysis program the agency used in its pending LPFM rulemaking to investigate the technical feasibility of developing a new LPFM service. The commission used the program, which is described in Appendix D of its February 3, 1999, low-power radio NPRM to study how many 1000W (LP1000) and 100W (LP100) low-power FM stations could be located in 60 communities of various sizes throughout the U.S. The program identified the frequencies for which LP1000 or LP100 stations could be located in conformance with the distance-separation requirements toward existing FM stations that are proposed in the NPRM.

The program may be used to explore the potential for assignment of LPFM stations throughout the country. According to the commission, the program identifies available frequencies at each grid point (by latitude and longitude) but does not take into account the preclusion of a frequency at one point because of the location of another LPFM station at a nearby grid point on the same or on an adjacent channel. The program also may be used to eliminate grid points that are unavailable because of current site use, zoning or aeronautical restrictions, or environmental considerations.

The Mass Media Bureau will provide interested parties with a diskette containing files that briefly describe the contents of the diskette, provide the source code for the program, and include the executable program and associated data files. It also will be necessary to download the Mass Media Bureau's FM engineering database and TV engineering database, both of which are available at www.fcc.gov/bureaus/mass_media/databases. More information concerning access to the LPFM computer program can be obtained from Jorden Brinn, Audio Services Division, Mass Media Bureau at jbrinn@fcc.gov.

Recent forfeiture actions

During a three-week period ending March 5, the FCC issued the following four forfeiture actions against radio stations for serious rule violations: An $11,000 fine was affirmed against a Tennessee AM station that failed to reduce its power at night as required by its license. The station also failed to maintain a proper public inspection file and did not have a fully functioning EAS system. With regard to the most serious violation — operating at night with its daytime power — the commission rejected the licensee's claims that the incidents were isolated and due to an unavoidable series of events, including use of a part-time employee untrained in powering down the station. The commission reminded the licensee that it had responsibility for assuring compliance with the station's license and the rules.

An Indiana noncommercial educational FM station was fined $11,000 for operating with an antenna constructed at a greater height (53m) than was authorized by the station's construction permit (25m). A co-channel station filed a complaint with the FCC's Chicago District Office, which detected the height discrepancy during a follow-up inspection. Of the total assessment of $11,000, $7,000 was levied for causing interference to the co-channel station and $4,000 for operation with the unauthorized antenna height. The commission rejected requests for mitigation by the offending station, which said it was a small, noncommercial station that had been in operation only for one week.

An AM station in Puerto Rico was fined $4,000 for operating at night even though its license specified daytime-only operations. In sustaining the forfeiture, the commission rejected arguments that the fine should be reduced on the basis of the small size of the market and the licensee's lack of a prior record of offenses. Also rejected was the licensee's claim that it believed nighttime operations were permissible during the pendency of a recently filed application for nighttime authority.

A Mississippi station was fined $1,500 (down from an original $15,000) for engaging in three unauthorized transfers of control. Though the violations were serious, the FCC was persuaded that the licensee did not have the resources to pay the original $15,000 fine or even the reduced $5.000 amount set last year. To have a forfeiture amount reduced, a licensee must submit detailed information, such as tax returns and profit/loss statements, indicating that the business is losing money and that there is no cash available to pay the fine.

Harry Martin is an attorney with Fletcher, Heald & Hildreth, PLC., Arlington, VA. E-mail martin@fhh-telcomlaw.com.

Dateline

Radio stations in the following states (and district) must file their ownership reports on or before June 1, 1999: AZ, District of Columbia, ID, MD, MI, NV, NM, OH, UT, VA, WV and WY.

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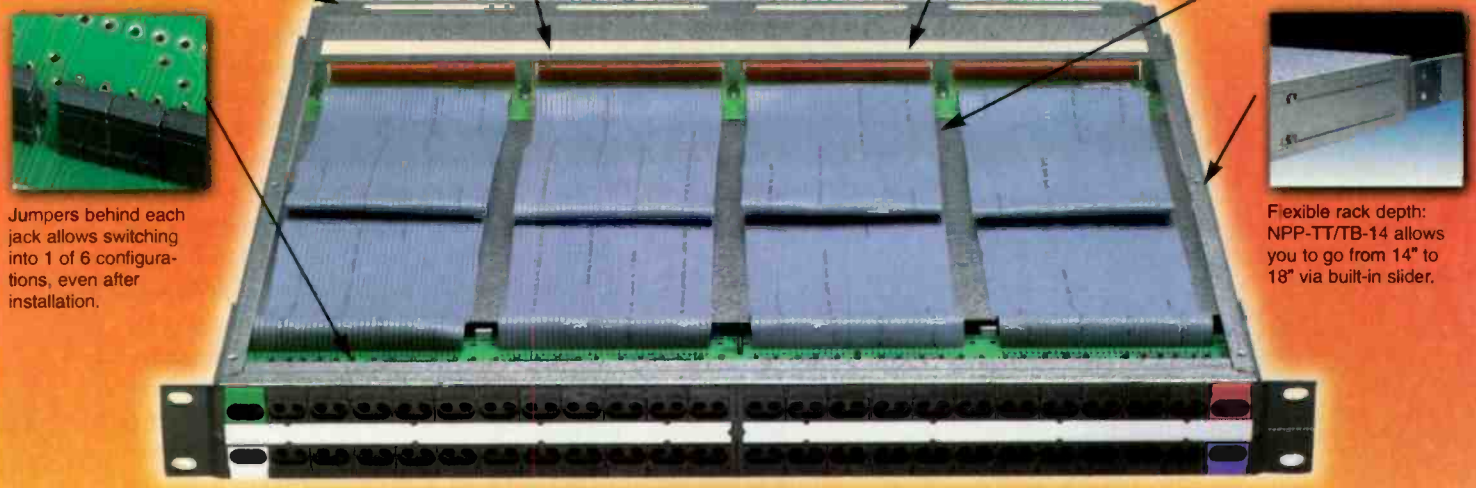

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RADIO ONLINE

Think you're getting a handle on the Internet?

THINK AGAIN.

By Skip Pizzi, executive editor

Understanding the Internet is about as easy as nailing Jell-O to the wall. Just when you think you have it nailed down, it wriggles away from you. This pattern is likely to continue for some time.

Consider today's common knowledge about online radio: Most people think the medium is interesting but fraught with technical problems, including poor audio quality, unreliable connections and cumbersome navigation. In addition, people think listening is limited to the desktop computer and that stations can only serve a small number of simultaneous listeners. Well, these assumptions may be wrong, as we'll all soon learn. Let's examine how these limitations are, or will be, overcome.

1) Audio quality. The next crop of streaming audio codecs is currently emerging. These codecs will essentially eliminate the notion that Internet radio is a second-class audio citizen. Because this software is distributed over the Internet via a relatively quick and essentially free download, these advances will penetrate the ever-growing Internet audience quickly. (If these advances continue apace, in subsequent years, audio fidelity on the Internet could *surpass* on-air quality.)

2) *Service reliability.* At the same time, a fresh round of browsers will propagate in the Internet community. The advances of these browsers will include a more reliable connection.

3) *Ease of navigation.* The new browsers will also feature some integration of radio listening features, making access to a user's favorite radio sites a simpler, quicker and more enjoyable experience. Exploration of new radio/media sites will also be easier, as the media-content aggregation services pioneered by *Audionet* and *broadcast.com* continue to expand.

4) *Increased capacity*. The continuous increase of network bandwidth will provide easier and cheaper expansion of the number of simultaneous users served by an online radio service. Another helpful factor is the ongoing implementation of *IP Multicast*, the Internet Protocol designed for webcasting. Unlike the typical arrangement in which each user occupies a discrete connection on the radio station's server (sometimes called "unicast"), IP Multicast allows the station's server to provide a single stream to the Internet backbone, with listeners' ISPs replicating the stream to each user. Thus the need for discrete per-user connections exists only in the "last mile" (user's computer to user's ISP), instead of the entire Internet path (user's PC to station's server).

However, for it to work, IP Multicast must be enabled on *all* servers and routers that exist on the Internet path between the user's computer and the station's server. Such universal deployment has been somewhat slow in coming, but is expected to be substantially in place within the next year or two.

5) *Desktop computers only*. To date, the Internet has almost exclusively been a wired, desktop experience. But the emergence of dedicated Internet browsing appliances, including mobile and portable units, plus the expansion of broadband wireless connectivity (first terrestrially, and later via low-earth orbit satellite), will put an end to this limitation. The accessibility of the Internet tomorrow may be similar to that of radio today.

Applications

Clearly, the Internet now has a function among radio stations, one that will become increasingly important with time. Applications begin with promotional websites, which can include bios and photos of air personalities, program guides or forward promotion of special station events, and even community news items. These features can expand to interactive services such as contests, and polls and chats. They can even grow to include transactional processes for sale of promotional items, concert tickets and more. Ultimately, they can involve streaming media (either live or on-demand) and downloadable media files (see Table 1).

Streaming media on a radio station's website can take many forms. The most basic is repetition of the station's air signal. For this, the station will need to obtain proper music licensing for online distribution. However, in some cases, the station may not be able to obtain online clearances for certain programming, such as network feeds or sports broadcasts. To avoid shutting down the online live stream during these periods, the station can air a time-shifted program. Today's multistream computer-based radio automation systems are ideal for such split feeding.

A station may also wish to place some auxiliary content on its webcast feed, such as graphics, low-resolution video, or text — identification of song and artist, for example. (For more on this topic, see Contract Engineering, p. 8.) Tools for creating such content have not yet been fully developed, but look for them soon.

Some stations may even wish to create a complete second stream, separate from the on-air signal, or perhaps offer certain dayparts with exclusive online content not available on-air. In some cases, the online second stream may feature time-shifted repeats of programs that were previously aired live on-air, such as sports broadcasts or live concerts.

Another possibility is the provision of on-demand audio, which will involve an inventory of short-form media files available for streaming listening (or downloading) at the user's command. Again, this audio can include items that have previously aired

Feature	Requirements	Upside	Downside
Promotional material	Web programmer	Competitive value, branding	Initial design cost, data refreshing requirements
Contests, polls	Database-driven site	Audience connection	Labor intensive
Chats	Specialized software and hardware	Audience-building	Time-consuming, production space requirements, connectivity costs
Transactional functions	E-commerce software	Revenue-producing	Fulfillment costs
Banner advertising	Designers, sales force	Revenue, value-add to advertisers	Training sales staff
"Tell me more" content	Custom content production, server space	Value-add to listeners, community service	Labor intensive
Live audio stream(s)	Encoding (plus signal-transport, if off-site server)	Coverage expansion	Encoder license cost, music licensing fees, signal transport cost, high connectivity-per-listener cost
On-demand audio	Encoding, server capacity	Listener convenience, re-use of content	Repackaging labor, cost of server space

Table 1. A list of possible features a radio station can include on its website, along with the basic requirements and primary advantages and disadvantages of those features.

on the station (e.g., local newscasts, ski/beach reports) and *tell-me-more* data, by which a longer version of a program that aired is posted to the website for those interested in further information. For example, a station's newscast may feature a 60-second report about a subject of significant local interest. The station's website could offer a three-minute version of the story available for on-demand playback, plus several photos, additional text and links for more information.

Architectures

Besides the labor costs involved in producing content for the station's website (which can vary widely), the most expensive elements of online service are the service- and connectivity-related charges. Two basic options exist: 1) Outsourcing the hosting of the website to a commercial Internet Service Provider (ISP) or 2) Installing the servers and telco connectivity in-house at the station.

On initial examination, this seems a fairly simple case of balancing capital investment vs. operating costs (owning vs. renting) — like any number of other business and service options the radio station deals with on a daily basis. But there are some unique issues in this case. First, the rapid growth of demand for online service and the steep curve of technological advances make capital investment in this field a high-risk endeavor. Therefore, the use of an outside ISP has considerable appeal.

Nevertheless, there are some advantages to in-house server operations. One is the ability to update online content quickly and easily. (This area may be of more importance to news formats.) Along these lines, owning the server fits the traditional comfort zone in which broadcasters operate their own delivery systems. Using an outside ISP for delivery service makes the broadcaster a pure content-provider. While this is a viable option, it may be a source of frustration if the ISP does not share the broadcaster's sense of urgency in the timely delivery of content. Fresh content is essential to the long-term success of any website, but particularly to a broadcaster's.

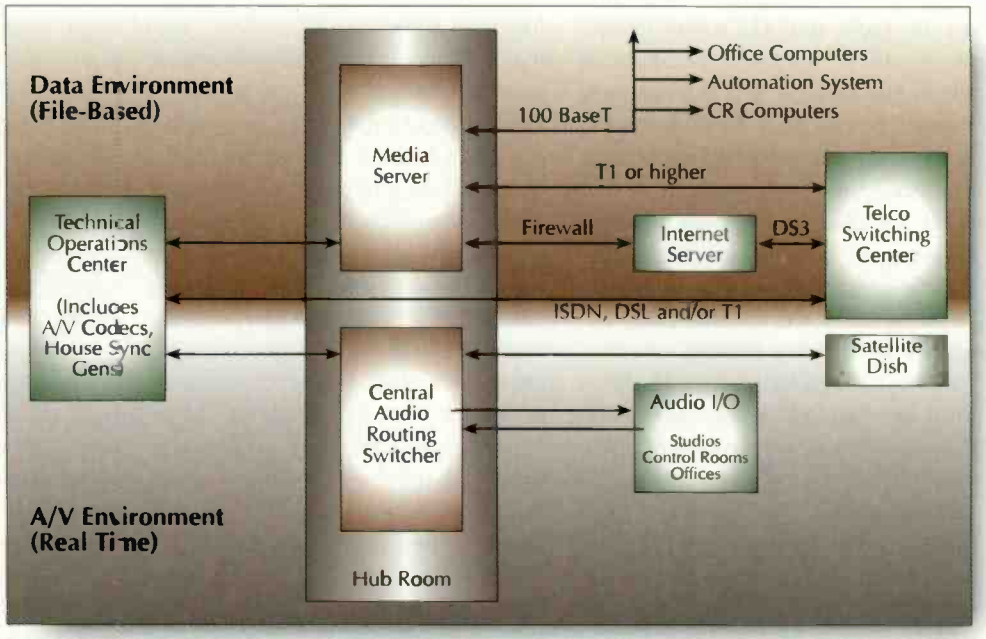

Figure 1. A conceptual diagram of the master-control facility for tomorrow's radio station, a hybrid facility that spans the two worlds of real-time audio and file-based media.

Another cost involved with off-site servers is the transport charges in getting live content to the ISP. Unless a full-time simulcast of the on-air signal is all the station wants on its website (in which case the ISP can simply take the signal off-air like a cable headend), a discrete delivery path will have to be established from the station to the ISP. This will incur costs for an ISDN or DSL path, or occupy some reserved network bandwidth on the broadband connection (typically a T1) that the station uses for its intranet connection to an ISP.

Finally, the ISP may simply not be willing or able to handle the growth of a broadcast station's online audience. The synergy of on-air and online is quite powerful: On-air mentions can drive substantial traffic to a station's website, with many users hitting the site at about the same time. Such peak demand may exceed the typical ISP client's needs, and thus the ISP may not be willing to appropriately accommodate the broadcaster.

Several hybrid arrangements may allow a station to hedge its bets on this issue. The first involves the familiar economies of scale that consolidation has provided to the industry. In this case, physical co-location is not required, so a jointly owned group of hundreds of stations spread around the country could share a server facility.

Of course, in this case, distant stations have an even higher cost of delivering live air signals to the server. A possible solution to this is the posting of recorded ("plausibly live") files for use on these stations' websites. Because these stations may be tuned in from nonlocal locations and time zones, there may be a reduced requirement for timely, local content on the website. Therefore, an encoded file of several-hours' duration may be produced at the station (without any date/time references made by the announcer) and transferred to the server via FTP, where it can be looped and run until it is replaced by a new file. Alternatively, some dayparts may be handled this way, while others are streamed live. This can also be a strategy for covering blacked-out

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OUTPUT Level	0, +4 dBm 600 Ohm Bal or Unbal, XLR
Variable Level	± 16 dBm (clips @ +20 dBm)
Frequency Response	± 0.5 dB, 20 Hz - 20 KHz
Channel Separation	96 dB
S/N (A-wt-filter)	86 dB
THD	.04%
Additional Commercial Time	2 Sec. - to - 4 Min., Mono 2 Sec. - to - 2 Min., Stereo
Variable Commercial Time	0.1 Sec. Steps

Note: Unit does not use data compression

OPERATIONAL CONTROLS

Enable Button	Enables each of the other buttons
Start Button	Starts Commercial Insertion Time
Hold Button	Stops Time Reduction (pass real time information)
Stop Button	Returns output to Real Time
2 Mode Buttons	Move forward or reverse in menu
2 Set Buttons & Knob	Increase or Decrease menu selection level or setting
Level Button	Push to enter Level menu
Time Button	Push to enter Time menu
4 Preset Buttons	F1, 2, 3, 4, Preset up to 4 events

ENVIRONMENTAL

Operating Temperature	+32°F (0°C) to 113°F (45°C)
Operating Humidity	10% to 95%, RH, Non-Condensing
Power Supply	117 VAC ± 10%, 60 Hz or 220 VAC ± 10%, 50 Hz or 60 Hz
Power Dissipation	50 Watts Max
Height	1 U, 1.75 Inches (4.44 cm)
Length	19 Inches (48.3 cm)
Depth	12 Inches (30.5 cm)
Weight	20 lbs. (9.1 kg)

OPTIONS

Rack Mount remote	R-A

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portions of the station's air signal (at either a local or distant server).

One of the final expenses is the licensing fee for streaming media encoding. This may set a fixed limit on the number of simultaneous users and can add significantly to the cost of on-line operations. In most cases, these listener numbers are already extremely low by broadcast standards (typically in the low hundreds), so for live webcasting, this is a serious obstacle. Broadcasters are well served if they shop around for the best deal in this respect, however. The cost for such licensing is not uniform across the industry. Different streaming technologies offer different encoding arrangements and costs. Costs for hosting of such streaming sites by ISPs can also vary substantially between vendors.

On the other hand, note that for *on-demand* listening, a few hundred simultaneous streams are quite adequate, particularly when you consider that most users only stream such content for a few minutes at a time, and that stream is then freed up for another user. As a result, the cost/benefit assessment of streaming media licensing is much more favorable for on-demand listening (a "parallel" process, and not locked to a schedule clock) than for webcasting (a "serial" process, where all listening is schedule-based, in real time).

Future trends

A new feature offered by streaming media formats is the ability to customize the player interface on the client. This is accomplished by a one-time download of a "plug-in" to the streaming media player already on the user's computer. It allows graphical branding of the service to be added to the player's appearance on the user's screen, as well as custom buttons, links and other features.

The next crop of streaming audio codecs will eliminate the notion that Internet radio is a second-class audio citizen.

Another emerging trend will be the use of zip code linking to lists of local stations, which will allow users to automatically populate the preset buttons on a browser's "radio tuner" window with associated local stations simply by entering the local zip code in a prompt field and invoking a "load local presets" command.

Audience use of online radio is also changing. On-air radio listening in the U.S. is about evenly divided between the car, the home and the office. In contrast, online radio listening is particularly strong and is growing in the office segment. As audio quality and accessibility of online audio improves, expect to see substantial growth of listenership in other locales. So-called *expatriate* listening is also on the rise, as listeners seek out distant stations. For some, the motivation is curiosity (like DX-ing), while others listen for news from a previous hometown or alma mater, or simply listen to their hometown station while they are traveling.

Some initial research has been performed on the habits of

online radio listeners. These results show a surprisingly high interest and repeat-visit rate, but new metrics of listening habits that reflect the differences of online listening must be established before any such data can be truly meaningful. Comparable advertising valuation schemes are also required for the online world if the business is to become a viable alternative to broadcast media.

At the station side, a new type of hybrid on-air/online master control or technical operations center will be required, which has a profile in both real-time and file-based media worlds. Figure 1 shows a conceptual diagram.

Note also that the "linear" hierarchy of network-to-station signal flow need not apply in the online world. A tighter and more complex interweaving of national, regional and local content can be accomplished in the online environment, and many station groups and networks are currently exploring such arrangements. This is new territory, so it will likely take some time to develop, but it could produce some exciting and valuable new media content styles for future radio audiences.

Face your future

The online radio environment is clearly still in its infancy. Yet even at this early stage, savvy broadcasters are already realizing its value and envisioning its potential. Perhaps future multimedia receivers will blend static and interactive content channels with onboard storage and back-channel connectivity to produce a rich experience that we can hardly fathom today. Or, tomorrow's users may have only a slight incremental extension in the features that we use today. Either way, the Internet will likely play a major role in radio's future.

Nobody knows how to deliver compelling audio content better than today's radio broadcasters.

At present, neither the business model nor the technical infrastructure of this eventual environment is well-understood. But what happens in the near future will do much to shape this transition. Broadcasters who embrace and explore this new media frontier today will be best-equipped to flourish in the coming age. (At the very least, online radio may be the best defensive action terrestrial radio can wield against rapidly approaching new competition from DBS radio services.) Stations should work the areas that seem to offer the greatest potential return first, then grow into other areas with time. They should also exploit economies of scale and native expertise whenever possible.

Nobody knows how to deliver compelling audio content better than today's radio broadcasters. There is clearly a place for such content in the new media environment, so take up the challenge, and don't let this role be filled by someone less qualified.

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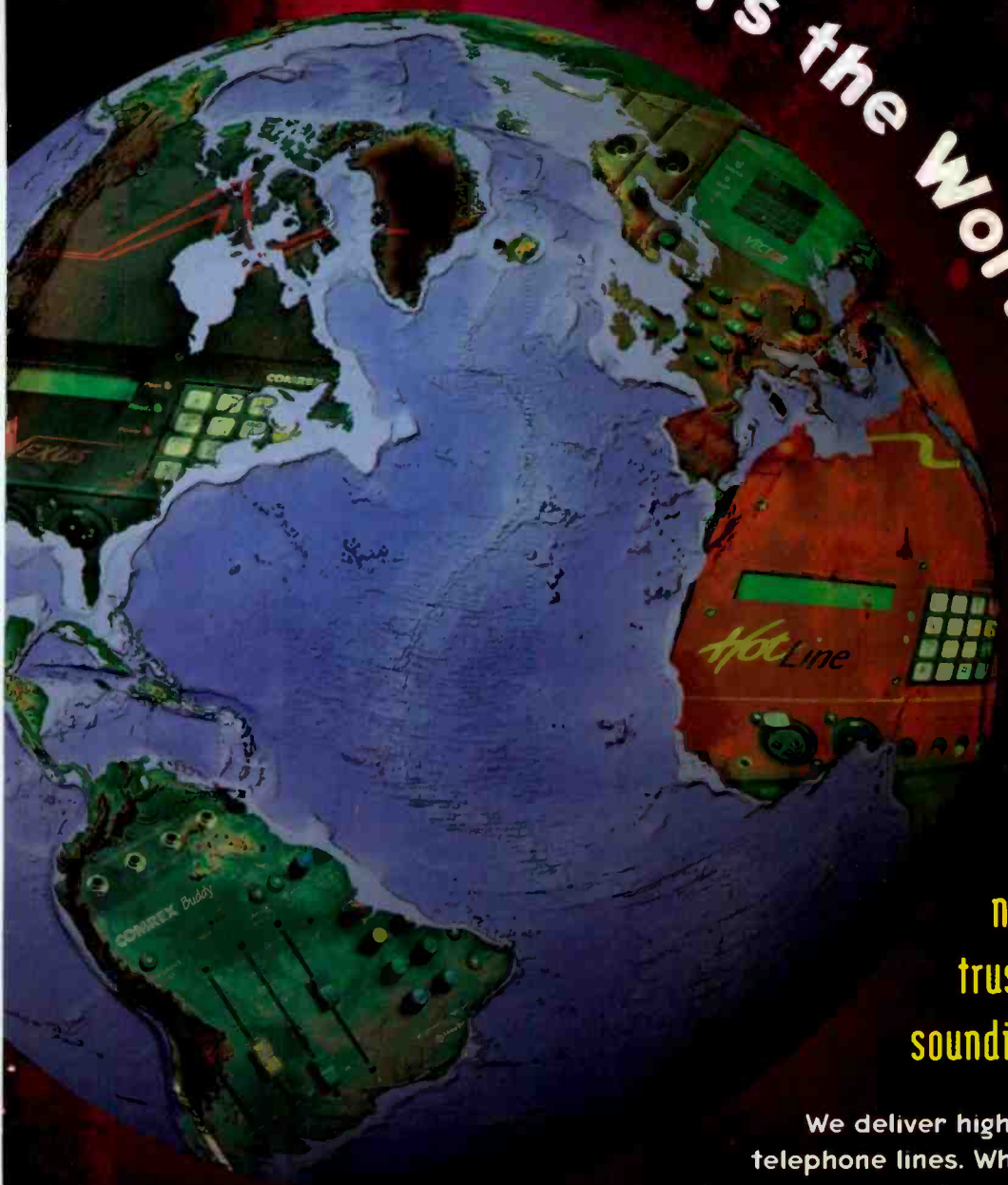

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Digital FM Exciters

They're ready — Are you?

A completely digital audio chain is possible today. Although the final transmission is still analog, the modulation doesn't have to be.

By Kirk Harnack

As broadcast engineers, we're familiar with the term *point of diminishing returns.* That's where spending more time or money on a problem results in diminished, perhaps not even worthwhile, improvements. The term has two distinct applications regarding digital FM exciter technology.

Many engineers are still waiting for digital FM exciters to prove themselves or demonstrate their value in an on-air signal chain. The point of diminishing returns in further delay is upon us. The value of digital FM exciter technology has been demonstrated, and digital exciters are ready for application. Two digital FM exciter manufacturers are already delivering second-generation products. All manufacturers have extensively tested their units in the lab and in real-world environments. Waiting to switch to digital FM exciter technology won't yield any benefits.

For engineers who have yet to begin implementing digital transmission technology, a point of diminishing returns is still some distance away. Assuming an audio chain of decent quality, replacing an analog FM exciter with a digital unit will likely result in the single biggest improvement in an FM station's sound. Indeed, many engineers agree that installing a digital FM exciter is the first logical step in moving to an all-digital air chain.

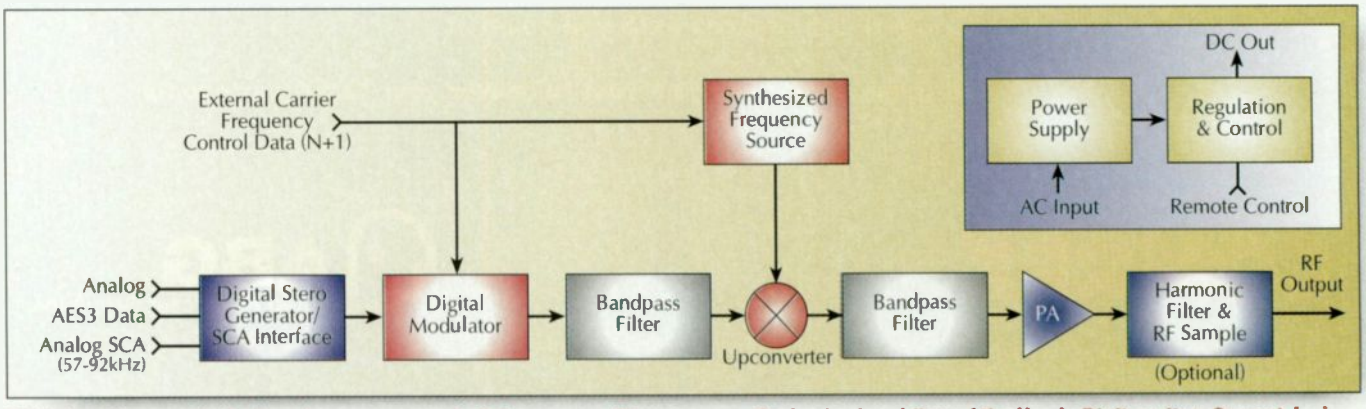
Let's review the fundamentals of FM exciter operation and examine the shortcomings of analog FM exciter designs. We'll then see how the application of digital technology addresses these shortcomings.

Analog operations

The basic purpose of an FM exciter is to frequency modulate a carrier wave with a station's program material. It's the box that actually turns audio signals into radio signals. Designing and implementing a basic FM modulator circuit is fairly straightforward. However, building a device that can effectively compete with the CD audio quality we're becoming accustomed to does present several problems.

Analog FM exciters suffer from at least three basic difficulties: audio noise and coloration, mechanical and environmental stability, and long-term performance repeatability. Most other analog circuits and devices also suffer from the same problems. Digital FM exciters have largely overcome these troubles. Indeed, installing a digital FM exciter will often reveal other problems in a station's audio chain that were masked by the analog exciter's shortcomings.

In an analog FM exciter, the heart



Digital exciters can be broken down into basic building blocks. Shown here is the basic signal flow of the Harris Digit exciter. Current designs all have certain differences between them, but all of them produce a more stable, cleaner output than their analog predecesors.

of the FM process is the voltage-controlled oscillator (VCO), sometimes referred to as the modulated oscillator. Using a varactor diode as the capacitive element in a tank circuit, a VCO produces a radio frequency (RF) signal whose frequency varies proportionately with the applied audio voltage. Even the best varactor diodes do not exhibit the ideal relationship between square-law voltage versus capacitance. Therefore, the FM signal the VCO produces is less than ideal: It doesn't match the applied audio exactly. Pre-distortion techniques are often used to counter the characteristics of typical varactor diodes. Still, the results are less-than-perfect frequency modulation.

Additional "coloration" of the audio is due to the basic conflict between the VCO and the automatic frequency control (AFC). While the VCO is constantly changing the carrier frequency to create FM, the AFC circuit is slowly trying to keep the carrier frequency constant. This battle is usually won by the AFC circuitry at the expense of clean, uncolored low bass response. The audio effect is often called *AFC bounce*. If the AFC actually loses the battle, the results are worse: The FM exciter will shut down until the AFC circuit locks again. Modern analog exciters often use "dual-speed" AFC circuits for better performance and less chance of losing AFC lock. Additionally, analog VCO/AFC circuits suffer from low-frequency phase noise. This noise is usually in the subaudible range, below 30Hz, and degrades an analog exciter's time-averaged signal to noise ratio.

Environment will affect analog circuits. To minimize noise from external sources and to minimize microphonic noises, the VCO is usually placed in an isolated vault inside the exciter. The RF-isolated VCO module is often further insulated from vibration with rubber mounts or even spring suspension. Over time, the rubber mounts deteriorate and the springs stretch, resulting in a reduction in isolation from the exciter's often harsh environs. Other environmental factors can coalesce to degrade analog FM exciter performance. For example, extreme temperature fluctuations can press the AFC circuit to its limits in trying to keep the exciter on frequency. Strong RF fields and transformer-hum fields also limit the ultimate performance specs of analog exciters.

Long-term performance repeatability is another problem with analog circuits. An analog FM exciter likely will not meet its original performance specifications after a few years of use. As time passes, electrolytic capacitors are apt to change value, fan bearings will become noisy or even fail, and resistors and semiconductors — often in low-level audio circuits — can become noisy or drift in value and characteristics. The signal-to-noise ratio and other modulation characteristics of an analog exciter are directly dependent upon these analog components operating at original performance specs. As these components age, change and drift, performance will suffer.

Enter the digital FM exciter. Instead of an analog VCO at its heart, a *numerically controlled oscillator* (NCO) is used. Instead of shifting a free-running oscillator up and down in frequency, an NCO actually generates a constant stream of numbers corresponding to points on a sine wave, then converts those numbers into the desired RF signal. Mathematical algorithms precisely control the NCO's resultant output. The NCO uses data from both a fixed-reference frequency generated inside the digital FM exciter and from a digital bitstream representing the composite modulating signal. In effect, the NCO contains a *digital signal processor* (DSP) and a *digital-to-analog converter* (DAC). The DAC's function is to convert the DSP's output bitstream into a corresponding sine wave. The DSP/DAC combination is often referred to as either an NCO or a *direct digital synthesizer* (DDS). The DDS' resultant RF output is a perfect frequency-modulated sine wave without the side effects of analog FM generation.

The digital FM exciter's NCO solves or minimizes each of the previously mentioned difficulties with analog FM exciters.

Problem solved

Audio noise and coloration are virtually eliminated. The noise floor of the NCO's output becomes limited by the number of bits used to represent the sine wave points instead of by the quality and design of finicky analog components and circuits. All digital FM exciters' published specs show at least a 90dB signal-to-noise ratio for wideband operation. This figure approaches the theoretical ideal for 16-bit quantization. One manufacturer claims the ideal 96dB S/N. All manufacturers' specs use DIN "A" weighting.

The specs for digital FM exciters are also quite favorable. Figures of 0.005 percent THD+N are shown in the product sheets of several models. Similarly, low figures are quoted for SMPTE intermodulation distortion. Frequency response is typically ruler-flat at ±0.05dB to 53kHz and ±0.2dB to 100kHz and is similar for all models.

Performance specifications shown for digital FM exciters approach and sometimes meet theoretical ideals. This isn't particularly surprising, since digital signal processing is considered more of a science than a black art. Small differences between manufacturer performance

claims sometimes have more to do with performance measurement techniques than with actual equipment differences.

One audio performance characteristic that is not easily quantifiable is that of the analog exciter's VCO/AFC phase-locked loop. Mention was made earlier of how these circuits affect the sound — especially the bass sound — of an analog FM exciter. Digital FM exciters operate far better than their analog counterparts in this regard. Indeed, there is no characteristic sound or AFC bounce to a digital FM exciter's modulator. The NCO faithfully synthesizes the FM carrier with exactly the audio presented to it — including low bass notes and all the way down to pure DC.

A digital FM exciter's NCO also exhibits essentially no overshoot. Transients and square waves are frequency modulated accurately in an NCO. Therefore, no modulation is wasted by the frequency modulating process, as can occur with analog FM exciters.

Since digital FM exciters use digital synthesis techniques, the mechanical and some environmental problems with analog exciters are dispensed with. While circuit design and layout are still critical to proper operation, they have little or no effect on the exciter's performance as long as it's working. Provided that the design of a digital FM exciter keeps it operating far from the digital cliff, one can be assured of full audio performance despite changing environmental conditions and vibration.

Additionally, long-term performance repeatability is absolutely assured, as long as the digital circuits stay on the high side of the digital cliff. Slow, insidious performance degradation is unlikely with a digital FM exciter. This benefit means a digital exciter will sound as good 20 years from now as it does today.

A good deal of supporting circuitry is required to prepare the audio — either analog or digital — for presentation to the NCO. Also, more signal manipulation is required after the NCO to obtain a usable FM signal equal to that of a conventional FM exciter.

Common to all digital FM exciters is the ability to use either analog or digital audio inputs. Stations just beginning a transition to digital operations will likely feed their stereo generator's or composite STL system's wideband composite output into a digital exciter's analog input. Some digital exciters come equipped with both composite analog and EAS3 digital audio inputs. With other models, installation of the appropriate input module to accommodate each type of signal is required. All digital FM exciters will receive analog subcarrier (SCA) inputs. Additionally, some units allow automatic fallback to an analog input if the primary digital input fails.

Some engineers are concerned about whether a digital FM exciter will deliver a true audio improvement over an analog FM exciter if the STL is still analog. For many broadcasters, the change to a digital FM exciter has resulted in noticeable audio improvement although an analog STL system is still in place. Converting to a digital STL system — either a digital RF system or a leased-line system — is the next logical step in progressing to an all-digital signal chain.

Switching a digital FM exciter from using an analog input to a digital input (typically AES3) is straightforward. One model requires swapping an input module. Others simply require plugging the AES3 audio feed into the back of the exciter and programming the unit to look to the AES3 input for audio. All digital exciters accept a variety of common audio sample rates (e.g., 32kHz, 44.1kHz and 48kHz) and will automatically sync to the rate provided.

Questions are often raised about exactly how to properly connect either existing or new station equipment to a digital FM exciter's input. What options are available? Will more audio processors or other equipment need to be purchased?

Let's discuss the two most common methods of feeding program audio to a digital FM exciter. If a digital FM exciter is fed with an analog, composite signal — as most analog exciters are fed now — there is essentially no change. Whether the exciter is fed by the composite output of the processor and stereo generator or by the composite output of an analog STL system makes no difference. Simply make sure that the digital FM exciter is equipped to accept an analog composite input.

Continental Electronics

802D-1 — Built around a standard PC motherboard, this second-generation unit displays its operating parameters on a color LCD screen. Operation can be configured for automatic switching to analog composite input upon loss of AES3 data. It occupies 3RU.
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Harris

Digit CD — The second generation of this unit can deliver up to 55W of output power in a 4RU chassis. The simple front panel has an LCD readout for operating parameters, an LED bargraph level meter and LED status indicators. The input module is field-swappable.
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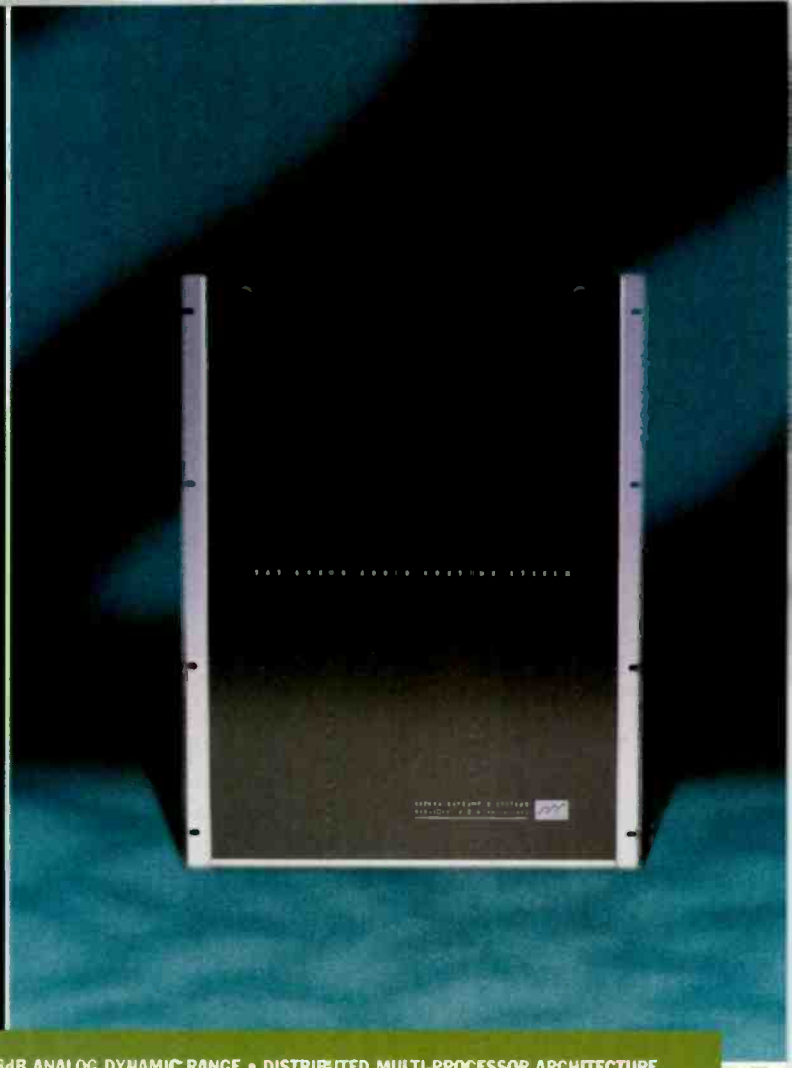

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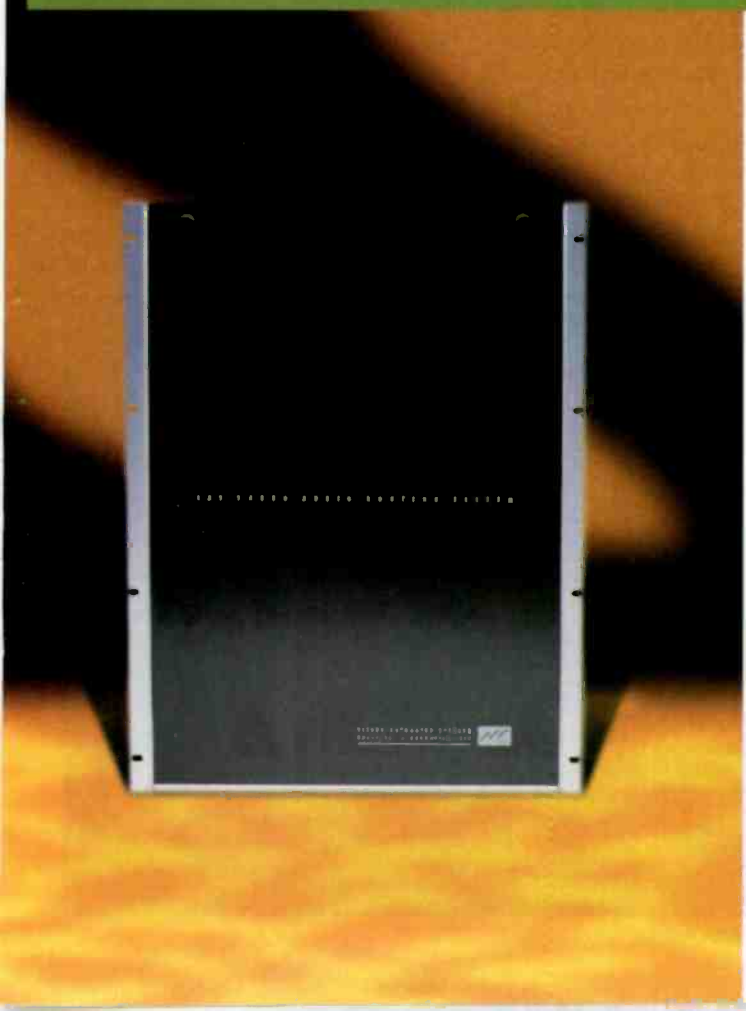

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Digital FM Exciters

Also, process and pre-emphasize the program audio as would be done for an analog FM exciter.

A digital AES3 audio path to the exciter requires additional consideration. Whether the program audio stays in the digital domain or at some point is analog, it must be processed using an audio processor intended for FM service. Such processors are pre-emphasis aware and will give special consideration to processing the audio so it will not overmodulate a pre-emphasized FM transmission system. However, it's important to ensure that the processor's output is actually de-emphasized prior to transmission over an STL system. In particular, an analog processor's nonde-emphasized audio outputs (if it has them) should not be used to feed program audio through a digital transmission medium and then to the digital FM exciter. Digital STL systems — whether they use lossy data reduction or are loss-less — should be fed flat audio. It's generally agreed that lossy STL systems should have the audio processing located at the destination end of the system to handle slight overshoots inherent in such systems. Loss-less, or non-data-reduced STL systems generally allow the option of placing all audio processing at the source or studio end of the system.

In the digital FM exciter, pre-emphasis appropriate for the application (75µs in the U.S.) is selectable and is added back in the digital stereo generator when the digital exciter's AES3 audio input is used.

Using the AES3 digital audio input and the digital FM exciter's built-in stereo generator results in the highest performance from our current digital standards. Stereo separation figures of 65dB or more are typical when using the included digital stereo generator.

Subcarrier inputs are similar to those on analog exciters. They're typically connected using a BNC jack on the exciter. An analog signal presented to the digital exciter's SCA input will first go to an *analog-to-digital converter* (ADC). The ADC's output is digitally summed with the main channel's digital composite signal and other subcarriers, and is delivered to the exciter's NCO.

None of the digital FM exciters currently available actually synthesizes the FM signal on the station's carrier frequency. Because of practical NCO limitations, the synthesized signal is usually much lower in frequency — typically about 5MHz. The synthesized FM signal is then heterodyned, mixed or up-converted to the desired final frequency. Each manufacturer uses a somewhat different method of obtaining the final, on-frequency signal.

Nautel

NE50 — This 3RU exciter has an alarm memory for storage of up to 99 events. Up to 55W of output power is available, and analog and digital input modules are available. The digital input module accepts AES3 and TOSLINK data. An LCD displays operating parameters.
Circle (210) on Free Info Card

Specific traits

Digital FM exciters all take advantage of the digital circuitry already employed within them to allow extensive remote control and monitoring options. Communications via an RS-232 port is typically available. One model offers computer VGA video and keyboard connections.

Other common attributes of the available digital FM exciters include the following: 19-inch rackmount hardware, muting circuitry, remote metering, and control via contacts or RS-232 and a rated RF power output capability in the neighborhood of 50W.

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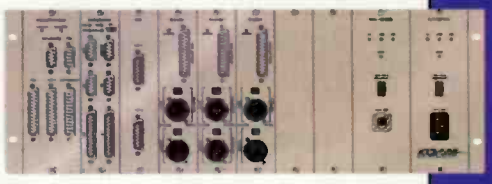

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Digital FM Exciters

Most units offer a 19kHz reference output for synchronizing external RBDS subcarrier equipment. A 10MHz input reference for use in synchronizing two or more exciters to a common oscillator source, such as GPS, is available for most models.

Two major differences are apparent in the designs of available models. The first is the operating base, or foundation, for subsystem implementation. One digital FM exciter is built upon an IBM-PC motherboard for control of the various subsystems. The other digital exciters use their own proprietary overall control schemes.

For many broadcasters, the change to a digital FM exciter has resulted in noticeable audio improvement although an analog STL system is still in place.

The second major difference is in the upconversion method employed to bring the synthesized FM signal up to the desired carrier frequency. One uses a DSP-controlled conversion process. Others employ more conventional heterodyning methods. All models end up with a clean and pure on-frequency FM signal at their outputs.

All available digital FM exciter model have been thoroughly tested in major and smaller markets. Despite a whole new technology implementation, very few surprises or hiccups have been reported in the field. After three years or more of continuous operation and some minor tweaks, it appears that digital FM exciters are fresh, rested, prepped and ready for prime time. If you're still waiting, the point of diminishing returns is here.

Information on exciters was obtained from manufacturer-provided product literature.

Kirk Harnack is president of Harnack Engineering Inc. and vice president of engineering for Delta Radio Inc., Columbus, MS. He can be reached at kirk@harnack.com.

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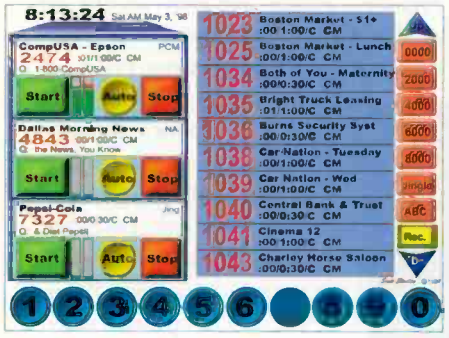

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ANTENNAS

Coax, ATUs and grounding

By John Battison, P.E.,
technical editor, RF

From transmitter to ATU, and from ATU to antenna and ground system

This is the fourth in a series of nine articles on basic broadcast antennas.

In every transmitter installation, once the carrier has been modulated and amplified within the transmitter, the next job is to get the RF signal to the antenna. There are many ways to do this. When radio was first developed, an open wireline was used. One problem with this approach was that the unbalanced wire also radiated a signal and thus affected the antenna's radiation pattern, making it difficult to maintain a good impedance match.

Next, balanced parallel lines consisting of one or more pairs of wire with opposite wires energized were tried, but they also eventually proved unsatisfactory. Problems included dielectric (air) failure in high-power use when the wires are moved closer together by the wind, sensitivity to debris falling on the open wires, and a certain amount of undesirable radiation.

The next step was to equidistantly space several outer-grounded conductors around a center "hot" cable. From this approach evolved the coaxial cable with a solid outer conductor and an insulated inner conductor held in place by spacers, stubs or a foam dielectric.

Coaxial cable characteristics

The impedance of the coax depends on the diameter of the inner conductor, its spacing from the inside of the outer conductor, and the overall diameter. Velocity of wave propagation is lower in a coaxial cable than an open wire because of the presence of the insulating spacers. Also, there is a certain amount of loss, depending on frequency. However, the loss at AM frequencies is *de minimis* and is rarely of concern when planning an AM station. When working at FM frequencies, the transmission efficiency becomes of great importance and has to be included in ERP calculations.

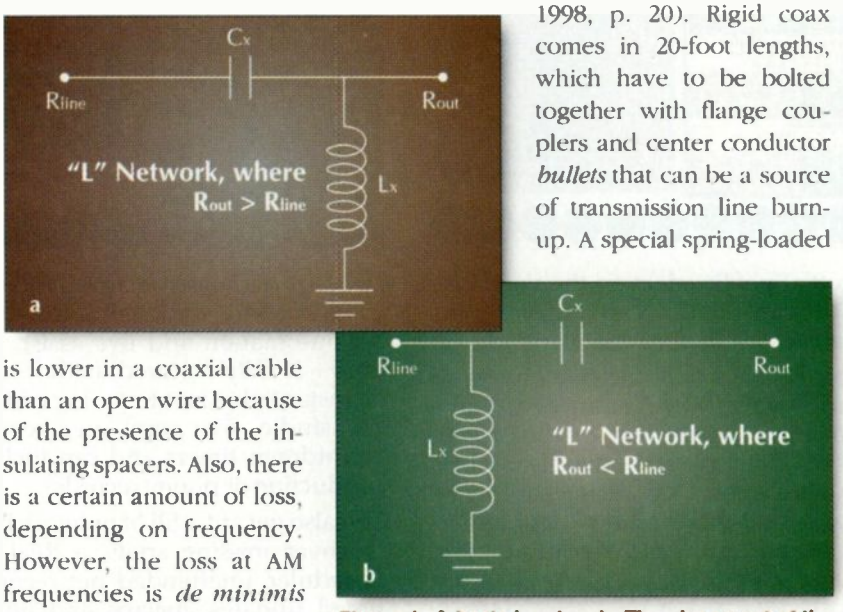

Figure 1. A basic L network. The placement of the capacitor changes the impedance relationship of the input and output.

Some early higher-power FM installations used rigid coax, but today flexible coax is the norm. This coax requires either nitrogen or dry-air pressurization to maintain safe operation (see RF Engineering, February 1998, p. 20). Rigid coax comes in 20-foot lengths, which have to be bolted together with flange couplers and center conductor *bullets* that can be a source of transmission line burnup. A special spring-loaded cable mounting takes care of the line expansion heat changes cause. As the line moves, the bullet slides inside the inner conductor and causes

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wear. This wear can result in poor connections, and arcing and sparking can occur, producing soot (carbon). Sooner or later, the wear often results in a larger electronic flame, which burns out the line.

If you inherit a station that uses rigid line, be sure to carefully inspect the line frequently. Look especially for hot spots on the outer conductor. It seems that such mishaps do not often occur at the lower end of the line where it is easier to spot problems, but rather occur up on the tower, where checking the line is more difficult.

Today, every AM station uses coax that is either buried or carried on supports above the ground. Jacketed coax should always be used. Although the flexible outer skin is usually almost completely airtight, the extra plastic coat prevents moisture ingress as well.

Coaxial cable manufacturers supply excellent tables of coax sizes, power ratings and efficiencies. Andrew Corporation provides a free CD called ECALC, which makes it easy to file and check line efficiencies when planning an installation. 50Ω impedance is usually used in AM work, and transmission efficiency is considered in general to be 100 percent.

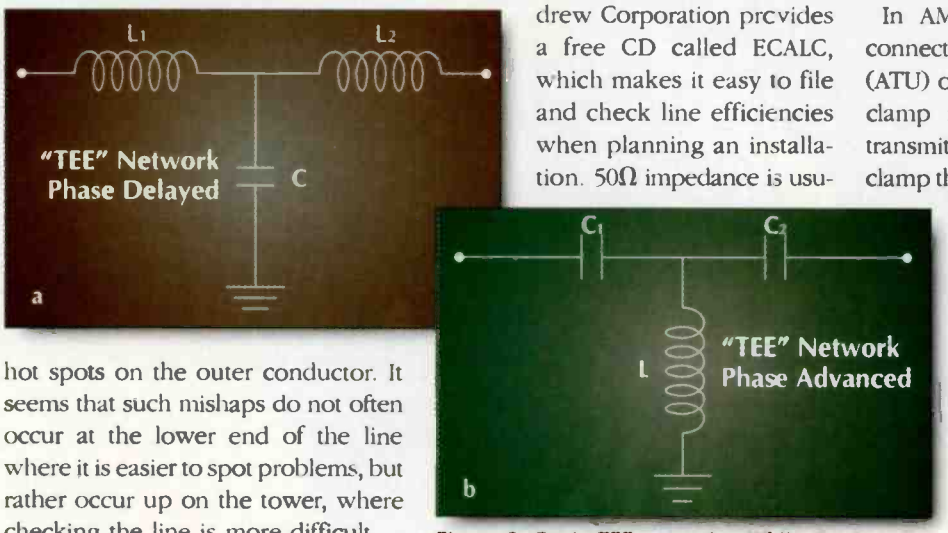

Figure 2. Basic TEE networks. While the two diagrams look similar, they have very different effects on the signal's phase.

Measure the length of the coax carefully. Be sure you don't measure short of the length you need. FM coax is usually ordered with the connectors already installed, which saves a lot of hard work in the field.

In AM, transmission lines usually connect to an antenna tuning unit (ATU) or phasor by means of a cable clamp in the ATU cabinet. At the transmitter end, it is not unusual to clamp the center conductor to a terminal rather than a connector. Thus, there is often no point in ordering coax with the connectors already attached.

Transmission-line connection

Usually, connecting an FM transmitter to its antenna is a reasonably simple job — excluding the physical labor of hoisting the antenna and several hundred feet of

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heavy cable up the tower. Because the impedance of the transmitter output, transmission-line and antenna input are all 50Ω, installation is usually much simpler than for an AM antenna. There is no need for an ATU because all the impedances are the same, and a regular single transmitter installation does not usually require any other equipment (except a harmonic filter mounted in, on or by the transmitter).

Depending on the installation and the antenna type, some fine-tuning may be required. Also, check for nitrogen or dry-air leakage and VSWR. Apart from that, the installation is basically complete, and low-power testing can begin.

An AM installation is quite different. Assuming a non-DA station, after the antenna tower is erected, the transmission line (which was installed while the tower went up) is connected to the ATU. The tower is connected, with tower light wiring if needed, and lighting is checked.

After the heavy tower work is completed, the ground system is installed. This is the point at which the antenna impedance is measured. Today, most engineers use an inline bridge and a receiver generator. Generator frequency should zero-beat with the transmitter's oscillator. There is usually enough energy leaking through the transmitter to check the generator's calibration.

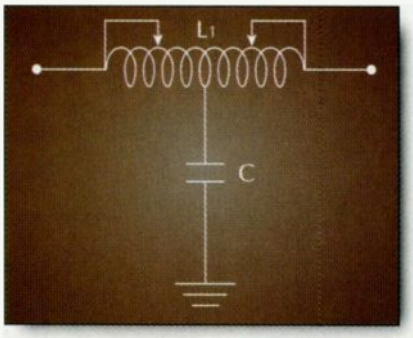

Figure 3. A TEE network using a single coil (L_1) with multiple taps instead of two discrete coils as shown in Figure 2.

The antenna impedance is measured and the FCC's required ±25kHz impedance spread is made to check the shape of the resistance and reactance curves. Bridge calibration is correct at 1MHz. Don't forget to apply the inline bridge reactance correction according to the instructions on the bridge. Once the antenna impedance is known, the ATU can be tuned.

The ATU

Used only in AM, the ATU matches or transforms the line impedance of 50Ω to the measured operating impedance. Two types of network are usually used: These are the "L" and the "TEE." In cases where a simple match has to be made, an "L" is often employed.

There are four types of "L" network, but most non-DA installations are not concerned with phase control, so we will only discuss two. The circuit used depends on whether the antenna impedance is less than or greater than the line impedance. Figure 1a shows an "L" designed to match an antenna that has impedance greater

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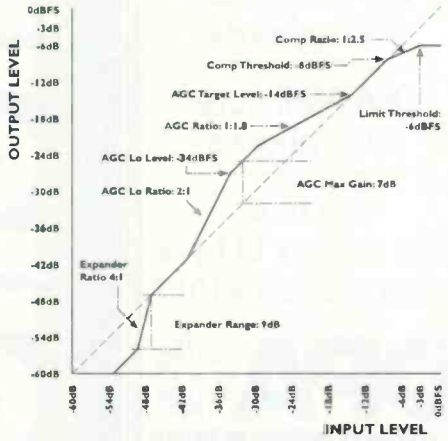

Example of Adjustable Parameters

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than the line. Figure 1b shows an "L" used with an antenna that has impedance lower than the line. Actually, each circuit will result in coincidental phase advancement. The position of the shunt leg on either side of the series element determines this phase direction.

"L" networks are simple and perform a necessary function in matching antennas to lines. However, their phase shift is hard to control. Folded unipoles and similar shunt-fed antennas use a simple type of "L."

The "TEE" is probably the most popular type of network with engineers. It is always used in DA installations to provide known and constant phase shift. Figure 2 shows typical "TEE" networks.

L_1 and L_2 are separate inductors (coils), and an inductance in series with the capacitor (C) in the shunt leg will provide positive reactance to adjust the capacitance to the required value. It is not unusual to economize on coil costs by eliminating coils L_1 and L_2 and using a single tapped coil in their place (see Figure 3). Often, the center tap of the coil is used as the connection to the shunt leg, and the input and outputs are tapped back from the coil ends.

Usually, connecting an FM transmitter to its antenna is a reasonably simple job.

Unless there are special circumstances, a tapped coil in series with a capacitor is used in the shunt to obtain the desired negative reactance. A suitable adjustable gas or vacuum capacitor is sometimes used to obtain the desired value with slightly improved performance and in high-power installations.

An inline bridge is used with a receiver generator to set the network legs to the values specified for the measured base operating impedance. Once this is done, place a 50Ω noninductive resistor across the input terminals of the ATU with the bridge equipment connected and confirm that the ATU is properly set. If this test is made, the *conjugate impedance* of the output arm will be read. For example, if the antenna operating impedance is 48 +j61 the bridge will read 48 -j61.

At this point, check the transmission line current at each end. The transmission line is relatively short compared with the wavelength. Therefore, the ammeter at each end should read approximately the same. Usually, these currents are very close or identical. A large disparity is cause for investigation.

The ground system

The ground system is an extremely important part of the AM installation. The FCC requires that at least 120 radials spaced 3 degrees apart and the same length as the tower height be used. If the soil is poor (e.g., sandy or rocky), an additional set of short radials may be added, spaced between the longer radials. As an alternative, a square, expanded, 24- or 48-foot copper screen may be used instead. If neither of these additions is made and the

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Part 5: Introducing AM directional antennas

number of radials is less than 120, or they are short, the FCC may require a set of measurements made after construction to prove that the required antenna efficiency has been obtained.

A 4-inch copper strap should run from the bottom of the base insulator on each face of the mounting to the 4-inch strap ring surrounding the tower to which the radials are connected. The ground wires should be buried about 8 inches to 12 inches below ground and should be composed of 8-gauge to 10-gauge copper wire (see Figure 4).

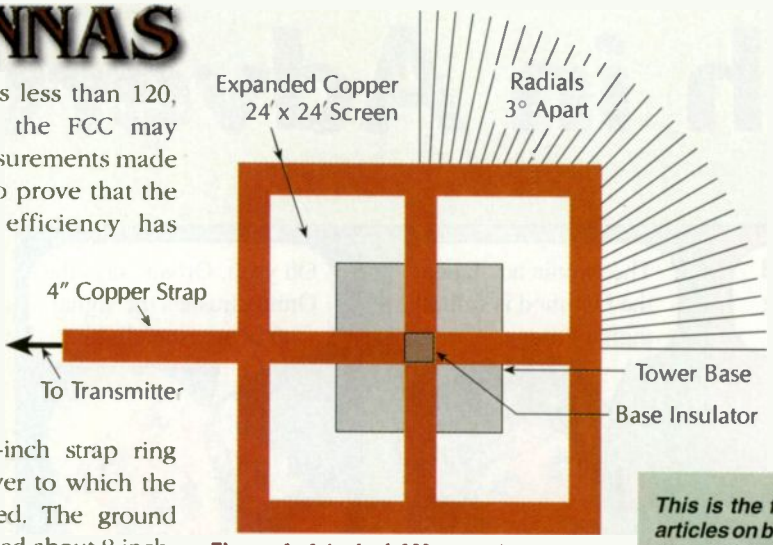

Figure 4. A typical AM ground system.

It is poor engineering practice to rely on the outer conductor of the transmission line for transmitter connection to the ground system. Another 4-inch copper strap must be run from the transmitter to the ground strap at the tower base. All connections between straps and wires and copper straps must be silver-soldered or brazed. If this is not done, the ground system will rapidly deteriorate.

A similar 4-inch strap must run between the ATU component-mounting panel, the cabinet, and the ground system. Don't rely on the physical mounting of the panel to the metal cabinet; always connect the strap to the panel.

DA ground systems are slightly different and will be covered in the installment on directional antennas.

This is the fourth in a series of nine articles on basic broadcast antennas. Upcoming installments will appear monthly in BE Radio through 1999. Once all the installments are published, the series will be available for purchase as a single document. For information regarding bulk orders of this series in quantities of 500 or more, contact Jenny Eisele at 913-967-1966.

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FACILITY SHOWCASE

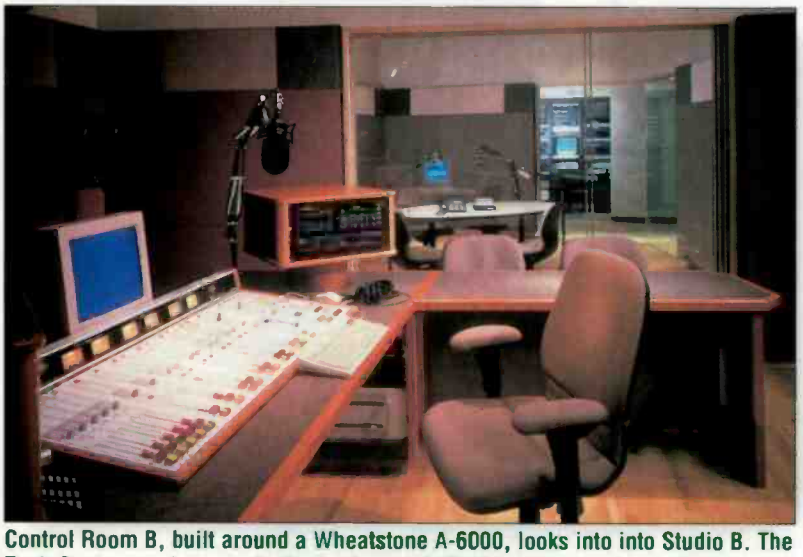
Nashville Public Radio

by Judith Gross

A public station worthy of Music City

Nashville probably boasts more people in the music business per capita than any other place on earth. For such a demanding, discerning audience, public radio has to be at least a cut above — from design to performance.

So when WPLN-FM's board of directors decided the station had outgrown its space at the Nashville Public Library, design excellence and top-to-bottom flexibility became the key principles behind building the new facility. A year and a half later, WPLN-FM's new home is a showcase, both acoustically and ergonomically.



Control Room B, built around a Wheatstone A-6000, looks into into Studio B. The Tech Center can be seen in the background (Position 1).

From library to Nashville Public Radio

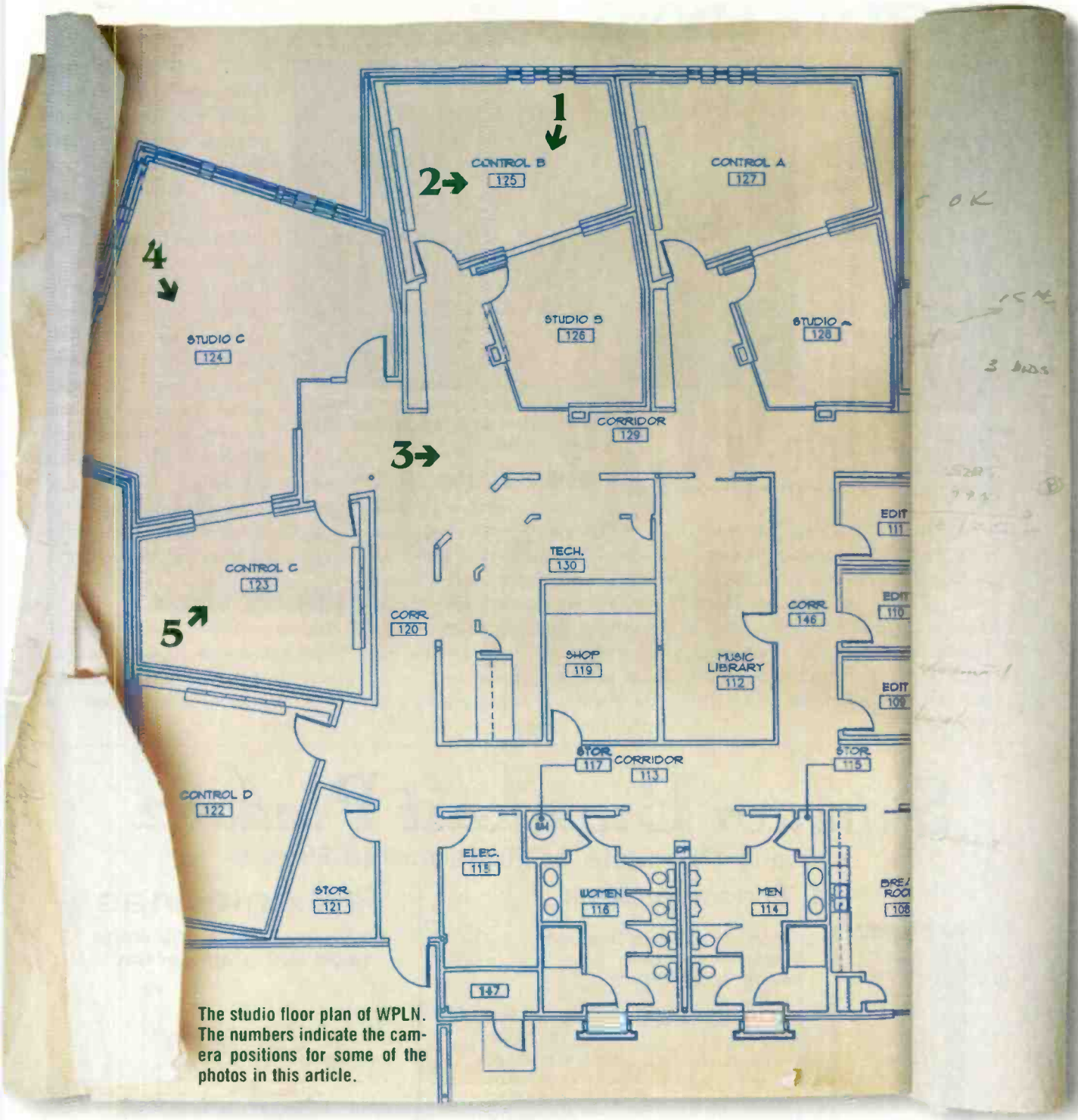
WPLN-FM came into existence in 1962 as an offshoot of Nashville's public library system, broadcasting first from a small, one-room studio in a branch library. As it grew, the station moved to a bigger facility in the downtown Nashville Public Library building.

In October of 1996, WPLN-FM became an independent community licensee, the not-for-profit Nashville Public Radio serving middle Tennessee. Nashville Public Radio broadcasts National Pubic Radio programs and classical music, and also produces programming for WPLN-FM in Nashville and WHRS-FM in Cookeville, TN — 80 miles away, where the station has a repeater.

Besides feature-length stories for the local drop-ins to NPR programs such as *Morning Edition* and *All Things Considered*, Nashville Public Radio produces a half-hour book program, a one-hour bluegrass show, a one-hour program focusing on acoustic music, Nashville Symphony broadcasts and a weekly live classical performance. As if this weren't ambitious enough, WPLN-FM plans to further expand its offerings.

Part of this plan calls for more in-house recording of live music and perhaps more elaborate productions for national distribution. One design goal of the new facility was to create an environment that could handle everything from talk shows to in-depth news to every type of live music, including acoustic, pop and classical. So, when Nashville Public radio grew up and out of the library system, the first order of business was a new home to accommodate a bright future.

Renovation of the existing space would not provide the needed acoustics, low noise level, sound isolation and layout. Thus, the decision was made to build from the ground up. Over the long run, the overall cost was also less to start anew. The board of directors charged the station with



The studio floor plan of WPLN. The numbers indicate the camera positions for some of the photos in this article.

building a state-of-the-art facility that would serve its listeners today and in the future.

Flexibility essential

Every design and equipment choice made was based on the ability to handle a number of important tasks simultaneously and allow for future expansion. Taking into account the performance of the leading-edge equipment available, WPLN-FM's new facility is a perfect hybrid of both digital and top-of-the-line analog equipment that can create the kind of quality sound a digitally conditioned world has come to demand.

In its list of design objectives, WPLN-FM emphasized flexibility — a focus the ultimate equipment choices reflect. First was the ability to originate multiple, simultaneous program feeds for both on-air and online. The staff also wanted to make sure the station could become a versatile distribution point for incoming programs that would either be broadcast live, on a delayed basis, or used in post production. Several elements were crucial: digital storage and versatile signal routing; a design that would accommodate a wide variety of programming formats; and the ability to originate live programming from the station's studios.

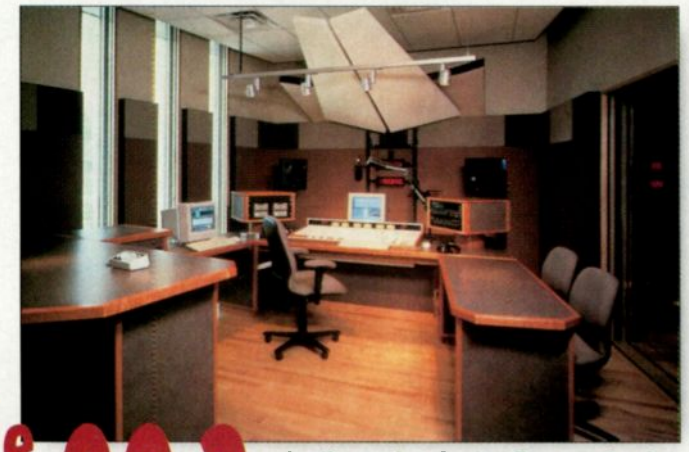
WPLN-FM also aimed to create a pleasant work environment for the staff, enough space to accommodate expansion and the capacity to handle

Nashville Public Radio 90.3

the all-important fund-raising events the station relies upon for its continued growth.

With objectives in hand, the next step was to find a location. Something visible but practical was hoped for. Downtown Nashville proved, like many thriving urban centers, to be unaffordable, so WPLN-FM opted for an 11,500 square foot single story-building situated in Metrocenter, an office park about two miles from the city center.

Nashville Public Radio bought an acre and a half of land to build its new showcase, and the build got underway.



Another look at Control Room B showing how the furniture reflects the shape of the room (Position 2).

Quality dictates

Three specific equipment and design considerations stand out as part of WPLN-FM's new facility. All reflect a focus on acoustical excellence and top-of-the-line performance. These three highlights are Russ Berger studios, Wheatstone consoles and furniture, and Quested speakers.

The intent was to create a team or partnership approach between the station and the contractors and suppliers. Patten-Beers was hired as the general contractor, and Russ Berger designed and built the studios.

The project is an open, spacious and attractive facility with a natural flow of traffic and energy. The wide hallways and studio positioning reflects the station's goal of complete flexibility. There are three main studios and control rooms and some extra room for future growth. WPLN-FM also has three smaller edit rooms, and the entire operation is angled around a technical control center, which includes the engineering shop and music library.

Equipment choices

The three main control rooms each house a Wheatstone A 6000 console. There are 28-input models in Control A and B and a 16-input model in Control C.

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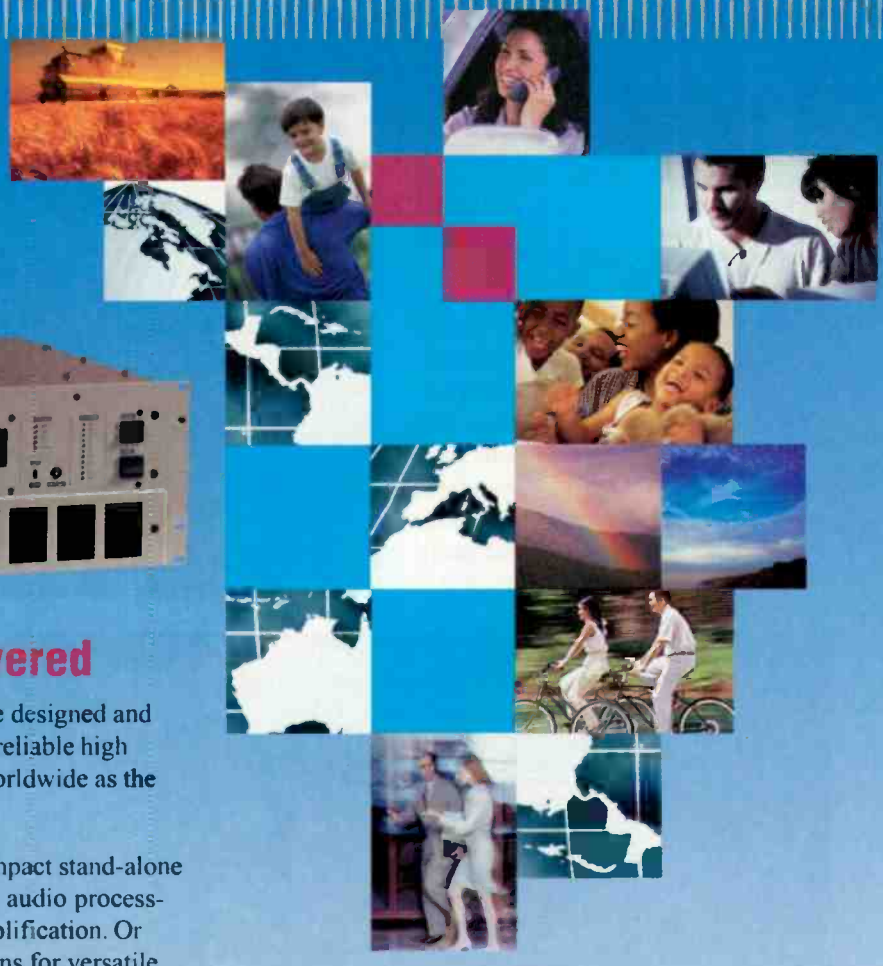

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The wide hallways give the facility a comfortable feeling. On the right is the Tech Center, with Studio B on the left. The Tech Center is open to the hallway but set away from the traffic area (Position 3).

A primary consideration in console selection was the need for multiple program and mix-minus bus outputs. WPLN-FM needs as many as five separate mixes for productions from live studios at one time. Particularly, this arrangement comes into play during the station's bi-annual membership campaigns.

The front lobby welcomes visitors to the new facility.

Control and Studio A are primarily for on-air and interviews, Control and Studio B were designed for production and interviews; the C complex is the largest of the three. With 750 square feet of space, Studio C was created especially for live music recording and production, and it has its own Control Room. Control D is for future growth.

Studio and Control C are the cornerstones of WPLN-FM's facility. Situated at the corner of the building, they are designed to accommodate live recording sessions with musicians and a live audience. A small Wheatstone A 6000 is in the control room. Live multitrack recording can be done in the studio using a Mackie SR24•8 mixer.

Two of the three smaller edit rooms have AudioArts R-16 consoles. These rooms are used for smaller production projects, primarily providing sources to the Sadie digital editing system and playback to the edit-room monitors.

Maximum versatility

Store-and-play and editing production are handled with a Broadcast Electronics AudioVault, making WPLN-FM a cart-free facility. The Tech Center houses the CPU, with redundant servers for backup. The AudioVault automates overnight programming, which is Minnesota Public Radio's classical service. It also handles timeshifting of NPR programs such as *CarTalk* and *FreshAir*.

For production, the station uses Sadie digital editing systems. An SAS audio router sends audio between control rooms, and Wheatstone AudioArts DAs are used throughout the facility.

The rooms are designed not only for their individual functions, but also to be pressed into service as needed for the various types of programming Nashville Public Radio may want to handle down the road. There's an element of versatility, which means the rooms are interchangeable as well.

Rounding out the equipment choices are Denon DN961-FA CD players, Tascam DA-30 MKII DAT machines, Audio-Technica AT4033 microphones, a Gentner SPH-10 telephone hybrid and Telos Zephyrs. Cable TV and other audio and video sources for internal monitoring are also part of the setup. The Tech Center at the hub of the control room and studio

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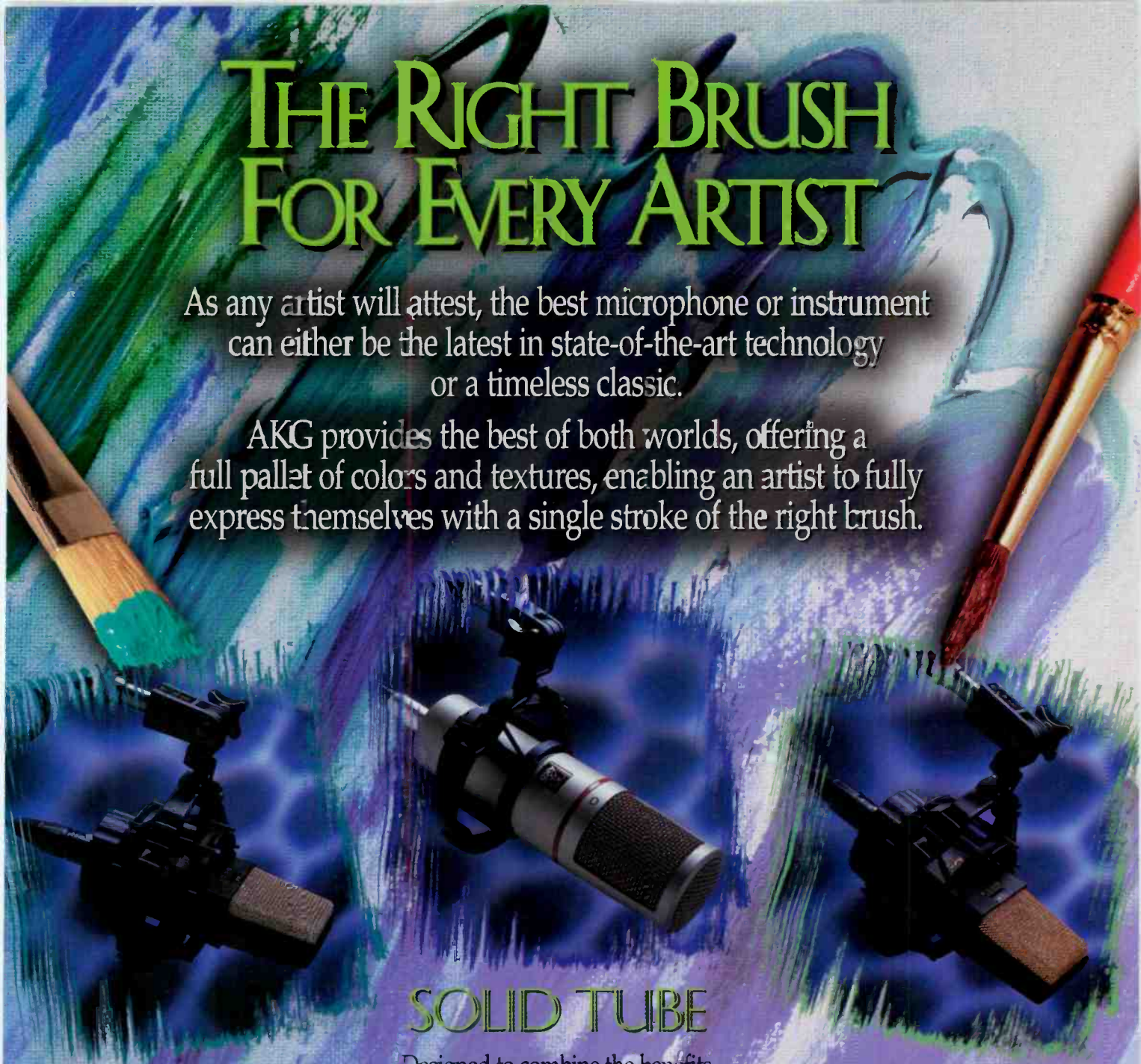

C 414 B/ULS

For over 25 years, this microphone has been the defacto standard for large diaphragm condensers. Switchable polar patterns, pads and low frequency attenuation make the C 414 B/ULS ideal for virtually any application.

SOLID TUBE

Designed to combine the benefits of solid-state and tube technologies, the Solid Tube delivers an exceptionally warm tube sound while maintaining the reliability of solid-state gear.

C 414 B/TLII

Specifically designed for vocals, the C 414 B/TLII features a transformerless output and the legendary C12VR capsule that enable vocals to soar over the rhythm section without disturbing the microphone's pristine sound.

AKG

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E-mail: akgusa@harman.com
www.akg-acoustics.com

Circle (150) on Free Info Card

section of the facility houses all broadcast computer CPUs, satellite receivers, audio routing and distribution.

An extensive conduit system interconnects all studios, control rooms and edit bays through the Tech Center. Each control room and its respective studio has self-contained wiring and only inputs and outputs to and from are cross-connected via router and/or audio DAs in the Tech Center.

An online 30kW UPS powers all of the technical equipment in the facility, including studios, control rooms, edit bays and the Tech Center. An emergency generator is on hand to power the UPS during an extended power failure, including lighting and HVAC for Studios and Control Rooms A and B, the Tech Center and the edit rooms.

Monitors and furniture

Two other examples of excellence in WPLN-FM's design are its top-quality, state-of-the-art monitoring and its custom furniture.

Studio C is ideal for live performances. Control Room C can be seen on the right. The Tech Center is visible through the door on the left (Position 4).

The station's aim in selecting good speaker/monitors was to eliminate the variation from room to room, which can result in mixing errors and, ultimately, uneven on-air sound quality. Having already paid careful attention to getting just the right room acoustics, it was equally important to select an audio monitor that would complement the clean, unaffected acoustical characteristics of the room. Quested 2108 powered studio reference monitors were chosen for the job.

Their small size allowed mounting the monitors on Sound Anchor speaker stands and their 210W bi-amplification provides enough headroom to avoid the need for peak limiting to prevent clipping distortion. For the remaining rooms and edit booths, the Quested F-11s were chosen.

The shape of the rooms was unusual, and thus the furniture had to be as well. The trapezoid shape of the rooms was dictated by acoustical concerns. The front ends are narrow and flare out at angles of 99 degrees. The Wheatstone furniture mirrors this layout. This not only gives the operator more room, but also allows for a rear producer area with equipment rack

The plaza at the rear of new facility has an arbor, space for events, and a unique, curved walkway.

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FACILITY SHOWCASE

Control Room C has two consoles to provide greater versatility and allows for mutitrack or basic stereo production (Position 5).

to consider the station's future. What will public radio be like in 10 years? No one can answer that question, but the staff of WPLN-FM believes it has a facility that is flexible enough to accommodate different kinds of programming, whatever they may be. The station that started in a single room in a public library has become a radio showcase in the music capital of the world.

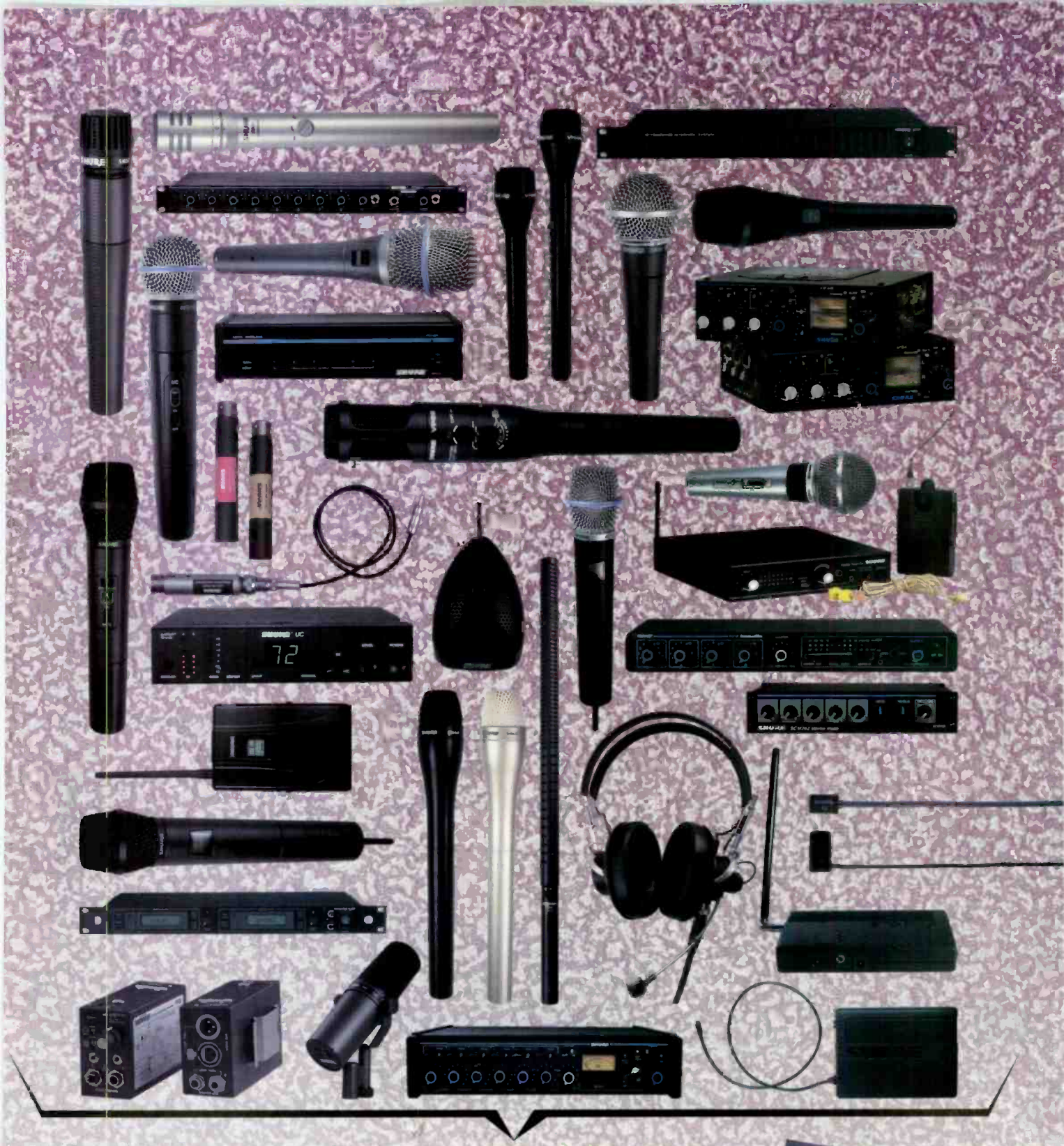
space below for DATs, router controls, phone hybrids and other equipment.

Ready for the future

The entire project — planning, building, installing and going on-air — was accomplished in only 18 months. To evaluate the results, it's important

Judith Gross is a freelance writer with more than two decades of experience in the radio industry. She runs JG Communications in Binghamton, NY.

Thanks to Carl Pedersen, director of operations and administration, WPLN and Russ Berger Design Group for their assistance in preparing this article. Photos by James S. Wilson and courtesy of Russ Berger Design Group.



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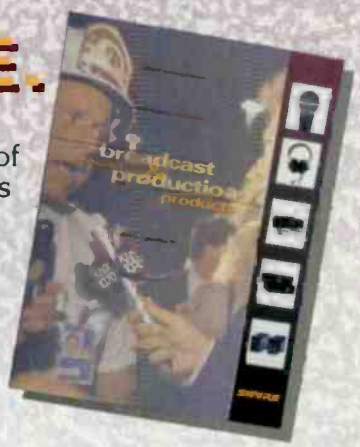

Circle (140) on Free Info Card

New Products APPEARING AT NAB99

Portable solid-state recorder
Maycom/Booth L10857

◀ The **Easycorder** is the second-generation, portable solid-state recorder with onboard graphic editing using both internal memory and removable PC cards. The unit is standard equipped with an internal memory facility that enables direct usability of the recorder. The battery pack lasts more than six hours in operating mode and is equipped with a module that provides a precise indication of the remaining capacity. The machine also operates using standard alkaline C batteries. Time-shift recording, which enables the machine to start recording before the record button is actually pressed, is available. Also available is communication software that enables the user to transfer audio files back to the studio using standard ISDN lines.

+31 481 377740; fax +31 481 3777380; miranda@maycom.nl; www.maycom.nl
Circle (211) on Free Info Card

Field probe enhancements
Holaday/Booth L13980

The **HI-4413P RS-232** computer interface and ProbeView EMF analysis software allow quick data gathering from Holaday electromagnetic field probes. The software provides real-time display, logging and analysis functions of EMF data and displays a variety of test information numerically and graphically. Complete data information can be exported into MS-Excel and is available for custom software applications.

612-934-4920; fax 612-934-3604; holaday@holadayinc.com; www.holadayinc.com
Circle (212) on Free Info Card

Rack-Systems
Equi=Tech/Booth L11597

▶ The **ET1.5R** (15 amps) and **ET2R** (20 amps) rack-system products, formerly 3RU-high chassis, are now offered in 2RU-high versions. The smaller chassis weigh 15 pounds less than their predecessors. The warranty has been extended to three years on parts and labor for all the rack systems, and there is a lifetime replacement warranty on the power transformer.

541-597-4448; fax 541-597-4099; www.equitech.com
Circle (214) on Free Info Card

10kW FM transmitter
Continental Electronics Corp./Booth L18830

The **10kW FM transmitter** eliminates the need for a standby transmitter and is available in single- or three-phase power formats. It offers a flexible air-handling system that allows for a variety of installation options. The transmitters can be tailored with internal or external blowers and multidirectional airflow.

214-381-7161; fax 214-381-3520; dburkey@contelec.com; www.contelec.com
Circle (215) on Free Info Card

Analog audio generator
Neutrik USA/Booth L16552

▼ The **Minirator MR1** provides a comprehensive set of audio test signals as required in broadcast audio environments. The instrument provides sinusoidal signals over the entire audio band, from 20Hz to 20kHz

at levels as low as –76dBu up to +6dBu, including sweep capabilities at various speeds. Alternative level units are dBV and volts. A dedicated polarity test signal enables the user to unveil devices with inverse polarity. The white and pink noise signals with low crest factors and high-repetition rates act as an ideal source for room acoustic measurements, frequency response equalizations and signal evaluation.

732-901-9488; fax 732-901-9608
neutrikusa@aol.com; www.neutrikusa.com
Circle (213) on Free Info Card

Redbox range of products
Sonifex/Booth L10687

The additions to the digital **Redbox** line will include a digital distribution amplifier with S/PDIF or AES3 outputs, an A/D converter and a sample rate converter. The units are able to handle 96kHz audio and are based on the same styling as the analog product range, with red anodised cases that can be screw-mounted or rackmounted.

+44 1933 650700; fax +44 1933 650726
sales@sonifex.co.uk; www.sonifex.co.uk
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Circle (152) on Free Info Card

New Products • Appearing at NAB99

Broadcast Network Transceiver
Audio Processing Technology/Booth L12470

The **NXL384** range is available in analog or digital versions. Designed as a cost-effective solution to audio communications across permanent digital networks, the unit provides the benefits of apt-X to STLs and studio to studio networking. apt-X technology guarantees uncompromised audio quality and lowest available coding delay to the broadcaster. The NXL384 offers features such as auxiliary data, alarm functions and integral backup circuitry to ensure program continuity.

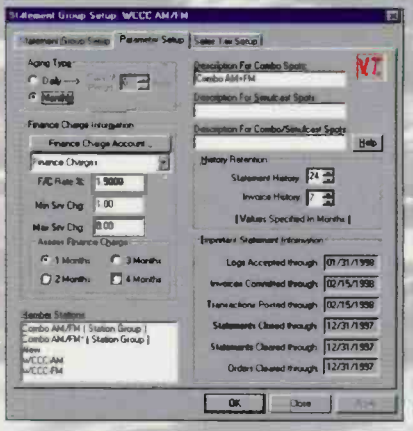
+44 1232 371110; fax +44 1232 371137; salesuk@aptx.com; www.aptx.com
Circle (217) on Free Info Card

Networked storage access
Transoft Networks/Booth S9152

FibreNet DS provides networked storage access without the restrictions caused by traditional network speed, bottlenecks or storage limitations. FibreNet DS presents the concept of "shared data" and allows heterogeneous or homogeneous hosts to concurrently access file systems. Individuals sharing data can now easily optimize their cross-platform environments. The data sharing features of FibreNet DS deliver unprecedented performance for distributed file systems, allowing a group of heterogeneous nodes to read and write to the same file system and even the same file using byte range locking. FibreNet DS provides a solution for high-speed digital data transfer where Mac, UNIX and NT systems access shared data in audio, video, animation, imaging, data warehousing and other storage-intensive production environments.

805-884-9114; fax 805-897-3355; enarmore@transoft.net; www.transoftnetworks.com
Circle (218) on Free Info Card

Visual Traffic corporate module
Computer Concepts/L13666



Visual Traffic is a 32-bit, Windows NT-based traffic and billing system with import/export flexibility, predefined and user-definable management reports, and the ability to calculate commission rates, splits and sales goals. The new Corporate Module uses a central database that allows users to enter an order once for many V.T. sites. Once entered, the order will be distributed to all V.T. sites targeted. Users may also view the actual and projected billing for the order for any or all of the targeted V.T. sites.

800-255-6350; fax 913-541-0169
Info@ccc-dcs.com; www.ccc-dcs.com
Circle (219) on Free Info Card

Analog radio console
Wheatstone Corp./Booth L12171

The **A-5000** uses the same mainframe as the Wheatstone D-500 series digital console, which allows future conversion to full digital operation. Standard features include four stereo buses, two internal mix-minus assigns, full machine logic, electronic switching, LED-illuminated switches and fully hot-swappable modules.

252-638-7000; fax 252-637-1285
email@wheatstone.com
www.wheatstone.com
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MP-1	1	600W	-3.3	$250
MP-2	2	800W	0	$680
MP-3	3	800W	1.4	$980
MP-4	4	800W	3.3	$1,280
MP-2-4	4	2,000W	3.3	$1,820
MP-3-5	5	3,000W	4.1	$2,270
MP-3-6	6	3,000W	5.2	$2,740

LOW POWER CIRCULAR SERIES

Model	Bays	Power	Gain	Price
GP-1	1	2,000W	-3.1	$350
GP-2	2	4,000W	0	$1,350
GP-3	3	6,000W	1.5	$1,900
GP-4	4	6,000W	3.4	$2,600
GP-5	5	6,000W	4.3	$3,150
GP-6	6	6,000W	5.5	$3,700

MEDIUM POWER CIRCULAR SERIES

Model	Bays	Power	Gain	Price
SGP-1	1	4,000W	-3.3	$690
SGP-2	2	8,000W	0	$2,690
SGP-3	3	10,000W	1.4	$3,595
SGP-4	4	10,000W	3.3	$4,500
SGP-5	5	10,000W	4.1	$5,300
SGP-6	6	10,000W	5.2	$6,100

The antenna gain may vary with the frequency. For powers up to 20 KW please, make the request to provide the specific configuration.

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Time-compression tool
Prime Image/Booth L23485

◀ **Cash** allows stations to create an additional 60sec for every 10min of programming. The system does so undetectably, without altering pitch or creating digital artifacts. It works live, in real time, on the air. The amount of time Cash creates varies from 0min to 4min and can be added to any period of time within the range of 2min and 2 hours. The station can select and change the amount and the rate at any time.

408-867-6519; fax 408-926-7294; primlmageinc@earthlink.net; www.primlmageinc.com
Circle (221) on Free Info Card

Microphone preamplifier
Neumann USA/Booth L24825

The **True Audio Precision 8** provides eight channels of transformerless mic pre-amps, two of which can be used as direct instrument inputs. Each channel also offers five-segment level indicators with a selectable peak-hold feature. A button on channels one and two allows them to be used as an MS pair for added flexibility. Designed for use with today's modular digital multitrack units and hard-disk recording systems, the system can be connected to Tascam or Mackie digital products via a DB 25 multi-pin connector.

860-434-5220; fax 860-434-3148; kwinkler@neumannusa.com; www.neumannusa.com
Circle (222) on Free Info Card

Speaker system series
Hafler/Booth S8729

▼ The **TRM6**, the latest addition to the Active Monitor Speaker System, is a two-way, bi-amplified active speaker system that is magnetically shielded. Offers a free field frequency response

of 55Hz to 21kHz ± 2dB. The peak acoustic output per speaker pair using music as a sound source at 1m is 120dB or greater. Total harmonic distortion is 100Hz to 21kHz (90dB at 1m on axis).

888-HAFLER1; fax 602-894-1528
www.hafler.com
Circle (223) on Free Info Card

Digital Universe expansion
Custom Business Systems Inc.
Booth L12553

The **NetCapture** facility permits flexible recording of incoming satellite programming, and live audio routing allows such feeds to be played directly to air in real time. With access from any Digital Universe workstation, these new functions vastly increase broadcasters' ability to route audio material intelligently through a facility. The NetCapture capability allows Digital Universe users to set up a schedule for pre-recording of satellite inputs. Schedules can be entered by exact time, or by other parameters: for instance, to begin recording upon receipt of a specific tone. As many as eight different sources can be recorded simultaneously from a single machine.

800-547-3930; fax 541-271-5721
Info@cbsi.org; www.cbsi.org
Circle (224) on Free Info CardDavicom

New Products • Appearing at NAB99

AES/EBU snake cable
Gepco/Booth L16461

▶ The **552608GCF** — a flexible, thin-profile, eight-pair digital cable — is designed for cable assemblies with multi-pin connectors, studio and rack interconnect, or medium-length permanent installation runs. Well-suited for terminating to the high-density multi-pin connectors found on many of the latest digital audio consoles, multirack recorders and routers. The color-coded pair jackets follow the base-10 resistor color code. The master jacket is UL-listed, NEC-type CM. The 100Ω cable features two 26-gauge tinned copper conductors, a foam PE dielectric and a foil shield with 26-gauge TC drain wire.

312-733-9555; fax 312-733-6416
gepco@gepco.com; www.gepco.com
Circle (225) on Free Info Card

Plug-on transmitter
Telex/Booth L24228

The **ProStar UHF UT-12** universal plug-on transmitter allows the use of any XLR compatible dynamic and electret-type microphone with Telex's ProStar UHF wireless microphone system. The system operates on the UHF band in the 690 to 725 RF carrier frequency range while offering a frequency response of 50Hz to 15kHz. Frequency stability measures .005 percent with an unweighted signal-to-noise ratio of 91dB with less than 0.5 percent third harmonic distortion.

612-884-4051; fax 612-884-0043
pro.sound@telex.com; www.telex.com
Circle (226) on Free Info Card

Music recording and mastering
Digital Audio Research Ltd. (DAR)
Booth L18107

DARs OMR8 lineup includes the high-resolution music recording and mastering **OMR-8MR** and the **OMR8-P** for audio production/post-production editing. A high level of audio networking is integral to DARs design approach, with the inherent flexibility of the OMR8 based on DARs Genesis software platform. Addressing the fundamental issues of file format and data handling, Genesis has adopted Microsoft .wav files as its native format, enabling easy compatibility with other products.

+44 1372 742848; fax +44 1372 743532
www.dar.uk.com
mail@dar.uk.com
Circle (227) on Free Info Card

Audio cart-replacement system
Virtual Sound and Video

V-CART is a full-featured digital audio cart-replacement system for the Mac. Offers unsurpassed flexibility and the most cost-effective solution to record, play and edit audio in the live environment. Features include 120 On Demand keys allowing instantaneous playback, a 10,000 entry playlist with single play, loop, segue, auto-cue, Jog, and playlist EDL. Other features include manual and automatic recording modes, logging to text file or database. (templates included), and drag-and-drop file entry and playlist assembly. A Windows version will soon be available.

732-274-9451; www.v-cart.com
Circle (228) on Free Info Card

FM power monitor
Davicom Technologies/Booth L13057

The **FMPM-01** monitors the RF power level at the transmitter output and includes a demodulator to provide a sample of the audio signal.

609-653-1065; fax: 609-653-1075
Infodavicom@davicom.com
www.davicom.com
Circle (229) on Free Info Card

Professional digital audio media
Maxell
Booth L24512

◀ The new family of media for professional audio applications includes the **MD-PRO**, **DAT**, **DTRS** and **A-DAT**. The MD-PRO74's sensitive magnetic layer delivers a carrier-to-noise ratio of 47dB, very low bit-rate errors and a wide magnetic power margin. A microscopic layer of protective lubricant covers the disc surface, which ensures longevity. The DAT cassettes use ceramic armor metal particles that deliver more than 2600 Gauss of magnetic energy. Also featured are a highly uniform dispersion and precision surface polishing, which result in higher RF output and lower modulation noise.

800-634-9366; fax 201-796-8790
pbyrne@maxell.com; www.maxell.com
Circle (230) on Free Info Card

New Products • Appearing at NAB99

Digital Telephone Hybrid
Gentner Communications/Booth L10671

▶ The **DH30**, with new customer-driven features, replaces the DH3 telephone hybrid. Ideal for an open studio or talk-show format, since its acoustic echo cancellation and digital signal processing (DSP) technologies eliminate unwanted noise and enhance the overall quality of incoming and outgoing audio signals. Additional processing features automatically compensate for abrupt increases or decreases in audio levels.

800-945-7730; fax 801-977-0087; info@gentner.com; www.gentner.com
Circle (231) on Free Info Card

Solid-state FM transmitter
Broadcast Electronics
Booth L13677

The **FM-10S** 10kW transmitter features an extensive redundancy and protection system that will keep the signal on the air even in the most extreme conditions. An available standby exciter, IPA, and power supply can give you full power standby capability without the cost of an additional standby transmitter. Large, removable front and rear panels provide access to every major assembly for fast and easy repair.

217-224-9600; fax 217-224-9625
kwinking@bdcast.com; www.bdcast.com
Circle (232) on Free Info Card

Integrated software suite
Dalet/Booth L13394

The **Dalet 5** addresses the complete range of tasks performed in radio: live or automated broadcasting, program scheduling, production, news and traffic management. Dalet's new InterWeb for group connectivity, TeamNews for all newsroom requirements, and TeamRadio for group-wide traffic management will be showcased.

212-825-3322; fax 212-825-0182
www.dalet.com
Circle (233) on Free Info Card

1x5 AES/EBU Digital amplifier
Harris/Booth L16710

The **HDDA** is available in two configurations. The HDDA 12/110 is a transformer balanced 110Ω device with inputs and outputs on screw terminals. The HDDA 12/75 is a 75Ω device with termination BNC connectors. Both feature cable equalization, data relocking and signal error detection. Detected errors can be used to trigger an external alarm. A seventh digital output is provided on a ¼-inch jack located on the front panel. Both models are suited for monitoring with an optional Harris ABB-1 Audio Bit Buddy, or they can be patched to route the signal to another destination.

800-622-0022; fax 513-459-3890; broadcast@harris.com
www.broadcast.harris.com/communications
Circle (234) on Free Info Card

Modular interfacing system
Leitch/Booth L22257

▶ The **Genesis 6000** Eurocard system can mix optical, analog/digital audio/video signals within the same racking system. With more than 30 different card-based products, Genesis offers solutions to simple or complex system-integration problems.

800-231-9673; fax 757-548-4088; www.leitch.com
Circle (235) on Free Info Card

New Products • Appearing at NAB99

Sound isolation enclosures
WhisperRoom/Booth S4514

▼ The **SE Series** of portable isolation enclosures offers a unique modular design with manageable component weights. Easily assembles and disassembles. Walls are 3 inches thick, and floor and ceiling panels

are an inch thick. Provides access for communications (e.g., microphone, headphones, speakers). Features acoustically engineered, detachable ventilation systems. A door window is standard, and a wall window is optional.

423-585-5827; fax 423-585-5831
whisper@lcs.net; www.whisperroom.com
Circle (236) on Free Info Card

Compact monitor
HHB/Booth L13994

The **Circle 3** monitor combines a custom-designed, linear response 5.5-inch mid/bass driver with a ferrofluid-cooled, soft-domed tweeter. Features a controlled order crossover and a consistent sonic signature across the range. The input is balanced XLR or unbalanced RCA phono (switchable), and the amp pack uses low-noise semiconductors, 1-percent precision resistors and heavy-duty power supplies with long-life capacitors to deliver 60W to the mid/bass driver and 60W to the HF unit.

310-319-1111; fax 310-319-1311
sales@hhbusa.com
www.hhb.co.uk
Circle (237) on Free Info Card

CD player
Tascam
Booth L22383

▶ The **CD-450** features Auto Cue and Auto Ready functions, Call and End of Message functions, Fader and Event Start capability, incremental play, numeric keys, and all the connectors needed to interface with other equipment.

323-726-0303; fax 323-727-7635; www.tascam.com
Circle (238) on Free Info Card

New Products • Appearing at NAB99

Digital console card
TC Electronic/Booth L10694

UnitY Yamaha O2R enhancements include the Finalizer studio mastering technology as an optional type of processing in lieu of M2000-style effects. A 24-bit ADAT/TDIF I/O card is also available. UnitY cards now ship with M2000 and Finalizer software and are active for a 100-hour trial period. At the end of this period, the user will be prompted to select which configuration to continue running. Accessing both types of signal processing is possible by purchasing an additional software license from TC Electronic. The optional ADAT/TDIF I/O card gives the user access to the inputs and outputs within the card slot occupied by the UnitY.

805-373-1828; fax 805-379-2648
tcus@tcelectronic.com
www.tcelectonic.com
Circle (240) on Free Info Card

Diversity wireless mic system
EVI Audio/Booth L24228

◀ The **R200**'s proprietary Secure-Phase diversity uses the signal from both antennas at all times to eliminate phase or polarity shifts and maximize signal strength. Operates in the range between 710.100MHz and 721.350MHz on single frequencies. The system's RCU receiver is designed to work with microphone signals and offers a three-pin, XLR-type balanced mic level and ¼-inch unbalanced line-level output connectors and specially tuned antennas.

616-695-6831; fax 616-695-1304; tbriggs@eviaudio.com
Circle (239) on Free Info Card

Joemeek stereo compressor
PMI Audio Group/L10883

The C2 is a 1RU stereo compressor. The unit offers a range of compression effects based on a new design that makes the compression ratio vary with the input control. Incorporates the newly developed Joemeek Sum and Difference compression system, thus improving the unit's stereo image stability and the accuracy of the left and right gains. Features auto-variable slope optical compression/limiting.

310-373-9129; fax 310-373-4714; sales@joemeek.com
Circle (241) on Free Info Card

AES3 audio distribution amplifiers
Audio Technologies Inc./Booth L16126

▶ Several models of **AES3 distribution amps** are available in single and dual input configurations. Optimized for balanced 110Ω XLR or 75Ω BNC coax outputs. The units detect sample rates from 27kHz to 96kHz, display standard rates, and generate low jitter outputs to drive up to 12 XLR or 24 BNC lines. They also feature adjustable input cable equalization with status and error readouts.

215-443-0330; fax 215-443-0394; www.atiguys.com
Circle (242) on Free Info Card

Wireless mic receivers
Azden/Booth L13157

◀ The **411DRH** UHF receiver is manufactured in a metal half-rack case and is designed to stand alone or mount, with optional rack adapters, in a standard full 19½-inch rack. Features include a front panel on/off switch, volume adjust and RF and audio level display. Also on the front panel are the group and channel adjustment switches for choosing one of the 63 user-selectable UHF channels. The rear panel features twin removable antennas, both a balanced XLR and an unbalanced ¼-inch output connector, the 12V DC power connector and a newly added Squelch adjustment.

516-328-7500; fax 516-328-7506; azdenus@aol.com; www.azdencorp.com
Circle (243) on Free Info Card

New Products • Appearing at NAB99

Instant shelter
E-Z UP
Booth L13691

◀ The **Eclipse** model features a white, powder-coated rustproof steel frame, a fabric top and glider inserts that provide smooth opening and closing action. Available in sizes ranging from 8'x8' to 10'x20'. Tops are available in 23 colors. The shelters can be customized with logos and call letters. Each unit comes with stakes.

800-45-SHADE; fax 909-781-0586; www.ezup.com
Circle (244) on Free Info Card

Modular ISDN multiplexer
Harris/Booth L12853

The **Intraplex IntraLink** ISDN monitor can control up to six basic-rate ISDN lines in a single 3RU shelf. Handles any combination of program audio, voice and data using standard Intraplex channel modules. It can link five shelves for 30 BRI and is compatible with most industry codecs. Delivers MPEG program audio up to 128kb/s and delivers LAN data at 128kb/s. Telex and Clearcom voice and data compatible for remote intercom use and is field-configurable via a new Windows-based user interface.

800-622-0022; fax 513-459-3890; broadcast@harris.com
www.harris.com/communications
Circle (245) on Free Info Card

Autoloading CD-R duplicator
MediaFORM/Booth S8664

▼ The **CD-3704** is a four-drive, standalone system that delivers one-button operation and unattended duplication of up to 100 CD-Rs.

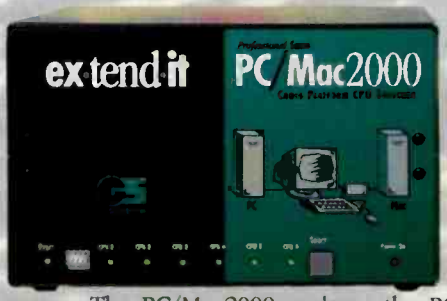
Features include separate accept and reject bins; prescan, which scans the master for errors prior to burning; and a Smart Controller, which automatically identifies complex formats like ISO, Hybrid, Mix Mode, HFS and Red Book CD-Audio.

610-458-9200; fax 610-458-9554
info@mediaform.com
www.mediaform.com
Circle (246) on Free Info Card

New Products
Appearing at NAB99

CPU switcher
Gefen Systems/Booth L17860

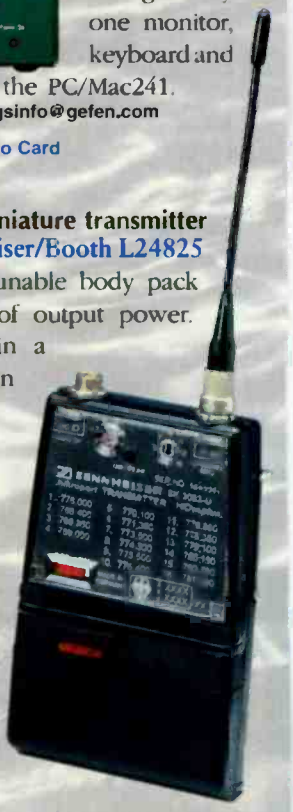
▼ The **ex-tend-it PC/Mac2000** allows for switching between any combination of up to six PCs and/or Macintosh computers using only one monitor, keyboard and mouse. The PC/Mac2000 replaces the PC/Mac241.



818-884-6294; fax 818-884-3108; gsinfo@gefen.com
www.gefen.com
Circle (247) on Free Info Card

Miniature transmitter
Sennheiser/Booth L24825

▶ The **SK3063** is a miniature, tunable body pack transmitter that provides 50mW of output power. Sixteen selectable frequencies in a 24MHz micro range operate within the UHF macro range of 450MHz to 960MHz. The micro range can be retuned within the bounds of the macro range to ensure continuous operation regardless of DTV frequency allocations. A HiDyn *plus* noise-reduction system exhibits a signal-to-noise ratio of 108dB(A). Phase-lock loop technology ensures frequency stability.



860-434-9190; fax 860-434-1759
www.sennheiserusa.com
Circle (248) on Free Info Card

Multidrive duplicators
Discmatic

▼ The **MDX7000** and **MDX3000** tower modules, featuring seven and three CD-R drives respectively, can produce up to 21 full CDs per hour. For quicker duplication, the newly designed SCSI bus allows a faster data transfer rate and copying of up to seven discs simultaneously. Both units can copy directly from CD to CD rather than working through the hard drive. They can also save the information to the hard drive during copying, combining two steps into one. The core logic for both units is stored on an advanced flash ROM and the internal firmware can be upgraded via a firmware CD or by downloading the firmware file from the Discmatic website.

800-422-6707; fax 516-894-9700; info@discmatic.com
www.discmatic.com
Circle (249) on Free Info Card

New Products
Appearing at NAB99

Transient voltage surge suppressors
Lightning Eliminators & Consultants/Booth L18109

▲ The **Sandwich Block** has been designed to withstand up to 1,280,000 amps per phase without destruction or potentially compromising the protected system. Meets UL 1449 Second Edition standards on its own. Its redundant safety mechanism ensures total protection from surges and overvoltages, and it has energy-handling capabilities of up to 50k Joules.

800-521-6101; fax 303-447-8122
www.lightningeliminators.com
Circle (250) on Free Info Card

PC-based digital audio system
Mediatron/Booth L10283

The 1999 version of the **AirControl NT** hard-disk PC-based digital audio system for radio, includes new plug-in tools to make it more effective in connecting with technologies like the Internet, intranet, and DAB. With the new system, it is possible to enter into the broadcast schedule of a Mediatron system anywhere and to record directly into the schedule. The recorded voice elements can be directly transmitted. Available in standard and professional versions. The standard version can be built up step-by-step to the professional version.

+49 8131 8305 0; fax +49 8131 8305 25
info@mediatron.com
www.mediatron.com
Circle (251) on Free Info Card

New Products • Appearing at NAB99

Multichannel audio converters
Euphonix/Booth L12483

This family of converters comprises 44.1/48/96KHz, 24-bit signal paths and features 28-channel modularity. Configurations include analog-to-AES3, AES3-to-analog, AES3-to-MADI, MADI-to-AES3, MADI-to-analog, analog-to-MADI, analog-to-analog via MADI (snake), and AES3-to-AES3 via MADI (snake). Features include on-demand sample-rate conversion and bit reduction per AES3 stream, and auto-detection of external sync.

818-766-1666; 818-766-3401; www.euphonix.com
Circle (252) on Free Info Card

Streaming audio player
Digigram/Booth L10653, S9524

Connected to a server via Ethernet (10/100BT), the **NCX200** decodes and plays a stereo audio stream. A bidirectional serial connection permits source selection, status and other communication with the server. This terminal is designed for a variety of networked audio applications, including audio-on-demand, permanent playback and public address in places. Programmed using the Digigram SDK, the NCX200 is the first in a new range of Digigram audio appliances.

703 875 9100; fax 703-875-9161
glassman@digigram.com
www.digigram.com
Circle (253) on Free Info Card

Surge protector
Tripp Lite

The **Super 10** features 10 outlets with built-in safety covers. Two of the 10 outlets are designed to remain on even when the master power switch is off. All Super 10 models include a 10-foot cord to reach distant outlets and a space-saving right-angle plug. Colored cord stickers identify each connected device's cord. A unique design allows transformers to be plugged in without covering adjacent outlets. The deluxe model includes a fourth LED to alert users to dangerous low-voltage conditions that could damage connected equipment and corrupt data.

773-869-1111; fax 773-869-1FAX; info@tripplite.com; www.tripplite.com
Circle (254) on Free Info Card

Windows to the Web

www.neutrikusa.com

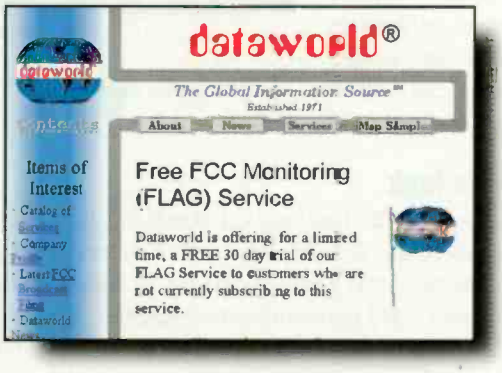
NEUTRIK USA, Inc.: The NEUTRIK USA, Inc. website features direct links to various sites including Authorized Distributors, Sales Representatives, NEUTRIK USA, Inc. offices and our parent company's website for on-line access to spec drawings through WHIP files. Viewing includes a What's New section for new product introductions and a Trade Show section so that you can come see our products in person!

www.contelec.com

Continental Electronics: Things to find on the www.contelec.com Web site are: District Sales Manager's contactdata; Factory Marketing & Sales personnel contact data; E-Slide - FREE engineering software; Product Line Descriptions and Specifications; Links from Broadcast Supply Division to vendor Web sites.

www.omt.net

OMT Technologies: MediaTouch by OMT Technologies provides radio stations with state of the art digital audio systems for live assist or full automation use. With over 14 years of broadcast experience, MediaTouch has innovative software solutions starting as low as $995. Surf to MediaTouch, see our exciting new products, and find out how our clients sound better and save money with our unsurpassed quality, reliability, and support.

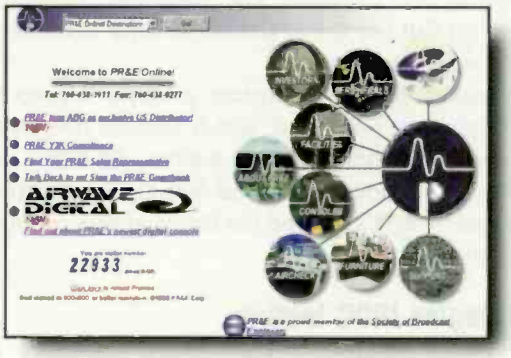


www.dataworld.com

Dataworld: Dataword is an industry-leading information services company founded in 1971. Twenty-eight years of software development and data processing experience allows Dataworld to set trends in information services and solutions. Click on Dataworld's home page for exciting information on our Flag Service, the production of DataXpert and our new line of digital television services.

www.prophetsys.com

Prophet Systems: Discover true digital audio with the Audio Wizard CFS32 from Prophet Systems Innovations.



www.pre.com

Pacific Research & Engineering: Since 1969, Pacific Research & Engineering has been the most respected manufacturer of on-air and production consoles, studio cabinetry and peripheral equipment for the radio broadcasting industry. Installations cover more than 2,000 studios including seven of the top ten radio stations in the U.S., as well as networks like ABC, CBS and ESPN Radio, and showcase facilities including Disney World and Universal Studios.

News

Radio Engineering Achievement Award


Mendenhall

▶ Geoffrey N. Mendenhall has been honored with the 1999 NAB Radio Engineering Achievement Award. The awards were established in 1959. They are given to industry leaders who've made contribution to the state of the art of broadcast engineering. Mendenhall is vice president for advanced product development of Harris Broadcast Systems Division. He has worked in the broadcast industry for 35 years and is an FM transmission expert.

GE-3 loses lock

Just after 4:00 in the morning on March 12, 1999, some radio stations in the U.S. experienced disruption in their services. The problems were caused by an anomaly with GE Americom's GE-3 communications satellite. The satellite experienced a sudden malfunction in the unit's inertial measurement unit. The IMU contains the gyroscopes that allow the satellite to remain properly positioned. Thus, the craft lost earth lock and began to turn slowly. The satellite was placed in "safe" mode and restoral plans were executed.

Some of the affected radio stations were able to use restoral services to maintain transmissions until the GE-3 anomaly was corrected. ABC Radio Inc., for example, relied on SatCom C-5 to provide a copy of the feed the GE-3 usually generates.

GE Americom provided constant progress reports to those receiving the GE-3 feed, which allowed owners to relay proper information to their stations. By 8:00 a.m., the satellite was properly stabilized. The C-band function was restored by 8:55 a.m., and the Ku-band was restored by 9:49 a.m.

Lucent begins IBOC testing

Lucent Digital Radio, a wholly owned subsidiary of Lucent Technologies, has announced that it is testing its In-Band On-Channel (IBOC) Digital Audio Broadcast (DAB) system with National Public Radio member station WBJB-FM. The field tests, which will begin immediately, will evaluate a range of technical issues associated with digital FM radio. WBJB-FM, licensed to Brookdale Community College in Lincroft, NJ, is the first NPR member station to test the current generation of IBOC DAB systems.

Lucent has also announced that it will begin commercial radio tests through an agreement with Nassau Broadcasting Partners, based in Princeton, NJ, a statewide radio network that owns 19 stations. According to Lucent, these tests will be the most extensive, advanced tests of digital radio to date in the U.S. Lucent will supply the hardware and software for the field-testing. Nassau Broadcasting Partners will provide the radio sites and will support the test evaluation.

In January, Lucent unveiled its Multi-Streaming technology, which solves the problem of providing high-quality digital audio reception over a coverage area equal to that of current analog FM stations.

The tests with Nassau Broadcasting Partners will evaluate several technical issues associated with digital radio, including interference, range of signal and audio quality. Lucent's IBOC system draws on a number of patented Lucent digital audio and channel coding techniques, including the Perceptual Audio Coder (PAC) algorithm; Unequal Error Protection, which prioritizes information based on its impact on audio quality; and Multi-Streaming, a combination of techniques that extends the coverage of digital signals by allowing for graceful degradation of audio quality.

Lucent will test its AM IBOC system in mid-1999 and will conclude all field tests on its system by the end of year. The company expects to have product-ready systems available in 2000.

FCC auctions coming slowly

By early April, the FCC is expected to release its order affirming its August 18, 1998, First Report and Order, which substituted auctions for comparative hearings as the method to resolve mutual exclusivity among competing applicants for commercial broadcast spectrum.

There still is no word as to when the freezes on processing AM major changes and AM and FM new applications will be lifted. Nor is there much hope that auctions will be held before September. Under the auction rules adopted in August, which are likely to be affirmed in most respects, each group of auctionable applications will be the subject of a public notice by the Wireless Bureau (the FCC's auction manager), which public notice will propose minimum bids and other specific auction methodology. These public notices will seek comment from the eligible participants. The public notice/comment procedure is not likely to begin until the reconsideration order becomes "final" probably in mid-May, and processing the many groupings of MX'd applicants will be time-consuming.

Business


Kaltman

▶ Recently, the French communications equipment manufacturer **AETA Audio** opened its U.S. subsidiary in Rockaway, NJ. Sales, marketing, shipping and technical support will be functions of the U.S. division. **Mark Kaltman** will serve as president of the operation. Most recently, Kaltman has held the positions of sales manager for Denon Electronics and for Wheatstone.

EMTEC Pro Media reports that no interruptions will occur in its worldwide operations when the year 2000 begins. Its Y2K compliance efforts have included outreach to its suppliers and haulage contractors as well as detailed testing of computer systems at all its manufacturing and business sites.

Blaupunkt has developed a technology that converts incoming radio signals into digital data, resulting in significant improvements in reception capability, sound quality and convenience compared with conventional radios. DigiCeiver technology will first be used in a new line of Blaupunkt car stereos that will be introduced later this year.

By converting the analog signal to digital, the unit performs the demodulation in DSP and produces high-quality stereo sound, reduces interference and distortion, extracts Radio Data System and other data subcarriers, and provides a high level of digital control over the functioning of the analog front-end circuitry.

CD Radio Inc. has announced the opening of a new office in Detroit. The office will give CD Radio a local base for furthering relationships with major automotive companies. CD Radio's Detroit office can be reached at 248-449-2970 and its fax number is 248-449-2971.

Bayerischer Rundfunk has signed an agreement to purchase 14 of **Continental Electronics'** new 10kW solid-state FM transmitters. The new transmitting system will be installed at transmitting sites in Ochsenkopf and Kreusberg, Germany.

In March, **Wheatstone** purchased **Auditronics**. Wheatstone recently moved into new facilities located at 600 Industrial Dr., New Bern NC 28562. Auditronics is currently based in Memphis, TN.

NETIA has two new websites. Check the sites out at www.netia.net or www.netia-broadcast.com..

Sonifex, in collaboration with its Danish distributor, **Interstage**, has completed a project for Danish Radio to produce 95 desktop units to connect to their existing journalists' **Dalet** workstations.

Each desktop unit, called PCXtender, comprises a steel box on which a PC monitor can sit. The box links to another unit that can be screw-mounted to the underside of a desk nearer the recording sources. The units provide dual stereo analog and stereo digital inputs to, and stereo analog outputs from, the PCX audio cards of the Dalet workstation.

An input switch has an input level control. An input balance control together with an image control set the stereo position, which can pan the stereo image to mono or to a reverse image. A monitor section allows the user to monitor the signal being sent to the Dalet workstation (recording) or the signal coming from it (playback). There is a separate headphone level control for the two headphone outputs as well as a separate stereo monitor output.

The **Mid-Atlantic States Expo** conference is scheduled for June 7-8, 1999, in Atlantic City. Guest speakers will include author Robert Spector, author and columnist Roy Williams, and Al Ries, chairman of Ries and Ries, an Atlanta-based marketing firm. To register for the conference, contact the New Jersey Broadcasters Association, Broadcast House, 348 Applegarth Rd., Cranbury NJ 08512.

ARMA will provide the Engineering Track technical sessions for the conference. ARMA is currently accepting applications for exhibitors at the convention as well as for technical session presenters. For more information, contact ARMA at 609-653-6130; fax 609-653-1075; e-mail mail@armagroup.org.

Also, ARMA is conducting a membership drive and invites interested parties to contact the organization for information.

▶ The **Spectrum Integrity Task Force**, formed by the NAB in January, held its first meeting on March 9 at NAB headquarters. **Bruce Reese**, Bonneville International president/CEO, heads the group, which will work with the FCC to make sure new services will not harm radio-service quality. See Table 1 for a list of the other task force members.

Broadcast Supply Worldwide has become a distributor for **Davicom** products. BSW will sell the company's remote control and signal monitoring lines, along with selected RF products. BSW can be reached at 253-565-2301.

People

Dosch

▶ **Michael Dosch** has been named managing director of Telos Systems/Cutting Edge. Formerly, Dosch was with Pacific Research & Engineering, where the positions he held included vice president and CEO.

McClellan

David T. Antoine recently was appointed to the position of national sales engineer and technical support for AETA Audio. Previously, Antoine worked as sales and project manager for DSI RF Systems.

◀ Joining Digigram as business development managers, **Paul McClellan** and **Joel Rasmussen** will focus on seeking out and establishing new U.S. partnerships. ▶

Rasmussen

Digigram has shifted its corporate management structure. Founders **Philippe Girard-Buttoz** and **Marian Marinescu** will hand over day-to-day company management to **Gérard Santraille** and **Neil Glassman**. With the consent of shareholders, Digigram's single board of directors will be split between a supervisory board and an executive board.

Name	Title	Company
Raymond Benedict	Director, Spectrum Engineering & Regulatory Compliance	CBS
Michael Carter	President/General Manager	Carter Broadcast Group Inc.
Ed Christian	President/CEO	Saga Communications
Diana Coon	Vice President/General Manager	WMAN/WYHT/WSWR
Richard Ferguson	Vice President/COO	Cox Radio Inc.
Joe Field	Chairman/CEO	Entercom Broadcast Group
Bert Goldman	V.P. Engineering, Radio Division	ABC Inc.
William L. McElveen	Executive Vice President	Bloomington Broadcasting Corp.
Randy Michaels	Chief Executive Officer	Jacor Communications Inc.
Randy Odeneal	General Partner	Sconnix Broadcasting Company
J. William Poole	General Manager	WFLS-FM/WYSK-AM/FM
McHenry Tichenor	President/CEO	Heftel Broadcasting
Bayard Walters	President	The Cromwell Group
Richard Weening	Executive Chairman	Cumulus Media Inc.
Lawrence Wilson	President/CEO	Citadel Communications

Table 1. Spectrum Integrity Task Force members.

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BE Radio

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FAX 541-271-1401
www.cbsi.org

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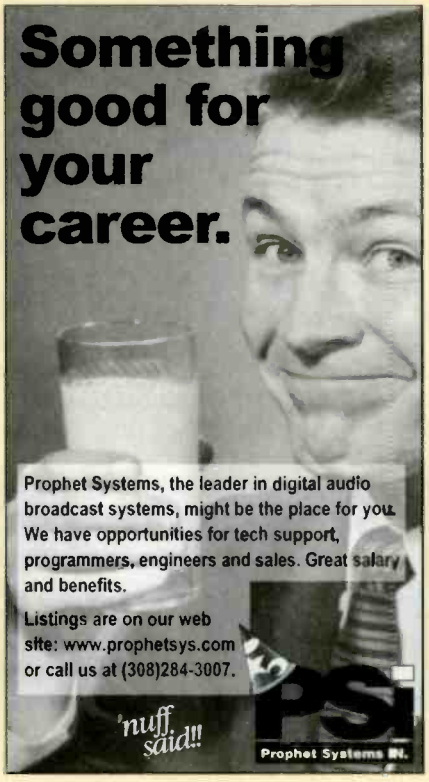

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AKG Acoustics Inc.	67	150	615-360-0499
Altronic Research Inc.	46	142	870-449-4093
Antenna Concepts	28	122	530-621-2015
Antex Electronics	48	144	800-338-4231
Aphex Systems	59	136	818-767-2929
Audio Broadcast Group	54	133	800-999-9281
Auditronics	2	101	901-362-1350
Autogram Corporation	69	138	800-327-6901
Avcom of Virginia	82	162	804-794-2500
A-Ware Software	17	108	414-717-2220
Broadcast Electronics	15	106	217-224-9600
Broadcast Electronics	73	152	217-224-9600
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Comrex Corp.	7	114	800-237-1776
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Living in the past, part 2

By Skip Pizzi, executive editor

Last month, this column discussed how legacy business practices are limiting the vision of radio broadcasters in their corporate acquisition strategies. This month, we'll consider similar conceptual inhibitors on the technical side.

Among broadcasters, there is plenty of discussion and interest in new technologies. The era of denial has largely passed, and many broadcasters are now embracing (or at least exploring) the Internet and other new delivery possibilities. But most broadcasters still envision a traditional relationship between the radio station and its listeners, its advertisers and its program providers. This assumption is artificial; it is based largely on convenience and retention of a conceptual comfort zone.

Historical analysis shows that technical changes can alter such relationships substantially. There is a delicate balance in the triangular arrangement that broadcasters, listeners and advertisers share today, and the fundamental technological changes that lie ahead are likely to disturb this scheme.

For example, while the Internet offers tremendous potential for interactivity, many broadcasters think of it as simply another broadcast medium — a function that it actually doesn't execute all that well (at least not now). Putting content on the Web also allows a break from the time axis along which stations have always delivered their content to listeners (while selling bits of it to advertisers). Just as broadcasting brought a huge conceptual revision to the world of print advertising in the 1930s, interactive media will require an equivalent measure of fresh thinking to fully exploit in the new millennium.

New platforms

So far, new delivery methods for radio stations have been limited to the Internet. Putting radio on the Internet has been a challenging effort, and not without its problems (see this issue's cover story, "Radio online," p. 34), although it is still in its infancy. But radios themselves could change in the future. If and when DAB systems are universally deployed, the option for inclusion of a substantial amount of auxiliary data will likely be provided, and the receivers for these services will take new and varied forms.

One idea is the inclusion of a small display screen for graphics, text and animation on some receivers. (The concept of extensible receiver-profiling applies: Some devices would have audio capabilities only, some would have monochrome displays, some would be full-color, etc.) The data displayed could be the same that appears on the station's (or other) websites, using an appropriate unidirectional data delivery system, such as the Unidirectional Hypertext Transmission Protocol (UHTTP) that has been proposed for interactive television. Data could also be cached onboard in some receiver profiles, while others could include true interactivity with the inclusion of a backchannel (via cellular/PCS or other wireless communications). Integration of GPS is also a likely option.

Beyond today's radio on the Internet could lie tomorrow's Internet on the radio.

The symmetry of this concept is intriguing — beyond today's radio on the Internet could lie tomorrow's Internet on the radio. In this respect, radio broadcasters can pursue convergence from both ends of the intersection. What's more, in the U.S., such data carried by DTV stations will not be receivable on mobile platforms, because of that system's use of 8-VSB modulation. This provides an exclusive market for mobile and portable data delivery to U.S. radio stations. (It is likely that DBS radio services will also enter this market, but they will be limited to national services.)

Seeding the market

As with any new format, content will drive audiences to embrace the new technology. Creating new enhancement or interactive data content for such an environment will be challenging. This is why it makes sense for new receivers to have their data component based on existing Internet content standards (i.e., HTML). In this way, new radio/browser platforms can take advantage of previously existing content, while new content is gradually developed with the platform specifically in mind. Content authors can write their code once and have it received in palatable form by a wide variety of receivers.

An open-standard approach for data delivery has proved successful in the Internet, so the same should apply to radio-delivered data content. Digital radio could then become the mobile Internet, virtually guaranteeing its security in an ever-expanding media marketplace.

To remain competitive, forward-looking, outside-of-the-box thinking will be required. The future will not be kind the close-minded.

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