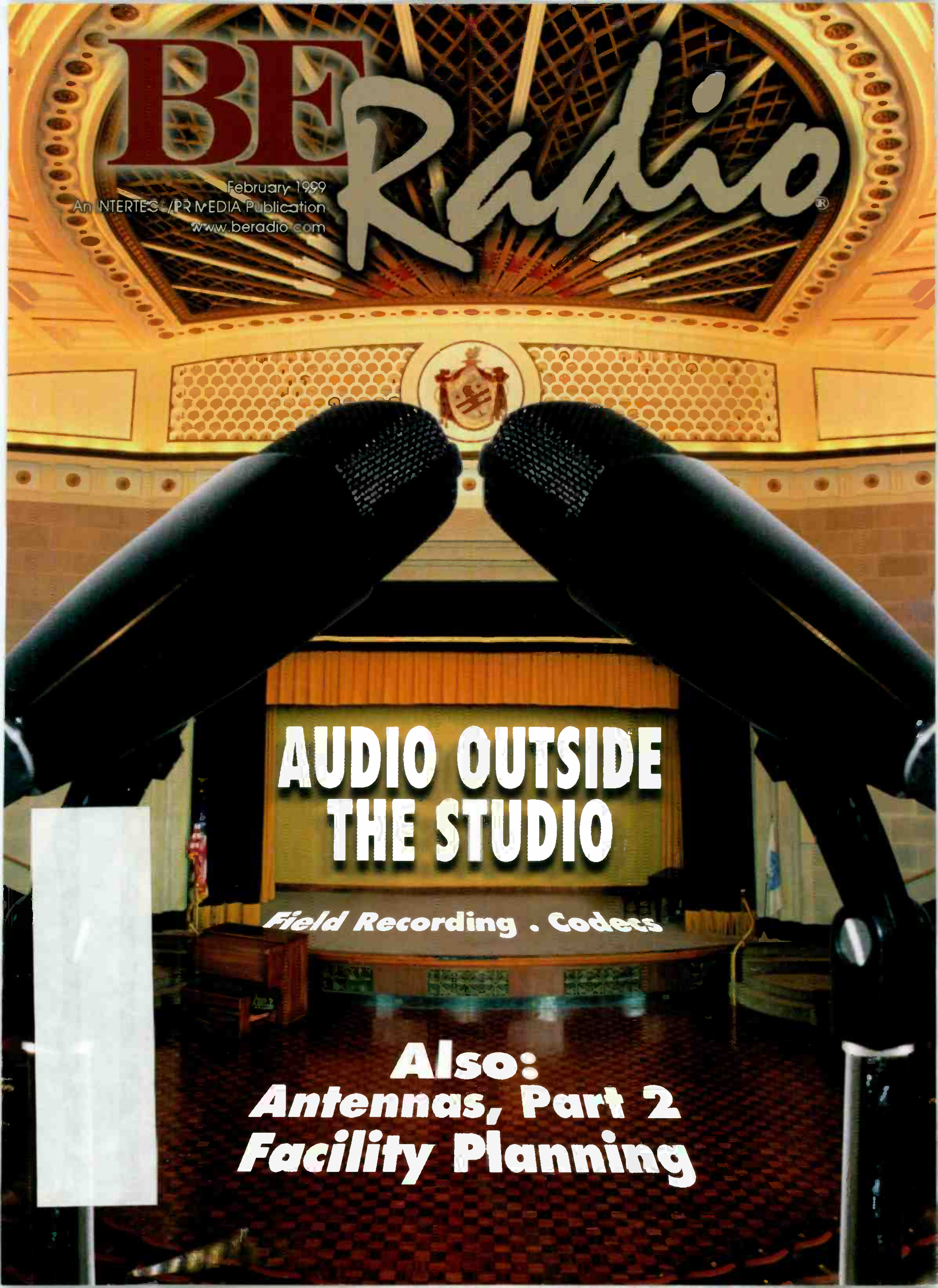

BE Radio®

February 1999
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AUDIO OUTSIDE THE STUDIO

Field Recording . Codecs

Also:
Antennas, Part 2
Facility Planning

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ON THE COVER: Current technology makes painting a clear picture for radio's sonic canvas simpler and can set the stage for success. Cover design by Michael J. Knust.

A financial catalyst

After a long hiatus, IBOC DAB is going strong in the headlines again. At the NAB Radio Show, USA Digital Radio made waves by filing a petition for rulemaking with the FCC calling for action on DAB technology. Last month, USADR once again basked in the spotlight when it announced the acquisition of 13 new investors, whose names are familiar to most of us in radio. And they can be found on many commercial-station licenses: Chancellor, Citadel, Clear Channel, Cox, Cumulus, Emmis, Entercom, Heftel, Jacor, Radio One, Sinclair and Chase Capital Partners. (It's always a good idea to include an investment firm when you're having some friends over.)

This group of investors represents a total ownership of about 1628 radio stations, with combined annual revenues of $54 billion. This figure represents almost half of all the radio revenue in almost 14 percent of all the stations.

For some time now, we have heard that U.S. broadcasters prefer the IBOC system. It seems that we now have proof, at least from most of the largest station owners. This newfound interest in IBOC makes me think the system could actually be developed and accepted. Perhaps it won't be just an entry in a future book (under the chapter "The system that never was").

I still feel that the move to DAB must result in a definite, marked improvement over current systems. DAB won't have to clear a very high bar to improve on AM. However, the bar for FM is much higher. FM is not perfect, but it is a respectable 15kHz medium. An additional 5kHz of frequency response (for a small area less than an octave) is not much. Overcoming multipath and other noise sources is good. Eliminating the beloved 75μs pre-emphasis will be a substantial improvement. But all of the current shortcomings must be addressed and eliminated for the new system to be worth anything. These shortcomings all relate to audio. Exceeding what we currently have is the goal — not just meeting it or replacing one problem with another. Additional capabilities, like streaming data and Internet access, are notable extras, but radio is audio. Unless the audio is superior, extra features won't win the case.

So what will all this combined new interest mean? USADR has been operating for several years with support from a few investors. Now the list has grown tremendously. Any business must please its investors. Having this new financial interest may help push USADR to refine a system that has been a topic of conversation for many years. The company will also receive input from several of the industry's leading groups. This support will also help establish a single standard in the U.S.

The FCC must still make the final decision on a system. That decision will be based on the next wave of field tests that are conducted. While USADR has substantial momentum right now, the basis of the final selection should be the field tests, not how many friends you have.

The other two IBOC proponents, Digital Radio Express and Lucent Digital Radio, are still working hard on their systems. One advantage of multiple developers is that competition drives success. When McDonalds and Burger King operate in the same area, they both benefit, as do the consumers. Only one IBOC system can be implemented (lest we revisit AM stereo), but the competition can result in a better system.

As other countries implement their DAB systems and the S-DARS licensees prepare to launch their satellites, IBOC is preparing to take some new steps. The U.S. may not be leading the way in implementing terrestrial DAB, but this revived interest in IBOC may help make it a reality.

Chriss Scherer

Chriss Scherer, editor


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Test and measurement

By Kevin McNamara, CNE

Unlike most industries, broadcasting has always embodied a dramatic contrast in technology. Many stations derive source audio digitally from some of the most complex compression algorithms in existence, route that audio around the station on some form of local area network, transport it on digital STL systems, then broadcast it through a transmitter that probably has power amplifiers based on those designed in the 1930s.

It seems like only a few years ago you could troubleshoot just about anything in the station with a multimeter, oscilloscope, signal generator and an audio test set. Analog signals, once dominant in the station, have taken a back seat.


Digital storage oscilloscopes offer many functions and features. Photo courtesy of Tektronix.

Given the radical shift in signal complexity, test equipment needs have changed. Along with the need for advanced equipment to measure and troubleshoot current generation audio and RF systems, additional tools are needed to analyze data communications signals, such as those found in local area and wide area networks.

Let's look at some test equipment that most stations should own, or at least have access to, for the future.

General purpose

Although the 100MHz analog oscilloscope is still one of the most useful tools for troubleshooting many electronic devices around the station, it is time to consider purchasing one of the current generation digital storage oscilloscopes, or DSOs. Both oscilloscopes will provide instantaneous views of signal levels. However, each uses a different method to process the signal. While the analog oscilloscope simply applies the signal directly to the electron beam moving across the cathode-ray tube (CRT), the DSO samples the input signal using an A/D converter. These samples are stored until there is a sufficient number of them to define a waveform. One of the key advantages of the DSO is its ability to capture a particular waveform in memory and analyze the waveform sample by sample. This is particularly useful for analyzing complex waveforms. The bandwidth of a DSO is determined by its sample rate. Many DSOs even have the ability to communicate with a PC, either directly (attached) or remotely (through a modem). Waveform information, downloaded to a PC, can be stored and used as a reference in the event that a problem develops later.

A complex waveform signal generator can be more useful than the old function generator you still have on the shelf. The Arbitrary Waveform Generator (AWG) can be programmed to produce virtually any waveform or data stream. If you've got any hacker in your blood, this is your device.

Audio

A reasonably small amount of digital audio equipment in your plant may justify an investment in one of the DSP-based audio test systems. These systems provide a wide range of tests for analog and all of the popular digital audio formats. They can even be purchased as separate units: a signal generator and an analyzer. With the proper options, the audio analyzer can be placed remotely from the signal generator (i.e., at the transmitter site). The units can communicate together and allow full end-to-end measurements to be performed with only one person. It's actually possible to perform frequency sweeps of your transmission system between songs.

RF

More specialized RF equipment is finding its way into radio facilities. Transmitters can now be digitally modulated, and new classes of solid-state power amplifiers use "switching" techniques for increased efficiency. Wideband digital microwave systems, previously used only in the telecom industry, are now used as STLs (and studio-to-studio) in increasing numbers. And let's not forget those digitally encoded satellite systems. The DSO is an essential tool for testing, troubleshooting and performance tuning these systems.

Some of the new generation of DSP-based spectrum analyzers are now affordable for most stations. Unlike analog systems, digital-based equipment is fairly immune to interference — until that magic threshold is reached. If you have a digital STL and have had such interference, you

understand how deafening the silence can be. The reality is that the RF spectrum we have occupied for years is being encroached upon by some of the new two-way paging and PCS systems. Receivers located in dense multi-user locations, such as high-rises, are subject to potentially crippling intermod products. Owning one of these devices is really starting to make sense.

LAN and WAN

LANs present a new challenge to station engineers. The typical LAN is built around an Ethernet topology. Once properly designed and installed, Ethernet networks operate fairly reliably. However, Ethernet is subject to severe performance issues that require some specialized test equipment. It's important to understand that problems with Ethernet networks are generally due to either physical problems (e.g., bad cabling and malfunctioning hardware) or by excess traffic hogging the pipeline.

Unlike analog systems, digital-based equipment is fairly immune to interference — until that magic threshold is reached.

Two basic types of test equipment are required to properly troubleshoot an Ethernet network: the cable analyzer and the traffic analyzer. Many manufacturers are now combining the two functions into a single unit. The cable analyzer determines specific characteristics about network wiring such as signal loss and near-end cross-talk (NEXT). It also incorporates a time domain reflectometer (TDR), which is used to find faults in cable runs (such as kinks and bad connections). In contrast, traffic analyzers read the packets of traffic passed through your network. Learning the proper interpretation of these packets can lead to the source causing the performance problems.

Telephone

If you use much ISDN equipment, you may find a line simulator useful. This device emulates a telephone-switching center and can be programmed with a number of configurations, allowing you to test the studio or remote gear before taking it into the field. These devices can also be purchased to simulate POTS and other types of public switched telephone networks.

As the technology we use changes, so must our tools change to keep it all running.

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; e-mail: exegesis@unidial.com.

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DTV's impact on radio, part 1

By Don L. Markley, P.E.

We have reached the point where even the most obtuse of broadcasters must realize that digital television is coming with the relentless and consuming pace of a mudslide. DTV has arrived in some places and is on its way everywhere else. For TV broadcasters, DTV means a significant expenditure to modify facilities. In the future, these broadcasters will realize the potential of new revenues that result from multichannel broadcasting.

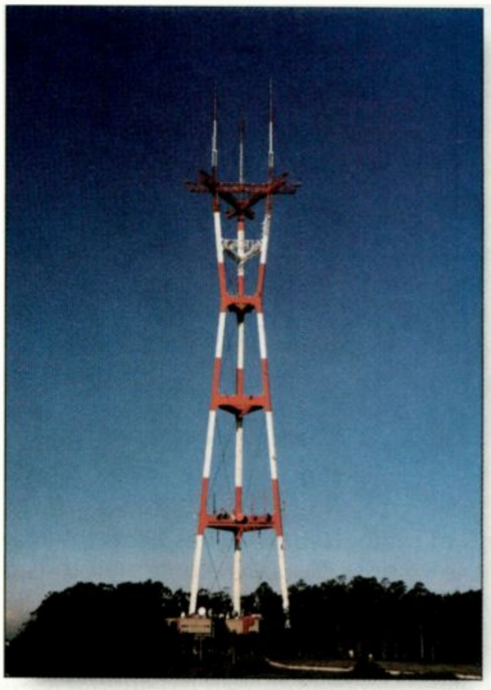
Unfortunately, radio broadcasters will also feel the impact of DTV, but will not reap the benefits of new revenues. For radio stations, the effects of DTV will range from a minor inconvenience to real trouble.

Dwindling tower space

Many FM stations share towers with TV stations. It is only necessary to look at the relative rental space costs to understand which stations the property owner will accommodate first. TV stations usually own the towers themselves, and they rent space to FM station(s) to generate some income on the side. The tower primarily serves to meet the TV broadcaster's requirements. With DTV, the need to add a second antenna and transmission line to the structure may eliminate the space FM stations currently occupy.

Older towers were constructed to meet the requirements of early versions of RS-222, the applicable ANSI standard. As the years pass, many of these structures fail to comply with the later versions of the standard. As a result, many insurance carriers have grandfathered existing, older tower configurations for some stations. The load on these towers cannot be increased or these stations will lose their insurance. Thus, nothing can be changed on the tower that will increase the loading. The solution is either to remove some of the existing load to accommodate the new antenna for DTV or to modify the tower.

As a tenant, letting the owner modify the tower is the least painful option. Modification requires a complete analysis of the tower construction and loading. Usually, this is best done by the manufacturer, if still in existence, as it is necessary to know a number of details for the analysis. The following information is important: the exact type of steel used for all of the tower members; the type of welding materials used; the exact size of all tower members, including legs, braces and horizontal members; the design and size of the base and guy points; and the dimensions and type of guy cables used. If the original drawings and data are not available, a structural engineer and experienced tower crew will need to gather the data, and some of the tower materials may need to be tested.



Like many towers, the Sutro tower in San Francisco pushed its maximum load with the addition of a DTV antenna in November 1998.

When all of the data is in, the study will determine the changes needed for the tower to handle all of the loads and comply with the latest version of the ANSI/EIA/TIA standards for tower construction. This may include replacing the guy points, changing the size and number of guy cables, replacing various parts of the tower bracing, and perhaps changing some sections of the tower legs.

Obviously, at a certain point, it will be more economical to simply replace the tower. But, before an order is placed for new steel, the possibility of constructing the new tower must be evaluated. Many communities want existing towers to be removed because of their age. In some areas, cities have developed around towers, and their local governments will give building permits to remove the structures, but not to erect new ones. Thankfully, this situation is rare, but it still occurs often enough to put real fear into a broadcaster's heart.

Crowded rooftops

With regard to rooftop antennas, building owners are spending millions of dollars this year to meet existing and new tenants' demands for DTV antenna space. Radio broadcasters can be confident that most buildings will still try to meet their needs, but radio will not be the priority. Because of the economics involved, the choice antenna spots will go to TV stations. For most FM broadcasters,

antenna locations are fixed by existing leases, and there is a reasonable period of time left before renewal. In these cases, changes could be made to the building that would harm FM antenna patterns. This is not usually a problem because most of the DTV antennas are in the UHF band, where FM broadcast signals look like DC. The problem is not usually one of re-radiation from the TV antennas but rather one of reflections due to the physical existence of the TV antenna and supporting structure. The new small structures on the building can cause a serration or ripple in the FM antenna pattern. The station's consulting engineer should address this potential problem.

Another problem with adding more antennas to a rooftop is the increase in the level of non-ionizing radiation that may occur on the roof and the antenna mast areas. While it is usually the responsibility of the building operator, this level may result in increased difficulty scheduling work. The ideal solution for FM stations using rooftop antennas is a standby antenna at another site. The standby will enable a station to remain on the air, albeit with reduced service areas, while work is being performed on the building structures.

Relocation

The worst case for the FM broadcaster is when the tower or building owner simply can no longer provide space and requires the FM station to move. First, the FM station must move to a different building or tower. Obviously, the first step is a spacing study to determine just where the station can move. A standard application for a construction permit will be needed, which has its own attendant problems. FAA approval for the new site will be needed, which may necessitate an airspace study to determine the site feasibility and/or limits. Then comes the problem of zoning, which is causing more and more difficulties. It used to be that the active term was NIMBY, which means "not in my back yard." In some parts of the country, the term has changed to BANANA, which means "build absolutely nothing anywhere near anything."

When all the permits are in-hand, or their arrival is anticipated, the next problem is actually getting the tower built. The need for a large number of new towers is making it difficult to get materials and crews. While many companies can handle small towers, only a limited number is capable of erecting tall structures. Those crews are fairly well-booked these days, which means that a new tall tower needs to be planned well in advance. Six to nine months is the minimal lead-time for such structures. Realistically, plan on a minimum of 18 months, including searching for a new site, waiting for the FCC to act, obtaining zoning and completing construction. Building a tower is neither simple nor quick, and stations should start the process as soon as possible. As more TV stations convert to DTV, antenna sites will become ever more scarce.

Don Markley is president of D.L. Markley and Associates, Peoria, IL.

An FCC rulebook review

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

A visit from the FCC inspector need not be frightening, provided you have read and followed your copy of the *FCC Rules*. Every station is required to have a copy of the relevant section(s) of the rules that apply to that station's operation. For radio stations, the basic relevant section is 73, as well as any others that apply.

I have visited many stations that don't have a current copy — or for that matter any copy — of the *Rules*. The FCC's attitude is that ignorance is no excuse. Thus it is in the licensee's best interest to have a copy. The *Rules* don't change all that often, but it is easy to get caught on a changed rule.

What to look for

One common oversight is Rule 73.49. Many stations operate without proper fences. Now that there's so much emphasis on the dubious danger non-ionizing radiation poses, fines can be higher.

The station license and all associated auxiliary licenses must be available. It's essential that operation be in strict accordance with these licenses. Many stations have been caught operating with day power at night, with excessive power, or with a directional antenna out of tolerance.

The *Rules* don't change all that often, but it is easy to get caught on a changed rule.

Since the FCC no longer requires licensed operating personnel, a missing or out-of-date operator license is no longer an issue. However, the station's operating parameters must still be posted. Check yours to be sure they are current.

Rule 73.54 details the required measurements. This rule also requires that a detailed antenna system diagram be available with the impedance data. This diagnosis is not often needed, but it should be present for the inspector. A new station engineer also needs this material to more easily troubleshoot a directional array.

For a non-DA station with a series-fed radiator, the antenna impedance must be measured at the base of the radiator under normal operating conditions. This means any STL antennas and other hardware must be in place. This measurement is usually taken when the station is originally constructed and as needed when changes are made above the base insulator, like the addition or removal of antennas or lighting equipment.

This information is vital when checking the operating power. Unless the base resistance is accurately known, the required antenna current can't be calculated and the inspector can't check for proper operation. If your station does not have an up-to-date impedance curve, you must perform one yourself and get it into the station's files. If the curve shows a change of more than 2 percent from the old values, you must also file an information copy of Form 302 showing the revised antenna data.

What an inspector looks for

§73.1225 Station inspections by FCC.

(a) The licensee of a broadcast station shall make the station available for inspection by representatives of the FCC during the station's business hours, or at any time it is in operation.

(b) In the course of an inspection or investigation, an FCC representative may require special equipment tests, program tests or operation with nighttime or presunrise facilities during daytime hours pursuant to §0.314, Part 0 of the FCC Rules.

(c) The following records shall be made available by all broadcast stations upon request by representatives of the FCC.

(1) Equipment performance measurements required by §§73.1590 and 73.1690

(2) The written designations for chief operators and, when applicable, the contracts for chief operators engaged on a contract basis.

(3) Application for modification of the transmission system made pursuant to §73.1690(c).

(4) Informal statements or drawings depicting any transmitter modification made pursuant to §73.1690(e).

(5) Station logs and special technical records.

(d) Commercial and noncommercial AM stations must make the following information also available upon request by representatives of the FCC.

(1) Copy of the most recent antenna or common-point impedance measurements.

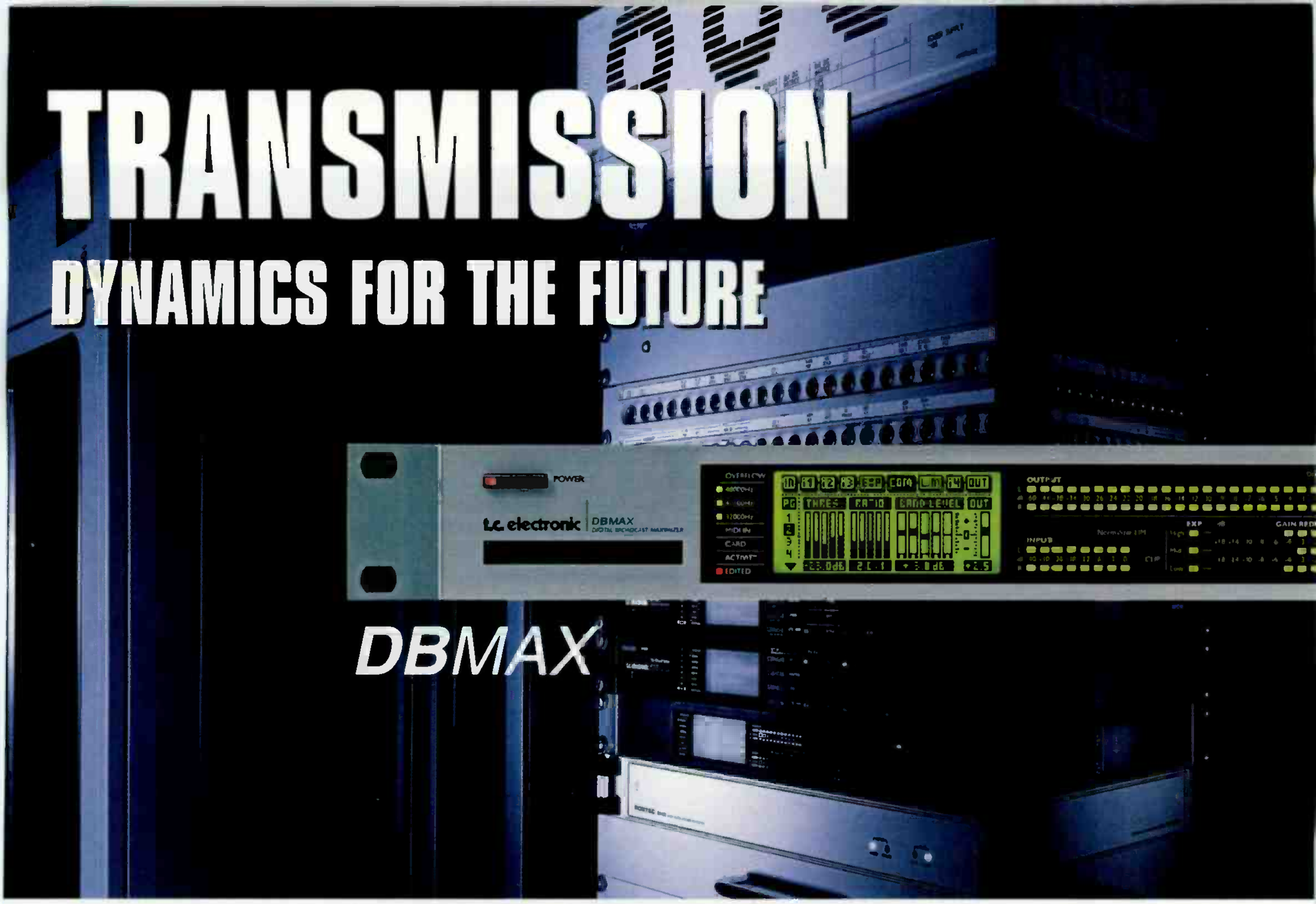
(2) Copy of the most recent field strength measurements made to establish performance of directional antennas required by §73.151.

(3) Copy of the partial directional antenna proofs of performance made in accordance with §73.154 and made pursuant to the following requirements:

(i) §73.68, Sampling systems for antenna monitors.

(ii) §73.69, Antenna monitors.

(iii) §73.61, AM directional antenna field strength measurements.



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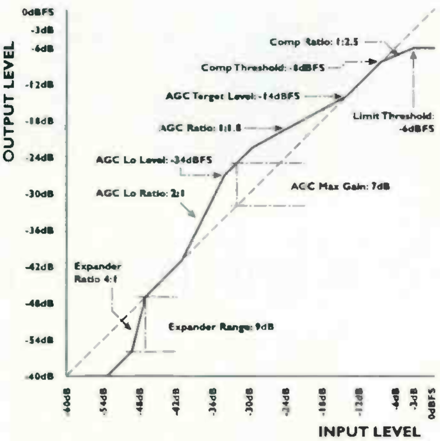

Example of Adjustable Parameters

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RF Engineering

Rule 73.51(a)(1) permits use of an RF power meter, instead of the base impedance and antenna current, to determine power. This is a tool that was authorized in 1984, probably because it was used by a number of international transmitter manufacturers. This device uses RF current, voltage and phase angle to determine RF power, and it does not rely on knowledge of base operating resistance. Its use *might* serve as an excuse for a missing operating impedance chart.

During any changes to the tower, like an STL installation, you must go to indirect power measurement until the work is completed and new impedance data is collected and filed with the FCC, as covered in Rule 73.45. Also, you must calculate RF power with measured *unmodulated* antenna current.

The best and easiest way to make your impedance run is with a Delta or Potomac receiver/generator and an *operating inline bridge* (OIB). The old days of a cold measurement with a GR bridge and separate RF generator and detector have long since passed. The OIB allows a *hot* measurement to be made. This measurement can sometimes show events that happen only after power is applied. Of course, the power used during an impedance curve run is only a watt or so, but an OIB inserted when full power is applied sometimes shows an impedance change that you didn't know was there.

We won't get into the hairy question of EAS, which still appears to be in a state of flux and is not strictly operational engineering. The Public File, though usually dumped on the station engineer, is also non-engineering, but be prepared to handle it.

If you have remote reading meters, be familiar with section 73.57, "Remote Reading Antenna and Common Point Meters." Also, be sure that you meet Rule 73.1215, which lays down scale requirements for metering and is often grounds for violations.

Look higher

Many engineers tend to think that only the lower-numbered rules, those below 73.100, apply to engineers. This isn't the case. Many rules in the often-ignored 'teen section, such as 73.1590 and 73.1690, can catch the unwary engineer. It is imperative that AM stations have records showing compliance with the NRSC spectrum mask.

Probably the cheapest way to get all the *Rules* is to buy a set of CFR 47 from the Government Printing Office. The cost is around $90, but it changes from time to time. The important thing is that you get *every* rule that affects broadcasting without having to buy a large number of separately priced sections. There are also Web sites that provide the rules online, but you may prefer a compact, bound copy.

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

For more information
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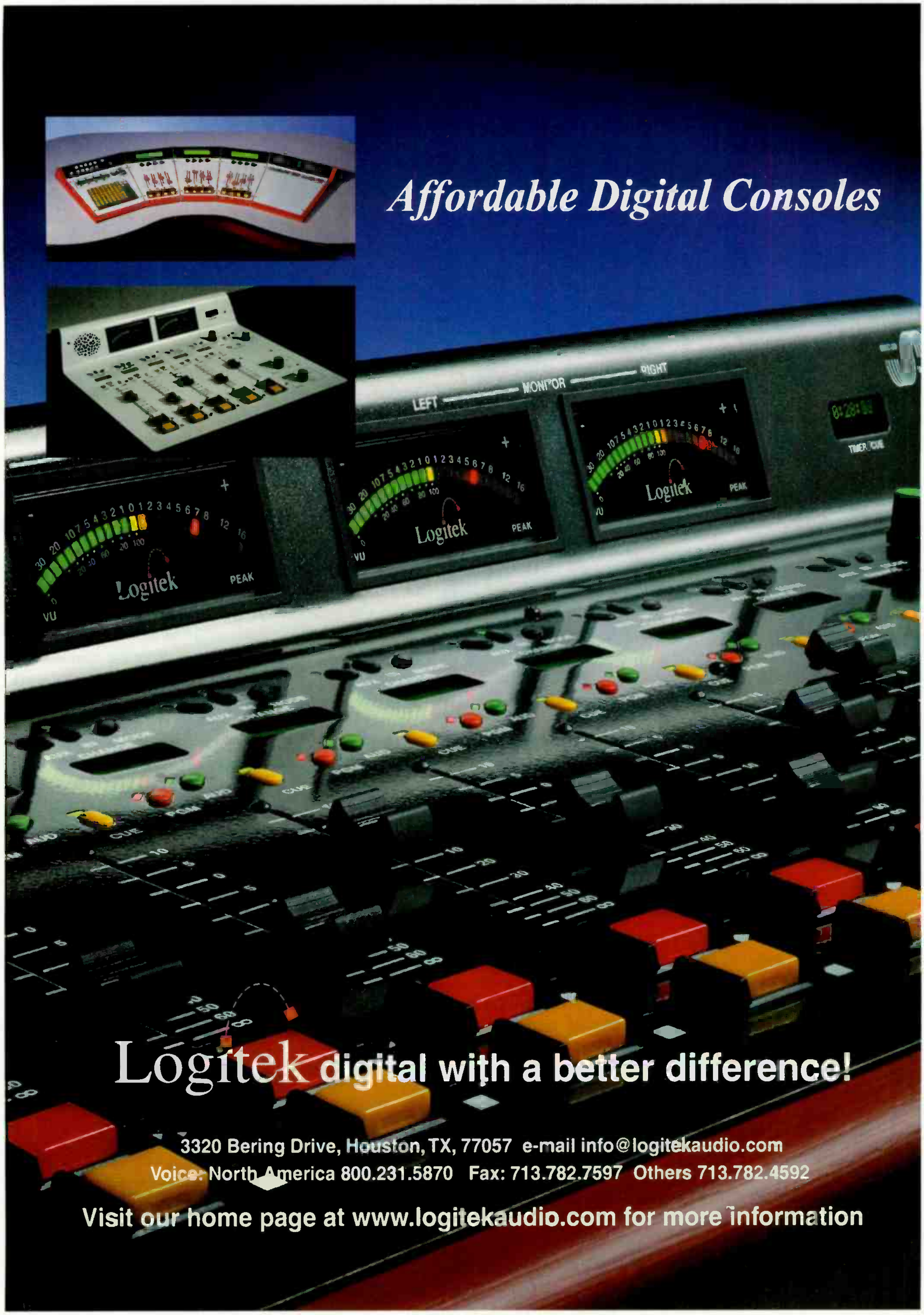

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EAS update

By Larry Wilkins, CPBE

A number of articles have been written lately about EAS and, more specifically, its problems. The EAS system isn't perfect, just as software programs aren't perfect (just ask Bill Gates). Software companies Alpha- and Beta-test products for months and sometimes years. Even then, when released to consumers, bugs pop up. Such is the case with the EAS. However, the system is fixable: EAS shouldn't be dismissed because of a few bugs.

A continuing mission

The head football coach at a major university once commented on why his team was having a dismal season: "We have to see where we are, what we did to get to where we are, where we need to be, and what we need to do to get to where we need to be." We all knew what he was talking about. My goal as chairman, and the goal of the Committee, is to see where we are with EAS and, more importantly, what we need to do to get EAS where it needs to be.

> **Online resources**
>
> FCC • www.fcc.gov/cib/eas
> SBE • www.sbe.org
> NWS • www.nws.noaa.gov

EAS is superior to EBS. Its two major advancements evidence this: the system's programmability and its ability to operate unattended. Stations can program the system to respond to any alert they wish and have it work completely unattended. I am amazed at the number of station managers and program directors who are not aware of these two improvements.

Recently, the FCC abolished the use of the pink envelope that contained the authenticator codes which were originally part of the EBS. In December, the FCC also issued a statement expressing its concern about broadcast stations' low level of participation in EAS, which became evident after the FCC polled more than 600 stations. The Commission has indicated that it will start taking a closer look at EAS compliance during inspections. Although not in the form of an official report, this statement should prompt stations to make sure they are in full compliance with the EAS rules.

This year, The SBE EAS Committee is undertaking the task of polling all the state chairs on implementation in their areas. This information will be compiled, and the study will give the Committee a good idea of what points to put their efforts toward. The SBE is also presently awaiting word from the Commission on a couple of petitions that cover the new National Weather Services (NWS) codes. Currently, EAS operates with the *Weather Radio Strategic Area Messaging* (WRSAME) codes NWS provided a few years ago. Since then, new codes have been added, which the EAS does not recognize.

Another of the committee's tasks will be to set up an e-mail list server with all of the state chairmen as well as government and industry leaders involved in EAS. This server will allow an exchange of information to help EAS become the system it was intended to be.

More on NWS

Many have pointed fingers at NWS, calling it the source of many problems. Granted, they have had some. If you have the opportunity, visit your nearest Weather Service office. Get to know the people there and see how they operate. Don't go in with a chip on your shoulder about the quality of their system. Rather, have the mindset that we all need to work together to make the system work for everybody. Interaction between NWS offices and radio stations will help strengthen the role each plays in making EAS successful.

The SBE EAS Committee is committed to helping all parties work together as one, including NWS, FCC, broadcasters, cable and EMA. Teamwork is the only way to realize the full potential of EAS.

Larry Wilkins, CPBE, is assistant director of engineering for Cumulus Broadcasting, Montgomery, AL, and chairman of the SBE EAS Committee. Contact him at larry.wilkins@cumulusb.com.

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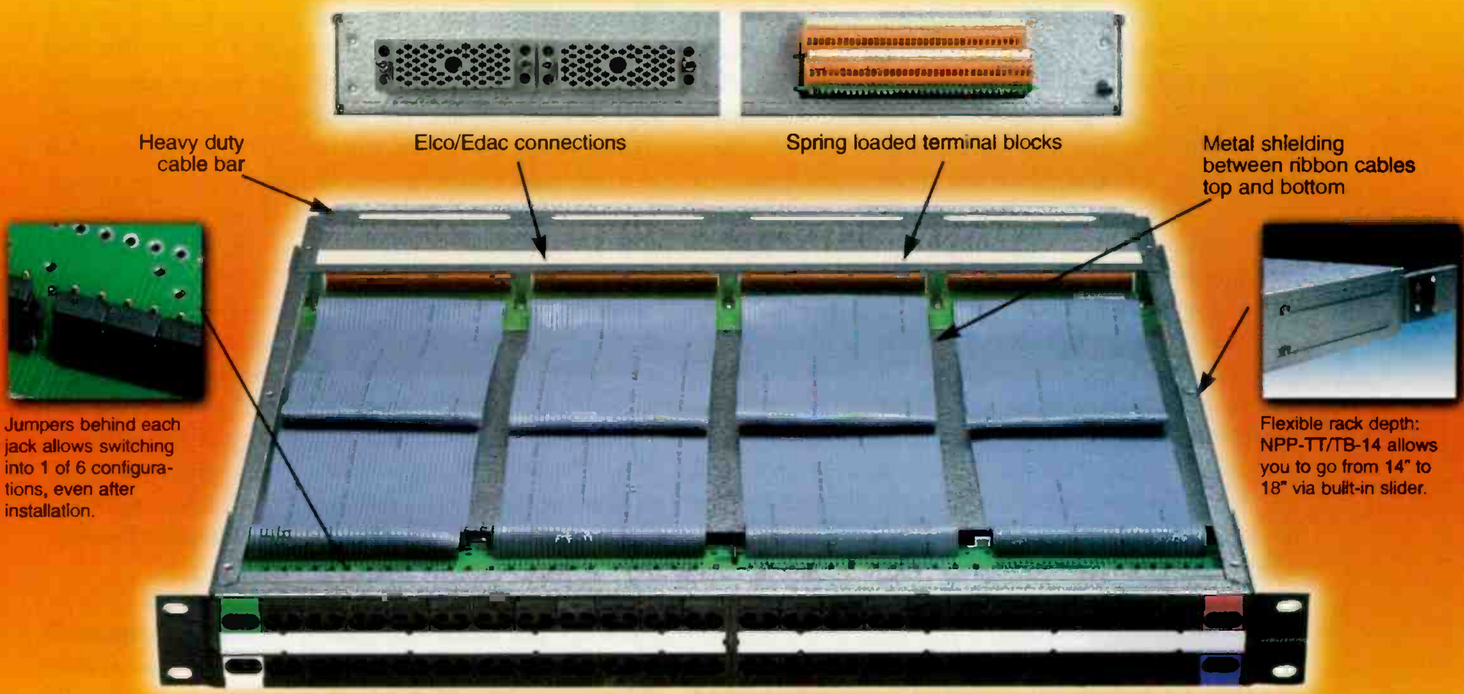

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Circle (121) on Free Info Card

FCC adopts online call-sign system

By Harry Martin

The FCC has adopted a new streamlined system whereby broadcast licensees can reserve new and changed call signs for their stations via the Internet. This online electronic call-sign system will enable users to determine the availability and licensing status of call signs; to request an initial, or change an existing, call sign; and to more easily determine the appropriate fee. The system will allow applicants to effectively reserve a selected call sign as soon as the user has submitted its call-sign request. In addition, the online system includes all of the steps and instructions necessary for reserving call signs, which will prevent users from filing defective or incomplete call-sign requests.

A licensee or permittee requesting an initial or changed call sign must provide its e-mail address. The Commission will then return e-mail a unique validation code for the transaction. This procedure will allow the tracing of inappropriate call-sign requests and will discourage unauthorized entries into the reservation system.

The Mass Media Bureau will announce by public notice how and when the transition to the new call-sign system will take place. The Bureau expects to implement the new system following its relocation to the Portals Building in early 1999.

Licensee fined $30,000

The FCC has notified a radio station licensee that it must pay fines for transferring control of its stations without authorization and for failing to maintain a "meaningful management and staff presence" at its studios. Although the Bureau took this action in conjunction with a pending assignment application, the FCC investigates such matters at various times. All licensees should be aware of the rules applicable to transfers of control and staffing requirements.

In the case under investigation, the FCC initiated its inquiry after the former station owner reported questionable activities. In December 1997, the management company that was the licensee of the stations was operating in bankruptcy. Upon reaching an agreement with a buyer, which included a compensation arrangement, the management company's owner transferred 100 percent of his stock in the licensee and all operational responsibility to the buyer. Eight weeks after this first transaction, the buyer initiated a second transaction and applied for assignment of the licenses to a different, third party. The original owner then filed an opposition to the assignment application and informed the FCC of the initial, unreported transfer. The original owner and the new owner have since filed an application for approval of their initial transfer of control. The FCC is still considering both of these applications.

The FCC reviewed the initial transaction between the original and new owners. It fined the original owner $16,000 for the unauthorized transfer of control. The FCC noted that the former owner had ceded control over finances, hiring and firing, and programming decisions. Main studio staffing violations resulted in an additional $14,000 in fines. In its disclosures, the owners advised the FCC that the AM and FM studios were located approximately 30 miles from one another. They also admitted that two full-time employees — a chief engineer and a business manager — floated between the two studios and that there was a receptionist at each studio. The FCC found that neither of the full-time employees satisfied the requirement for a "meaningful presence" at either studio. Noting that the meaningful presence standard requires management personnel who use the main studio as a home base to spend a substantial amount of time at that studio, the FCC found that the float arrangement did not satisfy its rules. The receptionists located at each studio also failed to meet the "meaningful management presence" standard. The FCC fined the licensee $7,000 for each studio location.

"No tolerance" for unregistered towers

The FCC has announced that the owners of unregistered towers will face monetary forfeitures or other agency enforcement actions. A recent FCC audit found that 28 percent of antenna structures surveyed were not registered, even though the nationwide deadline for such registrations was July 1, 1998.

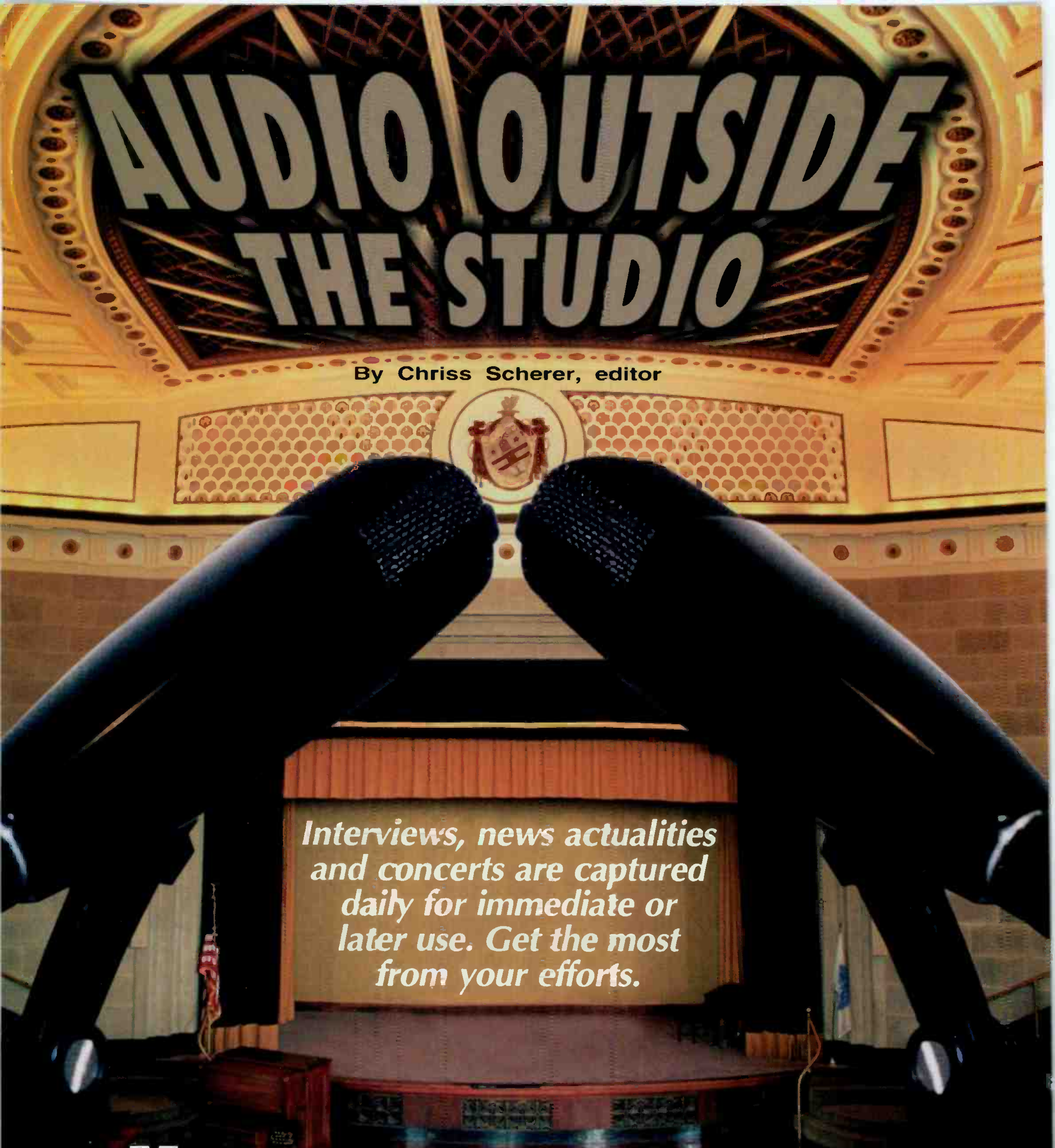
All antenna structures more than 200 feet in height, and those located near airports, must be registered. In most cases, they also must display special painting and lighting in the interest of air-traffic safety.

Currently, the FCC is identifying unregistered towers and is initiating appropriate enforcement action.

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

Dateline

Stations in the following states must file their ownership reports by April 1, 1999: Delaware, Indiana, Kentucky, Pennsylvania, Tennessee and Texas.



AUDIO OUTSIDE THE STUDIO

By Chriss Scherer, editor

Interviews, news actualities and concerts are captured daily for immediate or later use. Get the most from your efforts.

Not everything used on the air originates within the air studio. Depending on the station's format, audio recorded in the field may be the core of your operation or just a small piece of it. Either way, what you capture in the field can make the painted audio picture crystal clear or give it rose-colored glasses.

Getting an exclusive interview with a politician or celebrity can really boost a station's ratings. Since radio relies on one sense — audio — to convey its message, you want the best image you can possibly capture. The first element in any recording process is a microphone.

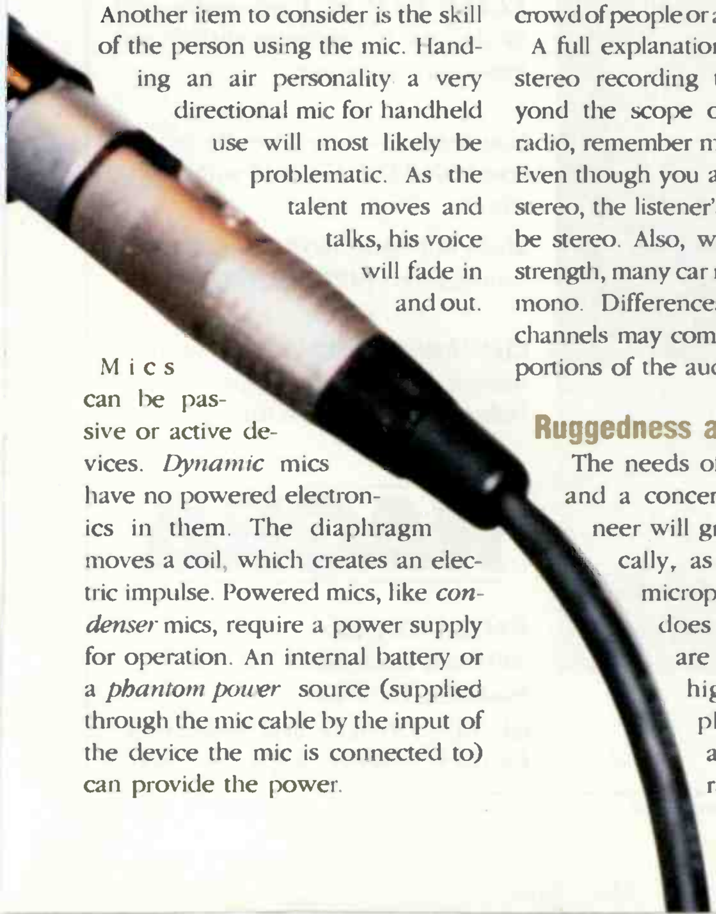
Many factors will determine the right microphone for the job. The most important elements to consider are quality and durability. Naturally, price will also play a role in this process, but most likely it won't be the principal factor. In most cases, the higher the microphone's quality, the more fragile and expensive it is. In most field applications, the sound environment is substantially less than a perfect recording studio. Wind and handling noise, not to mention ambience, can mask the finer nuances of some microphones. At the same time, these nuances may help establish a clearer aural image.

Microphones fall into several basic categories. The *polar pattern* of a microphone dictates how it will pick up sound. Generally, mics are either omnidirectional or directional. There are many different types of directional mics.

Audio can be gathered from unique locations.

Choosing the proper polar pattern for your application is crucial. For single-mic interviews (where the mic is shared between the host and guest), an omnidirectional mic is a good choice, since it will be difficult to ensure that both voices will be directly on-axis at all times. With multiple mic setups or in noisy environments, a cardioid pattern is a better choice. Also, keep in mind that directional patterns are usually not consistent through the audio range. Directional mics tend to be more directional at higher frequencies. Figure 1 shows common polar patterns.

Another item to consider is the skill of the person using the mic. Handing an air personality a very directional mic for handheld use will most likely be problematic. As the talent moves and talks, his voice will fade in and out.



Mics can be passive or active devices. *Dynamic* mics have no powered electronics in them. The diaphragm moves a coil, which creates an electric impulse. Powered mics, like *condenser* mics, require a power supply for operation. An internal battery or a *phantom power* source (supplied through the mic cable by the input of the device the mic is connected to) can provide the power.

Special micing

A single mic on a single source is not difficult to set up. However, when more than one mic is used, special considerations must be made to minimize unwanted effects.

Individual microphone placement is important to keep sources isolated. That's why you are using more than one mic in the first place. If directional mics are being used for multiple sources, use them to your advantage. Position the null of the pattern toward unwanted noise sources, such as a crowd of people or another mic source.

A full explanation of the variety of stereo recording techniques is beyond the scope of this article. For radio, remember mono compatibility. Even though you are broadcasting in stereo, the listener's receiver may not be stereo. Also, with reduced signal strength, many car radios will blend to mono. Differences between audio channels may combine to cancel out portions of the audio.

Ruggedness and quality

The needs of a news reporter and a concert recording engineer will greatly differ. Typically, as the quality of a microphone increases, so does its price. There are plenty of rugged, high-quality microphones that fall into a reasonable price range.

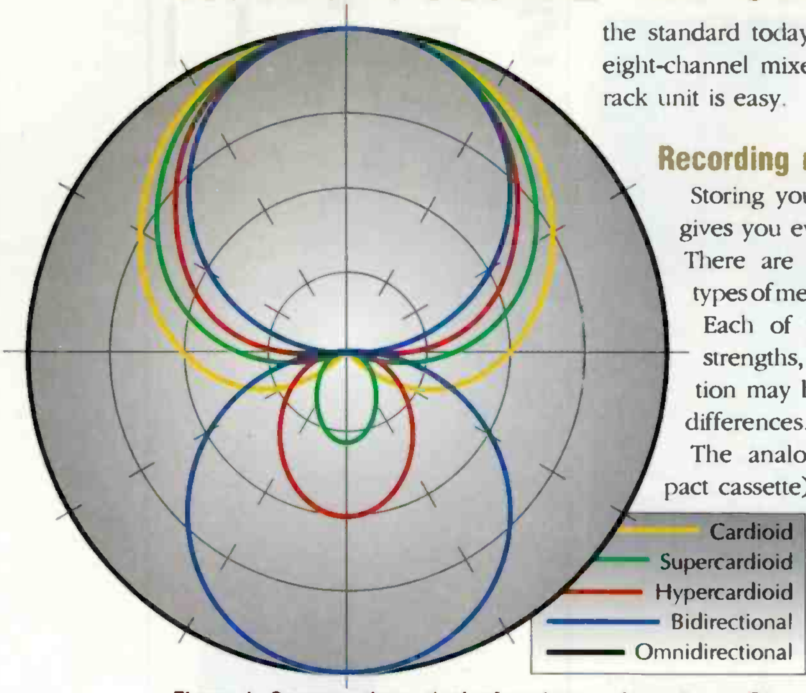


Figure 1. Common theoretical microphone polar patterns. Directional mics tend to have better directionality at higher frequencies.

Developments in the pro music industry have driven the cost and size of portable mixing consoles down. Small mixers with many inputs and incredible audio specifications are the standard today. Now, fitting an eight-channel mixer into a portable rack unit is easy.

Recording media

Storing your captured audio gives you even more options. There are a many different types of media to choose from. Each of them has certain strengths, and each application may benefit from these differences.

The analog cassette (compact cassette) format has been around for quite some time and is still commonly used. Its small size and fair to decent audio quality make it a practical choice today. The transport mechanisms are also relatively simple and easy to maintain. Media can be purchased almost anywhere, which is particularly useful for last-minute emergencies. Its shortcoming is that it is analog. Frequency response may be limited and, if cheap tape is used, tape hiss can render a recording useless.

The digital audiotape (DAT) standard was intended to replace analog cassettes for consumer use. The format has been eagerly accepted in professional audio applications. The media itself is not quite as inexpensive as cassette, but pretty close. Portable DAT machines are about the same size as cassettes, but their transport is much more complex. A portable DAT machine will cost more than a cassette, but the improvement in audio quality may easily justify this difference.

The mini-disc (MD) format has had some minor success in consumer circles. The advantages of MD are similar to DAT, but with a few extras. MDs can have labels attached to individual cuts, as well as cue-point tags, making it easier to find a specific audio cut later. Some basic editing is also standard on most machines. Over time, magnetic tape media will shed particles, requiring the tape-head to

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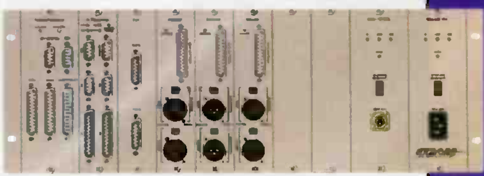

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be cleaned. MD is a magneto-optical format, so the transport will not need cleaning with the same type of use. MD also offers almost instant access to any part of the disc for very fast retrieval of cuts. DAT records audio in a linear, uncompressed format (PCM). MDs use a compression algorithm called ATRAC (adaptive transform acoustic coding). Without the compression, a mini-disc would hold only a few minutes of stereo audio. For most applications where audio from the field is used for contribution purposes, this will not be a problem.

Most everyone is familiar with the PC Card (PCMCIA) slots on laptop computers. These multifunction slots can be used to store data onto special RAM cards as well. Within the last few years, a few manufacturers have applied this technology to an audio recorder. PCMCIA recorders are about the same size as other portable recorders and function just like them. Unlike the MD and DAT cousins, there aren't any standards on formats yet. Recordings can be done in linear modes using wave (.wav and .bwf) files or compressed MPEG algorithms. Data cards are available in a variety of storage sizes. They are also considerably more expensive than DATs or mini-discs.

One manufacturer offers a PCMCIA recorder with dual card slots. This allows seamless, continuous recording over multiple cards. Long-form recording projects will find this capability very useful. There is also a model available with a built-in audio codec for transmitting the recorded audio back to the station.

Recording outside the studio environment can present some unusual situations. Paying proper attention to the initial setup will help you avoid audio problems. Always try to solve any acoustic problems acoustically instead of waiting to "fix it in the mix" at the studio. A little extra effort at the beginning can prevent major headaches at the end.

A safety net

Audio levels in the field are seldom perfect. They can be carefully set at the beginning of the session, but unforeseen changes can ruin a recording. Levels lower than expected are usually not a problem. Levels that exceed the input level setting will sound terrible, especially with a digital recorder.

When using a stereo recorder for a mono feed, take advantage of the second track. The microphone is probably already split with a Y-adapter to feed both inputs. By inserting a pad into one of the channels, you will allow for proper recording of louder sounds. The pad can range from 6 to 10dB. Some editing back at the station can put it all back together.

Another option is available for simple, two-person, two-mic interviews. Each mic can feed its own audio track. This method gives you a clean audio track for each voice and helps if there is any unwanted sound in the mic not currently being used. It also makes it easier to take out sound bites for other uses.

FOR MORE INFORMATION
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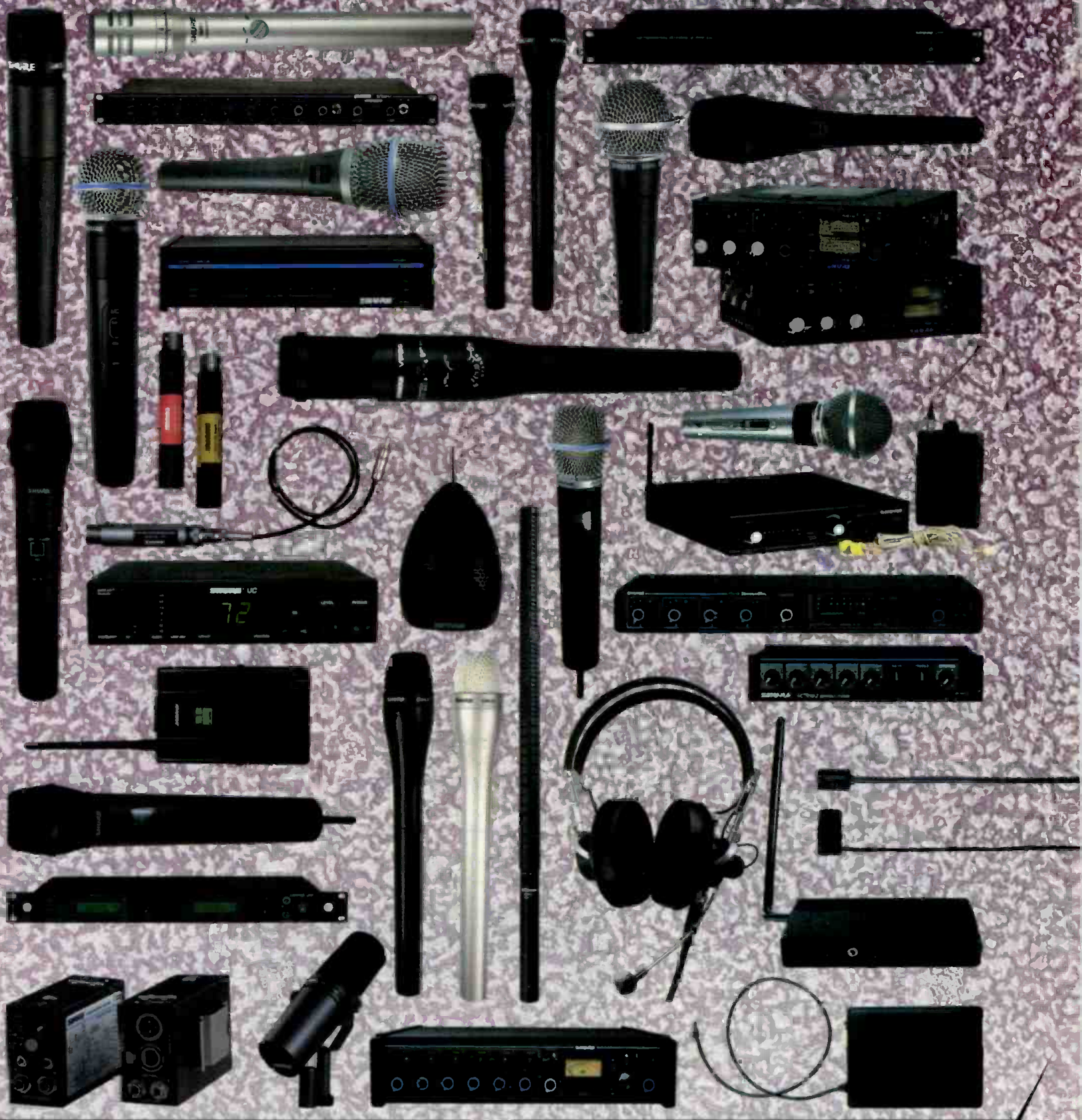

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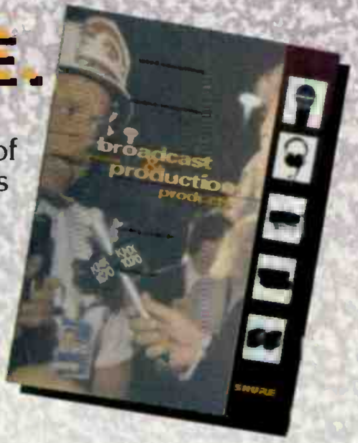

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High-quality audio via POTS & ISDN

By Skip Pizzi, executive editor

Live audio from remote sites is sounding better all the time.

Transmission of high-quality audio to and from temporary origination sites has become commonplace and inexpensive, thanks to a variety of devices that implement the *perceptual audio coding* or lossy data compression algorithms (data *reduction* is the term some prefer) developed in the last several years.

These systems have been developed for use with either the standard analog dial-up phone system (POTS) or the ISDN network. A few units can be configured for use on both POTS and ISDN.

Some of this hardware includes audio mixing and monitoring features, providing a single-box solution for simple remotes. Recently, software-only codecs have been introduced for the PC, allowing the audio capture/processing and POTS or ISDN communications capabilities of a laptop to be used for such remote applications.

The coding system should be appropriate for the channel used and compatible with the communications equipment at each end of the path. Naturally, the higher data rates ISDN provides make it the first choice for remote audio backhaul. But where ISDN circuits are not available (or time frames do not permit their installation), POTS can still be used for reasonable audio fidelity.

ISDN systems

ISDN codecs typically offer one or more of a handful of standard algorithms. These include ISO/MPEG-1 Audio Layer 2, ISO/MPEG-1 Audio Layer 3 or CCITT G.722. Proprietary algorithms from manufacturers such as Audio Processing Technology (apt-X or apt-Q), Dolby Labs (AC-2 or AC-3) and Comrex (Turbo G.722) are also available.

ISDN Portables

APT DRT128

Comrex Nexus

Some codecs, like those shown here, have compact cases and are designed for portable use.

Many of these units are self-contained, in that the user can simply attach audio sources and connect to the ISDN network. Other units require external interfaces to the ISDN network (see "ISDN basics," p. 41).

Most ISDN codecs offer a range of output data rates, allowing them to be used on a variety of ISDN connections from a single B channel (64kb/s) to six B channels (384kb/s). As a reference, consider that uncompressed CD-quality stereo requires approximately 1.4Mb/s (44.1kHz x 16 bits/sample x two channels), yet these codecs can provide excellent audio quality at one-fourth this data rate or less.

In addition, some units provide the capacity for adjusting the sampling rate of the input A/D converter. When

ISDN Rackmounts

MusicamUSA CDQPrima series

Telos Zephyr

APT BCF256

Rackmount codecs have a natural home in the studio, but they can also be installed in road cases for field use.

full audio bandwidth is not required — as in the case of speech-only — a low initial sampling rate can be used, such as 16 or 24kHz. This will create a signal that is bandlimited to approximately 8 or 12kHz respectively, which should be adequate for speech. A monaural audio signal sampled at 16kHz will produce an initial data rate of only 256kb/s. Now the lossy compression algorithm need not work as hard to reduce this signal's data rate to 64kb/s (a single B channel).

Take care to minimize the number of compression cycles applied to an audio program. This will affect your choice of codec and data rate, because some codecs survive multiple generations better than others. And for any codec, the less compression applied, the better the signal will stand up to further re-compression downstream. For example, MPEG Audio Layer 3 at 64kb/s may sound fine for a voice remote backhaul, but if the feed will undergo subsequent compression generations because of satellite transmission, hard-disk storage, STL or the like, then Layer 2 at 128kb/s is a better choice. (Layer 2 is designed to perform particularly well under multi-generational applications.)

Note that the G.722 algorithm is a special case. It is an older system designed for 56kb/s channels and does not employ sophisticated perceptual coding. As a result, its fidelity is not as good as the other codecs in

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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

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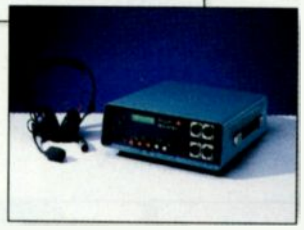
use today (7.5kHz audio bandwidth, S/N ~ 45dB). Nevertheless, its simple circuitry endows it with significantly less processing time than most other codecs, which can be advantageous for real-time monitoring of return-path signals, off-air monitoring or communications channels.

On devices that allow individual choice of codecs for each direction of the ISDN path, G.722 may be a good choice for the *return* path to the remote site, since audio fidelity is not a paramount concern there, but processing delay is a concern. One caveat, however: Bit errors or sync loss encountered on an ISDN path carrying a G.722 signal can create annoying noise bursts or "chirps," which will be undesirable in the monitoring feeds (typically talents' headphones) at the remote site. Most other codecs tend to mute under these conditions. It has also been reported that certain types of audio may cause a G.722 signal to lose synchronization. Most common in this respect is a 1kHz tone, because the algorithm was designed to retain self-synchronization with typical voice-type program material. The low statistical variation of a sine-wave tone is unexpected by the algorithm, and it may lose lock as a result.

ISDN codecs from different manufacturers generally can be interconnected across the ISDN network as long as they each support the same algorithms, initial sampling rates and final data rates. Recently, software-only systems have been introduced, which allow adequately fast PCs to compress and transmit MPEG-coded files via ISDN to other computers as files or in real time to

Telos ZephyrExpress

ISDN Mixers & codecs

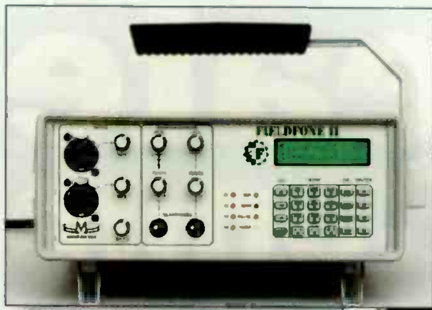


AETA Scoop Reporter II

Musicam RoadRunner

Portability with a plus. These codecs have built-in mixing capabilities for simpler setup on the road. The AETA and Musicam units can be converted for POTS use.

Comrex Vector



Musicam FieldFone II

Musicam RoadRunner

POTS Codecs

Comrex Hotline

POTS codecs appeared more recently than their ISDN cousins, but their functions are similar. Most of them also have some mixing capability as well.

Marti Smartl

AETA Scoop Reporter

AETA Scoop Reporter II

hardware codecs.

If you are using codecs by the same manufacturer at both ends of an ISDN path, you can take advantage of some systems' addition of device-control interfaces, typically several contact closures.

Watch for the emergence later this year of a new algorithm, called MPEG *AAC* (Advanced Audio Coding). This algorithm will provide single-generation performance better than Layer 3 at the same or lower data rates (e.g., excellent mono voice at 64kb/s or very good stereo music at 128kb/s).

POTS codecs

A number of companies have produced devices that provide moderate-fidelity (up to 15kHz mono), bidirectional audio interconnection on POTS lines. These systems combine the latest PC modem technology with a variety of telecom-industry and proprietary algorithms to produce a near-real-time signal that maintains adequate robustness at POTS-modem data rates (typically 14.4 to 28.8kb/s).

Unlike ISDN codecs, each POTS codec is proprietary in design, allowing only a mating device from its same manufacturer to be used at the other end of the path. Some of these units also integrate mixing and monitoring capability.

Between these two classes of devices, radio broadcasters now have a range of choices for backhaul of high-quality audio from nearly any remote site in a simple and cost-effective manner.

ISDN basics

By Fred Wylie

ISDN comes in two flavors: *Basic Rate Interface* (ISDN-BRI), which provides two user channels of 64kb/s capacity each, and *Primary Rate Interface* (ISDN-PRI), which offers 23 user channels. These user channels are also called B channels (for *bearer* channels), to distinguish them from the other component of the ISDN service, the D channel (for *data* channel), which handles all call signalling and routing data.

The telecom provider installs the ISDN line just like an ordinary POTS line — by entering the user's premises with a pair of copper wires and terminating these in a *network termination* box, called an NT1.

Telcos will provide ISDN users with a line number and a *Service Profile Identifier* (SPID) number. The SPID is a random number that may or may not be related to the line number or area code.

Inverse multiplexing

When the compressed audio bit rate is higher than 64kb/s, more than one B channel is required. To properly distribute the data across multiple B channels, *inverse multiplexing* (IMUX) is employed.

Like POTS, when you dial a number on the ISDN network, there is no control over the route the call will take. If two numbers are dialled to the same location (as in the case of an IMUX call), the two B channels will invariably take diverse routes through the ISDN network. The end result is that the signals on each channel will not arrive at the destination at the same time. The IMUX compensates for this differential line delay and allows two codecs to interact as if there were a contiguous data path of 128kb/s or more between them.

There are proprietary IMUXs available, but most systems use the de facto standard approach known as BONDING. More recently, the CCITT/ITU has introduced the J.52 algorithm for IMUXing. A significant difference between the two approaches is that J.52 continually monitors the ISDN connections in use on a given path and dynamically adjusts the IMUX as line conditions warrant. BONDING, on the other hand, becomes inactive once the ISDN channels have been initially connected and has no means for automatically restoring a failed channel or otherwise accommodating changes in the connection during the progress of the call. Newer systems will offer both BONDING and J.52.

Terminal adapter

The *terminal adapter* (TA) is the device that shakes hands with the ISDN network. It is the conceptual equivalent of the POTS telephone instrument. The TA provides the ISDN dialing facility, and it can include number storage, speed dial and automatic redial features. The TA can be a separate unit, but most current broadcast audio ISDN devices include it in a single chassis with the audio codec (and, in some cases, with other audio components as well).

Audio codec

Various data compression algorithms can be used with ISDN service. As long as the devices at each end of the ISDN path are compatible in these respects (i.e., algorithm and data-rate support), high-quality audio transmission should result. (See the main article for more detail.)

Any audio signal that has gone through the A/D/A conversion process will have been delayed by around 50µs. Adding a data compression algorithm to this process adds a great deal more processing time. Some algorithms introduce tens or even hundreds of milliseconds of signal-processing delay. Any two-way audio system with a delay of more than 10ms in any leg will produce delay effects that could be intolerable to the user. For this reason, a mix-minus backhaul is recommended.

Though higher compression ratios imply longer delay times, the differences between algorithm types also play a role.

Fred Wylie is a technical consultant at Audio Processing Technology, Belfast, N. Ireland.

ANTENNAS

RF Radio

Vertical AM antennas

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

The mechanics of radiation

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

We owe Maxwell, Faraday and Hertz a debt of gratitude. These men, as well as Volta, Ampere and Ohm, all contributed to the development of radio broadcasting. When they lived, these men were sometimes ridiculed by their peers.

> Faraday was the butt of a nineteenth-century poem, to wit:
>
> "Around the magnet Faraday
> Was sure that Volta's lightnings play.
> But how to draw them from the wire?
> Take a lesson from the heart
> 'Tis when we meet, 'tis when we part
> Breaks forth the electric fire!"

Faraday was concerned with the magnetic field around a wire, the rate of change of a current *di/dt*, or a make and break, which induced a current in another wire. Radio engineers are concerned with two fields: the radiation field and the induction field. The induction field contains only reactive energy, which quickly dissipates. The induction field is inversely proportional to the square of the distance.

On the other hand, the radiation field contains the real power. It is inversely proportional to the distance from the antenna. At half a wavelength distance, the induction and radiation fields are equal. Closer than this, the induction field rules. Farther than this, the radiation field rules. The radiation field is our radio signal. Radiation resistance strongly affects this field.

The basics

Vertical antennas work best for AM broadcasting. Vertical polarization provides the best ground-wave propagation and is the easiest type of antenna to design. For a long time, WOR, New York (with its transmitter in New Jersey), used a TEE antenna with a center feed to a flat top suspended between two towers. But it has been replaced by a vertical. The only horizontal antenna that I know of in service is at a college in Pennsylvania, where a circa 1923 style is used. This antenna consists of five wires about 150 feet long, spaced in a circular tube pattern with a diameter of about six inches. The center point is where the five wires come together, and that is also the feed point. The power is 100W, and it seems to work well.

Today, the engineer's preferred antenna height is 90 degrees. This value simplifies calculations, offers a reasonable working base impedance and provides good efficiency. However, below 120 degrees, the actual efficiency is less than the theoretical efficiency. Figure 1 shows typical resistance and impedance curves for various antenna heights. The curve provides a starting point for antenna calculations. It is unusual for an antenna to have exactly the same values as its theoretical model.

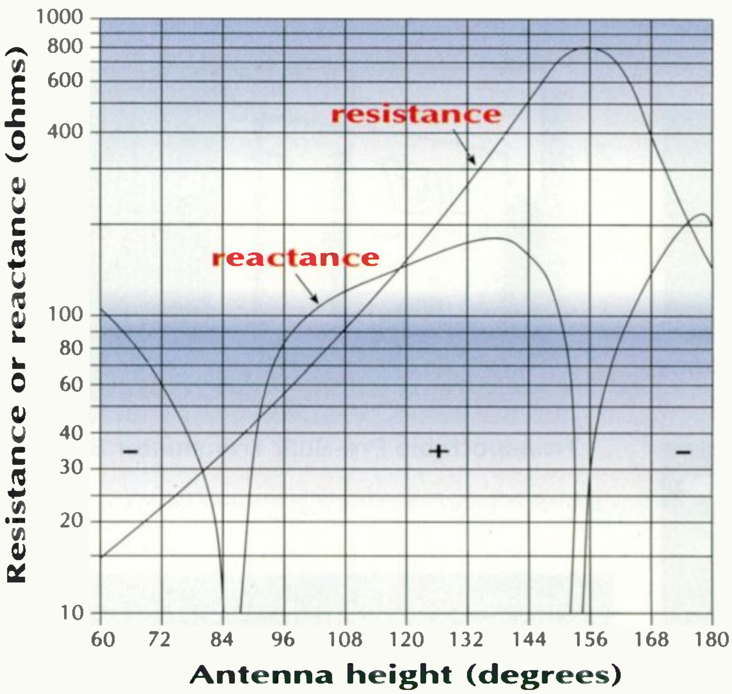


Figure 1. Base resistance and reactance for various antenna heights.

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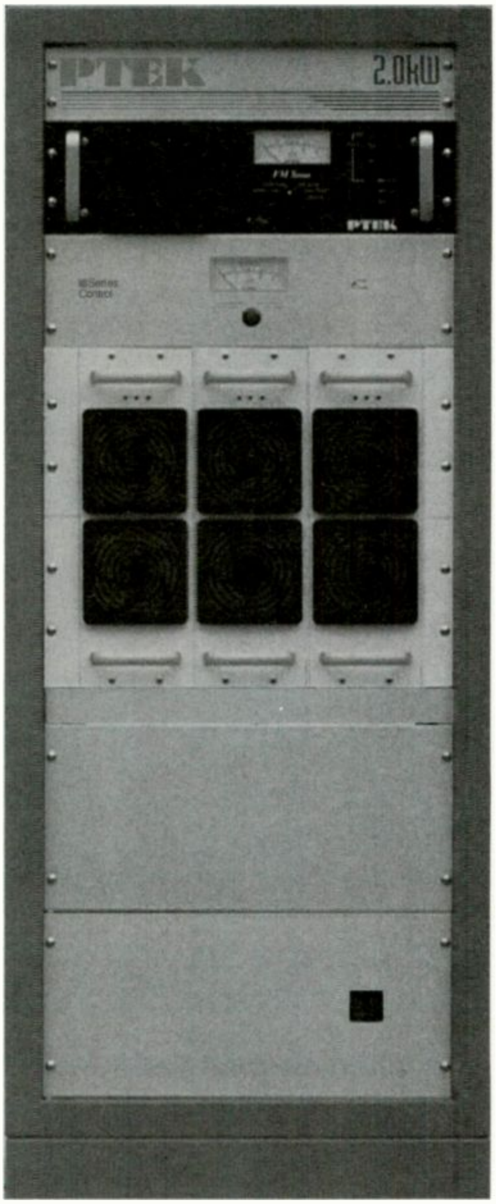

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ANTENNAS

Based on the electrical height, Figure 1 makes it easy to approximate the anticipated antenna impedance.

Engineers make certain assumptions when considering antennas. These theoretical assumptions include sinusoidal current distribution from a thin radiator over a perfectly conducting ground. Engineers also ignore the effects of velocity along the radiator. In practice, the shape of the radiator slightly modifies these parameters.

The base operating resistance for a single tower is always positive. However, it is not uncommon for a tower in a multitower array to have a negative resistance and actually put power back into the system. Tower impedance changes as we move along the tower. The radio engineer is generally most interested in the base resistance, which is another reason we like to use 90-degree towers. Last month, we showed the equation for the tower characteristic impedance (see January 1999, "Antennas," p. 48). However, two apparently identical towers usually will not have exactly the same impedance. In a 90-degree tower, the base feed point is approximately at its current loop. This is important because we use this current in radiated power calculations.

In a series-fed 90-degree tower, the current loop is actually a little less than 90 degrees down from the top because the velocity of propagation decreases as tower cross section increases. In the case of a 90-degree straight-sided tower with uniform cross section, the current loop is about 6 degrees up from the base insulator.

In a 90-degree tower, the current is a minimum at the top and maximum at the base. Conversely, the voltage is a maximum at the top and minimum at the base. With a half-wave tower, current will be a minimum at the top and base, and voltage will be a maximum at both points. Therefore, steps should be taken to protect personnel from RF voltages that can potentially be quite high.

Antenna height

The vertical field factor of a nondirectional antenna is important in attempting to control the vertical radiation at all angles above the horizontal. Known as Θ (theta), the vertical field factor is simply a comparison between the inverse field strengths above the horizontal on all elevations and the horizontal inverse field. In the case of non-DAs, this factor is important mainly when designing nighttime antenna systems to control skywave signals and avoid interference. Figure 2 shows the FCC vertical radiation patterns for vertical antennas.

The most efficient radiator is a 225 degree, or $^5/_8\lambda$. By selecting a suitable antenna height, it is often possible to arrive at a height that will produce the desired skywave signal reduction at a given location. For a $^5/_8\lambda$ antenna, it is also necessary to consider the *pip* at 60 degrees. The pip increases as the height increases until, at full wavelength (360 degrees), there is effectively zero radiation horizontally.

Figure 2 depicts this phenomenon. Note how the horizontal (ground-wave) radiation increases as the tower height increases. As the tower shortens, the high-angle radiation increases and reduces the horizontal component.

There is no point in building an antenna higher than 225 degrees. Above this height, unless special designs are used, the radiation efficiency decreases and the antenna becomes difficult to match and drive. Sometimes an existing FM or TV tall tower is used as an AM radiator, but unless it was built with that purpose in mind, it is very difficult to use. If the tall tower was planned for combination AM/FM/TV use, it can be sectionalized and made into a Franklin antenna or a variation thereof.

A variation

A complete Franklin antenna design explanation is beyond the scope of this article. Basically, a Franklin antenna consists of insulated sections with matching circuits between sections that produce an in-phase drive, which develops low skywave radiation with excellent ground-wave propagation. I don't know how many are still in use in the U.S. today — probably not many. If you do have to work with one, you should inherit a proof of performance that will provide full details of its tuning and measurements. If you don't find one at the station, you can obtain one from the usual FCC publications. The FCC requires a full engineering explanation of its design and a proof after it is built. The Franklin is really a *vertical* directional antenna, and often some form of antenna monitor is required. Some of the older high-power and clear-channel stations used the Franklin to obtain better ground-wave coverage and beat the *fading wall*.

This is the second 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.

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

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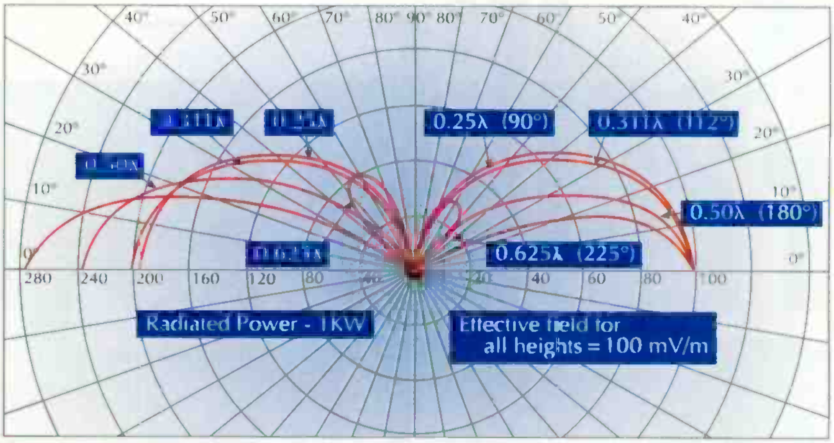
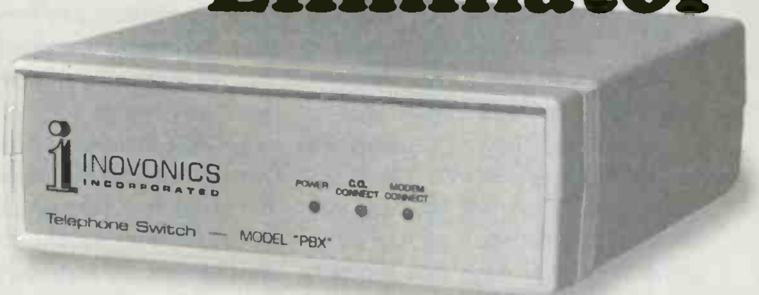
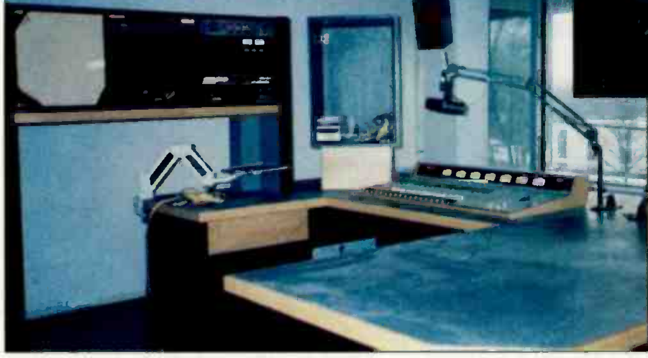


Figure 2. The effect of antenna height on radiation angles.



Facility Planning

Careful planning before the design process will make the installation smoother and yield better results for the final product.



By Barry Thomas, CSRE

Before building a showcase facility, make sure you have the technical tools to do the job right.

So you're going to build a new studio or even a new facility that will house the multitude of stations your company owns plus its various sales divisions du jour. You've already chosen a location or had one chosen for you. You have at least a rough idea of where and how large your studios will be, where the offices will sit and how many offices there will be. Now you actually have to begin putting those grand ideas you have into practice. You are about to start one of the most enjoyable parts of your project: the creative process.

In the process of physical design, you will have determined some critical information: the number of studios or workstations to build and the number of bodies that will fill them; the kind of studios they will be (e.g., talk/music, automated/live), which will be determined by the objectives of the station; and the overall budget you will have to work with. If you don't have at least a rough idea of the answers to these questions, do not pass go. These answers are the basis of everything else. In the past, it was popular tell engineers to decide what they wanted and deal with the budget later. This process appeals to managers because they can see what could be if the budget and other constraints did not apply. The problem with this approach is you will waste time recrunching numbers. This also puts you, as an engineering manager, in the position of having to defend your decisions from square one. More often than not, the engineer gets blamed for such castle building when simply following the manager's wishes. Get a target budget number and work within this framework rather than acting as if you're going on a free shopping trip.

Design preparation

The most important tools to start with are a legal pad, a pencil and an open mind. Take notes on the current, working operation. If the general consensus is that the current place is a mess, there are still features that make it work. Determine the staff's favorite studio qualities. You may want to include these features in the design, depending on the staff's flexibility.

Next, you'll need to spend some time with the operations or program director to determine the overall concept of the studios. Though this person may or may not have strong opinions, make sure he understands that he will make many decisions about the studio design. You'll need this department head to understand and endorse the layout. While a studio facility may be your baby, you must not forget that its purpose is to serve as the platform for the program director's operation.

Find the influential members of the operations staff, and get their likes and dislikes. Every air staff has one or two leaders, including the morning show anchor, who can articulate the air staff's opinions. These people should be free to give input without concern for the budgets. It's your job to translate this grand concept into a practical idea. The staff's desires may conflict. Use your judgment about which ideas to include, but don't discard anyone's input. You'll want to be able to discuss alternatives later.

Getting specific information from non-engineers can be challenging. Most creative people have short attention spans, which can be an obstacle when trying to discuss operations and design issues. Gather input over time, not during a single meeting. Spend time in the studios while they are in use and business is being done. If you stay long enough, you'll hear about issues and ideas when they are on people's minds. Also, make your own observations. Finally, when someone describes a need or idea, make sure you understand what the person really means. An announcer will not use tech-speak to describe a situation or idea. To make sure you're communicating effectively with non-engineering staff, confirm what they've said by repeating their recommendations back to them.

Now, start your personal brainstorming. Generally, you'll already have an idea of how the studio should work and even the technology you'll use. Don't worry too much about being specific. Things will change. Like a painter who starts with broad strokes and fills in with greater detail, start by laying out the overall design first, then fill in the ancillary details.

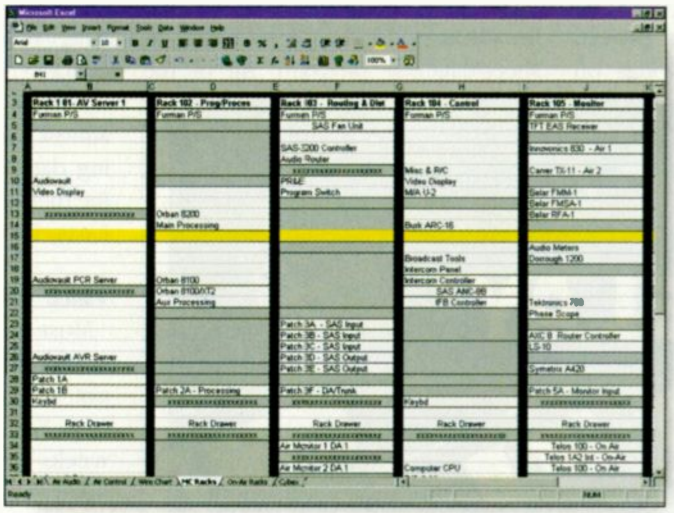


Figure 1. Lay out the racks before the equipment goes in to prevent unwanted surprises.

The design process

Broadcasting has been brought, kicking and screaming in some cases, into the computer age. In spite of this transition, much studio design and documentation is still done manually. Broadcast engineers aren't typically trained in computer-aided drafting (CAD) skills. Facility build-outs don't occur often enough in our careers for us to gain a great deal of proficiency with the more advanced CAD programs. However, learning the latest computerized design processes will help save you time and effort later in the project and will help you prepare for your next design challenge.

There are many sophisticated design tools available for studio design, from shareware CAD programs to full-release versions of professional CAD programs. For physical design, use software that is compatible with that your architects use. AutoCad LT can be purchased at a fairly reasonable price, and many of the entry-level CAD programs can read AutoCad files. Most engineers come from a pencil and paper background, and it's easier to jot down a drawing on a piece of paper than to fight with a mouse and software. I encourage you, though, to make the transition to computer-based drawings as soon as you can in your project. Using computer-based drawings on my last project enabled me to collaborate via e-mail on drawings with the architects and the furniture and systems designers. Since e-mail is extremely fast, in most cases we could send changes and sketches in the course of a phone call, which cut weeks off the design process. Sending faxes of hand-drawn sketches would not have been nearly as effective.

The most important tool for the broadcast studio designer is a spreadsheet/database program. All of the budgeting and equipment orders will be manipulated, inventories will be tracked, and man-hours will be calculated with this software. I go one step further — I use borders and shading in Excel to draw electronic block diagrams, flow charts, console layouts and rack-space plots. Granted, a real CAD program or even a flow-chart program like Visio may be designed for this purpose, but I've found no better way to make sure I've accounted for every rack space (see Figure 1). It's quick and dirty but it works, and almost everyone can read the resulting data file. Readability is generally the theme of all documentation: Make it easy for your successors to decipher.

Take your time

Most broadcast engineers think in terms of immediate needs and are not accustomed to the design process. You must be prepared to spend weeks in the design process. You'll need to concentrate on design without interruption. This may mean you need to find someone to watch the day-to-day operation for a while, which can often be included in the construction budget. It is impossible to operate a station full time and design a facility well.

The physical design, in which you design the general look of the furniture and room layouts, is usually the first step in studio and facility design. Layouts always depend on the personalities of the staff and of the designer. Determining layout should be a collaborative process with your space planners, furniture builders or system designers, and your staff.

Generally, engineers need to keep one thing in mind when planning the layout. We tend to put everything in view and at the fingertips of the operator. This is the way most of us like things, but it isn't necessarily a good idea for regular operators. For example, the aircheck cassette machine or the EAS receiver may not need to be directly in front of the announcer. Generally, keep the work area simple, uncluttered and populated only with the items he or she will need on a regular and constant basis.

Wiring design will take the lion's

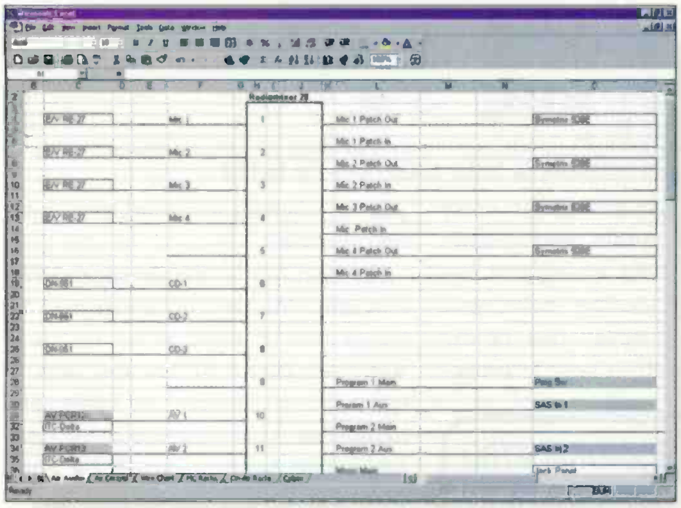


Figure 2. A basic signal-flow diagram ensures that all the sources and routing are accounted for.

share of your time. You should expect to decide where every wire in the plant will go. The reason for this is that you will need good written records to make the most of your wiring staff's time. If they are constantly asking you for clarification or are designing on the fly, they are not using their time effectively. This process is not as daunting as you may think. Break things down into parts. Start with block diagrams of each studio's console. Basically, draw a long box with inputs on the left side and outputs on the right (see Figure 2). The spec sheets of the consoles will have the information. Draw everything out, indicating every wire that goes outside the room and every device that's connected inside the studio. Most designers use a drawing computer program to do this, but many approaches will work as long as you can move things about on the page and try wiring "what-ifs." Add things like in-room DAs and switchers to the drawing, and you'll end up with an audio functional diagram of each studio. This functional diagram can be more helpful than any wiring chart you'll make because you can see the way the whole room will work at a glance.

Do the same for the control paths in the room. Use the console or mixer as your central point in the studio, and branch out from there. It doesn't matter if this is for a one-studio remote booth or a multistation network headend facility. You can use this process to conceptualize the entire project. You are, in essence, building the station in your head.

The functional diagrams give you an accurate count of every wire that needs to go in or out of the studio. You may even want to draw out the same sort of in/out drawing for your master distribution area, which will interconnect each studio. Using these drawings, you can see how large your audio and control trunk cables should be between studios. Take the number of connections (count two for

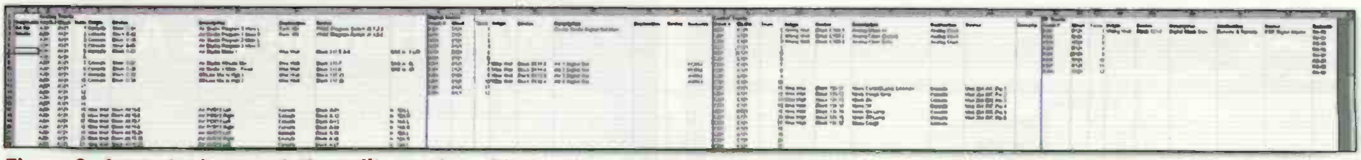


Figure 3. Accurate documentation will speed troubleshooting and allow a successor to better understand the facility.

stereo) and multiply this figure by two to determine the number of wire pairs. Plan for an extra 50 percent of your expected cable footage; otherwise, you will run out of cable. This will give you a quick way to determine the cost benefits of the many ways to route audio and control (e.g., point-to-point wiring and digital or analog routing switchers). You can easily apply this block-diagram approach to new technologies like digital audio routing systems and consoles.

The next step in the design process is transferring this functional plan to actual lists of destinations for each wire (see Figure 3). For this step, a spreadsheet program is extremely helpful. Since you know how big your interconnecting trunks will be, start with a columnar list of each trunk cable, pair by pair. You should have a column for the signal's origin and a column for its next destination. Termination method isn't really important at this stage, but you may have already decided on the system. Your table layout can be designed to complement the terminal blocks so it will be easy to understand later. Then go studio by studio and fill in your trunk chart. Use your functional drawings, and cross out each input or output you enter. You can be meticulous and note the cable-pair numbers on the functional diagram, which can be helpful for future troubleshooting. Do the same for the control paths. You will continue to build on these processes and, before you know it, you'll have a full station-wiring design. The functional diagram and wiring charts you entered will become the task sheets for your installation crew.

The initial creative process detailed in this article is crucial when implementing a studio or facility design. The work you do in here will save you time, man-hours and labor costs. Make sure you are comfortable with the tools you use and the process you take and that your crew and successors can understand your methods.

Barry Thomas is technical director for KCMG, Los Angeles.

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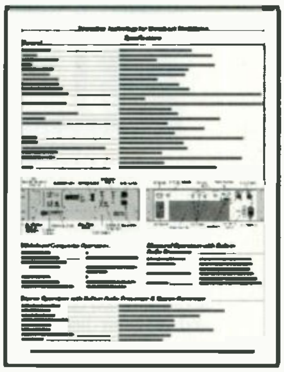

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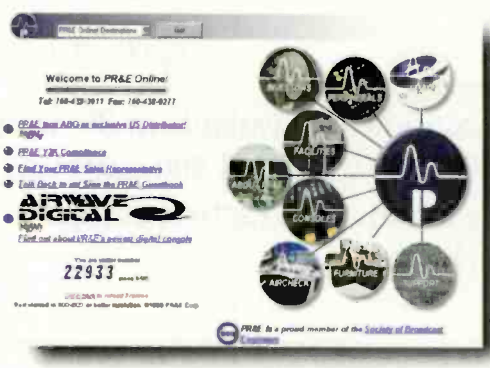

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News

EAS patent invoices delivered

At the end of January, radio stations across the nation received an unusual invoice. QDI, the company that did the billing, claims it holds the patent on certain elements of the technology used in the EAS. Further, QDI believes radio stations using EAS equipment should pay for licenses to use the company's patented information. Stations can opt to pay yearly ($240 the first year then $180 yearly for the duration of the patent) or in one lump sum of $1,495.

Why is QDI collecting from stations, not EAS manufacturers? According to QDI, the company's patent "...encompass[es] a system that contains emergency warning location and type codes that are interjected, transmitted, and received using the AM/FM or TV broadcast station channel. The hardware being sold by the EAS equipment manufacturers is a subset of the patented system."

In a recent meeting, the National Weather Service and the Department of Commerce developed an initial response to QDI's patent claim. As of this printing, the contents of the meeting have not been released, but a government request for reexamination of the patent is likely.

If you have questions about how to proceed, contact the NAB Legal and Regulatory Affairs Department at www.nab.org/legal or call 202-429-5430.

EAS inspections

The FCC has announced that broadcasters must come into 100-percent compliance with EAS. To ensure that stations are meeting the requirements, the FCC's field offices are conducting inspections of AM, FM and TV stations. These inspections began on February 1.

The decision to inspect stations follows a recent FCC survey, which found that compliance levels fell below expectations, particularly in the following areas: installing and operating EAS equipment, monitoring the correct station, maintaining EAS logs, making an EAS handbook available and sending and receiving EAS tests.

Stations that do not meet the EAS requirements may be subject to forfeitures.

USADR garners support of top radio groups

USA Digital Radio seems to have pulled ahead of its competitors, Lucent Digital Radio and Digital Radio Express, in the race to set the IBOC standard in the U.S.

The group of equity owners in USADR expanded recently to encompass the top U.S. radio broadcasters. The new shareholders include Chancellor Media, Chase Capital Partners, Citadel Communications, Clear Channel Communications, Cox Radio, Cumulus Media, Emmis Communications, Entercom Communications, Heftel, Jacor Communications, Radio One and Sinclair Broadcast Group. Chase Capitol Partners, a major media investor, also has an equity position in USADR.

These investors are banking on USADR's successful development and marketing of IBOC DAB technology. Perhaps the next hurdle for USADR is to outperform the competition in field tests.

Renters gain right to install antennas

On November 20, the FCC gave renters the right to install antennas and dishes on their properties. This decision, according to the FCC, balances the interests of tenants and landlords. The logic of this ruling is to ensure consumer access to new broadcast technologies.

Under the amended rule, renters will be able to install reception devices in areas under their exclusive control, including the space outside of buildings, such as balconies, balcony railings, patios and gardens. The rule also gives tenants the right to install devices inside of their units. However, the FCC did not extend this right to common property and restricted-access property.

The FCC noted that a landlord could likely restrict installation of a reception device if it would damage the property beyond the usual wear and tear.

Business/People

Business

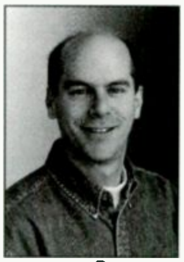
Eugene and Colleen Johnson have announced the completion of their buyout of **Ward-Beck Systems Ltd.**, effective August 31, 1998.

Itelco USA recently announced the purchase of three of the company's 1kW L-band DAB transmitters by the Canadian Broadcasting Corp. in Montreal.

CEMA president Gary Shapiro recently issued a statement of support for the new Secure Digital Music Initiative. For the full statement, visit CEMA's Web site at www.cemacity.org.

Gentner announced that the National Weather Service's NOAA Weather Radio Network has chosen its remote facilities management systems.

People

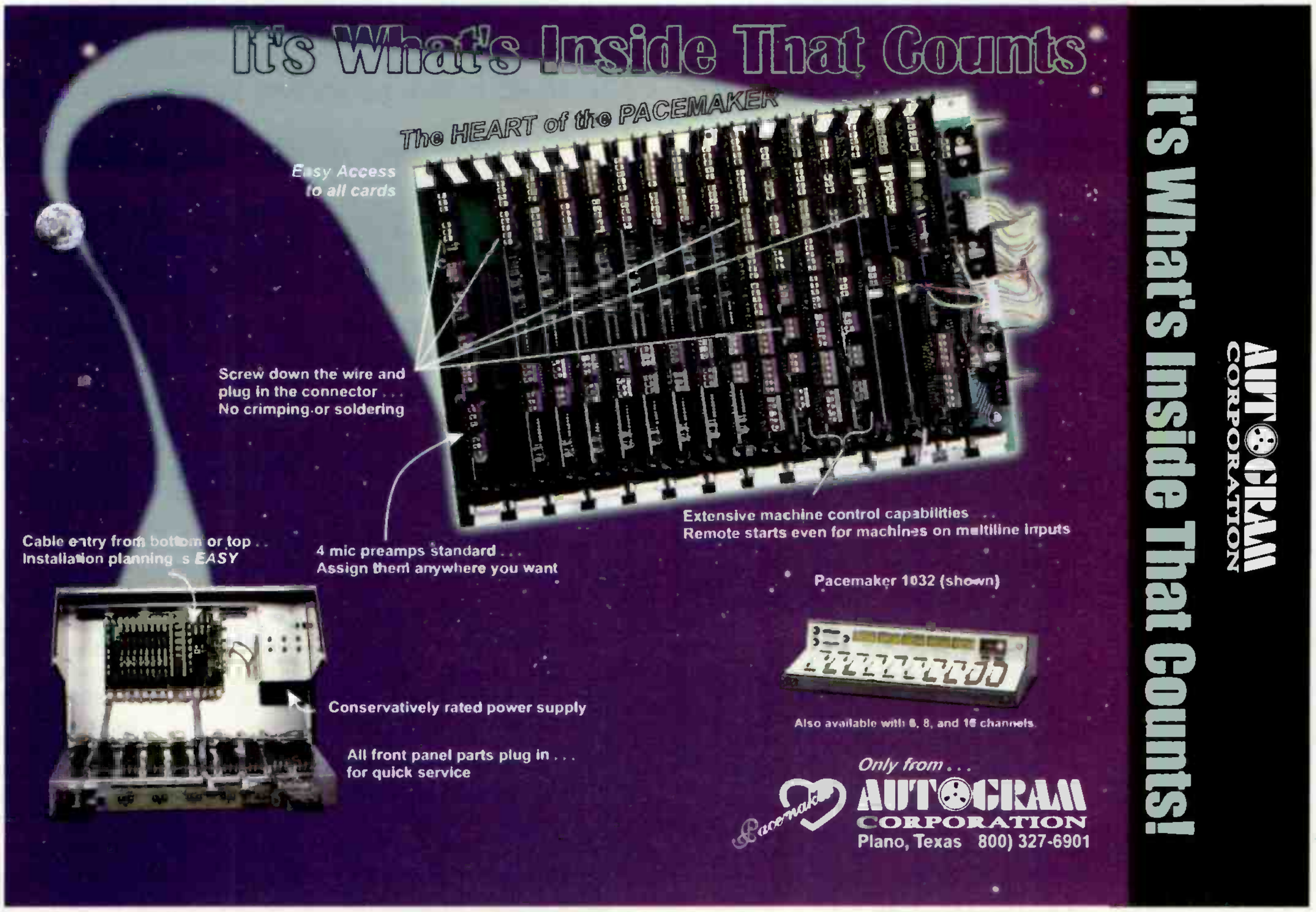

Grayson

▶ **John Grayson** has been named sales and marketing specialist at Telos Systems.

Cole Grace has joined Audio Broadcast Group's sales staff.

John Falcone has been promoted to president and CEO of Sennheiser.

BE Radio GALLERY



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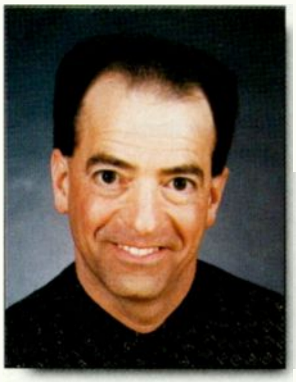
Upward mobility

By Skip Pizzi, executive editor

For several years, we've heard about the crossover of consumer usage between the television and the computer. Another, similar migration is taking place — one that may have an equally powerful impact on the broadcast industry, particularly radio. It is a convergence of the palmtop PC with the wireless telephone, thus creating a portable digital appliance with connectivity, processing power, storage, visual display and audio output.

Hardware and, more importantly, *content* businesses intending to serve this market are quickly emerging.

As with the convergence of the television and the computer, the established hardware communities approaching intersection are spinning this development in different ways. Wireless telephony considers it a way to add storage and "smarts" to the cellular phone, while the palmtop community thinks of it as adding wireless connectivity to palmies. These spins are analogous to making the television smarter or making the computer more entertaining.



But this is not "blue sky." Hardware and, more importantly, *content* businesses intending to serve this market are quickly emerging. Consumer interest in this technology is reportedly growing fast, and the low price points of these devices could allow quick market penetration.

Portable, on-demand audio

One incremental development is the extension of Audible Inc.'s Internet-downloadable spoken-word files to the palmtop platform (see The Last Byte, November/December 1998). Now, Audible files are not only playable on Audible's own portable hardware player or the user's host PC. They can also be downloaded from the host PC to any of several palmtop computers via their standard docks, then played on the palmtop using a screen-based player interface. Unlike Audible's own hardware player, no low-power FM transmitter is included on palmtops, so the user must listen directly to the palmtop's speaker or headphone output (although a plug-in transmitter module is rumored to be coming soon for some palmtops).

A different direction comes from Command Audio, which used the recent CES to at last unveil its CA-1000 player. Wideband FM-station subcarriers will be used to download compressed digital audio files to the player. The user then selects from these programs for on-demand playback. No back-channel transmission is required. Instead, the user sets up a profile in the player to automatically select from the list of available programs, providing a pseudo-interactivity, like the "broadcatching" Nicholas Negroponte conceptualized years ago.

Like the Audible player, the CA-1000 includes a low-powered FM transmitter, so the listener can place the player adjacent to a radio, including a car radio, and tune to an unoccupied frequency to listen through the radio's reproduction system. Direct listening to the player via headphones is also possible. Test broadcasts will begin later this year, with a nationwide rollout expected in 2000. Command Audio now has the considerable marketing might of RCA/Thomson behind it for retail distribution of its player — an important component in the success of any such venture.

RCA also has its eyes on the online radio market. At CES, the company displayed the pre-prototype concept of a portable Internet radio called Picasso.

Mobile data

As Command Audio enters the tightening market for wideband FM subcarriers, Seiko Communications has announced that it will be leaving. The Seiko Messagewatch system and its HSDS datacasting format will be shut down at the end of 1999, opening up a significant amount of the subcarrier spectrum in a few important markets (New York, Los Angeles, Seattle, Portland and Las Vegas).

Meanwhile, Cue Paging is adding a wideband FM subcarrier datacasting system to its existing narrowband 57kHz paging service. The new system will use the DARC format, developed in Japan by NHK. Cue has developed interfaces for a variety of mobile platforms, allowing the new data service to be displayed on the AutoPC and other similar devices.

With the expansion of players in the mobile market comes the need for interface standards in that space. To fill this requirement, the Society of Automotive Engineers (SAE) has developed the Intelligent Transportation Systems (ITS) Data Bus (IDB). It is an open-standard, serial communications protocol for the interconnection of many types of digital mobile electronics.

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