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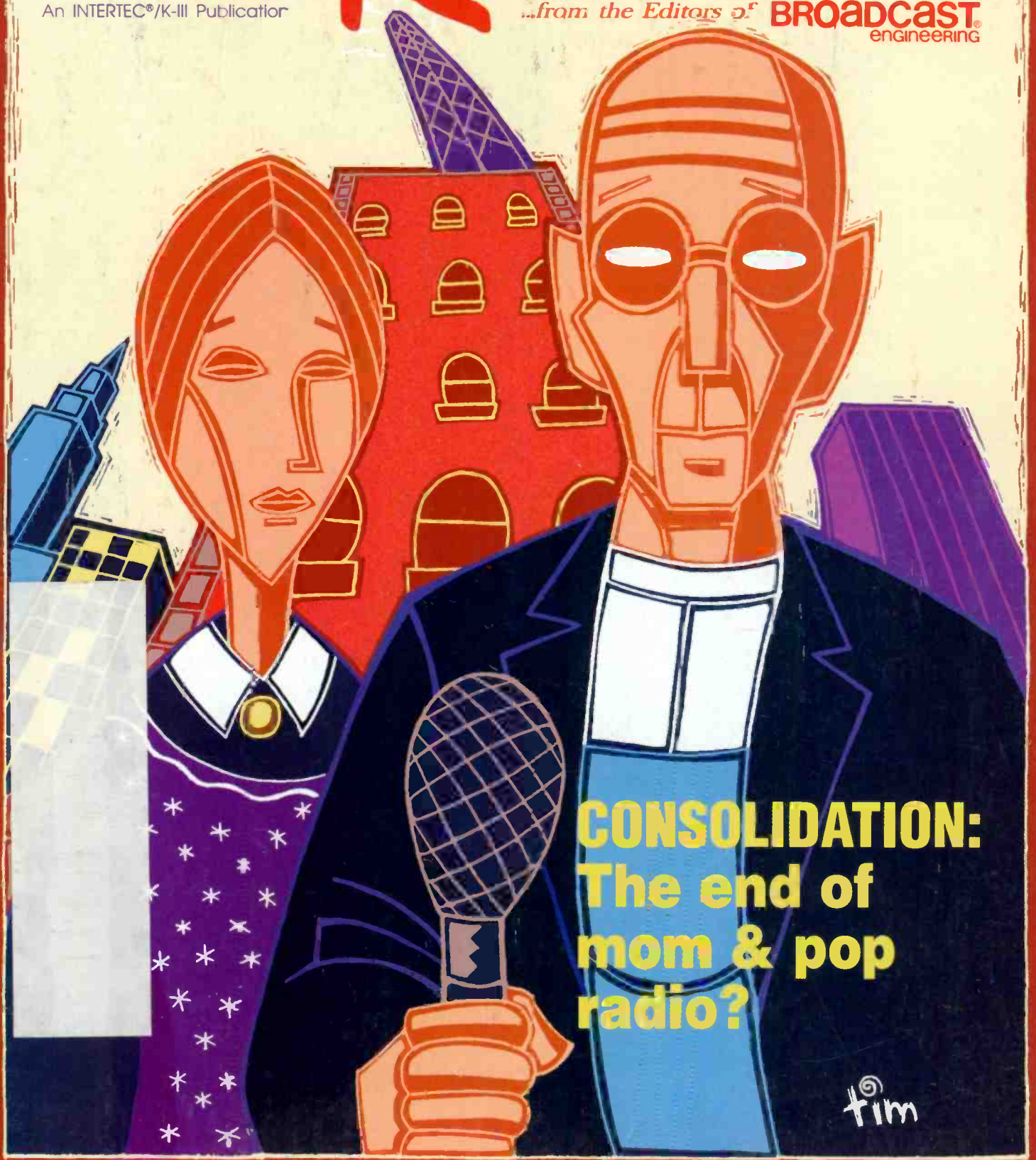
...from the Editors of BROADCAST engineering



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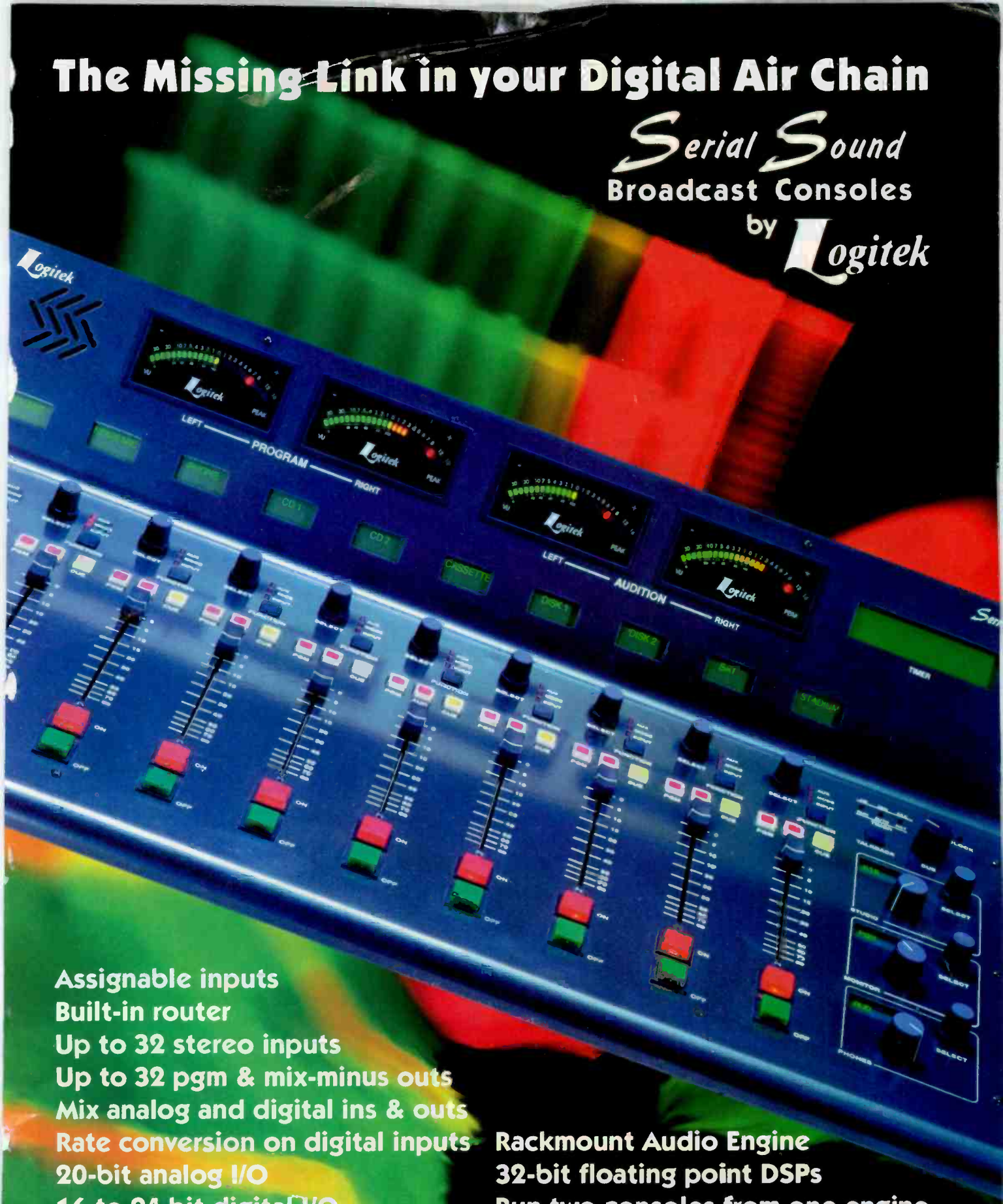

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BE Radio
November/December 1997
Volume 3, Number 7

FEATURES

DEPARTMENTS

ON THE COVER: The Mom and Pop radio station is becoming a rare breed in this day of mega-mergers and superduopolies. (Illustration by Tim Grace.)

While broadcast and video production environments have changed over the years, your need for a Shure mixer has remained.

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Editorial

Unintended consequences

It's generally agreed that the current wave of radio station acquisition and consolidation will have a dramatic impact on the industry. But exactly what this impact will be is still uncertain, and becoming more so. A few predictions about consolidation's effects that seemed like safe bets are already turning out to be wrong, at least in part. For example:

• **Prediction:** *Consolidations will bring mass layoffs.* **Reality:** At least so far, surprisingly few professional jobs have been lost from consolidation. Most stations were already running tight ships in terms of personnel, and many superduopoly owners are following the "if it ain't broke..." approach with their newly acquired staffs.

• **Prediction:** *The deep pockets that consolidation brings to formerly independent stations will allow substantial new capitalization of facilities.* **Reality:** Many newly acquired stations are having greater difficulty than ever in getting proposed purchases approved by their corporate HQs, where a tighter breed of bean counters reigns fiscally supreme.

• **Prediction:** *Maximum-sized super-duopoly owners will have so many stations in a market that they will experiment with new formats; thus, consolidation will promote increased variety.*

Reality: The requirement for high return on investment is so important for new acquisitions that owners are not inclined to take risks with marginal formats. The result is actually *less* variety across the dial, with some formats disappearing entirely (e.g., classical in Philadelphia).

Considering these early lessons, analysts are inclined to step more carefully as the consolidation process continues. Most expect the acquisition phase to last for another year or so, followed by a period of large groups merging or selling out to megacorporations from other industries. During this time, here are a few more pivotal points to ponder:

• How will the nature of competition within a market change? Fewer owners will manage multiple stations, sometimes with the same or similar formats within a group. What's the best way to leverage advertising dollars across these multiple channels? How does one station group establish identity and distinguish its service or value from any other group in the market?

• In cases where stations are physically consolidated, the net space per station is typically reduced. Will this squeezing and sharing of space have a negative impact on the formerly unique character — and by extension, the quality — of individual stations? Could this result in an "anti-synergy," where the whole is *less* than the sum of its parts?

• Perhaps most important, this highly acquisitive period is driving up the price of stations. Even with the economies of scale resulting from consolidation, substantial advertising rate increases are likely. The timing of these rate increases could coincide with the beginnings of serious competitive impact from new DBS and on-line radio services. The traditional radio market's economics could thereby become inflated at exactly the wrong time, with potentially disastrous results. The need for competitive agility against new entrants may be lost just when it's needed most, as a bulked-up radio industry plays right into its new competitors' strategic hands.

Of course, other scenarios are equally plausible. What if IBOC is a roaring success? Will its cost-effective digital delivery capacity reinvigorate the industry? As we're learning, the increasing number of variables involved here make predictions a risky business. But at least we've got plenty of data for you in this issue of *BE Radio* on a few of the relevant subjects (consolidation, IBOC and DBS radio). Study hard and draw your own conclusions.

Skip Pizzi, editor in chief

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Viewpoint

Superopolies are everywhere

What does the word *consolidation* mean to you? Does it stir any feelings or emotions? Over the past few years, it is interesting to think that the meaning of this word has not really changed in definition, but it certainly has changed in scope.

When we first started using the word, the ownership limits set by the FCC were still in place, although already relaxed from the earlier barriers set. The first steps of consolidation efforts affected basic LMAs and then a few duopolies. Stations that were stand-alone or AM/FM combo operations for ages were suddenly joining forces with another station. There were so many possibilities.

Various formats and even fragmentation of formats could be covered under one roof. The double or even triple team effort could cover a corner of a given market. The price tags for the licenses were already somewhat high, but not too far out of reach (to cover the debt in the long run).

There were some uneasy situations for employees, including engineers, as the consolidated operation came into place. Many situations involved moving one or all of the stations in the transaction into a common facility. The new operation could usually cut some costs by reducing the staff on hand. Many station engineers moved into the contract engineering field. Before long, there were contract engineers serving four or five facilities — not stations — facilities. The engineers that kept their jobs at the station level usually felt fortunate. The contract engineers that picked up work at several facilities usually felt lucky as well because they still had work.

Now, the meaning of consolidation has changed again. No longer is it just two stations combining operations — it's two major groups. The consolidation effort is not just three stations, but six or eight and sometimes even more. Again, the staff cutbacks can occur, leaving talented people without jobs. Those that make it through the gauntlet feel lucky. Many of these new superduopolies keep an engineer on staff to take care of four or five stations. Not a contract engineer, but a staff employee. The more things change, the more they stay the same.

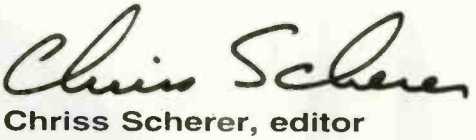
The frenzy of buyouts and mergers continues. The large group owners keep getting bigger as the big guns get together. Even at the NAB Radio Show there was buzz about the latest merger between Westinghouse/CBS and ARS.

Just over a month ago, the rules of the game changed again. The mergers and buyouts have grown to a scale that has left several large owners raising the question of 'what is left to buy?' When the biggest fish has eaten all the other big fish, what does he do? He goes after the medium-sized fish. The next trend in mergers and buyouts will be the medium-sized groups of 10 to 30 stations, as can be seen with the recent news of Nationwide Communications being sold. The larger groups keep growing, but at a slower rate. The next item on the menu will undoubtedly be the small groups and the few remaining stand-alone stations.

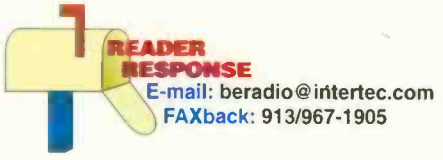
The current selling price for these stations and groups is around 16 times cash flow (and sometimes more). These are not small numbers. The price tags being attached to these transactions is so high that the amount of debt needing to be serviced makes reselling the station a difficult task without assuming a large debt. There are already situations of a single group almost completely owning an entire market.

Where will this all end? Will it come down to two or three superowners? Maybe even one owner if things keep changing. Is this good for radio broadcasting? Competition normally makes all the players stronger. You have several choices of laundry detergent and hamburgers. We'll still have a choice of formats, but they all could have the same man behind the curtain.

On a different subject, there is one news item that needs to be mentioned. *BE Radio* has been coming to you every other month for the past few years. There were some recent additions made to the staff and now there will be a change in the frequency for 1998. *BE Radio* will be coming to you every month starting in January for a total of 10 issues in 1998. Look for more of the quality articles and information you already expect more often. This is another way that *BE Radio* is changing to stay on top of all the technology and news that you need.



Chriss Scherer, editor



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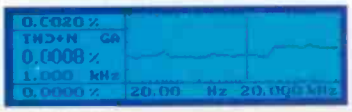

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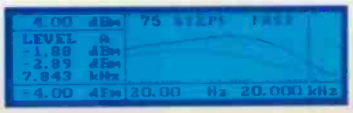

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Tower lighting

By William Fawcett

The staggered FCC antenna structure registration process is about two-thirds complete. If you have registered a tower or have an application pending, you probably have been looking at your existing tower light situation.

Even with recent changes, there continues to be confusion about multiple specifications for lighting. Until recently, the FCC listed its own specifications in Part 17 of the FCC rules. Furthermore, when a license was issued, pertinent paragraphs of FCC Form 715 would be cited, often with a copy of Form 715 attached to the license. Current registrations may quote the FAA specifications contained in FAA advisory circular numbers 70/7460-1H and 150/5345-43D, which are now incorporated by reference into Part 17.

Your license or registration may cite pertinent paragraphs or chapters of *current* or *previous* versions of any of these documents. Be sure to compare your new registration with the specifications listed on your license to make sure that they agree; some processing errors have occurred.

Note that Section 17.17 specifically states that older specifications are grandfathered (as long as the current tower is not modified). Therefore, you may have a 399-foot tower with only one beacon level or alternate flashing beacons; things that might not be permitted under the current rules. You should keep the upgrade cost in mind when considering any proposal for modification.

Under WT Docket 95-5, the *owner* of the tower is responsible for compliance with lighting and marking requirements. In the case of a renegade owner, the FCC may require each licensee and permittee authorized on an antenna structure to maintain compliance in accordance with the antenna structure registration. Therefore, it is critical that the station engineer have a working knowledge of lighting requirements and maintenance procedures, even when dealing with a leased tower.

Tower light maintenance is the responsibility of the owner. (Photo by Chriss Scherer.)

To strobe or not to strobe

It is amazing how the pendulum swings. When strobes were first introduced, the public outcry was great. Early designs did not attenuate strobe radiation below the horizon. With the proliferation of strobed cellular towers we are seeing a desensitization to these aesthetic concerns. Now, many local ordinances discourage the orange and white marking required for red lit towers.

Some local situations may call for the use of red lights at night and strobes during the day. This can be a costly compromise, but at least it will save you the expense of frequent re-painting and re-lamping. Rather than installing dual fixtures, you may consider a strobe design that mechanically places a red lens over the strobe at night. Not only is it likely that new towers will incorporate strobes, many red lit towers are making the transition. For various reasons, it is becoming difficult to even find contractors that will bid on a tower painting project.

Before making changes to a lighting system, you must file an FAA Form 7460-1. Additionally, the tower owner must also submit FCC Form 854, antenna structure registration when such a change is made (generally after FAA approval is obtained). Later, FAA Form 7460-2 is used to report construction status.

Maintenance procedures

You will likely receive a report of any problems encountered during a re-lamping procedure or a periodic on-tower inspection. Typical problems include damaged wiring and fixtures broken by ice or errant bullets. Conduit system breathers should be checked and cleaned to avoid water accumulation. Apart from climbing the tower, a number of items can be checked on a regular basis.

The most basic of all inspections is the 24-hour daily check. By law, a visual inspection must be made and logged at least once a day. Remote site installations may feature an automatic alarm. You must test the alarm(s) at

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intervals not exceeding three months. If lights are out (other than non-flashing intermediate side lights), you must immediately report the failure to the nearest Flight Service Station. Information concerning malfunctions and repairs should also be recorded in the station log.

A trained eye can usually spot when one lamp is out in an incandescent dual-beacon fixture. Binoculars can be useful for checking this, as well as looking for broken or open fixtures.

Most incandescent alarm relays will dropout when only one lamp is burning. A clamp-on ammeter will quickly verify if any lamps are out; side lights typically draw 1A each, beacons (620W) draw 5.2A at 120V.

Mechanical flashers should be periodically lubed and their contacts burnished when necessary. The lights

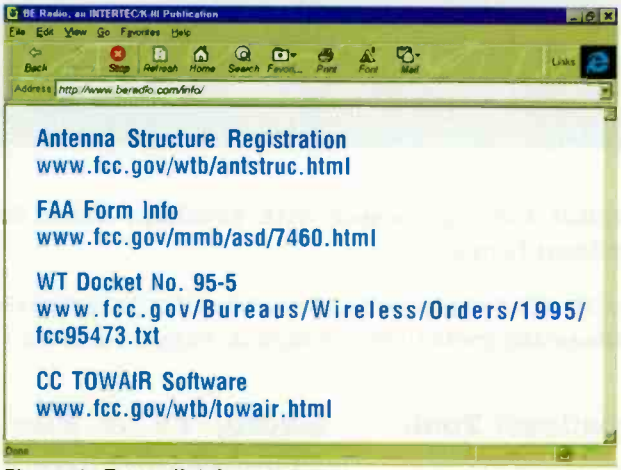

Figure 1. Tower lighting resources.

should flash between 12 and 40 times per minute, with a 50% duty cycle. Some mechanical flashers get slow when cold weather causes the grease to harden. Most modern designs use a solid-state flasher, which will not wear out mechanically, but may require replacement after a direct lightning hit.

Strobe systems should be checked to ensure that the lights change from day to night mode. Although the public is getting used to strobes, you will hear complaints if your system stays in day mode during the night. On either a strobe or red light system, you should make sure that the photocell eye is clean and that it is facing the north sky.

On a hot AM tower, you will likely have a lighting transformer to isolate the tower from the power lines. Occasionally, these transformers or the associated bypass capacitors will be damaged by a lightning strike. Controllers, photocells and flashers may be mounted on or off the tower. Those on the tower will be more difficult to service. Solid-state flashers on AM towers may require special bypassing to avoid RF-related malfunctions.

Because the AM tower is also the radiator, any changes to the lighting system may cause a change in impedance. A substantial change may require re-tuning and, in many cases, the submission of FCC Form 302. For stable operation, the neutral lead on the tower of an incandescent system should be bonded to the tower at the base, and at each junction box. Strobe systems on an AM tower should be installed according to the manufacturer's recommendations.

National Electric Code considerations

Certain provisions of the National Electric Code (NEC) may require the installation of a safety disconnect for the lighting circuit at the tower. Even though you could lock-out the circuit back at the transmitter building, a disconnect at the tower makes servicing the system easier and safer. Speaking of safety, one of the pen-sized AC power detector buzzers will help keep you off hot circuits. A buzzer also is the fastest way to find a blown fuse or open circuit. You can even use it to check the flasher and photocell in the daytime.

The installation of fuses at the disconnect may afford some measure of lightning protection to the AC circuits away from the tower, but you may find yourself replacing the fuses on a regular basis.

Wiring to the tower and on the tower should be sized according to voltage drop and not the minimum code requirements. Section 17.54 requires that the voltage rating of an incandescent lamp be no more than 3% of the actual voltage measured at the socket. Long runs may require the use of step-up transformers and/or 240V systems.

Under Article 250 of the NEC, bonding of the neutral to ground usually only occurs at the service entrance. Because towers have their own grounding electrodes, they can be treated as a separate "building." This will allow you to bond the neutral to the ground at the tower, which is essential for lightning suppression and RF control. Your tower ground must also be bonded to your power system ground.

As mentioned before, it is important to bond the neutral on an AM tower to the tower at regular intervals. This practice is not addressed by the NEC, and some interpretations might prohibit it. Fortunately, most jurisdictions do not inspect electrical wiring on towers; some specifically exclude such wiring. To get around this problem in some locales, you might install a twist-lock receptacle and plug at the cold side of the lighting choke and call it "equipment" or alternatively supply a schematic plan with a professional engineer's seal with your permit application.

Three-fold approach

It is already understood that a broadcast engineer's job requires expertise in many different areas. Where tower lighting is concerned, you must have knowledge in regulatory issues, lighting hardware and electrical wiring. Because of public safety concerns, it is critical that the station engineer is competent in the theory and practice of all three.

William Fawcett is president of Mountain Valley Broadcast Service Inc., Harrisonburg, VA. He also is director of engineering for the Center for Public Broadcasting at James Madison University, and holds tradesman certification as a Master Electrician.

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Archival storage

By Chriss Scherer, editor

The ability to record and store audio in some form has been around since Edison's inventions more than 100 years ago. Fortunately, advances in storage media have given us formats that have a longer life than those early innovations. We tend to think of many formats as indestructible, only to find this to be incorrect when it is too late. There are many decisions to be made when storing archived audio material. Some are driven by technical needs and others are more instinctive.

Forms of media

Analog or digital? The analog choices are few, but are still a viable option for some applications. Digital technologies and storage systems continue to be introduced allowing for more flexibility in the decision process.

Various forms of archiving media.

There are really only two forms of analog recordings that have any longevity with high-quality storage: open reel tape and phonograph records. Because most of us do not have a lathe cutter around, archiving to a phonograph is not really a consideration. Storage of phonograph records requires cool temperatures and low humidity.

Reel-to-reel tape recorders are common in almost every broadcast facility. They have been around for ages and even though digital replacements continue to make strong inroads, plenty of reel-to-reel recorders are in use.

Digital recording has many options to choose from and the options for digital can get diverse. Some basic considerations should make the selection process easier.

Once digitized, the audio data can be manipulated in a variety of ways. For archiving purposes, one of the most important considerations should be the quality of the recording. Ideally, the system chosen should exceed the existing parameters of the recording or audio source. Take into account the possibility of future use over a medium with better frequency response and dynamic range. Some digital distribution systems have limitations, but continuing advances will allow for the premium audio source to be enjoyed again.

Digital audio should be linear and not data-reduced (more commonly called data compression). The methods of data reduction have certainly improved and will continue to do so, but throwing away part of the data at the beginning of the process just doesn't make much sense. Data-reduced algorithms will decrease the amount of storage space needed. The costs of high-capacity media also decline.

Selection of a storage medium should take into account the goal of the project and the budget. A proprietary system that is not widely used will be orphaned to use within the facility. If the archive is to be used out-of-house, it will need to be converted to another format for remote playback. With so many computer-based systems in use, archiving to a data backup is common. However, if the system ever changes, the archive is worthless.

Whatever system is chosen, an important issue after medium longevity is format longevity. A system that seems popular today may vanish in a few years. With so many choices available, let's look at the dominant choices and their individual strengths and weaknesses.

- ***Analog reel-to-reel***. The biggest advantage of reel-to-reel archiving is the popularity of the medium. Unfortunately, analog tape does not stand up well over time. An analog recording is subject to any noise of the storage media. As the signal decays with age, more noise will appear in the recording.
- ***CD-R***. The cost and availability of CD recorders has significantly dropped since its introduction. With CD-R, you are able to record on the disc once. There are two types of CD-R discs: green dye (cyanine) and gold dye (pthalocyanine). The gold dye formulation is much more robust, as a result of a better reaction from the laser, helpful at record speeds of 4X and above. Longevity tests of green dye discs show life spans of 20 to 30 years, while gold dye discs have life spans approaching 100 years. The biggest advantage is that CD-R discs are playable on any CD player once finished.
- ***CD-RW***. This newer format, takes the advantages of CD-R and adds the ability to re-record on the same disc. The cost of the hardware is similar to CD-R hardware, but the cost of the media is five to six times greater. Most archival recordings will be recorded once and then

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played back several times, so the biggest advantages over CD-R are lost. They are also not playable universally like CD-R.

• ***DAT***. Digital audiotape is a convenient medium that offers the ease and portability of a cassette tape with digital quality. The linear (PCM) recording scheme has the same advantages of CD, but it is still a tape storage device. The same problems with analog tape can affect DAT. DAT is a fairly robust medium, but take a look at the block error rates and you will see that it is working hard to account for lost data, especially if the tape is old. If DAT is chosen as your archiving medium, do not cut corners on the tapes. Saving a few cents per tape today only to have a worthless recording in five years is hardly any savings at all.

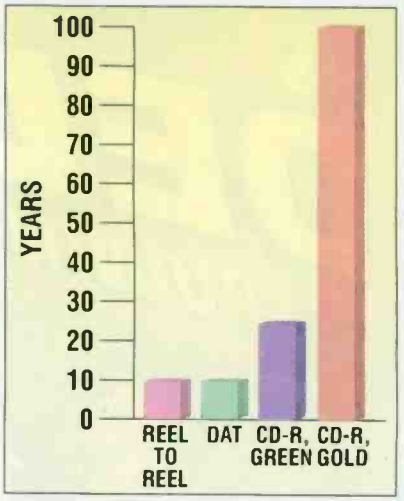

Table 1. Life spans of various media.

• ***DVD***. This format has a high data density that makes it ideal for video applications. It achieves this higher density by using narrower bands on the disc surface. There are several varieties of DVD (like the varieties of CD), and one proposed standard is DVD-Audio. It will be able to store at least 4.7GB of audio data (compared to the current CD capacity of 650MB). This is a proposed standard and has not yet been settled.

• ***MiniDisc***. Magneto-optical (MO) storage has some of the advantages of both worlds. MiniDisc also has a compact size making storage much simpler. MiniDisc uses a non-linear encoding scheme called Adaptive Transform Acoustic Coding (ATRAC). Although this algorithm does sound good, you are still using data reduction. MiniDiscs can hold up to 74 minutes of stereo audio using ATRAC.

Storage for the long run

Considerations must be made for the appropriate storage of the medium — climate being the most important concern. Many stations consider the transmitter as a storage facility, but that is usually one of the worst choices. Temperature extremes, changing humidity and airborne dirt can destroy recordings in a short time. The archive storage room (sometimes called a tape morgue) should have a constant temperature and low humidity. For audiotape, the recommended storage conditions are 70°F (±5°) at 70% (±5%) relative humidity.

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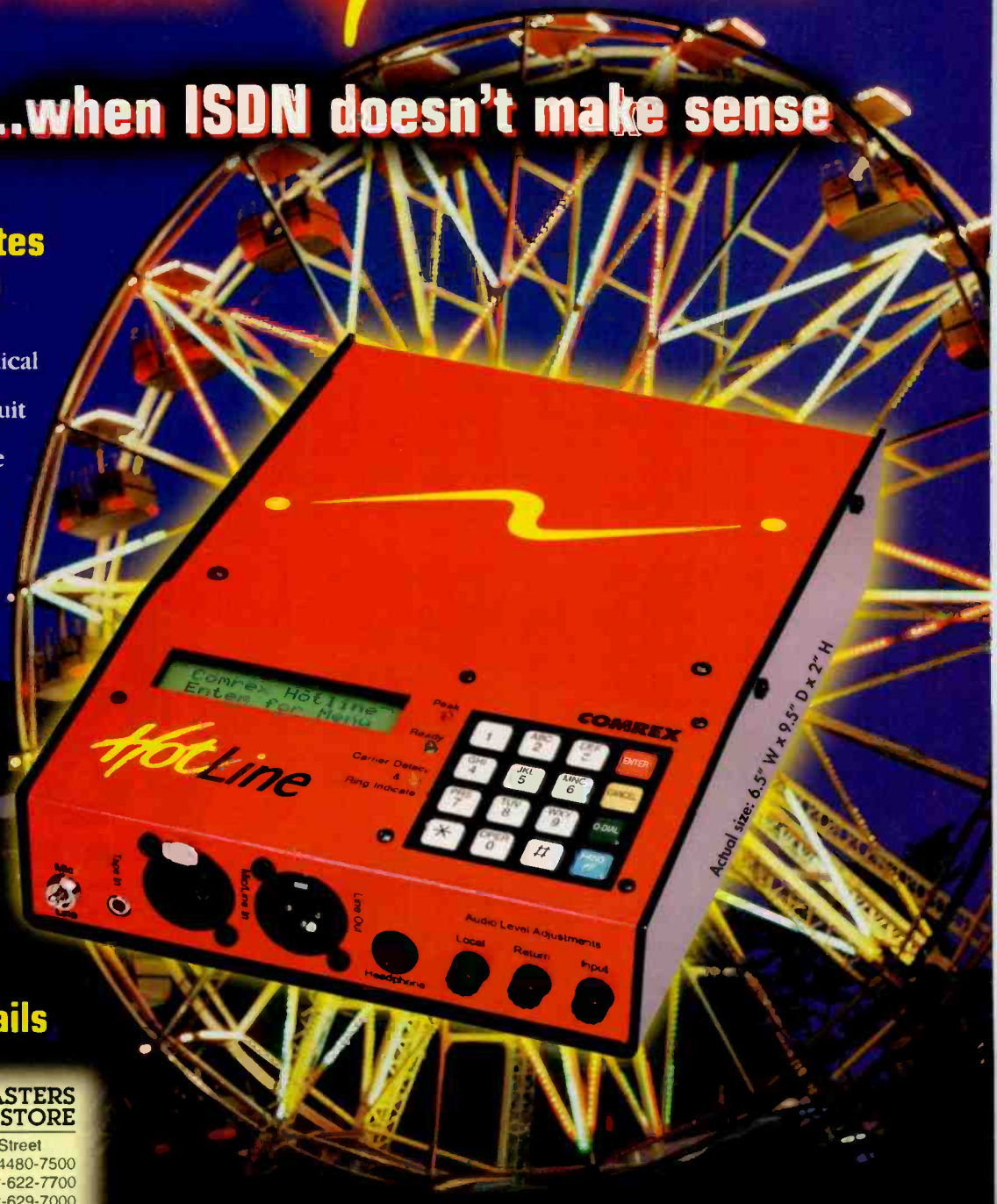

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The real culprit for tape damage is a dramatic change in this environment, which causes the tape to break down. The backcoating and binding lose their adhesion and the tape becomes sticky. Even worse, the magnetic particles can be scraped off the backing on playback. When breakdown occurs, the tape must be "baked" to restore it to a temporary usable condition. CDs are much more robust, and while the tape storage guidelines are a good measure to follow, the CD is much more forgiving. Another consideration for magnetic media is *retentivity*, the ability of the magnetic particles to retain their flux. Although some tape formulations boast long physical life spans, if the magnetic information decays, the recording will be lost.

What to keep

This is always the most difficult question to answer. The most limiting factor is the allotted storage space. Following are a few things to consider in your archive selection criteria:

1. *Is it unique in some way?* Routine events may have some value for a short period of time, but without any meaningful content, the archiving expense is not justified.
2. *Is it being archived somewhere else?* Many national archives are already in place. Don't duplicate limited resources unnecessarily.
3. *What is the source?* Speeches and performances aired once may not have any value in a few months. It is hard to know that the private club performance today will be the debut of the next musical supergroup. This is an intuitive decision.
4. *How often do you use archived material?* If your need for archived material is minimal, perhaps short-term storage (for immediate use) is all that will be required. Purchasing an occasional archive dub may be cheaper than housing volumes of material for many years.

Given the current state of technology, a digital storage archive media is a proven winner. Select a format that has a wide usage for compatibility and longevity. The hardware costs for any accepted technology will always decrease with acceptance over time. Be sure to account for proper climate conditions in the storage area. Excessive heat and humidity are obvious considerations. Depending on the medium, ultraviolet light and electromagnetic fields may also be a concern.

Editor's note: *Thanks to Richard Wilson and Richard Elan of Apogee Electronics for information for this article.*

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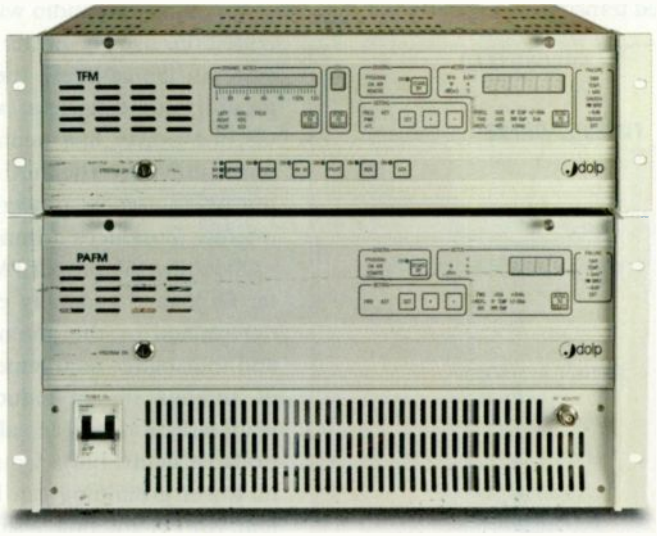

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RF grounding

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

Grounding or "earthing" as it is called in Europe, is of vital importance to the RF engineer — and of almost as much importance to the audio engineer. Fortunately, for the audio engineer, an inferior ground does not usually result in catastrophic damage to transmitting equipment.

Failure to provide proper RF grounding can result in many undesirable conditions. The extensive list includes: wandering common point or antenna base operating impedance, out-of-tolerance operating parameters, burned or damaged transmission lines and sometimes antenna sampling lines, transmitter damage in the final stage, power supply failure, constant RF arcing that results in noise on the carrier, static discharge (lightning) damage, induced lightning strike damage in nearby equipment, loss of airtime (especially in remotely controlled transmitters), loss of telephone lines, fire, personal injury (or worse) and poor audio quality and distortion due to RF in the audio lines and associated equipment. Although "the damn thing is grounded" is a complaint that every electronics engineer has heard from day one, a proper ground is the broadcast engineer's best friend.

In cases of studios closely located to the transmitter, RF can get into audio wiring, consoles and associated equipment. When television was coming into service, it was not uncommon for licensees to build their newly authorized TV facilities onto the existing radio station. When the radio transmitter was turned on after installing video facilities, "herringbone" interference was often found in the video. This was particularly troublesome in the case of an AM station co-located with television.

If the problem had been considered beforehand, adequate copper screening and shielding could have been built into the building design. Unfortunately, sometimes it was necessary to jerry-rig a Faraday shield around and into an existing building, with great expense, to shield the video equipment. Sometimes, too, the original station grounding system was inadequate and had to be rebuilt to provide proper RF *and* power-line shielding.

When a transmitter or a studio is built from scratch, deciding how to install the ground system and where to put it is generally not much of a problem. Fortunately, for RF engineers, construction of a new AM radio transmitter is seldom contemplated in existing buildings. RF environment rules and physical antenna space seldom permit it. Roof-top AM antennas have long been unacceptable to the FCC — except for the few still operating.

FM grounding

FM transmitter location is more common in built-up city areas, and here the grounding problem becomes more acute. In general, FM does not seem to have the insidious property that AM does of getting into audio wiring. Local conditions usually dictate grounding systems. Sometimes, the building ground proves useless, and at others, the power line neutral ground gives problems. The third grounding pin on equipment power cords frequently introduces a hum problem.

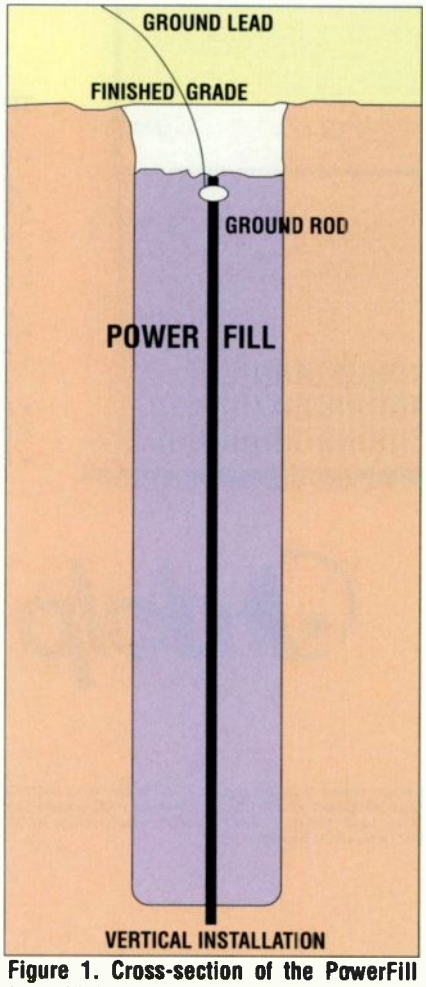

Figure 1. Cross-section of the PowerFill from Lightningmaster.

Obtaining the proper FM transmitter RF load is generally easy and is determined by the antenna system and transmitter requirements. Proper antenna design reduces downward radiation to acceptable or controllable limits, but adequate antenna tower grounding can be a problem. An FM antenna system mounted on top of a building involves the building's ground for safety when lightning occurs. But for AM towers and FM antennas in rural areas, the problems are greater. FM antennas supported on their own towers are frequently inadequately grounded. The fact that an FM antenna is automatically DC grounded by its construction often gives users a false impression of lightning safety. Many of us have seen a 300-foot FM tower with only one or two grounding rods connected by No. 10 copper wire to the tower base. Owners then wonder why their antennas and other

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equipment are damaged when a storm occurs. FM towers certainly don't need the extensive ground system that AM antennas do; but they deserve something better than two grounding rods connected by somewhat inductive No. 10 wire.

There are commercially available tower leg grounding kits that connect to the tower leg and then go straight to ground rods buried in the soil. There must be enough surface area on the conductor to dissipate a strike instead of forcing it to jump or induce charges in other adjacent lines.

AM radiators, either series or shunt fed, generally have adequate grounds provided by the standard multiradial ground system required by the FCC's rules. But even these systems can be inadequate and/or inefficient. Ball gaps that are incorrectly set are useless.

The FCC's minimum ground system rules call for 120 radials one-quarter-wave long. Experience has taught us that there is generally not much to be gained by extending the radials much farther. However, we have learned that providing a ground "plate" with a larger area around the tower base usually produces better results.

I always like to see an extruded copper ground plate of at least 24 feet by 24 feet at the tower base. In the case of high-power transmitters or poor soil, an area of 48 feet by 48 feet is advisable. Unfortunately, the cost of the copper required makes this an expensive proposition.

This area around the antenna base is the place where most ground losses occur. It is the region where the highest space current returns and I^2R losses mount up. Radials usually start at the copper strap forming the surrounding edges of the copper screen. These edges form a girdling loop around the tower. Experiments have shown that copper loops further out on the radials do nothing more than connect ground points of approximately the same potential and add nothing to the efficiency of the system.

Stay on common ground

The tower base below the series-fed ground radiator must be connected directly to the transmitter via a four-inch copper strap. If the antenna system uses more than one tower, each must be tied into the transmitter/ground system with a similar four-inch strap. This involves a lot of four-inch copper, but it has been shown that this provides a far more stable system than relying on the interconnection between individual tower grounds in a directional array system.

In the interest of economy, some stations rely on the outer layer of the coaxial transmission line to tie the towers and transmitter together. This is not good. Although the coax is usually buried, it has inductance, because it is round and not a flat strap. This inductance can cause problems when a heavy lightning strike occurs. Every unit of a transmitter should be tied directly to the four-inch ground strap after it enters the building.

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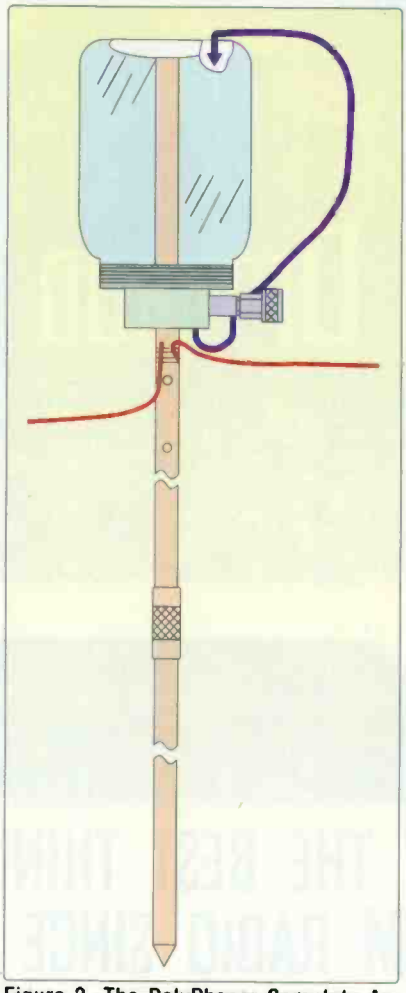

Figure 2. The PolyPhaser Complete Active Salt grounding system.

A quality ground system properly connected plays a major part in preventing lightning damage and operating problems. Using two grounds is an invitation to trouble. When there is a separation between grounds and lightning strikes, the sudden change in potential between the two grounds produces a current that can (and usually will) damage electronic equipment. A small ground current can do a great deal of damage.

An important role

We sometimes lose sight of the fact that the ground system plays two parts. One is to collect the space current from the radiator and complete the circuit. The other is to provide a direct path to dissipate any static or lightning charges that excite an antenna and prevent them from entering equipment or inducing potentials in adjacent lines.

In areas where the soil has poor conductivity with dry and sandy conditions or where there is little or no soil at all, chemical grounding methods should be used in addition to an on-the-surface "ground" or a *counterpoise*. Chemical grounding is offered by several companies. The *PolyPhaser* system of active salt grounding uses a perforated tube inserted into the soil with a glass container of water and Epsom salts on top of it. (*See Figure 2.*) The solution leaches into the ground and provides excellent ground contact.

Another ground system, *LightningMaster's* PowerFill involves drilling a hole in the earth's surface, then inserting a ground rod and filling the area around the rod with a backfill material, as shown in Figure 1. This provides a ground that will accept an extremely high lightning surge.

Naturally, both of the above devices lend themselves to multiple soil insertions as required by an antenna system to provide sufficient grounding. The literature provided by these and other manufacturers can be informative and offer a variety of grounding solutions.

A safety note

When working on an AM tower array, keep in mind that sometimes towers that are not active in a particular pattern will not have power applied to them, but they also may not be grounded. Depending on the design of the array, some unused towers may be floating (in relation to ground) instead. These towers can be energized from the surrounding RF field and present a safety hazard if touched. Before working on a tower that is in use like this, be sure to take the necessary safety precautions, like connecting a sturdy ground, while working around it. Be careful of this as well, because you may adversely affect the pattern with this connection or even cause damage to components. Be sure to remove any temporary ground when you are finished.

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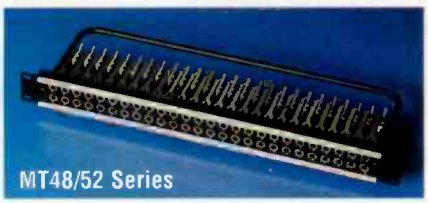

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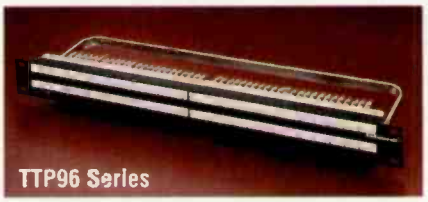

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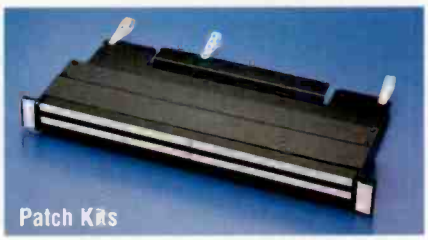

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FCC Update

Settlement caps lifted

By Harry C. Martin

The Budget Reconciliation Act of 1997 authorizes the FCC to issue construction permits (CPs) for new broadcast stations through public auctions where there are mutually exclusive applications pending for the facility. However, until Jan. 30, 1998, the FCC also can waive its restrictions limiting the amount of funds that may be paid to dismissing applicants as part of a settlement. This 180-day "settlement window" applies *only* to those applications that were filed before July 1, 1997.

Pending comparative cases may be settled is several ways. The first is through a straight buyout, whereby one party buys out all of the remaining applicants for the facility. One variation is for an outside party (a *gray knight*) to acquire a minority interest in the prevailing applicant, finance the settlement by buying out the dismissing applicants, finance construction of the new station, and hold an option to acquire the controlling interest in the permittee shortly after the station goes on the air. Although the FCC has not addressed it, it also may be possible for an outside party (a *white knight*) to buy out all of the applicants in a mutually exclusive proceeding and obtain the CP directly.

Two other means of achieving a settlement are through a private auction or mediator. With the auction, the highest bidder obtains the construction permit for the station and the other dismissing applicants share in the proceeds of the winning bid.

With mediation, an experienced neutral person works with the applicants as a group and on an individual basis to find a solution. Mediation provides an opportunity for creative solutions that may not arise in negotiations among the parties. Because a mediator is not an arbitrator and does not impose a disposition of the proceeding, mediation can be a risk-free means of attempting to resolve conflicts among applicants.

After the settlement window closes on Jan. 30, 1998, the settlement caps go back into effect. It is unclear whether the FCC will permit parties to enter into any form of settlement at that time or whether it will require these applications to be subject to a public auction, as is the case with applications filed on or after July 1, 1997.

The act directs the commission to allow an adequate period of time in scheduling public auctions to permit notice and comment on the proposed auction procedures before issuing the new bidding rules, and to ensure that interested parties have sufficient time to develop business plans and assess market conditions before any auction. Although the FCC is in the process of drafting proposed auction rules, it is doubtful that any auctions will be held for new broadcast facilities before next spring.

New commissioners grilled

The Senate Commerce Committee held hearings on the nominations of the four new commissioners on Sept. 30 and Oct. 1.

Questioning of the nominees Michael Powell, Gloria Tristani and Harold Furchtgott-Roth centered on the FCC implementation of the 1996 Telecommunicatins Act. All three nominees agreed that failure to adopt the new ratings system might be a reason for reviewing a license renewal application more closely. None of the candidates would commit to not renewing a license on this basis.

The separate hearing on William Kennard's nomination to be chairman also focused on the FCC's implementation of the Telecom Act. Senator John McCain (R-AZ) questioned Kennard about the TV ratings system, and Kennard stated that the commission has a role in determining the acceptability of the ratings system. McCain did not ask Kennard whether failure to adopt the ratings system should be a factor in license renewal. Industry observers believe that McCain's failure to ask for and Kennard's failure to give a commitment linking the ratings systems and license renewals means the Senator has retreated from the hard line that he has taken against NBC, which has refused to adopt the ratings system.

The three new commissioners and the chairman took office at the end of October.

Harry Martin is an attorney with Fletcher, Heald & Hildreth, PLC., Rosslyn, VA.

dateline

Renewal applications are due Dec. 1, 1997 for radio stations in the following states: CT, ME, MA, NH, RI and VT.

Ownership reports are due Dec. 1 for commercial radio stations in the following states: Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, South Dakota, Rhode Island and Vermont.

Tower registrations are due between Dec. 1-31 for towers in Alabama, the District of Columbia and Maryland.

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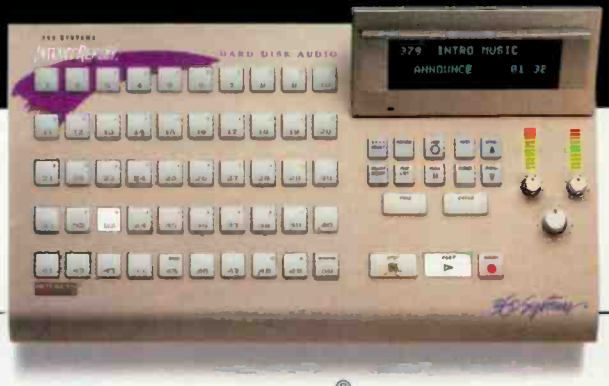

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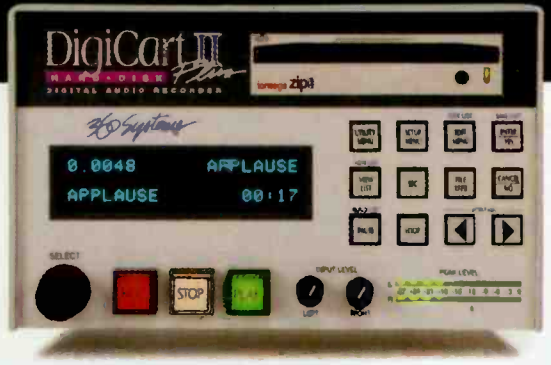

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CONSOLIDATING FACILITIES

It has been two years since the liberalization of duopoly rules. What is involved when superduopoly stations move in together?

By Chip Morgan

You've just returned from a strategic meeting where it was announced that the company would be consolidating all the local stations into one building. Having completed a huge project last year (with the previous owners) where you did just that, many thoughts go through your head. You consider that the brand-new facilities will be abandoned, but know with many millions of dollars invested in the market, this newest consolidation move will actually save more in the long run. You think about how much work a job like this is, how much it interferes with the daily operation of the facility and how you can do it better this time.

Then you think back to the days when most of the radio stations were "mom & pop" facilities. In those days, a group was considered large when it had the maximum of seven stations in the country. Today, a large group might have more than a hundred stations.

With ownership limits lifted by the FCC and a huge influx of public money coming into the business, radio is changing again. For the first time in radio history, all of the pieces are in place for consolidation and large-scale networking of radio stations. The choices you make today will affect the immediate future and the next generation of radio broadcasters. The answers come from all over the world and some surprisingly new solutions exist which, until now, were not well publicized.

Economic issues

We don't know what will happen to the economics of broadcasting over the next few years. Perhaps the current concept of having local facilities for each group of commonly owned stations will prevail for many years. Perhaps network studio facilities will be built in each region, in each time zone or even in one master facility for the whole country — as the major radio networks have done for years. It's likely that a combination of these tactics will be used.

Regardless of the future, one thing is perfectly clear today. If each new facility is designed with maximum flexibility so that every part of it is modular, movable and changeable, the investment will be maximized and the value will be retained when portions of the facility are reorganized from sales, purchases or

Photo: Running multiple stations under one roof has many advantages. Photo by Chris Bennett.

CONSOLIDATING FACILITIES

relocations. The cost to do it this way from the beginning is no higher than the traditional methods of design and construction.

Radio's greatest strength is its flexibility and ability to quickly react to changing times. Radio is truly portable.

Today, the equipment and systems exist for most of the dreams we've had over the years for radio programming. With public investment in the industry, the money is available, the growth is rapid. The return on investment is being scrutinized and decision-makers are looking for new and innovative ideas.

On-air facilities

When we see how well modular office furniture works for changing requirements, we begin to understand why this idea can work for on-air facilities, as well. Modular office furniture is designed to work in any business from an office on a farm to an office in a space agency. It is the flexibility that makes it attractive. The same concepts can be applied to on-air facilities. The facilities can be designed from the beginning to be moved or rearranged later.

If the studio furniture is portable instead of screwed and glued to the walls, it can be rearranged or moved later with no great difficulty. In fact, if an entire group designs its facilities around this concept, individual station facilities can be relocated anywhere in the group as needed. This standardization toward more portable radio is no different than standardization by using modular office furniture.

Today, you can put your music, news, network feeds, commercials, production, traffic, billing and logging in a single computer system. Now that's consolidation!

If we think of the industry as being a portable, changing world by design, it's easy to think of ways to make the facilities as flexible as a traveling stage show. If we design for change, we can use stage techniques, such as putting everything on wheels, using multipair and multipin stage boxes and making every I/O patchable — whether through routers and switchers or by using XLR connectors everywhere.

The other benefit is that for the first time studios can be custom-built off-site, prewired, pretested and nearly ready to plug-and-play.

Infrastructure

To support the concept of more portable radio, we can turn to new digital systems, which have been under consolidation themselves. Today, you can put your music, news, network feeds, commercials, production, traffic, billing and logging in

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CONSOLIDATING FACILITIES

a single computer system. Now that's consolidation!

If we look to design the rest of the facility using consolidation techniques, we begin to notice that the technology exists in the infrastructure, as well.

For example, today you can buy an entire system of digital consoles that are connected by fiber-optic cables. A built-in router system allows instant and flexible rearrangement of I/Os as needed on the fly. Plug in a few digital audio sources, including your computerized audio playback system, and *voila* — instant radio. Now the trick is to make it fully portable. The answer is entirely in furniture design. If the furniture and the master control racks are fully portable, smaller systems can be combined with larger systems and larger systems can be broken down into smaller systems.

Let's take a closer look at some of the new technologies that can work in the consolidation of facilities.

Digital mixers. Over the past five years, radio station designers have struggled with the transition to digital because the one key ingredient was missing — a digital console. This is no longer the case. In fact, the advent of the complete digital mixing system brings many of the new interconnection and integration concepts.

Today, you can buy an integrated digital mixer and distribution/routing system that provides many advantages: One or more main production consoles that act as servers for the rest of the facility; slave consoles in control rooms with digital signal processing (DSP) on each channel; built-in computer screens and keyboards for control and standard PC programs; fiber-optic interconnections between rooms; automation of programs and easy reconfiguration of console layout for different show requirements.

Digital routers. It used to be that we'd run anywhere from 25 to several hundred cable pairs between studios and master control or rack rooms to carry the analog signals throughout a facility. Designing and wiring just this portion of the system could take up to half of the engineering time on a typical studio design/construction project. Huge walls of connections and/or racks of jackfields and distribution amplifiers supported the interconnection and distribution requirements of such a system. Changes and temporary connections were difficult to accomplish and nearly impossible on short notice. Engineers were required for the simplest patches.

Today, a digital router the size of a single rack can handle four or five station's worth of interconnections, with fully flexible patching at the click of a mouse or push-button control by an operator.

Digital audio routing and interconnections are modular, with excellent sound, ease of control and ultimate system redundancy. Systems can be designed with star and/or ring topology. Distributed intelligence prevents system failure and good systems have a comprehensive alarm system to locate defective components that can be hot swapped without affecting the rest of the system.

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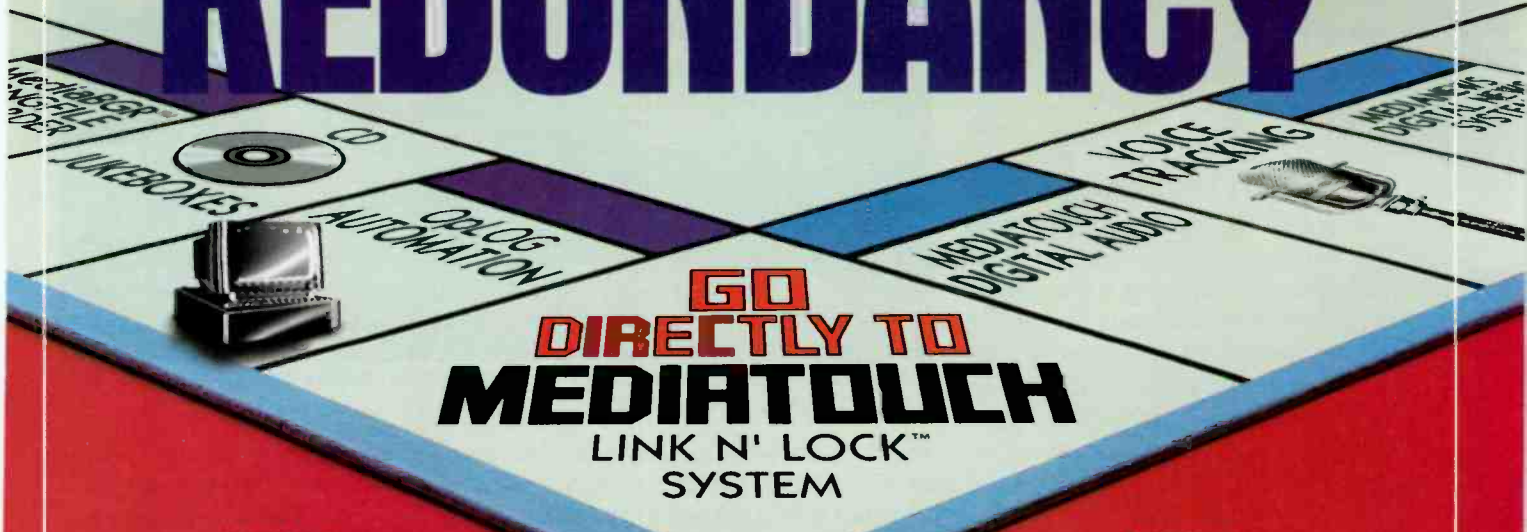

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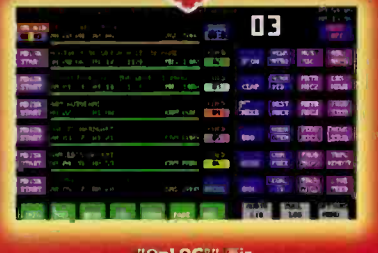

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CONSOLIDATING FACILITIES

Fiber-optic trunk cables. We used to send analog audio around the station with constant concerns about ground loops and crosstalk due to the long runs of cable required between studios and rack rooms. Not only were the trunk cables physically large, difficult to distribute and expensive, but they were a source of signal degradation.

Today, we can replace the entire trunk cable with one or two fiber-optic cables to each studio. The fiber-optic cables carry all digital audio to and from the studio with no noise, ground loops, crosstalk or degradation of signal quality. The costs of designing and installing such a system are low compared to the cost of designing, documenting and wiring the thousands of wires it replaces. When it comes time to move or change the system, the savings are huge.

Expansion or relocation? Sometimes existing facilities must be expanded to house new tenants. Photo by Chris Bennett.

Synchronization signals. Synchronization has been something that radio engineers thought of as a TV buzzword, but now it's an important issue in digital audio design. Luckily, sync is handled by the AES/EBU (AES3) standards and you don't have to give much thought to it as long as your facility is a fully synchronous system. The use of asynchronous equipment (that use an external sync to lock up with the rest of the facility) creates troublesome clicks, pops and glitches when mixing audio. Most stations do not have a sync generator, nor do they want to install one. Much of the newer digital routing equipment can perform sample-rate conversion and compensate for the differences in sync.

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Legacy systems. No doubt you have equipment that was purchased recently and could be re-used in the new facility. Source equipment, such as microphones, studio telephone systems, CD machines and digital editors may already be state-of-the-art. If you already have digital automation systems with storage and playback of audio and traffic and billing interfaces, you may be able to re-use some or most of this system. It is common to determine a list of the equipment that will be reused and to design for this by preparing cabling and physical locations for the equipment. Keep Murphy's Law in mind. Most well-used equipment will fail when moved and probably at the most critical time or when technicians are scarce.

Concentrate your energy and finances on the best infrastructure system and you'll be way ahead of the game.

There is much involved in the physical design of a facility. Issues such as architectural design, ergonomics, traffic flow and visibility are important. It's also critical to locate the facility away from noisy areas, such as heavy transportation or manufacturing areas. And don't forget that you need line-of-sight to the transmitters.

Concepts in architecture are like formats in radio. Everyone has his or her own idea. One concept that has proven to work in the real world is to design the whole facility as a single working system, but to break up the elements into suites. The suite concept means that the designer places spaces together that work together. This sounds simple, but in practice it can be challenging. This idea bears strong consideration when you have multiple stations with different personalities in the same building. Many times the stations want to maintain individual environments, but they need to share common areas, such as lunch rooms, mail rooms, sales areas and major production.

Make the suites 'sweet'

From an on-air operational standpoint, each station can be designed as if it were a stand-alone facility. Cluster together all the critical elements, such as programming staff, basic production/editing studios and on-air studios into one suite for each station. You may want a separate lobby for each station or you may want a combined lobby for several stations. Close evaluation of your particular situation will determine this.

Office furniture should be chosen that could function as studio furniture in the future. As more tools become available on the desktop, we'll see more basic production and manipulation of audio that can be done by anyone with a PC, whether at their desk or on the road.

Most radio studios are designed with an eye on size first. The furniture is made to fit the space. After construction, acoustic treatment is applied to make it sound good. This results in wasted space, ergonomically poor layouts and bad sound from the room. At

Digital audio links

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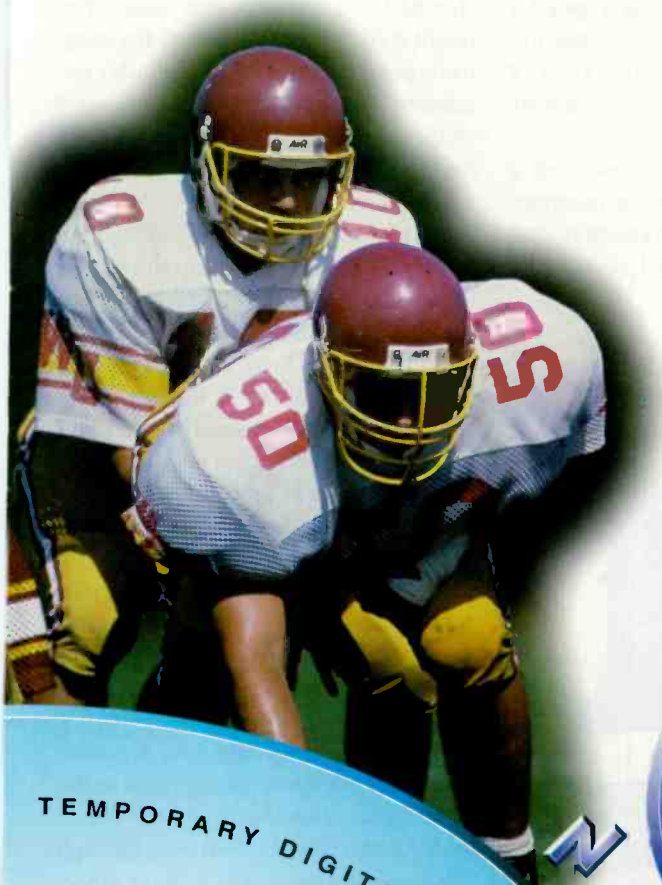

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the higher levels of design, the space is designed acoustically, taking the furniture into account. An old adage in architecture is "form follows function" and if that is applied to studio design, the furniture and acoustics should drive the room design.

Each station in a superduopoly has its own production needs. The volume of production for morning shows, news and station promos will probably not change much, but commercial production can be shared among all of the stations. Instead of dubbing a spot for each station, a digital audio storage and playback system can hold one copy of each spot that can be simultaneously accessed by all of the stations.

With many stations under one roof, it makes sense to do all major commercial and complicated production in a suite of studios designed specifically for creative production. Copywriters, creative services people and the like should be located in this suite. You might have interview studios for long-form programs that require studio engineers. You might have performance studios where musicians can perform live or be recorded for future on-air playback. All basic rip-and-read and station-specific production can be done in the edit studios located in the station suites. You might even have a green room for salespeople to show clients the progress of their production.

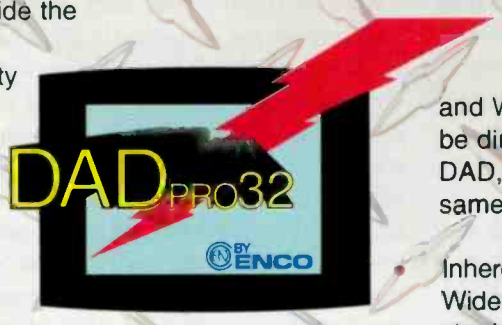
Sales areas should be flexible. Sales management will probably want to try several different sales organizational techniques, such as team selling, account-type assignments, territory assignments and selling by station. Therefore, if you design the workstations and layout of sales for maximum flexibility, changes in the way the sales department is organized can be easily accommodated.

Some general managers and market managers like to be located right in the heart of the operation and some like to be located so they have to walk through the entire station to get to their office. Wherever they are located, a GM and the MM must be connected to the operation acoustically, visually and ergonomically. The GMs may or may not have individual executive assistants. If not, they need access to the administrative support staff. It's typical to arrange presentation rooms near the administrative suites for sales presentations to large groups and for staff meetings.

The promotions/marketing department works day and night and needs access to the street at all times. If your facility is located in a building with other tenants, you don't want to be constantly moving equipment and promotional materials through the hallways and elevators. A ground floor location for promotions is desirable and an added benefit is a loading dock. You may consider having a promotional store where listeners pick up prizes or come to the stations to buy or be given station merchandise. Impulse or point-of-purchase merchandising at the station lobby can generate additional income.

Industrial Strength Digital Audio Delivery

Digital Audio Delivery systems are now recognized as a must for every broadcast facility. But few systems provide the features, flexibility or reliability required to maintain profitability in this demanding and fault critical application, nor the support mechanism to maintain them.



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The technical areas should be centrally located for several reasons. Most of the studios will need to be connected to the engineering area, so you want to keep the cable lengths reasonable. Engineering needs to be located near the central power and communications sources, in other words, near the main phone rooms and power rooms. Engineering also needs to have good access to the roof or a tower next to the building for antennas. STL shots, two-way radio antennas and remote antenna systems require regular attention and easy access is important.

RF and spot insertion

For those thinking about group network feeds and local spot and programming insertion, think about putting an automation system at each transmitter and using the station's studio as one of the inputs to the automation system. Other feeds could come from the group network, other networks, remote system receivers or the legal main studio.

Spots can be uploaded to the transmitter-based automation system from production studios anywhere in the world. The audio can be delivered through a dedicated, real-time method of STL or T-1 link or downloaded as individual files via modem. Remote access to the system can handle scheduling and traffic/billing functions.

With all those tower sites and old studio locations, you're in a great position to develop a flexible and wide coverage remote system. Whether using dial-up digital codecs or RF equipment, you should be able to do remotes from anywhere. RF links from transmitter site to transmitter site could even allow an ad hoc network to be put together among your group-owned stations in a market in case of an emergency or need for simulcast. In addition, these line-of-sight paths between commonly owned facilities adds the potential for other new technologies, such as data and voice transmission on RF paths, as well as digital and/or analog links between locations in a market.

Feng shui

The last thing we want in a radio facility is negative energy and if you want the latest in quirky decorating techniques, have your designers incorporate feng shui — a combination of geomancy, psychology and Chinese philosophy. Feng shui literally means "wind-water" and advises such things as putting stones along windowsills to deflect bad energy, being sure your chair faces the door with walls behind you and hanging jade butterflies to symbolize growth in the company. In these days of fast changes and rapid globalization, maybe some retro insurance isn't such a bad idea.

Chip Morgan is president of CMBE, Inc., a worldwide broadcast facilities design and integration firm located in Sacramento, CA. Contact Chip at 916-676-4344 or chip@cmbe.com.

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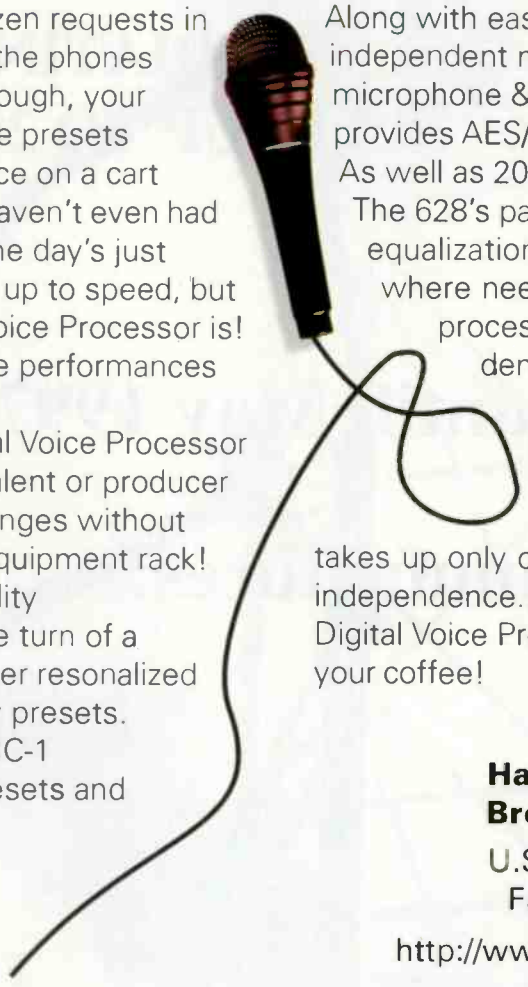

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DAB: THE INSIDER'S VIEW

By Skip Pizzi, editor in chief and Chriss Scherer, editor

DIGITAL RADIO IS AROUND THE CORNER.

On Sept. 17, 1997, *BE Radio's* editor in chief Skip Pizzi and editor Chriss Scherer interviewed representatives of USA Digital Radio (USADR) at the NAB Radio Show in New Orleans. USADR personnel who appear in the following transcript are identified by their initials as follows: E. Glynn Walden (**GW**), director of engineering at Group W/Westinghouse Broadcasting; Rick Martinson (**RM**), manager, Broadcast Systems at Westinghouse Wireless Solutions; Suren Pai (**SP**), business development director at Lucent Technologies; and Bob Struble (**BS**), acting president at USADR.

BE Radio: ***Where does development stand right now on IBOC radio?***
RM: We are completing the detailed design, which includes the modeling and simulation of the overall waveform. This is for both the AM and the FM systems. That will conclude by the end of this year, after which we will go into laboratory development where we'll be doing testing using prototype receivers and transmitters, modulators, etc. When we are successful with that, then we will go on the air in the Baltimore-Washington area with small (experimental) AM and FM stations and do mobile testing ourselves. That will take place next spring and into next summer (1998). This will be followed by field tests on actual AM and FM radio stations, late next summer into September of next year. That would be followed by working with receiver and transmitter manufacturers for a rollout that would happen by the summer of 1999. Right now, we have the waveforms and we are confident that the system will be robust, for both the hybrid system, which is the combined analog and digital system, as well as for the all-digital system, in which eventually, if broadcasters decide to, they can turn off the analog and move the digital to the center of the channel.

Photo: Bob Struble, Rick Martinson, E. Glynn Walden, Suren Pai and Skip Pizzi in the USA Digital Radio booth.

BE Radio: ***Are both AM and FM working on the same time frame and in the same receiver product base or are they still on two different paths?***
GW: We have spent an awful lot of time (recently) making commonality between the systems. In fact, all the frequencies of the subcarriers in the AM and the FM system are modified for total compatibility between the two systems. In reality, the AM system is a small subset of the FM system. In terms of the decoder, the amount of (signal-processing) real estate required is not doubled. In fact, there is also commonality for the analog (receiver). We really have *four* systems under development: There's (1) the hybrid IBOC AM system, (2) the hybrid IBOC FM system, (3) the all-digital IBOC AM and (4) the all-digital IBOC FM. The hybrids are transition systems, much like Windows 95, which was a transition system from 16 bits to 32 bits. Hybrid IBOC is the transition system that carries us for the next 10 to 15 years into the era of all-digital. When we go with all-digital, it will be more robust, basically because we can increase the power. What we call our "baseline FM system" uses (digital) carriers between 129kHz and 196kHz and there are 95 OFDM (orthogonal frequency-division multiplexing) carriers on each side. After extensive research we decided that we would use the OFDM waveform. It needs no amplitude correction or phase correc-

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tion. So we don't have to use an equalizer with the FM system.

RM: And it's very robust against multipath.

GW: In the middle (of the channel), we have FM, as before, but we don't go out to 220 (kHz) like we did before. Also, these (digital) carriers are about -43dB down. They are not sitting on the mask.

RM: As a result, we don't have a problem with second-adjacent (channel interference).

GW: The baseline system provides a small amount of (auxiliary) data, plus 96kb/s of PAC (perceptual audio coding, the audio compression algorithm used). It's not real-time data, but data that's opportunistic in nature. In other words, if there are pauses in the audio, it can carry you at a minimum of about 2kb/s. With (a variation on this) system, we add two more groups of carriers (to the digital sidebands), each having 19 subcarriers, that increase the amount of auxiliary data (up to 64kb/s). We had talked about using some of these carriers for more robustness, but Dr. Brian Kroger, the lead scientist on the project, says we don't need that. The system is robust, playing well with two first-adjacent interferers at the same time. In the all-digital mode, we send the PAC audio twice: once at 96kb/s and once at 32kb/s. The 32kb/s mode has a short interleaver on it and it allows rapid signal acquisition. That's used for (initial) tuning, and then after a time period of about five seconds, (the receiver) switches to the 96kb/s mode. One of the things that is totally unacceptable about digital systems is they tend to drop out. In this system, we have a backup channel that's intentionally delayed by five seconds — that's the 32kb/s "tuning channel" — so we have something that can rapidly re-acquire and actually be there before the listener hears the outage (on the 96kb/s channel). So, we are transmitting the signal twice, in different parts of the channel, (providing) diversity in frequency and diversity in time. With the hybrid system, we have analog to fall back to if the digital should fail. In this case, the analog has been delayed by five seconds to match the interleaver for the digital. Once the receiver knows it's going to run out of bits in the digital signal, it has five seconds to get into the analog mode. Then five seconds later, if it sounds right, you can go back to digital again.

RM: Another thing to point out on the hybrid system for FM is that the sidebands on either side are repeated. So, you can lose a whole sideband and still have robust coding to decode the digital signal on the other one. This is particularly important in a lot of tight market stations — for instance, in the Baltimore and Washington area — where you have stations that are first adjacent between the two cities. You might get wiped out on one side and still have the other side to rely on.

GW: We also have something called a "first-adjacent canceller" (FAC). Westinghouse has been working on this circuit for many years and we've adapted it. When you have an analog interferer, there's a carrier that's tracking back and forth. We actually have a device that cancels the analog carrier. It causes minor degradation to this sideband, but when you combine its remaining energy with the (other sideband) energy, we still have a robust system. The interesting part is that we can actually take the interference up all the way to -0dB — totally wiping out the whole sideband. But it's not wiped out, because the FAC is removing (the interference).

RM: The stronger the interfering first-adjacent signal becomes, the better it (FAC) works because the stronger signal is

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easier to track. And when you do have an impact on one side, it's not all or nothing, because we're replacing the information and the bits there such that you can keep the ones that still come through. We're doing a signal-to-noise ratio-type measurement on each one of those subcarriers. (FAC) is simple, but it was originally designed for a stationary environment. The trick is to get it to track in a mobile environment with a lot of multipath.

GW: Remember, those carriers are fading as we are trying to track them.

RM: Something else to note: On the all-digital IBOC system, one enhanced service that is possible is multichannel sound going out beyond +/-100kHz. We can do up to five channels of virtual CD-quality sound or something that is close to what you have now in home theater. Or, you can put (auxiliary) data through that.

GW: Also important: 64kb/s of wireless data. There's nothing like that in the marketplace today.

RM: And it's mobile. Now with all this technology, you might think these receivers are going to be expensive. In fact, it's all in DSP. It's all software. And what's unique about the receiver is that you get the analog FM demodulated for free.

BE Radio: *So the receiver is completely DSP-based, including the analog?*

GW: Yes, once you pass the 10.7 (MHz) mixer.

RM: Send it to the IF. It's an A-to-D and all "secret sauce" after that.

GW: This is going to be the best analog AM and FM you ever heard, because we can put perfect filters in. And it doesn't cost. It's all free once you make the decision that the receiver is going to be DSP.

BE Radio: *Will these receivers use off-the-shelf DSP chips?*

GW: No, they're going to hard-wire it. They're not going to build (the production receivers) as a DSP.

RM: They'll build it in firmware.

BE Radio: *So, there's no need to have a programmable receiver?*

GW: Understand that the first receiver that comes off the line decodes all the modes we are talking about — including the extension of the DAB into the all-digital mode. These additional modes don't really cost a lot because they are all subsets of hybrid IBOC.

RM: So, in a sense, you have forward and backward capability, which is key. Therefore, the radio stations don't have to lose listeners (after the transition period) because they don't have a receiver that doesn't receive all-digital.

BE Radio: *You said analog AM is going to sound great on these new radios because of the improved filtering, but aren't you having to reduce the analog bandwidth to 5kHz?*

GW: Yes, we're going to reduce, (but) we're going to give the broadcasters more frequency response than they have now in the analog mode. Currently, they have 3.5kHz (in most receivers). We're going to stretch it because our receiver can have a perfect 5kHz filter in it. By the way, there will be no noise on analog because we have to have a noise blanker for the AM system to work. There won't be any first-adjacent-channel interference at night for analog. That goes away because you've reduced the transmission standard and the receive standard to 5kHz. There's no more birdie whistle at 10kHz and you now have a true 5kHz system instead of a 3.5 or a 3kHz system that we currently have. Analog (AM) is going to sound great and digital (AM) is going to sound like FM.

DAB: The Insider's View

BE Radio: ***And how will existing AM receivers be affected by this?***

GW: You are going to gain a little loudness. Because some of the audio that's being sent beyond 3.5kHz isn't showing up in the receiver — it's only showing up in the stop-band filter and heating up your ceramic filter.

BE Radio: ***From a broadcaster's point of view, what kind of steps are going to be involved for IBOC conversion?***

RM: On the AM side, the broadcasters will need a new waveform generator — an exciter. That generates PAC, the forward error correction, all the OFDM carriers and everything right there, that is then sent to the AM transmitter. Now, as long as the broadcaster doesn't have a vintage 1940s, 1950s or 1960s AM transmitter, they will be able to use their existing AM transmitter for that. As we get further along in the development, we will be able to specify more clearly what particular transmitters that are out there today for AM will work with our system. On the FM side, they need the waveform generator, of course, but with the addition of a linear power amplifier — a "DAB power amplifier" — that runs in parallel with the Class C FM power amps. Since FM is non-linear, we have to have a linear power amp, and that is followed by a high-level power combiner (into the FM antenna). We are looking at other ways of doing this. There are some transmitter lines coming out that will potentially allow this (internally) instead of having to add a DAB power amp.

GW: Another approach is to provide "I and Q" (components). You would put Q into the FM transmitter, which would carry the FM wiggle, plus the frequency component of the DAB. The amplitude component of the DAB would then go into a transmitter that would be built much like a DX50 for FM that would carry the amplitude part. That transmitter would be capable of operating at the higher power level DAB. If you look at the way (solid-state) transmitters are being built, they're stacking a bunch of modules to build FM. You only have to have one or two of the modules be linear — you don't have to have the whole transmitter linear. And one well-known transmitter manufacturer has discussed the possibility of using predistortion to pass the hybrid IBOC waveform through the existing FM transmitter. Our exciter design is providing them the ports they need to do that.

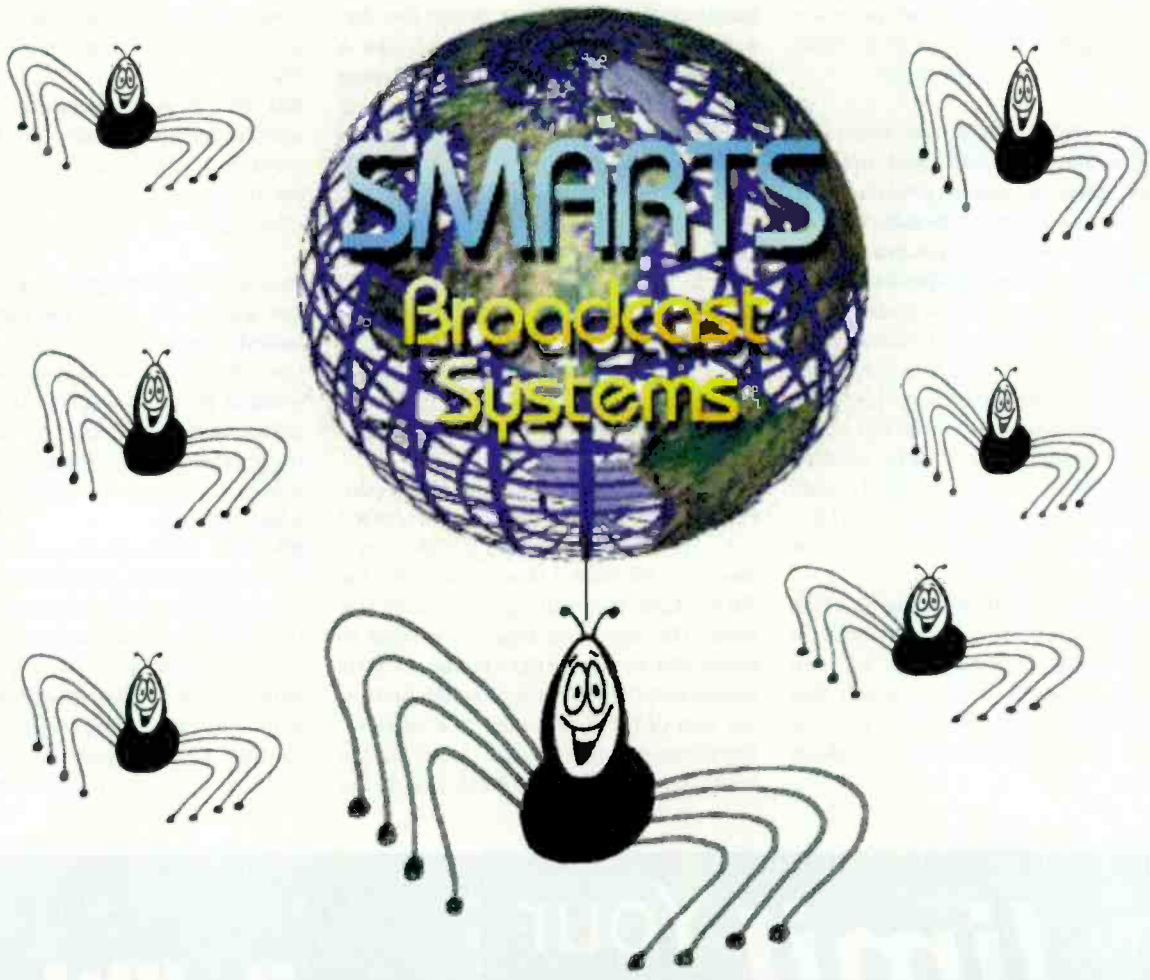
BE Radio: ***Let's talk about audio. You're going to be limited even in the eventual all-digital system to 96kb/s for main channel audio coding for the FM system and for the AM, 48kb/s . . .***

GW: Before you make a judgment on that, you really have to listen to it. Lucent's (PAC) system continues to be able to be improved as time goes on. The change has to happen at the transmission end. What we do is send a header on every packet. That header tells PAC how to decode the audio, so future improvements can continue to happen to PAC forever.

SP: There are no upgrades required at either the transmission end or the receiver end in terms of hardware.

BE Radio: ***Is this being generated by the requirement for even lower bit rates for on-line audio?***

SP: Development of PAC is driven by trying to get better and better audio quality at lower bit rates. PAC is employed at a number of different applications. We have a venture called *Elemedia*, which is essentially putting out software components for audio streaming on the Internet. The same PAC algorithm is also being used now for the first time here (in DAB), for "wireless



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audio streaming," if you call it as such. I think in this particular case, we are essentially driving PAC fairly close to its limits, at least as far as we know today.

BE Radio: ***What about the transmitting hardware? Would that also be just an open standard presented to the usual suspects for production or would it be something you have some interest in handling exclusively?***

BS: That becomes a business question. Do you cut exclusive deals with someone for a given time period who will maybe get the technology out there more quickly or do you just make it available through a straight licensing? I don't know whether we've got those details worked through, but the discussions are going on and it *is* with the usual suspects. And they *are* interested.

SP: We are essentially targeting to be an intellectual property company and at some point that's all going to be an open standard. Assuming we will reach that stage, it will be out there for the world to take on and develop all the products around it.

BE Radio: ***What about the period of making the transition from the hybrid to the all-digital system? Can a station that wants to make that change do it unilaterally or is it something that the entire market would have to change simultaneously?***

GW: We are analyzing that right now and we certainly see that it's going to be difficult to run the two systems side by side. In the case of the AM, it may be less of an issue than in the case of the FM. We might have to have an introductory period for all-digital or we might have to have a certain date. Some broadcasters have indicated to us that they preferred a certain date.

BE Radio: ***What other regulatory concerns are there going to be for IBOC?***

GW: We want the system adopted as a standard, we want a new mask called the IBOC mask that will apply to both systems. The only rule changes needed to make this work are the change to 5kHz (audio bandwidth) for analog AM, both on the part of IBOC and non-IBOC stations. Improvements that this brings are so dramatic that it's worth it. For FM, you do not have to do anything in order to use our system within the existing guideline, although we also want a mask change for FM.

RM: We are working closely with the FCC and the State Department on the development, keeping them abreast of what we are doing. They are excited at NTIA and other agencies, as well.

BE Radio: ***What effect is hybrid IBOC FM going to have on existing FM subcarriers?***

GW: The 92kHz subcarriers are going to work if they are digital. Analog 92kHz subcarriers are going to have added noise. There's no getting out of that. On 67kHz (subcarriers), there's no impact whatsoever.

BS: It's a non-technical point, but when the story's written and this thing's successful, they'll talk about the last year or so as being the big turnaround of digital radio in the U.S. I think we've accomplished more in the last six to eight months than we did in the prior five years, probably. It's going to work. It makes great sense. We've got the right team put together. And it's not

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DAB: THE INSIDER'S VIEW

only the technical progress that's being made, but also all the ancillary issues that are important. We're feeling really good about it.

GW: Seventy-five years ago, commercial broadcast began at Westinghouse's KDKA. The future of radio is being written at Westinghouse today. At Westinghouse/CBS and Lucent in Baltimore, Murray Hill, Holmdel and Cincinnati, and they are going to make it work. This team is really doing it. I have no questions or doubts that they are going to make this work.

Counting down to SDARS' launch

Also at the NAB Radio Show in New Orleans, *BE Radio's* editors caught up with Lon Levin (LL), president of American Mobile Radio Corporation (AMRC), one of the two licensees for mobile DBS radio — or what the FCC calls *Satellite Digital Audio Radio Service* (SDARS).

BE Radio: ***Where is AMRC right now in terms of its planning and deployment?***

LL: In April (1997), we successfully bid for one of two licenses to provide this high-quality audio service nationwide. It is our plan to have a satellite up and operating for the year 2000. That's a tight deadline, but we think we can make it. We'll be selecting a vendor shortly, definitely before the end of the year.

BE Radio: ***One satellite?***

LL: No, it'll eventually be two satellites, but the first one will hopefully be up before the year 2000, the other one will follow shortly thereafter. The two satellites are used for diversity (reception) purposes. The specific orbital locations haven't been decided yet, but it will be one east and one west.

BE Radio: ***How many channels of service will you provide?***

LL: We think we can have 50 high-quality audio channels. We're aiming for quality that is as good, if not better, than today's FM. And 50 is the *approximate* number. If we have more talk radio, we are going to have more channels; if we have symphonic stations, which require more capacity, then it's going to be fewer.

BE Radio: ***Your most direct competitor will probably be the other licensee, CD Radio. Would your service require its own receiver, separate from CD Radio's?***

LL: The FCC has recommended strongly that we have common receivers. We have been supportive of that notion, and we are in conversations with CD Radio. I'm comfortable that they also believe that a common receiver makes sense.

BE Radio: ***What is your plan for getting receivers into people's hands? Obviously, you're targeting primarily or exclusively the mobile market.***

LL: Let me not say "exclusively," but the targeted market at this point is the mobile market. That's the best opportunity we have for quick growth. In the beginning, it's going to be an aftermarket product — it's not going to necessarily be built in cars. That takes a longer cycle, and we have to prove the concept. So, we will do what any other electronics business does and deal with electronics stores.

BE Radio: ***Will your service be totally subscription-based?***

LL: The FCC has allowed us flexibility to do both advertiser-supported, as well as subscription services. At this point, we are going to maintain that flexibility. We have not made any choices on that. My sense is that there will be a mixture of both.

BE Radio: ***What delivery format will you use — something existing like Eureka 147 or are you starting from scratch with your own technology?***

LL: We are fortunate to have as a strategic partner an organization called Worldspace, which has a 20% interest in our company. They are well on their way to providing SDARS through Africa and Asia, and we are taking advantage of all their good work and their proven technology. Fortunately, Worldspace is going to be up and running

sooner than the year 2000 in these other countries, and we'll be able to take advantage of the tests on their satellite and see if it works. Worldspace's format is a TDM technology (not Eureka 147).

BE Radio: ***But they're going to use L-band in those other countries, and you're using S-band in the U.S. Any problem with that?***
LL: No, to date that is not one of the challenges. The engineers are comfortable that it can work in S-band.

BE Radio: ***On the programming side, will you originate or broker original content or work with existing players in the market, such as broadcast or cable radio operations?***
LL: At this point, it's all three and probably more. The radio business in the U.S. is well-developed, and I think our plan is to offer similar programming, better programming and certain niche programming. We have a number of programmers who are asking us whether they can participate. We recognize, however, that we are going to have at least 50 channels to fill, and we may have to do it ourselves. By the way, there is a good business in just developing your own programming, too.

BE Radio: ***How about the need for terrestrial repeaters — probably the biggest challenge to SDARS?***
LL: Our plans include terrestrial repeaters. When you're dealing with line-of-sight reception in urban canyons, you can get blocked. There are potential ways around it with the diversity, but we think it is not sufficient. The urban canyon is going to have to have some repeater boosters available.

BE Radio: ***Is that included in your initial phase of operation?***
LL: That is part of the design of the system, yes. The goal is to have everything in place. This service from the beginning has to be high quality. The plan is to have the terrestrial repeaters in place in those markets that we start in. If they are not built out, maybe we won't start in certain markets, but we have to have them in place.

BE Radio: ***What are your plans in terms of auxiliary data — the kind of display, the value-added idea for digital radio to distinguish the service?***
LL: Well, you can let your imagination run wild on this one. There will be text, the artist and record company and other information. But one exciting idea is that car manufacturers can tell these addressable receivers — because they'll know of every receiver and what car it's in — that they have to change their oil or there is a part that has to be recalled, etc. There are opportunities here to have a relationship not only with the radio, but with the car. Our goal is to have a "relationship" with every terminal. We are going to create an incentive for people to tell us information about themselves so that we can give them information while they are driving that they really want. For example, on a symphony (wideband) channel, during spot breaks you can use that bandwidth to run six or eight simultaneous advertisements. We can program so they can get (only) the advertisement they want, depending on what they tell us they want or don't want to hear. Another exciting idea is that the DJs will be able to speak in different languages.

BE Radio: ***You're targeting just the U.S., but obviously there is some overlap into the full North American footprint. Is there any problem with the S-band DARS interfering in Canada or Mexico?***
LL: We need to coordinate with them. The good news is that it doesn't seem to be that difficult. We are working with the FCC and the bands are not heavily used in Mexico or Canada. We are confident that this will be resolved well before the satellite is up and operating.

BE Radio: ***Any closing thoughts?***
LL: This is an extraordinarily exciting opportunity for us. And I do think that people will want (SDARS). People want choice. If they have the opportunity for $150 to $200 more when they are buying another radio anyway, I think they will choose us. It's just human instinct to want that great a choice, as long as it doesn't cost that much. I don't know if people can deal with that much choice, but they always want it. Also, the (car audio) aftermarket is really hot. Six and half million radios were put in during 1996. I think it's going to get even hotter as digital (radio) comes on. So that's why I think this business is going to work.

THE FALL SHOWS OF 1997

By Chriss Scherer, editor

A RETURN TO RADIO AND A GOLDEN ANNIVERSARY.

NAB Radio Show 1997

September brought two fall shows that both held their own honors. The NAB Radio Show, held at the New Orleans Convention Center, Sept. 17-20, marked the return of this fall gathering to a radio-only event.

Absent from stand-alone status for the past two years, the NAB Radio Show had been held in conjunction with the World Media Expo (WME), that joined conventions with the Radio and Television News Directors Association (RTNDA) and the Society of Broadcast Engineers (SBE). Whereas the focus of WME was on a variety of topics in media, the NAB Radio show is a welcome return to a radio-only exhibition.

In the past, the fall show was also heavily involved in topics and exhibits for programming and management. This year, equipment vendors showed their products to an audience that attracted engineers, programmers and managers alike. NAB reported attendance figures totaling 7,246. The sessions also covered topics that drew heavily from the engineering attendees.

The technical sessions covered three areas. The first day's session was an AM directional antenna workshop. Ben Dawson of Hatfield and Dawson and Ronald Rackley of du Treil, Lundin and Rackley moderated the various discussions from basic DA theory to the hardware used. Additional focus was given to various principles of and practical solutions to troubleshooting. The session was concluded with a discussion of the various FCC procedures for filing modifications and new applications and included a review of the applicable FCC rules.

An important issue for any broadcaster was covered on the second day: RFR compliance and measurement. Compliance with the rules is important not only for legal reasons, but it also covers some safety issues, as well. Verifying compliance was also demonstrated.

The third session offered a general review for engineers with the AM/FM transmitter workshop. John Bisset of Multiphase Consulting moderated this session, which reviewed the basic principles of transmission and discussed the process of troubleshooting problems. Several transmitter manufacturers were present to offer suggestions for their own products. The panel concluded with reports of several station emergency situations and some of the innovative solutions that the stations back on the air quickly.

The technical sessions offer engineers a chance to network and learn from other professionals in the industry. These sessions, along with the exhibit floor show that the NAB Radio Show is not just for programmers and managers.

Other sessions covered topics from motivating your sales force to ensuring the success of a new format. One topic that was covered from various points of view was, of course, the Internet. The

topics ranged from establishing a web site and a service provider, to content and streaming audio. Several manufacturers had even more detailed information and demonstrations on streaming audio.

The exhibits on the show floor covered every aspect of the on-air operation. Computer-based or computer-controlled equipment is everywhere. The idea of a computer-based commercial playback system or audio workstation is not a new one, but it is interesting to note that even though there are already a variety of systems to choose from, more are being introduced all the time. More of the playback systems are adding the ability to store all the station audio on hard drive, not just commercials and promos. This is largely due to the continuing drops in cost of storage media and refinements in operating platform stability. Many manufacturers are also moving to Windows NT as an operating system. The built-in network capabilities and familiar Windows environment allows NT to be a simpler solution for many installations.

This return to stand-alone status for the NAB Radio Show was crucial to its future success. The general feeling from the show conveyed a positive reaction to the event. Previous fall shows had a regional feeling, drawing attendance primarily from the region in which it was held. This year's show had more of a national audience than in the past, but the international attendance did not seem as high as the spring show. It can be seen that the industry wants a radio-only show or at least a radio-focused show.

Held simultaneously with the NAB Radio Show in a separate hall was the annual RTNDA convention that attracted 3,165 attendees. The NAB Radio Show 1998 will be held in Seattle, Oct. 14-17.

For more information, go to www.nab.org/conventions.

AES GOES GOLD

The 103rd convention of the Audio Engineering Society was held Sept. 26-29 at the Jacob K. Javits Center in New York City. This annual show attracts heavily from the recording and live sound industries, but there is plenty for the radio broadcaster, as well. As the move to digital continues, the separation between these industries gets smaller and smaller. The Audio Engineering Society was established in 1947 and leads the audio industry in the creation of audio standards.

There were two sessions held at AES that had a direct appeal to radio. A forum on DAB was held with representatives from the various systems for the United States and overseas. Although the individual systems and methods themselves are not new, each representative took time to cover how each one will work and the obstacles each one faces. For more on the state of DAB in the United States, see "DAB: The Insider's View" on p. 44.

On the last day of the show, a special forum, moderated by *BE Radio's* editor in chief Skip Pizzi, focused on computer-based audio delivery systems. Several leading manufacturers were on hand to discuss the various ways of integrating a system into a broadcast facility.

Attendance for both of the radio sessions was lighter than other AES sessions, which is to be expected from a show tailored for the pro sound and recording industries. Although there are many shared traits between radio and our cousins, those topics had a specific appeal to radio. They did spark some interest from those in attendance.

For more information on the AES and upcoming conventions, go to www.aes.org.

A COMMON IDEA

There was a common idea that was present at both shows. More and more collaborations between manufacturers is happening. This is not so much in adopting common standards, but in providing interfacing solutions and plug-in components for other products. This kind of cooperation helps an operation by providing smoother integration of different systems into one facility. Some of these collaborations take the form of plug-ins for an existing product, while others are a direct cooperation between two manufacturers to interface or integrate the function of two products.

Field Report

Musicam FieldFone

By Jeff Johnson

Our general manager is a tech junkie and loves to acquire the latest equipment for the station. One of those goodies, a Musicam FieldFone, has become a major asset.

WVXU, Cincinnati, OH, is the flagship station of the AHL Cincinnati Mighty Ducks. In planning for the broadcast feeds from the away venues, a variety of methods were considered. Each had specific shortcomings. A straight POTS line is inadequate for FM broadcasts of pro sports. Single-line frequency extenders are not much better. Dual-line frequency extenders have possibilities, but require additional equipment purchases and there is no certainty of having two lines available everywhere, let alone a third line for IFB. ISDN has excellent quality, but availability is out of the question at most of the venues. We then considered a POTS codec.

Performance at a glance

- Good S/N (66db)
- Frequency response flat from 37Hz to 6.225kHz at 24kb/s connect rate
- Adjustable Sound Shaper encoding algorithm
- Uploadable system firmware for future improvements
- Simultaneous two-way use

POTS codecs are a new technology recently made possible by the confluence of fast modems, affordable digital processing and refinement of extreme data-reduction algorithms. POTS, of course, is an acronym for plain old telephone service. Codec is a contraction of digital *encoder* and *decoder*. Because of the refinements in coding algorithms, quality audio through a data-reduced POTS connection is possible.

In order to squeeze a barrel through a mouse hole, something must be removed. Low-bandwidth data-reduction algorithms have been independently developed by POTS codec manufacturers, each using a different non-compatible algorithm for data reduction. This lossy coding may cause the resulting audio to sound different than the original, though not necessarily worse. The effect can be similar to the audio processing done to recordings, microphones and a radio station's air signal.

All POTS codecs work on the same principle. They digitally encode the incoming analog signal and reduce data volume. The data is then transmitted via a conventional modem across a dial-up POTS connection and then the signal is decoded at the other end. This process takes time, otherwise known as *digital delay*. The FieldFone is no exception. The more sophisticated the data-reduction algorithm, the more time is required to process that algorithm. For a one-way feed with little interaction, the delay is not important. The delay of the FieldFone in one direction is roughly equivalent to a satellite hop.

Making the grade

The FieldFone was the best solution in our application for several reasons:

- It requires one POTS line, normally available at any sports venue;
- Connection can be made from a dial-up line anywhere;
- IFB can be made over the same line without any interference;
- Audio quality is acceptable technically and subjectively; and
- Encoding delay is not an impediment.

We tested a FieldFone connection end-to-end. A generator commonly used for broadcast loops was placed on the input of one of the units and the corresponding tester on the other. The results, +/-1dB from 37Hz to 6kHz, -2.9dB at 6.225kHz and -9.2dB at 6.5kHz with a 66dB signal-to-noise ratio (S/N), were impressive. Distortion analysis was not made because a lossy algorithm would render these numbers meaningless.

The remarkable S/N of 66dB over a dial-up line is one of the best features of the FieldFone. The amps are noisy and an improvement could be made here. Unlike other similar equipment I've worked with, the FieldFone has this remarkable S/N, plus an ability to avoid audio overloading. Although not mentioned in the documentation, there appears to be internal analog input limiting.

The firmware used by the FieldFone is upgradable through the RS-232 connection on the back. I upgraded to the current version 3.0 by downloading the data from

Musicam's web site and uploading it to each machine. This required no special equipment or procedures and was accomplished on the first try. The upgradable nature of the firmware is an important advantage of the FieldFone.

How does it sound?

Subjective analysis of the sound is a major concern for all POTS codecs, just as it is when selecting a microphone, speakers or an audio processor.

To ensure optimal listenability, the FieldFone offers adjustable *Sound Shaping*. Five settings can be modified on the fly. The Sound Shaper is selected at the receiving end where the results can be monitored, however, the encoding algorithm is determined at the sending end. When a new Sound Shaper is selected, it is transmitted to the other end and applied. When this happens, two momentary mutings occur, but the connection is not dropped. Sound Shaper 5 emphasizes the highs by taking data out of the middle, making for a hollow sound. Sound Shaper 1 fills in the middle nicely while muting the highs. I prefer SS4 as the best compromise.

Some voices sound more natural than others. A male, low, raspy voice is not as well served as smoother voices. Women's voices are usually quite listenable. If you are familiar with the source, you will notice a difference, especially if an A/B comparison is made. Otherwise, the clue to encoding is the 6kHz roll off. I recommend placing an equalizer before the FieldFone to optimize the results with particular sources. The inherently good signal-to-noise ratio allows equalization before and after if you really want to play with it.

Music transmitted over the FieldFone fares even better. The FieldFone offers such a high level of audio quality that a musical remote is certainly possible. For critical applications, ISDN or broadcast loops would be necessary, but a short live performance would sound good enough to entice those interested. The FieldFone has proven its value to produce high-quality remotes from sports arenas and other remote sights.

Jeff Johnson Is network engineer with WVXU, Cincinnati, OH, and the X-Star Radio Network, Cincinnati, OH.

Editor's note: *The unit evaluated was a FieldFone I model, equipped with a 28.8kb/s modem. When FieldFone I connects at 28.8kb/s, frequency response extends to 8.8kHz. The current FieldFone II units are equipped with a 33.6kb/s modem, a quieter audio section, a three-channel mic mixer and dual independent headphone circuits. At a connect rate of 33.6kb/s, FieldFone II frequency response extends to more than 10kHz.*

Field Reports are an exclusive BE Radio *feature for radio broadcasters. Each report is prepared by well-qualified staff at a radio station, production facility or consulting company.*

These reports are performed by the industry, for the industry. Manufacturer's support is limited to providing loan equipment and to aiding the author if requested.

It is the responsibility of BE Radio *to publish the results of any device tested, positive or negative. No report should be considered an endorsement or disapproval by* BE Radio *magazine.*

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At the network headend, SpectraCast combines *multiple MPEG content streams* into a composite stream for most efficient space segment usage (multiplexing). This job is accomplished with the DTMX1000, a DVB-compliant transport multiplexer. Network management and control software provides the headend necessary control while giving affiliates needed freedom for local customization.

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For radio networks, the real power of SpectraCast is at the affiliate sites. Each addressable integrated receiver decoder (IRD) features built-in FLASH memory for store and forward manipulation of your filecasted material.

In addition to this *patent-pending* approach, SpectraCast IRDs offer up to 3 MPEG audio decoders and up to 3 audio mixers/faders. Each mixer/fader handles up to 8 channels in (L/R from any or all of the decoders plus an auxiliary L/R input) and 2 channels out. You get full control of your analog audio outputs.

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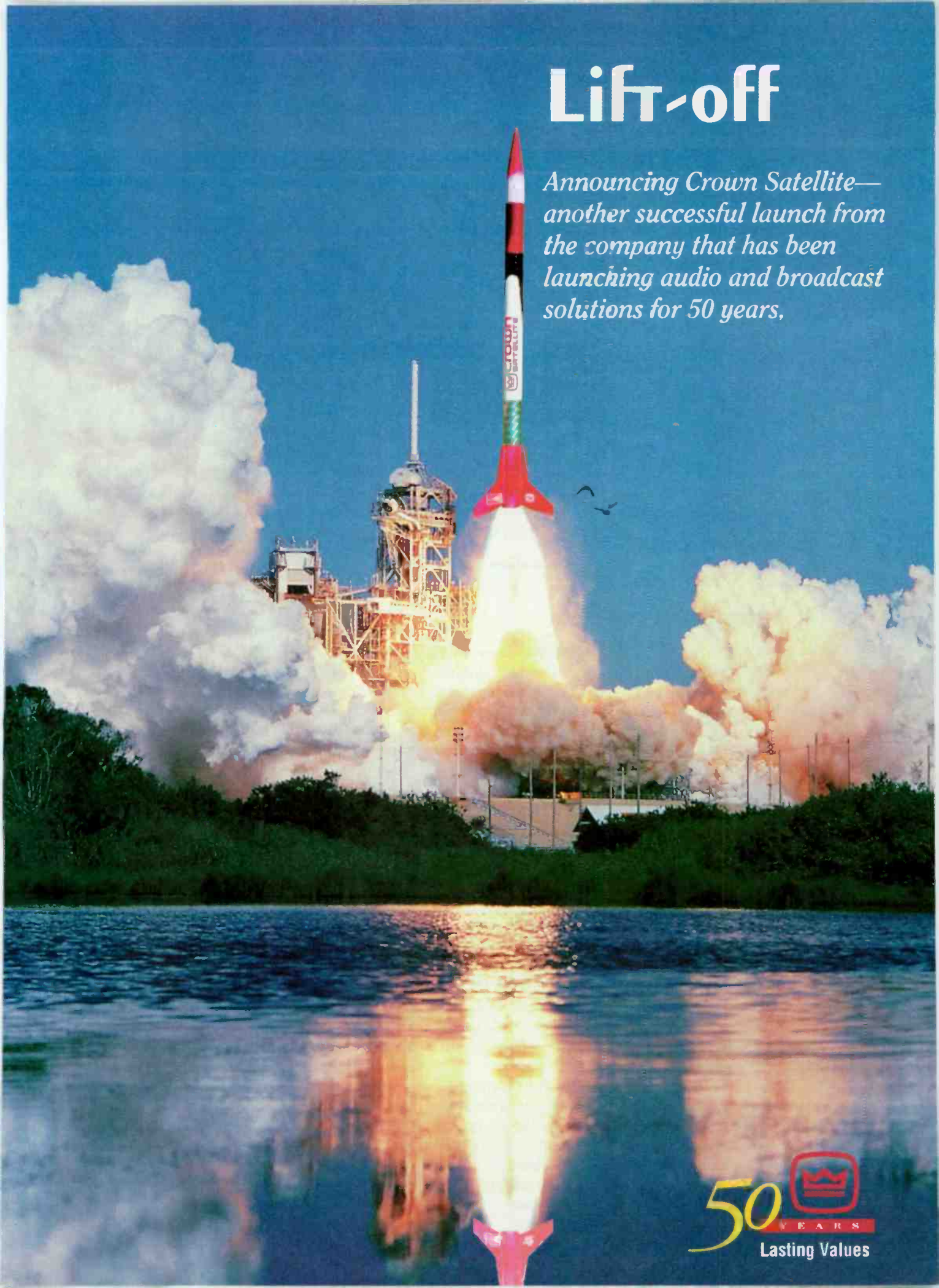
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219-936-4221; fax 219-936-6796; www.pirod.com
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Musicam USA

• **FieldFone II:** operates at speeds up to 20% faster ; users can employ the unit's Sound Shapers to fine tune the encoding algorithm on the fly without losing the line so that sound quality can be maintained throughout the broadcast; offers three mic inputs, two headphone jacks, balanced line output, individual volume controls on each input, and a switch that allows users to plug in their own mixer.

• **RoadRunner Plus:** remote broadcast package consists of RoadRunner codec, ISDN terminal adapter, an analog line interface card and a high-speed modem; completely bi-directional unit provides 20kHz audio on two B channels or 15kHz on a single B channel for the highest quality digital audio at the most efficient data rates; fully compatible with all ISO MPEG codecs; supports CCS Musicam enhanced, IRT-compatible Layer II at 56-,64-, 112- and 128kb/s; supports Layer III at same bit rates and G.722 at 56 and 64kb/s for 7.5kHz audio.

908-739-5600; fax 908-739-1818; www.musicamusa.com
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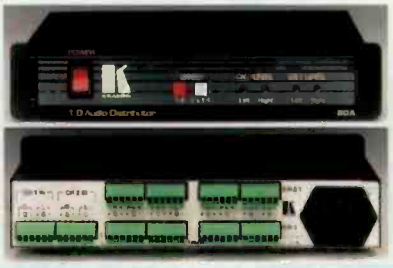
▼ **80A audio distribution amplifier:** part of the company's "half-rack" family of products, the 80A can be positioned by using a special 1U rack adapter, side by side with any other



unit in the half-rack family; the 80A is a stereo audio DA with two balanced stereo audio inputs that split the input source into four identical outputs; can also function as a 1:8 DA or as a 2x1:4 DA, and has front-accessible trimmers to fine tune the levels of each channel individually; designed for use in audio duplication and production studios as well as broadcast studios, the unit has an audio bandwidth of 20kHz to 1dB, THD of less than 0.02% and signal-to-noise ratio of -100dB at 1V.

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www.radioshack.com
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612-483-5338; astarte@winternet.com
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November/December 1997 Card
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7RF

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3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213
4	14	24	34	44	54	64	74	84	94	104	114	124	134	144	154	164	174	184	194	204	214
5	15	25	35	45	55	65	75	85	95	105	115	125	135	145	155	165	175	185	195	205	215
6	16	26	36	46	56	66	76	86	96	106	116	126	136	146	156	166	176	186	196	206	216
7	17	27	37	47	57	67	77	87	97	107	117	127	137	147	157	167	177	187	197	207	217
8	18	28	38	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188	198	208	218
9	19	29	39	49	59	69	79	89	99	109	119	129	139	149	159	169	179	189	199	209	219
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220

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An INTERTEC®/K-III Publication

November/December 1997 Card
Expires March 1998

BE Radio®

...from the editors of BROADCAST ENGINEERING

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1	11	21	31	41	51	61	71	81	91	101	111	121	131	141	151	161	171	181	191	201	211
2	12	22	32	42	52	62	72	82	92	102	112	122	132	142	152	162	172	182	192	202	212
3	13	23	33	43	53	63	73	83	93	103	113	123	133	143	153	163	173	183	193	203	213
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Title _____
Company Name _____
Mailing Address _____
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ZIP/Postal Code _____ Country _____

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Please allow four to six weeks for processing.

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Phone _____ FAX _____
E-Mail _____ @ _____

7SF

2 **Please check the ONE type of facility or operation that best describes your primary business classification:**

A ☐ Radio Station & Network (including education, government and religious)
C ☐ Recording Studio (including education, government, religious, production and research)
D ☐ Consultant
E ☐ Contract Engineer (including maintenance, technical support)
G ☐ Dealer or Distributor
F ☐ Other (please specify) _____

3 **Which of the following best describes your title? (Check only ONE box.)**

A. Company Management:
01 ☐ Chairman of the Board
02 ☐ President
03 ☐ Owner
04 ☐ Partner
05 ☐ Director
06 ☐ Vice President
07 ☐ General Manager
08 ☐ Other Corporate/Financial Official (including corporate sales)

B. Technical Management & Engineering:
19 ☐ Vice President Engineering
09 ☐ Technical Director/Manager
10 ☐ Chief Engineer
11 ☐ Other Engineering or Technical Title

C. Operations & Station Management/ Production & Programming:
12 ☐ Vice President Operations
13 ☐ Operations Manager/Director
14 ☐ Station Manager
15 ☐ Production Manager
16 ☐ Program Manager
17 ☐ News Director
18 ☐ Other Operations Title

D. Other (please specify) _____

4 **Which statement best describes your role in the purchase of equipment, components and accessories? (Check only ONE box.)**

A ☐ Make **final decision** to buy specific makes, models, services or programs
B ☐ **Specify** or **make recommendations** on makes, models, services or programs
C ☐ Have **no part** in specifying or buying

5 **Which of the following types of equipment will you be evaluating for purchase in the next 12 months? (Check ALL that apply.)**

01 ☐ Audio distribution services
02 ☐ Audio mixers
03 ☐ Audio monitoring
04 ☐ Audio processing
05 ☐ Audio recorders/players
06 ☐ Automation equipment
07 ☐ Consulting, contracting & design services
08 ☐ Data compression codecs
09 ☐ Digital audio workstations
10 ☐ Information services
11 ☐ Microphones and accessories
12 ☐ Racks, studio furniture and cases
13 ☐ RDS/RBDS & subcarrier equipment
14 ☐ Routing/switching
15 ☐ Satellite equipment
16 ☐ STL, RPU, & remote site control
17 ☐ Tape/optical storage
18 ☐ Telephone interfacing
19 ☐ Test & measurement equipment
20 ☐ Transmitters/antenna systems/towers
21 ☐ Wire and cable
25 ☐ None of the above

6 **What is the budget for equipment and services you are evaluating for purchase in the next 12 months? (Check only ONE box.)**

1 ☐ Less than $10,000
2 ☐ $10,000 - $24,999
3 ☐ $25,000 - $49,999
4 ☐ $50,000 - $99,999
5 ☐ $100,000 - $299,999
6 ☐ $300,000 - $499,999
7 ☐ $500,000 and up

7 **If you checked A on question #2, what is the ADI rank of your market? (Check only ONE box.)**

A ☐ Top 20
B ☐ 21 to 50
C ☐ 51 to 100
D ☐ Over 100

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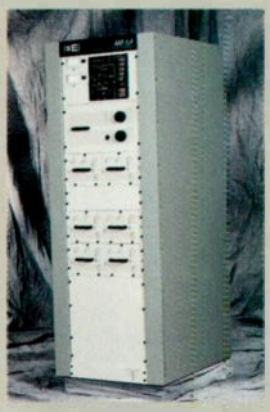
New Products FROM AUDIO A ES THE NAB RADIO SHOW

Medium-power AM transmitter
Broadcast Electronics



▶ **AM6A:** the latest in the PowerMizer line of AM transmitters, the AM6A is a 6kW version of the AM10A 10kW transmitter; all the advances made in the earlier versions of the PowerMizer line are included in the AM6A, including higher power handling RF devices, more rugged power supplies, fewer RF modules and better cooling capabilities; the unit also offers Broadcast Electronics' standard features, such as built-in AM stereo, wide input AC operating range, 145% modulation capability and a wide range of output settings.

217-224-9600; fax 217-224-9607; www.bdcast.com
Circle (151) on Free Info Card

Management and delivery of streamed media
Free Range Media

• **Lariat:** a Java-based performance application allowing the controls to manage and deliver streamed media content; GUI is an easy-to-use management interface that serves as a site-wide console for administration and a shortcut to the individual suite tools; administration function automates and simplifies audio and video file management for the webmaster, enables manipulation of file and database attributes with options to refresh, change properties, name, sort, move, search and delete files; statistics tool offers performance measurement, analysis of critical end-user and system-level data and the generation of reports on a daily basis with trends analysis available monthly, quarterly or yearly.

800-570-3873; fax 206-340-0509; info@freerange.com; www.freerange.com
Circle (163) on Free Info Card

Microphone continues tradition
Neumann USA

▶ **TLM 103:** at the heart of this large-diaphragm, transformerless condenser microphone is a newly developed capsule based on K87 used in Neumann's U67 and U87 mics; the new capsule, the K 103, exhibits a frequency response which is acoustically well-balanced and features extraordinary attenuation of signals from the rear of the microphone; by using a fourth-generation transformerless circuit, the unit features 7dBa self noise, a 131dB dynamic range and has the ability to handle acoustic signals up to 138dB SPL.

860-434-5220; fax 860-434-3148; www.neumannusa.com
Circle (153) on Free Info Card

New switcher/router
DK Audio/TC Electronic

• **CRD1616:** this new switcher/router from DK Audio/TC Electronic features a 16x16 AES/EBU routing matrix, with each input offering a sample rate converter and a channel status synchronizer; allows asynchronous inputs of various sample rates to be locked to the AES/EBU reference input; routing through the matrix to any of the 16 outputs can occur in real time without any noise or switching artifacts; the unit is a 19" 2U compact matrix with logic front operation, including 32 banks of switching presets.

805-373-1828; fax 805-379-7598; www.dk-audio.dk
Circle (152) on Free Info Card

Compact balanced power distribution
Equi=Tech

• **Model ET1R:** this AC power distribution system is ideal for applications such as small recording sessions, project studios and mastering rooms; the two rack-space unit has a power handling capacity of 1000W and measures 16 x 12.5 x 3.5 inches with a weight of only 29lbs.

541-597-4448; fax 541-597-4099
Circle (158) on Free Info Card

Automation solution
IBM/ADC Labs

• **StarTrax:** a completely integrated broadcast management system that enables storage of digital audio, precise management of advertising, simplified program scheduling, fully-automated or live-assist airplay and program customization for local markets; based on IBM server technology and accessible from any PC or workstation, the solution is highly scalable and can be used for one or many stations; employs a drag-and-drop GUI to perform all programming and management functions.

914-642-3730; fax 914-642-6729
Circle (157) on Free Info Card

Digital broadcast maximizer
TC Electronic

• **DBMAX Mark II:** this maximizer features 24-bit A/D and D/A converters, a new EQ with a multiband clipper function and five bands of expansion, compression and limiting; hardware analog signal bypass function allows signal to pass through even if the unit is off; offers the ability to simultaneously insert multiple signal processing functions in both pre and post; also includes stereo adjust, and automatic gain controller, three-band compressor, limiter and expander.

805-373-1828; info@tcelectronic.com
Circle (172) on Free Info Card

New Products FROM AES & NAB RADIO

CD Recorder
HHB Communications

▶ **CDR800:** this CD recorder is rack-mounted and features a full complement of professional features; includes balanced XLR analog inputs, unbalanced RCA analog I/O, an AES/EBU digital input, and optical and coaxial digital I/Os; direct digital copying from DAT masters and other digital formats is made simple by an on-board SRC that instantly recognizes sample rates between 32- and 48kHz.

310-319-1111; fax 310-319-1311; sales@hhbusa.com
Circle (155) on Free Info Card

Automated school-closing system
RCS

• **Stormcenter:** this software program automates school and business closing announcements and the related management of this information by on-air and air support staffs; authorized people call into the Stormcenter system using a series of pre-designated PIN numbers to eliminate fraudulent calls and, by the use of automated voice prompts, is able to cancel school or delay opening times for schools in their jurisdiction; features an on-air script and a refresh button so announcers get the most up-to-date cancellations and delays.

914-723-8567; fax 914-723-2258;
www.rcsworks.com
Circle (162) on Free Info Card

Smart compressor/limiter
Presonus Audio Electonics

• **The Blue Max:** this unit offers full control over compression parameters, including variable I/O, attack and release times, as well as ratio settings from 1:1 to 20:1; full on-board metering shows I/O levels and gain reduction; can be operated in stereo or mono with a high gain mono input; includes a sidechain input for de-essing, ducking and other forms of spectral processing; I/O are ¼ TRS unbalanced and operation is switchable to +4dBu or -10dBV.

504-344-7887; fax 504-377-8881;
www.presonus.com
Circle (165) on Free Info Card

New Products
FROM AES & NAB RADIO

Dual DAT recorder
Tascam

DA-302: incorporates external control I/O capability for multiple unit operation, high-speed and append dubbing capability, independent S/PDIF digital I/O for each deck, digital output format selection supporting S/PDIF and AES/EBU protocols, continuous record capability between decks one and two, simultaneous record capability and an optional LA-D302 balanced analog I/O kit.

• **DA-98:** provides confidence monitoring, individual input monitor select switches , switchable reference levels, and integrated electronic patchbay, digital track copy capability, a comprehensive LCD display, dedicated function/numeric keys for system operation, a built-in synchronizer and a D-sub connector for parallel interface control.

213-726-0303; faxback 800-827-2268 #2570
Circle (159) on Free Info Card

Pop-free switching
Leitch

• **Synchronous Quiet Switch (SQS):** this unit uses synchronous switching to maintain ALS framing and integrates user-selectable, cross-fade mixing to guarantee quiet switching; the cross-fade processor mixes the two input signals around their switch point, lowering the high signal's volume and raising the low signal's volume; cross-fade duration between 5.5- and 500ms; adjustable by using a DIP switch located on the router module.

800-231-9673; fax 757-548-4088; www.leitch.com
Circle (156) on Free Info Card

Stereo encoder
Orban

• **8218 Stereo Encoder:** engineered to complement the Optimod-FM 8200 digital audio processor, this unit is an all-digital FM stereo encoder with a built-in limiter that controls peak overshoots caused by lossy data rate reduction employed by digital STLs, low frequency tilt, or ringing in analog STLs; its all-digital encoding accepts analog or AES/EBU digital inputs, with the AES/EBU inputs adjustable over 20dB in four ranges; detects errors that are received at the AES/EBU input and provides an alarm output.

510-351-3500; fax 510-351-0500; www.orban.com
Circle (160) on Free Info Card

Solid-state AM transmitters
Energy-Onix

• **Pulsar:** available in 250W, 500W, 1-, 2.5-, 5-, 10-, 25-, 50- and 100kW power levels; unit feature a stronger signal with 145% positive peak capability at rated power, output tuning and loading controls for a perfect match to antenna, three times fault recycling and a redundant modular design to avoid downtime; solid state design is the same at 1kW or 50kW; all Pulsar transmitters use identical broadband power amplifier modules.

518-758-1690; fax 518-758-1476; energy-onix@energy-onix.com
Circle (170) on Free Info Card

Cable management
GS Metals

• **Flextray:** provides solid support for plenum runs of Category 5 and fiber-optic cabling; twist-and-bend capabilities help avoid installation obstacles like pipes, HVAC ducts and conduit; snip-and-bend obstacle avoidance eliminates need for any special parts and pieces and allows quick installation.

800-851-9341; 618-357-3605; www.gsmetals.com
Circle (161) on Free Info Card

New Products FROM AES & NAB RADIO

Digital satellite receiver
StarGuide Digital Networks

▶**Starguide III:** represents the next generation of flexible bandwidth efficient and expandable satellite receivers; receiver's flexibility includes operating as a single channel per carrier (SCPC) receiver, multiple channel per carrier (MCPC) receiver based on StarGuide MX3 technology, or as an MPEG-DVB-compliant receiver; supports data rates from 128kb/s to 30Mb/s; designed with two option card slots for additional audio, video or data service modules; fully compatible with the StarGuide II and can coexist on the same network using the StarGuide MX3 multiplexer/uplink system.

619-452-4920; fax 619-452-3095; sales@starguide.com
Circle (166) on Free Info Card

Multi-level DAW
Ensoniq

• **PARIS:** the core of this 128-track, 24-bit disk-based digital audio solution consists of an Ensoniq EDS-1000 PCI card, a cross-platform CD-ROM contains both Mac and Windows 95/NT-compatible software, and a 16-channel control surface; each EDS-1000 PCI card provides real-time access to 16 channels with four bands of fully parametric multimode EQ, as well as pan and fader control; the unit offers eight assignable stereo aux sends and eight stereo aux returns; insert effects such as compressors and gates may also be assigned to individual input channels; the DSP resources are dynamically assigned.

610-647-3930; fax 610-647-8908;
www.ensoniq.com
Circle (171) on Free Info Card

Software audio codec
MAYAH Communications

• **Send*It* and Edit*Pro*:** this software-only solution requires no proprietary hardware and is capable of transmitting mono and stereo high-quality audio in real time; real-time stereo transmissions require a Pentium Pro with standard audio and telecommunications cards; real-time mono transmission requires a standard 166Mhz Pentium; able to determine the destination capabilities and to store those parameters in a database.

+49 811 5517 0; fax +49 811 5517 55;
info@maya.com
Circle (154) on Free Info Card

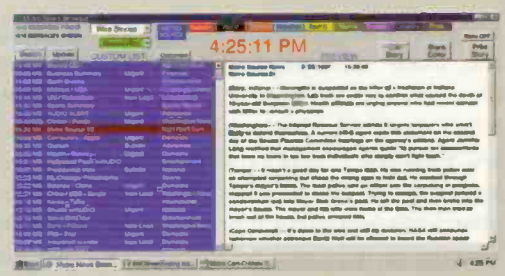
New Products
FROM AES & NAB RADIO

New series audio cable
Gepco International

▶ **Plenum-rated multi-pair audio cable:** available in pair counts of four (model 6604HS), eight (6608HS) and 12 (6612HS), the new multipairs are 22-gauge with tinned copper conductors and drains; color coded with Halar insulation; each pair is individually shielded, features an overall white polymer jacket, a characteristic impedance of 70V and a mutual capacitance is 25pf/ft.

312-733-9555; 312-733-6416
Circle (168) on Free Info Card

Digital information system
Metro Networks



▶ **Metro Source:** an information service and digital audio workstation that allows Metro news affiliates to receive via satellite, view, write, edit and report the latest news and features in both text and audio formats; service affiliates receive continuously updated and breaking local regional, national and international news, sports and weather reports, as well as business and entertainment information; Cool Edit component is a complete DAW that takes advantage of all the cut and paste benefits of the Windows environment to fully edit and re-edit audio as needed; Cart-O-Matic feature displays audio on screen for use in an information segment and has the equivalent of six five-deck cart machines in one window.

713-407-6000; fax 713-407-6049;
www.metronetworks.com
Circle (164) on Free Info Card

Easy-to-assemble XLR connectors
Neutrik USA

• **EaZyCon connectors:** originally known as the Z series, these highly reliable contacts are designed according to Neutrik's patented-design tuning-fork principle that comes standard with gold plating; also available in a solder version which comes with contacts pre-tinned and pre-fluxed, taking 30% less time to assemble; all essential parts of the female connectors are enclosed by a soft-coated surface; a digital version showing a strict coaxial link between two shields with an entirely new locking mechanism on the female connector will soon be available.

732-901-9488; 732-901-9608
Circle (173) on Free Info Card

Magneto-optical disk recorder/ editor
Otari Corporation

• **PD-80:** this powerful, ready-to-use, stand-alone eight-channel digital recorder and editing system features high-quality 20-bit A/D and D/A converters, onboard DAP and a full-featured editor; analog I/O is handled by balanced +4dBu XLR connectors; digital transfers are made via AES/EBU and S/PDIF ports on the rear of the unit.

PD:20: this two-channel MO recorder offers four internal tracks, allowing more convenience and creative freedom than the two offered by DAT and ¼-inch analog tape; MO disks recorded on the PD-20 are completely compatible with the PD-80, providing simple transfer between machines; in addition to XLR mic/line inputs and an SVGA output for waveform editing, a SCSI port allows users to easily back up files and connect high-capacity hard drives for log projects.

800-877-0577; www.otari.com
Circle (167) on Free Info Card

Business/People

Business

Olympia Online Inc. and **ASCAP** announced a licensing agreement for radio stations webcasting via Olympia Online's new Audiolounge site. Stations that webcast via Audiolounge, www.audiolounge.com, will pay an annual licensing fee to ASCAP based on web-specific advertising revenue. Revenues derived from licensed broadcast activities, as such, are not included in the calculation of ASCAP licensing fees. ASCAP and Olympia will continue to monitor the success of licensing agreements as technologies emerge to better track broadcasts over the web.

Pacific Research & Engineering, Carlsbad, CA, announced the initial delivery and installation of its Integrity digital broadcast console. The company installed two consoles in the production and broadcast studios of radio station KFMB-FM in San Diego.

Thomcast AG, France, and **Continental Electronics**, Dallas, reached a settlement that put an end to the patent litigation between the parties relating to solid-state switching amplifiers. Under terms of the agreement, Continental agreed to pay an undisclosed amount to Thomcast and to withdraw its claims contesting the validity of certain patents registered in Thomcast's name. In exchange, Thomcast waived its claim of patent infringement regarding the modulators that were in dispute and agreed never to sue Continental.

The companies have also entered into a license agreement giving Continental a worldwide license to use Thomcast's patents relating to solid-state modulators, if needed, in exchange for a royalty for manufacture and sale in certain countries.

360 Systems, Westlake Village, CA, and **Telos Systems**, Cleveland, announced the interface of 360 Systems' Short/cut editor and the Telos 1A2 multiline telephone system. The interface will allow the activation of Short/cut's recording functions from a button on the Telos desktop switch console.

Scott Studios, Dallas, has become the latest of **Digigram's** OEM development partners. The collaboration with Digigram will enable Scott to more quickly launch *Lazer Blade*, a multitrack production editor that taps the advantages and processing power of Digigram's signature PCX digital audio cards.

Broadcast Electronics, Quincy, IL, has changed ownership. **Hoak Communications Partners** has become the majority shareholder in a management buyout led by it and the management of Broadcast Electronics. Broadcast Electronics' two major subsidiaries, **Broadcast Programming** and **MARTI Electronics**, were also included in the transaction.

Dielectric Communications, Raymond, ME, has been chosen by **Miller Tower Company**, New York, to provide a complete RF package, including multistation combiner equipment, a computerized protection system, dual high-power coaxial transmission lines, nitrogen pressurization equipment and master antenna, for a new tall-tower project to be built in Cedar Hill, TX. The tower will accommodate TV and FM transmission.

The first single from the Rolling Stones' new album *Bridges To Babylon* was electronically delivered to 1,780 stations via **DG Systems'** distribution service network. The Rolling Stones' release marks the largest digital delivery in the history of San Francisco-based DG Systems.

ComStream, San Diego, announced a distribution agreement with **NPR Satellite Services** for representation of its line of satellite products. Among the products to be distributed by NPR Satellite Services, Washington, DC, is ComStream's ABR202, a digital audio receiver that can be used for radio program and news distribution, point-of-purchase audio with advertising insertion and data processing.

Susquehanna Radio Corporation, Dallas, purchased five **Yamaha** O3D digital recording consoles for use in its radio stations nationwide. The consoles, which are being used in conjunction with Spectral Synthesis digital workstations, were purchased after Susquehanna's successful installation of an O2R digital console in its Dallas facility.

People

Herb McCord was appointed to the board of directors for Pacific Research & Engineering, Carlsbad, CA.

Dan M. Dantzler was named acting chief executive officer for EV International, Buchanan, MI.

Jim Woods has been promoted to vice president of studio and radio products for Harris Broadcast Division, Quincy, IL.

Also from Harris, **Jay C. Adrick** has been promoted to vice president of systems operations.

Toussaint Celestin has joined Orban, San Leandro, CA, as product manager for on-air digital delivery systems.

Tom Rodman has joined Radio Computing Services (RCS), Quincy, IL, as Midwest sales manager.

Rick Plushner has been named president of Solid State Logic North America, New York.

John Folger has been appointed manager, radio syndication for The Associated Press, Washington, DC.

Reader Feedback

In search of a better reason

Dear Chriss:

In reading your "Viewpoint" in the July/August issue, I find that I must take exception with your very first sentence. As a 30-year veteran of broadcasting, I find no compelling technical reason to "make it our goal to have a totally digital audio path". The main reason for a digital audio path (at this time) is largely the same reason for the EAS debacle: the sales of new equipment. Having requested demonstrations of supposedly superior digital devices, I have found in side-by-side tests that many digital devices cannot even equal some of the performance specifications of high-end analog audio devices.

Yes, our FM station does have digital storage on hard drive, and it is convenient. But I think your assumption that every station's audio path must "keep up with the Joneses" is a bit presumptuous. While we may add a piece of digital audio/transmission equipment here and there, I, as VP of Engineering, cannot at this time with a clear conscience go to the boss and tell him we "gotta" change everything to digital. It isn't fiscally responsible, nor is it technically responsible.

I hope you will enjoy your new assignment at BE Radio. *I read every issue cover to cover.*

Cordially,
Jerry D. Arnold
VP Engineering, Hester Broadcasting
Terre Haute, IN

Chriss Scherer replies:

I suppose I should clarify what I meant with my statement "a completely digital audio path is or at least should be the goal of any radio station." I completely agree with you, that going digital for the sake of being digital is not a good enough reason. Any installation or upgrade should draw from the highest quality available, be that analog or digital. However, when it is time to replace the station's cart machines, the analog choices are limited. The digital options present themselves well based on cost and longevity. There are other areas in the program chain that are not such an obvious decision, but as digital technology advances, there will be fewer analog choices available, for better or worse.

Chriss Scherer,
editor

Advice from golden ears

Dear Skip:

I have a bone to pick with you regarding the "Editorial, Recrystallizing the ball," July/August 1997). I take technical excellence very seriously, golden ears and all. For me, digital audio was incapable of fully replacing analog until it achieved a data rate of 24 bits/sample at a sample rate of at least 96kHz.

But, in spite of current technological shortcomings, we did migrate over to compact discs, DAT recorders and now data-reduced network satellite feeds and hard-disk audio automation because there were significant benefits to be had. The absolute fidelity and resolution may be slightly worse than the best of analog but the uniformity of product, reliability, lack of obvious noise and mechanical wow and flutter were significant improvements that all of our listeners could hear.

Golden ear audio has always been a niche market. Maybe 5% of all of the audio consumers demand state-of-the-art audio fidelity. Most listeners are equipped, at best, with mid-fi equipment. Today's best perceptual coding algorithms sound almost as good as a compact disc to astute listeners. Thus, the Grand Alliance IBOC system could succeed in spite of your inference that it is out-of-date technology being introduced too late.

Your comparison of the fidelity difference between early FM radio and a telephone call vs. IBOC and 24-bit audio is erroneous. Sure, the former is vastly different audibly. But the difference between Sony's ATRAC 4.5 (MiniDisc compression algorithm) and 24-bit linear is very small to most ears.

Let's put this into perspective. If you had to choose between an almost imperceptible loss of fidelity or nasty multipath distortion and static, I think you'd chose the former every time.

The real issue with IBOC is whether the data rate can be high enough to make the signal robust. If not then we'll still suffer the same multipath problems of analog FM. Only instead of flub-flub distortion, we'll get long moments of silence as the system mutes. And that will be far more annoying than traditional multipath noise bursts.

By going to L-band and using spread-spectrum techniques, multipath performance improves dramatically as long as the symbol rate is high enough to provide enough redundant data.

So the real issue is not fidelity. The differences are too small for public perception. The real issues are the other benefits of digital technology and not disposing of them in the quest for an IBOC solution. This would be narrow minded and doomed to disaster.

Ira A. Wilner
Wilner Associates
Putney, VT

Skip Pizzi replies:

Thanks for the thoughtful letter, Ira. Of course, you're correct that today's perceptual coders sound very close to the best uncompressed digital audio signals. That's the point, of course, and it's the goal to which all coders aspire.

But you're also right about fidelity not being the real issue. We've got to look at the bigger picture. Today's digital communication systems have to think in terms of overall data rate and service profile, not just audio quality. The consumer environment is a relative one, always governed by "compared to what." If I can get 128kb/s on my two-way phone line — perhaps even via cellular or PCS — how much will I value a non-interactive, 48kb/s (AM) or 96kb/s (FM) broadcast channel? How will that channel compare with an equivalent or greater bandwidth from a multichannel, national DBS radio service? And will audio be the only occupant of the radio channel? What about the visual data that today's web users are getting used to having served with their audio?

Furthermore, without delving into the value of 24-bit/96kHz, how will the perceptual coding algorithms that seem transparent today fare in the more demanding listening environment of tomorrow? It's happened before, as the artifacts of a particular recording system are learned, first by "golden ears" and later by (at least some of) the general audience.

Of course, the real key to future success lies in the content of those competing services, not their technology. But in order to play on a level field, tomorrow's broadcasters need some technical parity to deliver a signal that's roughly equivalent to the other service providers of the day. By a purely empirical analysis, it's not clear that the IBOC solution being contemplated at present will provide such capability. By that metric, the comparison of broadcast to telephone bandwidth seems at least a conceptually apt one to me.

Skip Pizzi,
editor in chief

To the editors:

Jeff Keith wrote probably the most definitive description of audio processing I have ever had the pleasure to read. Having been there when a Gates Level Devil fed an SA-39 for processing, I remember all the steps in the development of the maxi-squeeze miracle box.

I am amazed that these days, audio "experts" are after old tube boxes like they were gold. Just try to buy a Gates Sta-Level, SA-39, Collins 26 whatever or anything Western Electric...

It's articles like this that we ol' farts can use to teach the young who daily gather around our feet for instruction in ways of the ohm and electron, so keep 'em coming.

Thanks again for a great magazine and thanks to Jeff for a great contribution.

Sincerely,
Bob Mayben
Chief Engineer WRGA/WQTU
Rome, GA

Thanks for the kind words.

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Dennis Triola,
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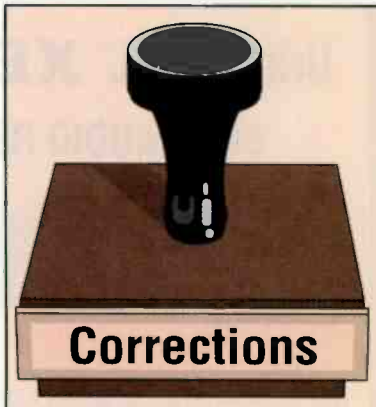

Corrections

- **In last issue's cover story (*Talk Radio,* Sept./Oct. 1997), several photographs appeared without proper attribution. The opening photo on page 24 was taken at the studios of KCMO-AM, Kansas City, with Mike Murphy (left) leading the interview.**
- **The photos on pages 32 and 34 should have been credited as follows: *Courtesy of WBUR-FM and Russ Berger Design Group.***

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Optical recording

By Skip Pizzi, editor in chief

Consumer audio recording seems poised to make a major shift from predominantly linear to non-linear (or *random-access*) storage media, including the capacity for recording. Like other recent format shifts, this consumer-industry conversion will have some resonance in the professional broadcast environment.

The development of random-access (i.e., disk) recording has been spurred by the desktop computer, in which files are typically stored in non-contiguous fashion. Such storage systems have been developed using magnetic and optical techniques. The large capacity required by digital audio files and the preference for removable media favors optical disk media, which offers greater storage density and robustness at the expense of slower access times. For these reasons, magnetic disks are preferred during non-linear *production*, but optical makes more sense for long-term storage and distribution of finished audio.

The Marantz CDR620 is an audio CD recorder with a SCSI-II interface.

CD-R

Although it has not yet made significant penetration into the consumer audio market, the recordable CD (CD-R) has a number of applications in radio broadcasting facilities. CD-R is a write-once format and it is compatible with standard ("Red Book"-format) CD players, making it ideal for archiving and small-scale (10 copies or fewer) distribution.

Audio CD-Rs can be made on stand-alone audio CD recording decks or on writable CD-ROM drives as peripherals to desktop computers ("CD burners"). If the audio is already stored on a DAW, the computer CD drive makes the most sense. When source audio is coming from a live or linear medium, the stand-alone CD recorder may be more appropriate. Of course, the computer drive allows any kind of multimedia CD-ROM data to be recorded (typically at a speed less than real time for audio playback), while the CD recorder provides only real-time, 16-bit/44.1kHz digital audio recording capability. Computer CD-burner drives are also about one-third the cost of the stand-alone CD-R decks.

The latest standards governing CD-Rs are covered under "Orange Book II" documents. Although CD-Rs are write-once disks, with Orange Book II hardware they are "multisession" capable. This means that audio can be added to the CD-R in a number of separate recording sessions rather than in a single, continuous pass. But in order for the CD-R to be playable on standard CD players, a Red Book table of contents (TOC) file must be recorded on the disk. This serves as a file directory for the CD player and once it's recorded, it cannot be updated.

No audio can be erased from a CD-R disk, but some recorders allow certain cuts to be ignored by Red Book players by simply not including them in the TOC. This is tantamount to erasing these cuts, although it does not recover the recording time used by them. A few professional CD *players* are also Orange-Book compatible, meaning that they act like multisession CD recorders by reading CD-Rs without a Red Book TOC. This allows users to keep a CD-R "open" by continuing to add cuts to the disk on a CD-R recorder until it is full.

Like regular audio CDs, the CD-R's maximum capacity is 74 minutes of audio (or 99 cuts). Blank CD-R media is available for around $10 per disk.

CD-RW

A new variant on the CD format is now emerging, called the *rewritable* or *erasable CD* (CD-RW). It allows multiple recordings and erasures, but it is not compatible with regular CD players, either optically or in its file format.

This is why CD-RW will not compete with CD-R for broadcast applications, but it may rival removable magnetic disks and drives, such as the ZIP and JAZ systems.

DVD

The next movement in optical recording is expected to come from the *digital versatile disk* (DVD). DVDs are also 4.7-inch disks like CDs, but they use red (as opposed to the CD format's infrared) lasers, and offer the option of double-layer and double-sided recording. This provides an increase in storage capacity from the CD's 680MB to anywhere from 4.7GB (single-sided, single layer) to 17GB (double-sided, double layer) per disk.

The first DVD disks are already on the market, in a prerecorded, playback-only format, primarily intended to compete with VHS tapes for movie rental. In 1998, the DVD-ROM format should debut, which will include write once recording. The DVD-RAM disk will follow, providing erasable storage at the same disk capacities.

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