RF Radio
October 1998
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SPECIAL REPORT: TRANSMISSION

- Remote Site Control
- Maintenance
- Datacasting
- Grounding
- Combiners

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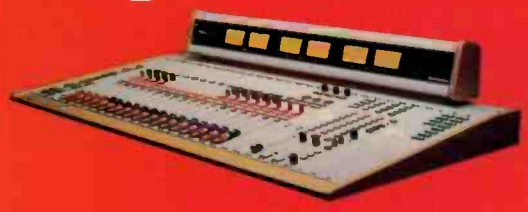
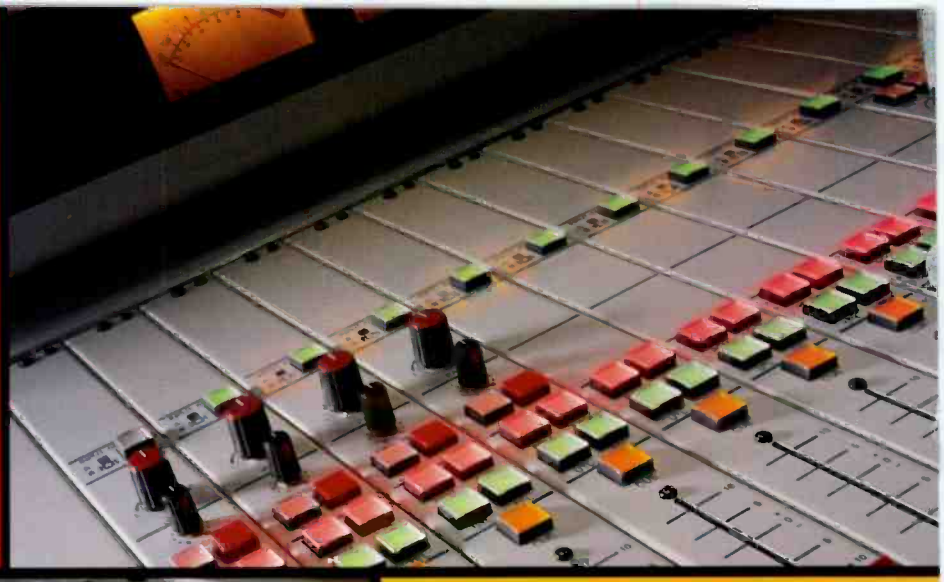
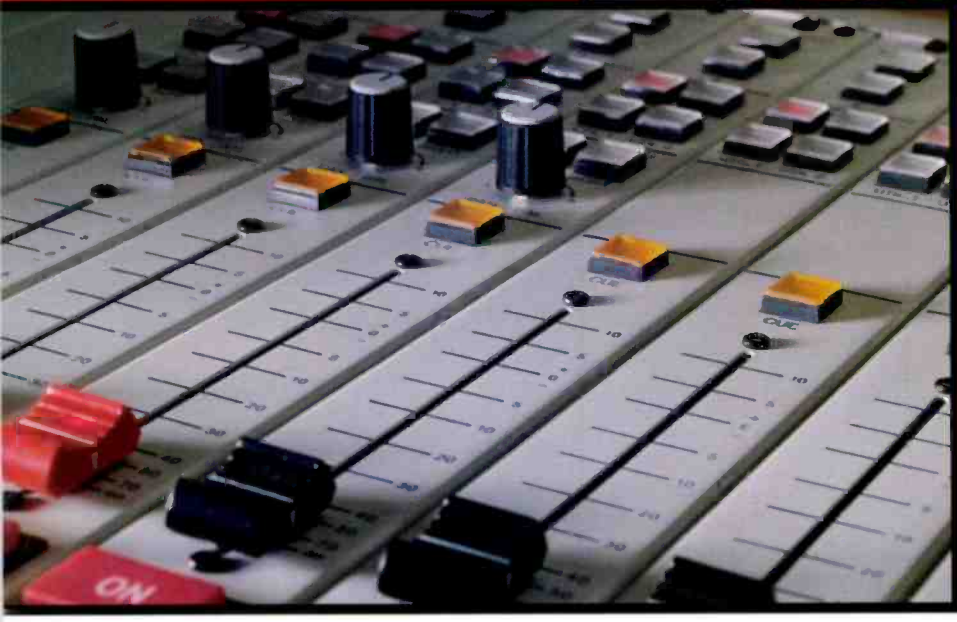


Auditronics COMET





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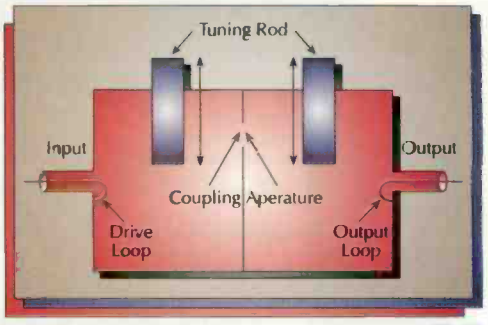

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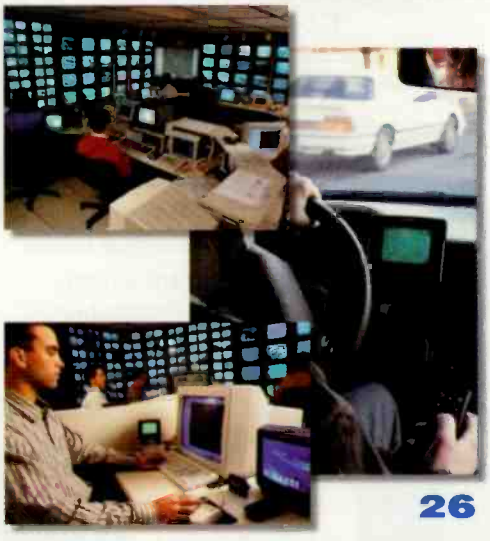

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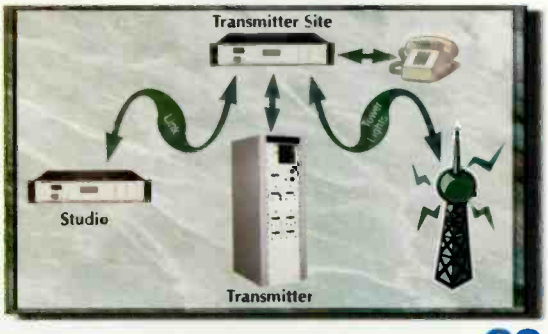

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ON THE COVER: On the cover: RF and transmission has always been at the heart of radio. Tom Silliman, P.E., president of ERI has a bird's eye view of New York City from the master antenna on the Empire State Building. Photo by Lou Bopp, courtesy of ERI.

When you compare the all-digital Omnia.fm from Cutting Edge to other audio processors, is it apples to apples? Not quite. Unlike other audio processors, the Omnia is designed for today–and easily upgradable so you're always on top of the technology you'll need tomorrow.

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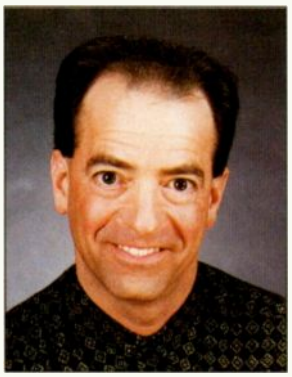
A deadline that can't be postponed

It's become almost expected in business today that the dates initially set for a project's completion or product's availability will not hold true. In fact, we're pleasantly surprised when something occurs on schedule, and the parties responsible for this feat are typically portrayed as heroes.

Unfortunately, we are all facing a project with a finish date that cannot be postponed: managing the vaunted "Millenium Bug," less sensationally known as *Y2K*. Notwithstanding the hype, everyone involved in the technical management of a radio facility today should have this on their high-priority project list. By about this time next year, a Y2K plan must have been formulated and in the process of execution (or already completed) throughout your operation. No amount of pleading for extra time or well-crafted excuses will allow this deadline to be extended, so use you time wisely. In the meantime, don't expect someone to ride in with a silver bullet. Some software vendors will provide help, but you're basically on your own.



The massively intertwined nature of today's computing systems greatly complicate the Y2K solution. To indelicately update John Donne, "No platform is an island." A particular PC in your shop may be Y2K-ready, but if it makes a one-time network connection to a problematic component living elsewhere, your whole system could go down. The best you can do is be exhaustive about Y2K compliance throughout your system, and hope everyone else does the same.

The uncertainty exists at a number of levels. For example, fully 20% of the computers on sale today are estimated to still have Y2K problems in their BIOS. Other difficulties live at the OS level. Most applications that don't involve time-based functions can be made Y2K-ready by a fully compliant OS. But the schedule-based applications so common in radio require specific compliance-updating themselves, as well. There are also archived files that will have to be corrected upon opening or conversion by a Y2K-compliant application. Finally, there are the data interfaces to other sources that may require updates.

The recommended Y2K compliance process therefore starts with an *inventory* of your computer resources, hardware and software. (You should already be performing this phase.) Next, *analyze* the inventory for what needs to be brought into compliance, and finally, *execute* the updates. (Some recommend a fourth step: *prayer.*) Also set any compliant software to use a four-digit date structure for any files written from this point forward. Like EAS, this is a conversion task that none are absolved from, and that engineering must drive. (See next issue for an article on Y2K's effect *on* EAS.)

> **I've been on a calendar, but never on time.**
> **— *Marilyn Monroe***

Keep in mind that January 1, 2000 is a Saturday, so some problems may occur on a holiday weekend, and others may not be evident until the following week. Also note that 2000 is a leap year, but that most years ending in 00 are *not*, even though they all fit the quadrennial pattern. Remember that the 00 years are used as the smallest-resolution corrector in the Gregorian calendar, accounting for the remainder left over after leap years try to compensate for the inexact diurnal length of the solar year. So only every *fourth* century takes a leap year in its final year, and thus 2000 is a leap year, while the years 1700, 1800 and 1900 were not. (Those familiar with drop-frame SMPTE timecode will recognize a similarity in its structure, as it attempts to resolve non-integer rates with fixed-length units.)

If Y2K conversion depresses you, keep in mind that it could be worse. Most U.S. radio stations don't have to worry much about the coincidental introduction of the new European currency unit, the Euro. If you're in finance or international trade, however, you'll have to deal with the Y2K and the Euro conversions simultaneously. Nice to see that Murphy still lives.

Skip Pizzi, editor-in-chief

See Skip at:

- **NAB Radio Show, October 14-17**
  Skip will chair and present in the "Digital Facilities Workshop" (October 15, 8am - 5pm), and will also chair the "Future Trends — 21st Century Radio" session, (October 17, 10:30-11:45 am).

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Viewpoint

For the sake of digital

I was talking with a colleague the other day about his recent purchase of a new computer — preloaded with Windows98. Hold on, this is not another "Evil Gates Empire" story. Anyway, my friend told me that the computer and new peripherals were all plug-and-play and that (theoretically) the installation of them should have been easy. Obviously it was not or I wouldn't be telling you about it.

He has been struggling with the system for two weeks now. This has included four attempts to start from scratch (the power of *format c: /s*) on the entire installation process, yet he continues to get conflicts with IRQ settings and drivers between printers, sound cards and DVD drives. He has followed all the instructions and suggestions of customer support. We shake our heads at the idea that had he started six months ago, he would have purchased a mature Win95 system with, more than likely, fewer problems. On the other end, had he waited an additional six months, he could have purchased a Win98 system with most if not all of these bugs worked out.

Isn't technology supposed to work for us and not against us?

Don't get me wrong. I like the Windows operating system. I held off going to Win95 until it was out of the danger zone. I will do the same for Win98.

At the same time I keep reading and hearing about new technological breakthroughs developing in the lab and will be available to consumers in a few years. It seems that most of these advances include the word *digital* in them. Why do I need them? What's wrong with what I already have? The answer usually includes a quip about how much time it will save or a description of how it is technically superior.

The time factor is a valid concern. But when will I realize this time advantage? For my friend, he has lost considerable time because he upgraded. The other argument for technical advancement also has a price. I can pay 10 times as much for a nanosecond of speed or .001dB of improvement. Now that's a real bargain.

This is hardly to say that we should abandon all work on furthering our technology. Innovation and development have brought us to where we are today. Without the same dreaming and planning we wouldn't have radio. My concern is technology for the sake of technology. In some cases this becomes digital for the sake of digital.

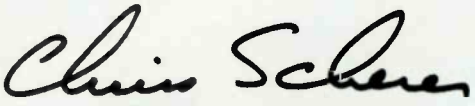
Any technological change should be urged by a need. I'm sure you've had to deal with some non-technical person, perhaps a general manager or program director, who is convinced that the station needs the latest device just because it's digital and therefore better.

The early digital audio editors were touted as the only path to great production. It turned out that they cost more and were slower than the analog equipment they were designed to replace. They were in their infancy. There was no real reason to switch to the new technology. "Being digital" was not reason enough. In time, technology caught up and broke the barrier.

Make the change because you really need to, not because someone told you that you should. My friend made the change to a new computer system because he needed to. Unfortunately, he was caught between technologies.

There is concern that the US is not leading the way on the DAB frontier. I say, "no problem." Let's allow Eureka and DTV to learn their lessons, and then we can benefit from their experience. There is really nothing technically wrong with radio today. AM stations do well in ratings, so it can't be that terrible. Current DAB solutions would only meet and not exceed FM.

Let's let the labs do their dreaming and planning. We'll implement it when it makes sense, not when we're told that we should.



Chriss Scherer, editor

See Chriss at:

- **NAB Radio Show, October 14-17**
  Chriss will participate in the "Digital Facilities Workshop" (October 15, 8am - 5pm) with a presentation on *Computer-based audio operations: Production & delivery*, 9am.

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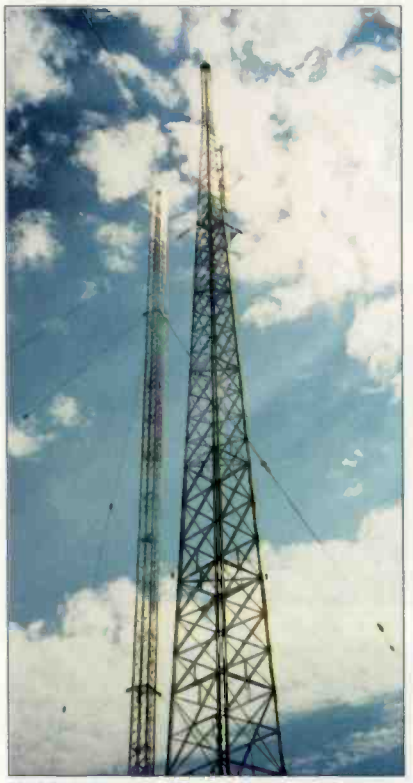
Maintaining the multi-transmitter site

By Kirk Harnack

With more than 12,000 AM and FM radio stations licensed in the US, an increasing number are sharing tower space and transmitter housing. Placing high-power transmitters in close proximity raises a number of installation and ongoing maintenance issues.

Multi-transmitter sites are the result of sharing precious vertical real estate. Generally, transmission facilities at these sites can be categorized into one of two broad scenarios.



Multiple transmitter facilities can live and work together and save some costs.

- Two or more facilities operated by one licensee. Most often this is a shared AM/FM site where the transmitters share a building, incoming power mains, and a common RF and lightning ground.
- Two or more facilities operated by different licensees. Often, but not always, the transmission facilities are in separate buildings with individual power mains, grounding schemes, and environmental controls. It's common that the only shared items are the tower and the entrance road.

Both scenarios share several installation and maintenance concerns.

Intermodulation

Foremost among concerns where more than one transmitter exists is establishing and maintaining adequate isolation between the transmission systems. The slightest ingress of one station's signal into another station's transmitter can cause illegal levels of intermodulation.

Such signal ingress normally occurs in either the final amplifier — back-fed from the antenna — or the low-level input stage of a transmission system. Interference can occur between or among transmitters within the same service (FM to FM for example), between services (TV to FM) or other, more insidious combinations. One of the most common opportunities for intermodulation products to occur is the shared AM/FM site. A strong AM RF field in the transmitter building can impose on the FM station's exciter through the wideband, composite input and cause modulation of the FM carrier at the AM carrier's rate.

For example, a shared site hosts a 1kW AM daytime station at 1000kHz and a 6kW FM station at 95.3MHz. The AM station's RF may be quite strong in the transmitter building due to its proximity to the shared tower. A strong 1000kHz AM signal is induced upon the coaxial cable leading to the FM station's exciter input and, despite some internal low-pass filtering in the exciter, it is modulated not only with the desired FM composite audio, but also with the AM station's 1000kHz carrier. The result will be additional FM carriers at 94.3 and 96.3MHz (plus and minus 1000kHz from the FM carrier). These additional resultant carriers are normally considerably lower in magnitude than the desired carrier, but can easily exceed the FCC's specification for spurious and harmonic emissions.

Resolving a problem such as the example above begins with reviewing the facility's grounding system and improving or augmenting it as necessary. A proper, effective grounding system is easy to recognize — and so is the lack of one. Heavy copper strap from each device back to a common grounding point is the first essential element in any shared site. In fact, an effective ground system is so important that other troubleshooting efforts should take a back seat to first ensuring that all equipment and racks are well grounded to each other and to a common ground point.

Improper grounding can cause or contribute to intermodulation problems at a multi-transmitter site, but there are other causes as well. RF signal ingress into low-level connecting cables can be problematic, even when they're properly grounded. High-quality, double-shielded coaxial cables are standard equipment in high-RF environments. Sometimes it's also necessary to bond the outer conductor of these cables to the station ground. Occasionally, ferrite suppression beads must be used to reduce RF energy travelling along a cable and into equipment. Additionally — and if the frequency of the undesired signal is several multiples above the desired signal — some additional low-pass filtering may be employed in the field to reduce or eliminate the interfering signal.

One more source of signal mixing and intermodulation products comes from other high-level RF signals entering a station's transmitting antenna, travelling down the transmission line and mixing with the main signal in the

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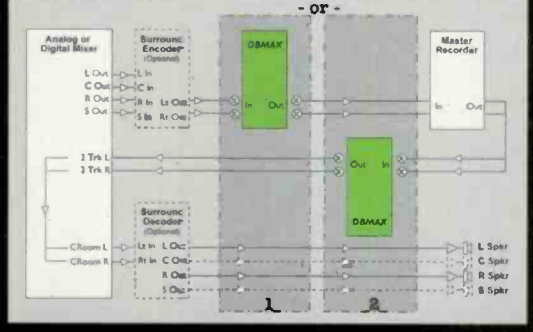

TV or Radio Production & Transmission Emulation

Example of production for DAB, Digital TV and FM

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transmitter's final RF amplifier. Such undesirable signals may also come from a poorly designed or mis-adjusted RF combiner system or from a poorly matched combined antenna. These sources of trouble usually show after new construction or installation work has been performed, although lightning or other damage may precipitate new intermodulation difficulties. In situations where stations employ discreet antennas that are in close proximity, each station may use either bandpass or notch filtering to keep undesired energy out of their final amplifiers.

In any physical configuration, multi-transmitter sites need to have access to an RF spectrum analyzer for monitoring and troubleshooting purposes. Good spectral documentation is essential to later troubleshooting when intermodulation problems arise. In cross-ownership scenarios, having a spectrum analyzer handy can mean the difference between finger pointing and problem solving. However, even sites of common ownership need to use a spectrum analyzer to document emission compliance.

RF neighbors may not always be broadcasters, but the same problems and considerations will apply.

Tower and antenna maintenance

The one shared item in most multi-transmitter sites is the vertical real estate — the tower. Almost any work on the tower affects the operation of every station sharing it.

Having a documented policy is critical to avoiding legal problems that can arise from tower climbers being overexposed to RF energy. Use the services of a qualified FCC Consulting Engineer to establish a tower-climb policy specific to your site. Well planned, this policy should not only adhere to regulations, but allow for minimal disruption of service. If good solutions can be found which minimize off-air time during tower maintenance, then a consultant's fee can be well worth it.

Security

When stations change hands, different, competing parties sometimes own transmitters in the same room. As engineers we tend to be trusting of our peers even if they work for a rival station or group. Station owners and

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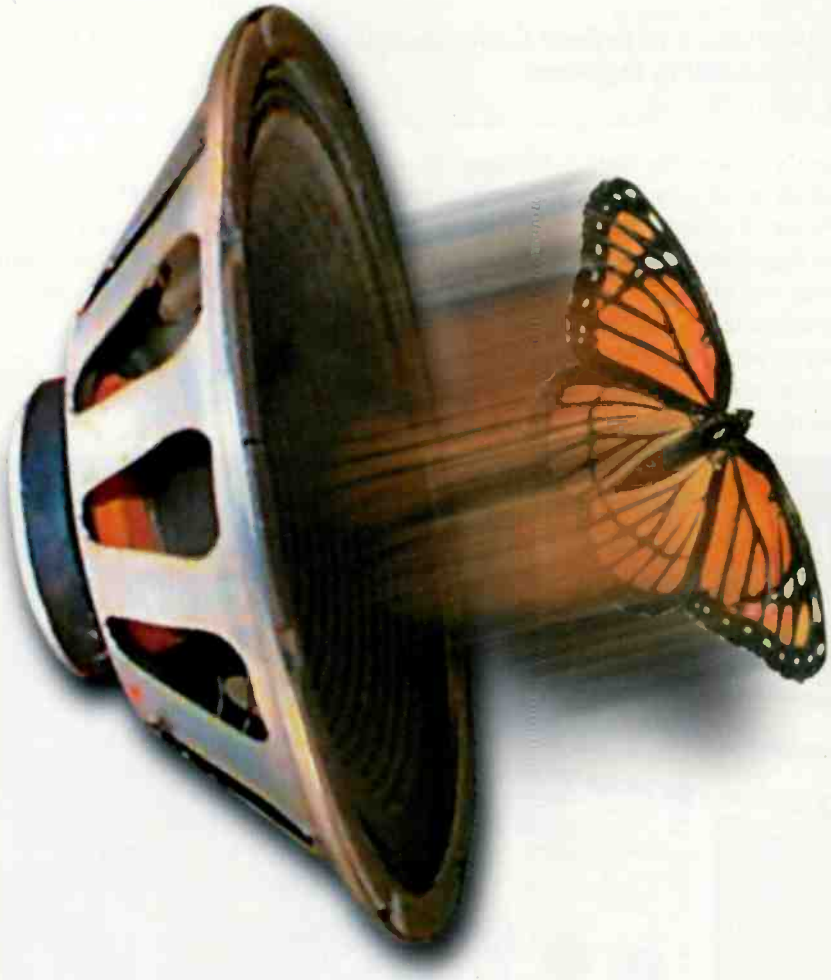

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managers don't often presume such faith and consequently new walls are put up.

If your site is divided, moved or annexed, take some common-sense security measures. Know who has access to your transmitter and equipment. Guard against convenient sabotage, too — especially from disgruntled listeners.

Responsibility vs. freedom

Being a tenant at a multi-station site brings with it certain limitations and some offsetting conveniences. Not having to mow the grass, maintain the road or paint the tower means fewer things to worry about (unless you are the site owner). However, if the station needs to install a backup transmitting antenna or another RPU or STL antenna, a whole process of tower analysis, rent negotiation, power reductions for installation and the like will ensue.

Stations that share tower space should strive to be good neighbors. This includes transmitting a "squeaky clean" signal from any transmitters under your control. It also includes reducing or eliminating hazards such as gas cans and other flammables, discarded parts lying around, and keeping weeds and brush under control.

Online resources

The RF Connection
www.therfc.com

Andrew
www.andrew.com
- **Information on lightning and grounding**
www.andrew.com/products/article/pdf_article/lightning.pdf

Cablewave
www.cablewave.com
- **Information on passive intermodulation**
www.cablewave.com/rfs/iguazu.htm

Red Cross
www.redcross.org

Association of Federal Communication Consulting Engineers
www.afcce.org

Safety

Coordination on safety issues can produce an immeasurable dividend — that of a saved life. Find out what emergency training other engineers or workers have at your shared site. Each station should have a basic first aid kit plus supplies to deal with electrical burns.

Arrange for an emergency care instructor to speak at your next SBE meeting and follow up with training for engineers and technicians once or twice per year.

Working in a multiple transmitter facility has many advantages. Economics usually drive most of the benefits. Other advantages exist as well that are not as easy to quantify. One of the most important things to remember if you are a tenant at a multi-site is to always be a good neighbor.

Kirk Harnack is president of Harnack Engineering, Inc. and director of engineering for Delta Radio, Inc., Cleveland, MS. Email: kirk@harnack.com.

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Canada: Tel: 514-426-3013 • FAX: 514-426-3953 • Mexico: Tel: 52-5-639-0956 • Fax: 52-5-639-9482
World Wide Web: http://www.neumannusa.com

Circle (6) on Free Info Card

Buying a new transmitter

By John W. Caracciolo

It is 3:30am, the telephone rings and the pager goes off at the same time. This cannot be good news. This is the moment you hope the transmitter purchase you made is the right one.

The purchase of a new transmitter is probably the most expensive capital investment a station will make. Unlike consoles, remote gear, or studio playback equipment, the transmitter is the integral piece of the delivery system. This investment can mean the uninterrupted transmission of audio to the end user, or a constant source of trouble that can financially cripple a broadcast facility.

The price tag on the transmitter is only part of the actual cost. Include installation and any special considerations.

Planning

In this age of double-digit multiples, every broadcaster strives to meet an owner-imposed bottom line to succeed or prosper. There are two ways to achieve bottom-line success for a company: increase the intake of dollars or decrease the output of money. With this philosophy in place, every purchase a broadcast station makes must be scrutinized to meet the needs of the facility and still fit into the capital investment plan.

I have had the unique opportunity of sitting on both sides of the desk and know that several factors must be taken into account when a station plans to purchase a new transmitter. They can be put into three steps:

1. Evaluate your needs and wants.
2. Factor in site and location parameters,
3. Examine cost and savings

Evaluating needs and wants

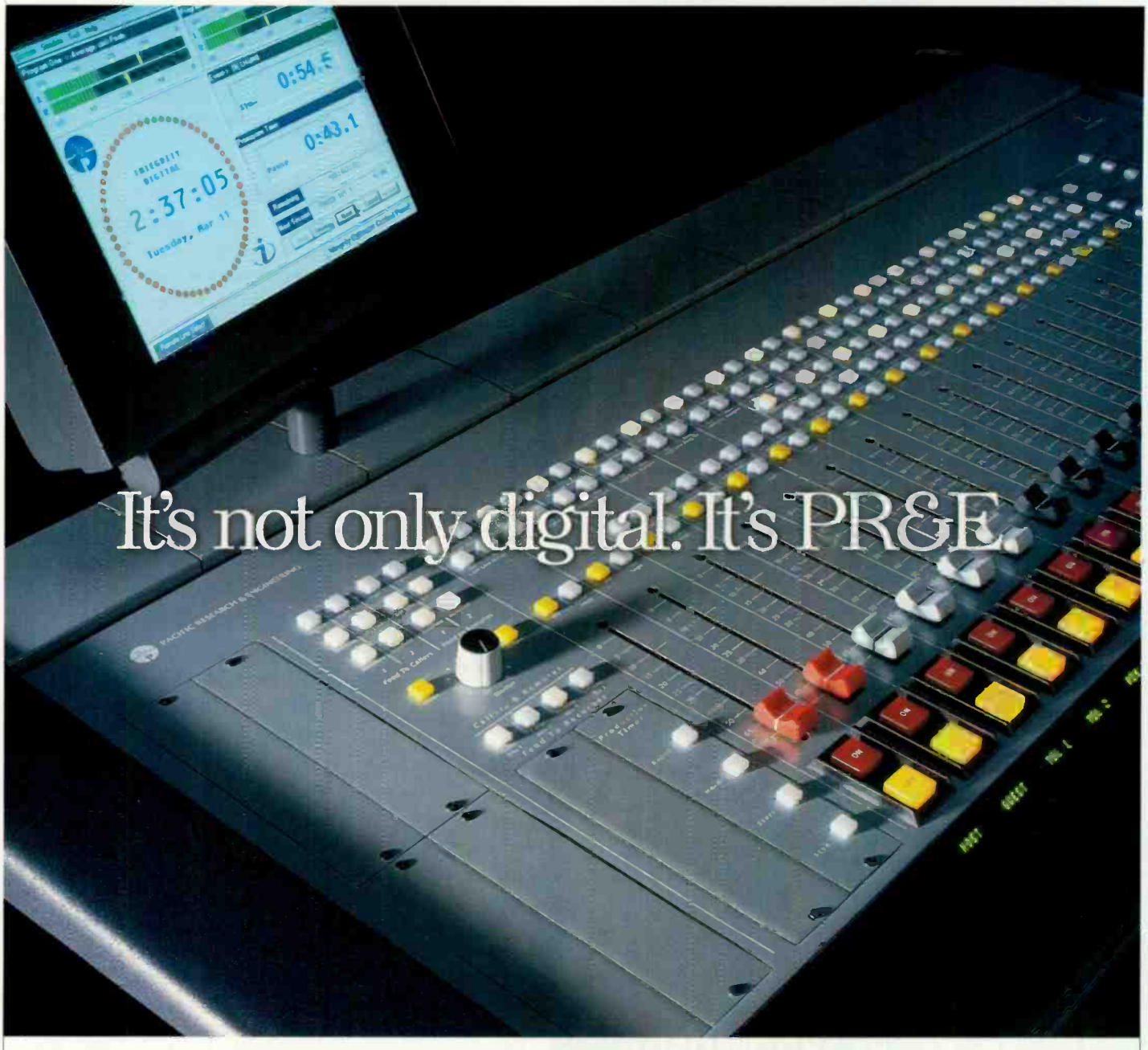
What does the station need to operate? What TPO will you need to achieve your authorized ERP? Make sure you get enough transmitter to efficiently deliver the required output to your antenna. Will you be changing your antenna and line? If so, remember to factor in antenna gain and line efficiency. Various manufacturers of line and antennas have slightly different gains. Therefore, even if you are replacing a one-bay antenna with another type of one-bay antenna, the gain could change slightly.

What features do you want? Do you want a tube or solid state design? There are positives to both types. Do you need a digital or analog exciter? Consider what other types of transmitters you have in your group. It is always wise to keep the major purchases uniform for ease of maintenance and part replacement.

Consider technical support. Does the prospective transmitter company offer 24-hour emergency tech support? Try it. Before you make the purchase, call at 11pm on a Saturday night and see if you can get support. Most major manufacturers offer excellent tech support at all hours. Also, check their stock of replacement parts.

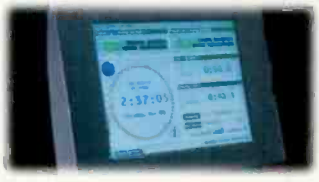
It's always beneficial to have the opportunity to look inside a transmitter before you purchase one. If you cannot get to the factory, most broadcast transmitter manufacturers attend area trade shows like NAB or ARMA. Managers should know that this is an excellent monetary investment to make. Engineers can tell you that they have saved their companies thousands of dollars by attending trade shows and getting a first-hand education on various products and equipment that were planned for purchase. Managers: before you spend thousands on a new transmitter, spend a few hundred and send your engineer to a local trade show so he can test drive the rig. You would not dream of purchasing a new car without a test drive or a look under the hood. Most manufacturers will set appointments with you and give you ample time to inspect their product.

Inside space is important. Can you access important components? Check the access to the high-voltage stacks, blower motor and bleeder resistors. If it is a tube design, pull the tube. Is replacement easy? If your are looking at a solid state transmitter, do the modules pull with ease? Can they be repaired in the field? Can they be pulled while the transmitter is operating? What types of connectors are used on each power module? Can the combiner be accessed with ease? Look at the manual and schematic included with the transmitter. This is going to be your



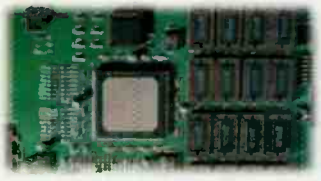
Now you can get digital technology and PR&E reliability in the same console. Integrity. It's the first digital on-air board that also speaks fluent analog. All 16 inputs can handle analog signals. Ten can also accept digital inputs at any sample rate. So you can deal with the hodge-podge of equipment in real-world studios. A unique architecture also guarantees a level of reliability other digital consoles can't match. So you can rest assured your signal will stay on the air.

And with digital programming, you get seamless show transitions, fewer board-op errors and fewer make goods. For a brochure, call 760-438-3911, visit www.pre.com or e-mail sales@pre.com



The LCD screen and Windows® interface provide access to powerful configuration management and session-based features.

Four special-purpose buses provide automated mix-minus for telephone and remote feeds, each with IFB.



An array of state-of-the-art, floating-point digital signal processors perform mixing, routing and other functions.

The 10-character display changes when another audio source is assigned, either manually or at a preassigned time.

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bible for the life of this rig. Make sure schematics and part layouts are included for every board in the device. Simple theory-of-operation and troubleshooting guides are also important features.

Site location and parameters

Now that you know what you want, you must look at the installation site and determine if your needs and wants fit in to those parameters. First, let's look at the available line voltage in the building. Is there enough line voltage coming into your site to adequately run your new transmitter? If you are considering your old transmitter for auxiliary status, can the line voltage efficiently run both transmitters simultaneously? All transmitter manufacturers will tell you what the power consumption at a given line voltage will be for their product. However, make sure you have an accurate line voltage for the site. Include in your electrical planning a cutoff switch and separate breaker for the new rig. Have an electrician run a load evaluation on your site to make sure your incoming power can handle the increase. Will you be using single or three-phase power? If you have three-phase power, is it a delta or Y configuration. These are important questions and accurate information is critical to have your transmitter shipped with the proper wiring and taps. Do you have a generator on-site? If so, can your current generator and transfer switch handle the new load?

It was up to us, four engineers, one Ford Explorer, one station van, and lots of hand tools to get the transmitter up to the site.

The second location consideration is cooling. Will the current site have enough cooling capacity to handle your new load? HVAC planning can be accomplished by contacting the manufacturer and evaluating the needs of the transmitter. The station should invest in a quality HVAC service contract, one that has 24-hour emergency service.

The third consideration for your location is physical size. Can the transmitter you want fit into the room that you have, and more importantly can it be delivered to that room? I was contracted to assist a station in the recent install of a new 10kW FM transmitter. They checked everything out before the purchase was made, room size, electrical load, cooling, and remote control hookup. The one area they overlooked was delivery. The transmitter site was at the end of a one-lane two-mile dirt road. The transmitter was delivered on an 18-wheeler. The truck driver pulled off the main highway at the entrance to the dirt road, and informed us that was where he was leaving the transmitter. It was up to us, four engineers, one Ford Explorer, one station van, and lots of hand tools to get the transmitter up to the site. What should have been an easy install turned into two days of problem solving due to lack of planning and site preparation.

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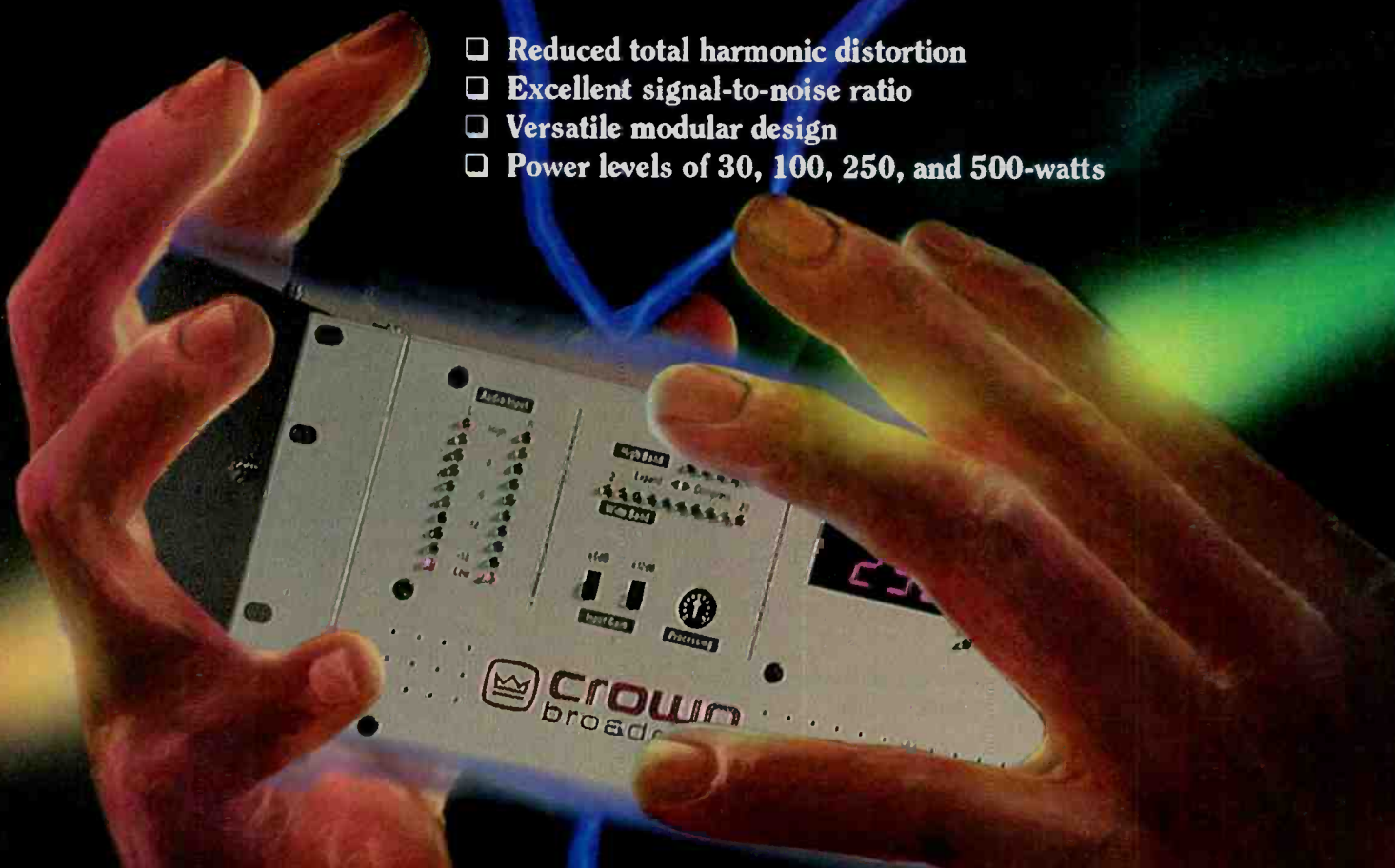

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Did you factor in a price for delivery? Remember to include any electrical work you will need on-site. Some manufacturers offer a spare parts kit, always a good idea, and an extra set of manuals. I always purchase an extra set of manuals to leave at home in case I have to talk

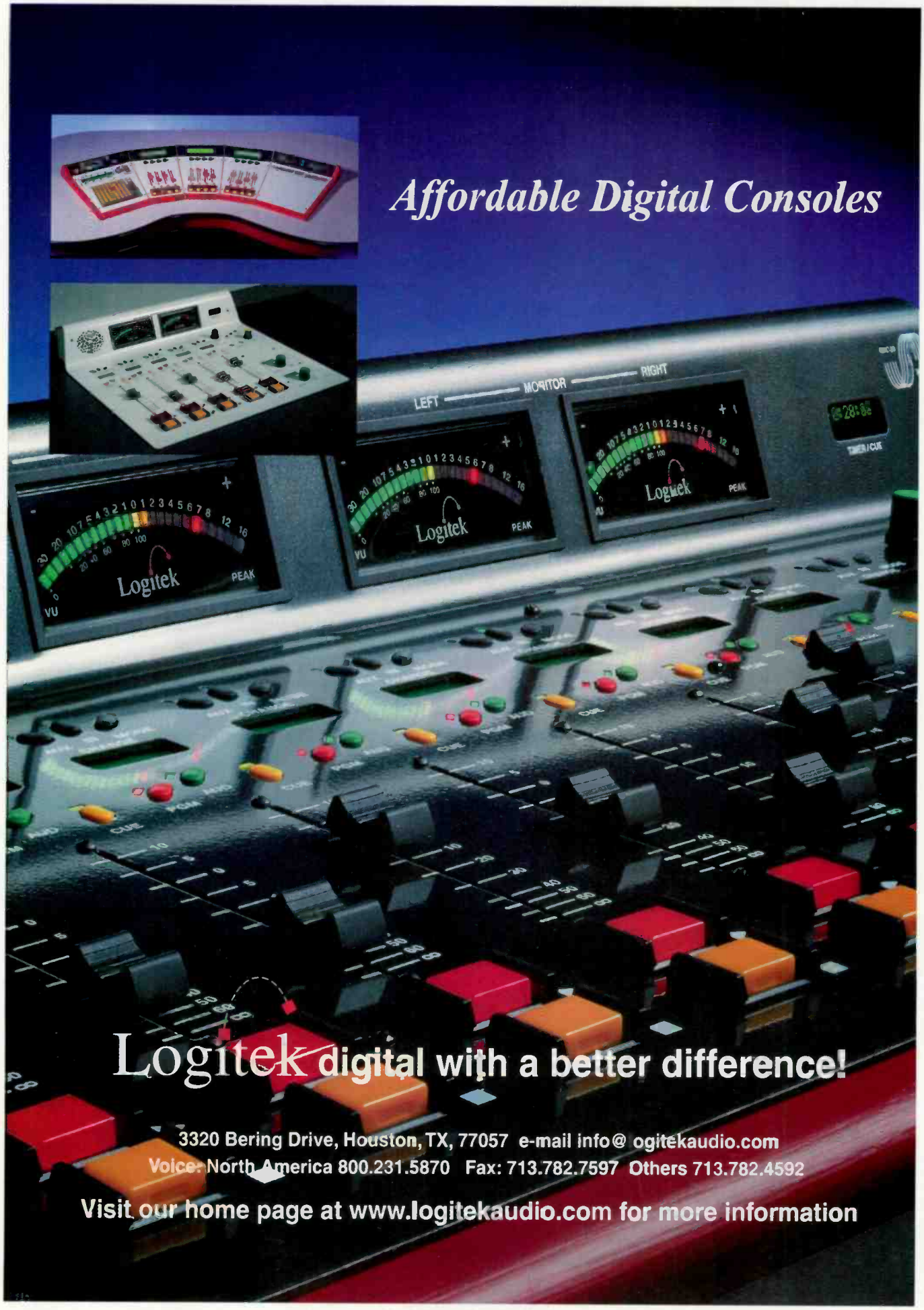
Attending trade shows is an excellent way to shop for any capital purchase, especially large items like transmitters and other RF equipment.

someone through a problem. HVAC work, site work, and maybe an extra hand or two adds up to a total project cost. Will you place your old rig into backup service? If so, do you need to purchase a coax switch or extra line? Factor that into the total project price and you have a completely redundant RF system. This is a nice added selling point when making your pitch.

An engineer's role is to help the station grow and prosper, not just fix things. Run the engineering department as a profit center and not just a department that spends money to get new equipment. Make proposals to the your manager as a salesperson would make a proposal to a client. Show how it will make money. Gather the facts. Include your needs and wants. Take into account all the variables of the site and present a cost and savings proposal that shows a project's total cost. Show how your department is not only conscious of and understands the bottom line, but also that an important capital investment is needed to ensure increased and dependable profitability to your station.

A new transmitter purchase should be something to look forward to. With the proper planning and attention to all the details, it can easily be a successful one.

John W. Caracciolo is vice president and general manager for Jarad Broadcasting Company, WLIR, WDRE, WXXP, Garden City, New York.



Diplexers, multiplexers and combiners

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

When the FCC accepted the first applications for construction permits for FM stations they surely didn't anticipate the eventual popularity of the FM service. As people began to realize that the few FM stations on the air offered half hours and more of uninterrupted "good" music, broadcasters began to discover that the "forgotten medium" had something to offer. Tall-building antenna sites grew in demand and more tall towers were built.

Licensees in large cities began to squabble over antenna rights on tall buildings. In cities like New York, some licensees actually began to talk about calling on the Commission's rule concerning "hogging" the best antenna sites. Eventually, most if not all the licensees were accommodated on the preferred building.

A new problem

However, once access to the top of the tower or the building was realized, another problem raised its head. This turned out to be antenna space and/or support strength. In some cases, there was not enough room for additional antennas. In others, the existing tower could not support another antenna and the weight of a second transmission line.

Broadcasters turned to the antenna manufacturers to solve the problem. Two solutions were presented. One was the development of broadband antennas that would radiate more than one FM signal without bandwidth and power restrictions.

The other additional solution was the development of the *diplexer*, the *multiplexer* and the *combiner*. There may have been other maker's pet names that didn't survive. These all accomplished the same thing — they made it possible to feed more than one FM carrier up a transmission line to one or more antennas on a tower.

Originally, diplexers were used to feed a wide-band FM antenna and radiate two adequately separated signals using a single transmission line and a single antenna. FCC Rules require a minimum separation of 800kHz between FM stations in the same area. 1MHz is normally considered the minimum acceptable frequency separation for combiner operation. However, by careful design and the use of many cavities, satisfactory operation with only 800kHz separation has been accomplished.

Basically feeding two or more signals into a single length of coaxial cable doesn't appear to be a big deal. Actually it isn't; the problems arise when internal cross modulation or *intermodulation* (its modern name) due to feedback from other powerful FM signals occurs in the power amplifiers of the transmitters involved. Spurious frequencies and spurs are generated from the interaction between the various carriers.

There are various types of combiners. The *constant impedance* combiner, as its name implies, presents a constant impedance to the transmitters in use. This type is also known as a two-port hybrid combiner. It is used to combine the outputs of two identical FM amplifiers for the purpose of increasing the total transmitter power output. The signals must be identical in frequency and amplitude, otherwise a lot of expensive RF power can be wasted in the dummy load.

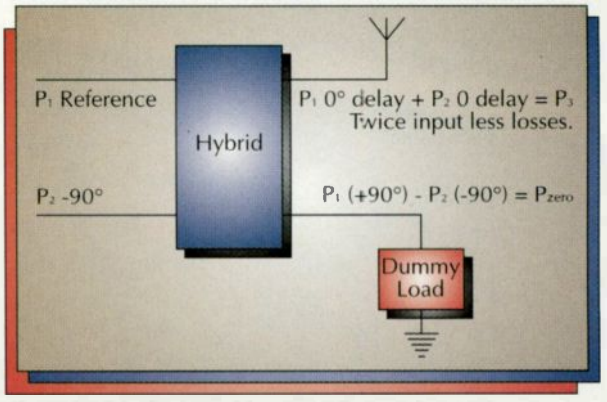


Figure 1: A typical combiner installation at an FM station.

How it works

One of the two signals produces the reference phase by splitting it into two equal parts. This reference phase has no delay and arrives unmodified at the output port. The other is delayed 90 degrees and arrives at the dummy load port.

A second signal, identical except that it has a phase delay of 90 degrees, is applied to the other input port and also split in two. The portion arriving at the output port will be in phase with the first signal, adding to it. The signal arriving at the dummy load port will be out of phase and should cancel out. In practice there are often slight differences consisting of spurs and products due to phase differences. These spurious signals are dissipated in the dummy load and not radiated.

Figure 1 shows the layout of a typical hybrid combiner. This is a passive device that does not require any power to drive it, and when properly designed it does not dissipate much wasted RF power.

It is generally not feasible to use coils and capacitors in the design of diplexers and combiners. Physical size can be a problem as well as the amount of power to be handled. Precise tuning is essential if the system is to operate satisfactorily. Very small variations caused by

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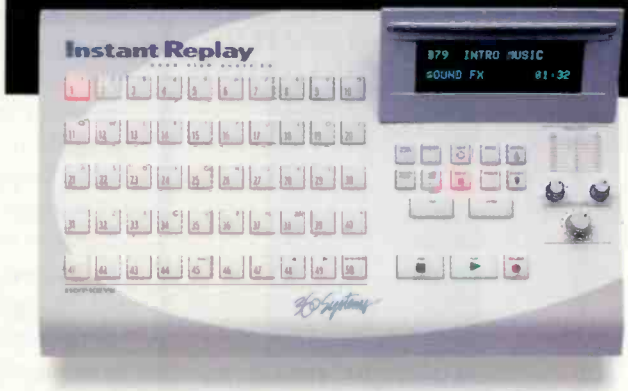

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temperature changes in actual coil size or capacitor plate spacing can affect tuning sufficiently to cause a lot of power to be dumped into the dummy load instead of being radiated. Cooling such equipment can also be a problem. The solution is to use cavities and often to paint them black.

During and following World War II, tremendous advances in cavity design were made. The radio industry has benefitted greatly. First designed for microwave work, it seemed natural to adapt the cavity theory to FM transmission. Today, cavities with very low insertion loss are possible, together with reasonably high-load Q. Invar steel is used to improve temperature stability and that, together with adequate cooling, allows few problems.

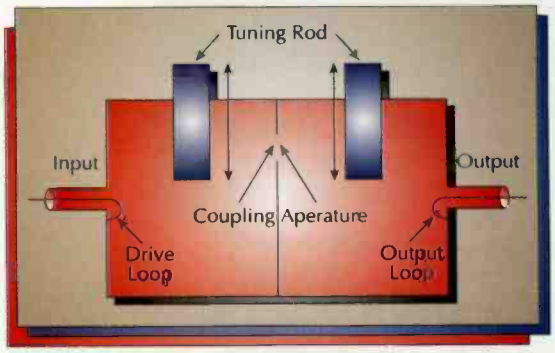

Figure 2. A typical cavity layout and the arrangement of feed and tuning mechanisms.

Styles and sizes

Square and round cavities are used and may range up to five feet in size. Normally the cavity is silver-plated and polished inside to improve the Q. Most of the losses found in a combiner are caused in cavities and efficiency increases as the frequency separation between the pass and reject frequencies increases.

The larger the cavity the less effect a change in temperature will cause. Figure 2 shows a typical cavity layout and the arrangement of feed and tuning mechanisms. Sometimes a notch filter is required in a combiner to produce the rather steep skirts needed to provide adequate separation. Considerable physical space is required to house a combiner for several FM transmitters. Normally, coaxial cable is not used for cavity interconnection because it increase the space required.

Instead of using coax the cavities are usually constructed side by side with an iris opening between them. This can be adjusted as required. It is desirable for a notch filter to have a high Q in order to keep the insertion loss as low possible. It is not at all unusual to have four notch filters in a simple two transmitter band stop combiner in order to provide adequate separation and minimize intermodulation effects. While a high Q is necessary for a notch filter FM, sideband response would suffer if the overall Q of a combiner were excessively high.

There are four main points to watch in combiner operation.

- VSWR: High VSWR can produce undesirable spurs.
- Insertion loss: every added cavity increases insertion loss, and can be costly in wasted RF power. Every non-resonated cavity will add to the loss.
- Group delay: Because the signal takes a finite time to pass through the cavity system, the frequencies farther away from resonance tend to take more time to pass through the system. The FM signal today is quite different from the early days of FM and usually takes advantage of full channel bandwidth. This is especially true when maximum allowable modulation is used. Excessive group delay will produce audio distortion. Group delay correction circuits are available, but they also increase the number of cavities used.
- Rejection isolation: Unwanted FM signals that are supposed to be suppressed will enter the PA and may produce spurious emanations.

Combiner design and maintenance are not simple. It is essential to remain continually aware of the possible products of intermodulation and to ensure that an errant spur does not escape and produce interference. Adequate ventilation and protection from mechanical damage are essential to the maintenance of a perfectly tuned system.

Thanks to Shively and Jampro for providing information on combiners for this article.

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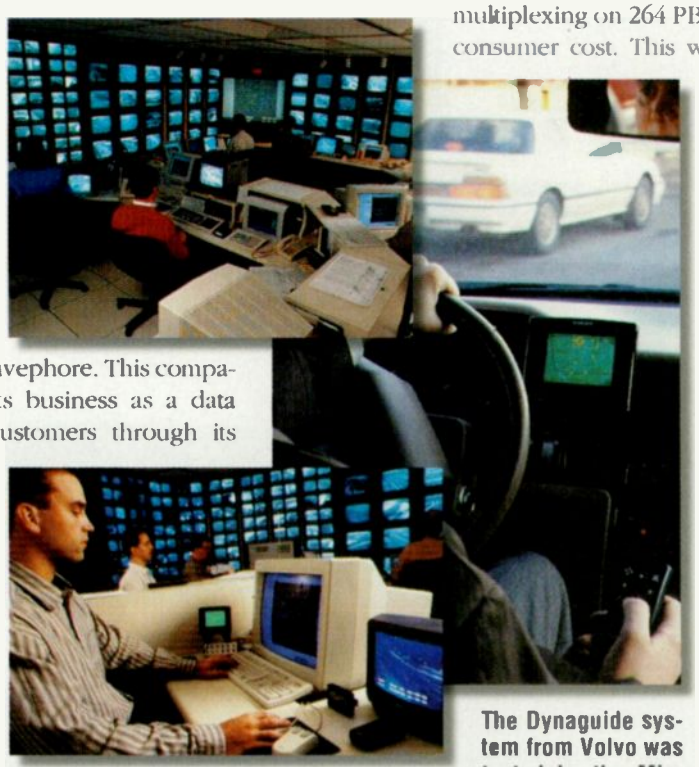
Datacasting update

By David Maxson, CBRE

Datacasting is now a piece of the Internet puzzle. It may seem contradictory that a medium used to broadcast data to users in a wide area (point-to-multipoint) is becoming an integral part of our point-to-point networked world. But if we can broadcast radio or a rock concert on the Internet, it isn't so far fetched that Internet action is spilling out to radio, TV and satellite airwaves.

In this update we'll take a look at the state of datacasting. From a Slovakian data broadcasting company to analog datacasting in China, datacasting in the international market is hitting its stride. Here in North America, the business of datacasting is also seeing impressive growth. You can almost hear the munching as companies acquire each other to be in better positions in the hungry world of Internetworking.



The Dynaguide system from Volvo was tested by the Minnesota Department of Transportation. The transportation management center updates the information that is received in cars.

An old friend

One such company is Wavephore. This company was doing most of its business as a data pipeline for corporate customers through its Networks division. Wavephore Networks leases out their network capacity, sets up private network links and supplies the hardware. A little piece of the company, its Newscast division, began to supply its corporate customers with data broadcasts of timely information. Soon, Wavephore Newscast was offering Reuters, Dow, Skytel, Weather Bank, and other data services to its clients. Wavephore reports that its growth in the first half of this year was due mostly to a tripling in revenue in its Newscast division.

To stay ahead of the game, they have steadily acquired related businesses and launched a new one. You may recall that Wavephore picked up Mainstream Data, a familiar subcarrier tenant to many FM broadcasters. In fourteen major US markets, Wavephore gets its content to subscribers by subcarrier. This spring, Wavephore picked up a company that builds Web-based news and information services for the financial marketplace. They have dubbed it Wavephore Labs. This could be a strategic move to compete with rival Data Broadcasting Corporation, which has always been strong with financial institutions.

Meanwhile, last April, Wavephore launched WaveTop, a data broadcasting service for consumers. (Windows98 includes WaveTop software. All you have to do is pick up a TV tuner card for your personal computer, and tune in to your local PBS TV station.) WaveTop claims to be able to reach 85% of the US TV households through its multiplexing on 264 PBS stations, and there is no consumer cost. This will be an advertiser supported medium. This is the kind of service datacasting was invented for — a free, over-the-air data medium that streams away 24/7 for all to intercept. It remains to be seen if it will fly.

On the road

There is another angle on datacasting that has the financial backing of government agencies and private corporations, and it's possible you may be its beneficiary in the not-too-distant future for only the cost of investing in the hardware to receive it. What kind of data service would have no advertising and could be offered at no charge? Traffic management information.

While our High Speed Subcarrier Subcommittee was deliberating on the various technologies for FM broadcast data, the Intelligent Transportation Systems people (ITS) have been diligently experimenting with an integrated approach to traffic management. The approach is part FM subcarrier technology, part remote billboard technology, part GPS mapping and location technology, and a lot

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more. The systems our highway experts have been designing take advantage of multiple media. The FM subcarrier datacasts current traffic information to every car in the city. Billboard datacast technology reprograms *variable message displays* along the highway. GPS data updates the map display in your car. The traffic radar people have been expanding their technology to turn a radar detector into a traffic information display. You already see special cellular phone numbers to get traffic route information in many markets, and this is a natural next step.

Relationships

What is the connection between ITS and the High Speed Subcarrier Subcommittee? The Federal Highway Administration (FHWA) had more than a passing interest in the outcome of the subcarrier standard setting process. As it turns out, earlier this year the committee members agreed to disagree. No recommendation for any voluntary standard was going to come from the process, so the group has folded indefinitely.

But highway-related datacasting has huge potential. Increasing traffic efficiency can save on costly highway expansion, diminish the growth of automotive emissions, and save lives on the road. Prognosticators at the Consumer Electronics Show predict Intelligent Transportation System technologies will be a $400 billion market in sixteen years.

Online resources

WavPhore, WavePhore Labs and WaveTop
www.wavephore.com

Intelligent Transportation Systems (ITS)
www.its.dot.gov

Minnesota Department of Transportation Trilogy project
www.powermaxconsulting.com/trilogy.htm

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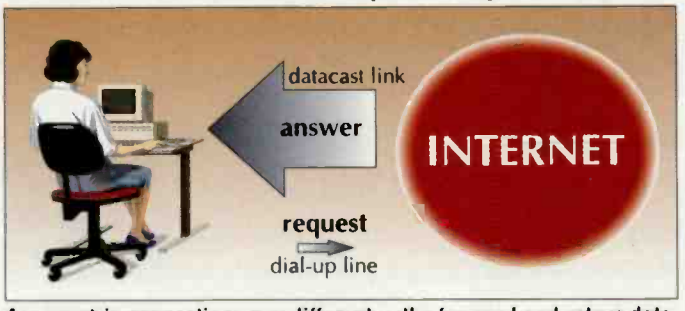
Next Wave

Back on the road

Minnesota Department of Transportation just completed a three-year trial (called the Trilogy project) to measure the usefulness of a variety of technologies and information. 150 highway truck drivers and 75 commuters were equipped with datacast receiving hardware and software. Volvo's Dynaguide system was used to display real-time data from the local traffic management center. The data comes to a central processing point where it is piped over FM subcarrier to the Dynaguide receivers. (Conventional data subcarriers and the RBDS Traffic Message Channel were used.) Imagine glancing at a display on your dashboard that gives you a quick read on which route is least congested. Average speed, breakdowns, construction, weather delays and the like are integrated into the display. The Minnesota test was conducted to see if putting this information in front of drivers made enough of an impact to make the system cost-effective. Results were not available at press time.

Global view

While this huge public/private effort harbors gigantic rewards, there is still room for entrepreneurship in datacasting. In China, subcarrier datacasting is a growth industry. Analog subcarriers are very inexpensive to implement, and it's not hard to find someone to read your data into a microphone. So some of the first FM datacasting networks in China are, in fact, analog. However, there is currently some work with datacasters to build a digital datacasting infrastructure.



Asymmetric connections use different paths for send and return data.

A company in Bratislava, Slovakia called Main Data is promoting its soup-to-nuts services to Europe. Main Data touts the benefits of asymmetric communications. We tend to send out small instructions and get back huge files. The phone line to our Internet provider is just fine for the small instructions. The return path can be different and have a greater bandwidth. Companies like DirecPC and DigitalXpress also use satellite datacast technologies in asymmetrical fashion. DirecPC uses digital satellite TV technology to bring Internet data back to your computer faster. DigitalXpress used its satellite and Internet technology to connect Bill Gates' Windows 98 presentation with some 50,000 people at United Artists theaters and on the Technology Education Network.

As broadcasters, our datacasting future will be determined by the digital audio broadcasting scenarios currently playing out. Canada is implementing its version of Eureka 147. An ensemble of data streams is woven together, transmitted, received, and then unwoven. While the system is designed with many channels of digital audio in mind, other forms of data can be blended in. In the US, in-band, on-channel (IBOC) proponents tell us they plan to have some reserved data capacity, but the lion's share of available bandwidth would be for digital audio. IBOC and Eureka camps point out that you can get more bits for datacasting by fiddling with robustness and audio quality. Plus, the looming question of IBOC compatibility with the host station's subcarriers will be answered in the coming months.

Datacasting has converged with Internetworking. The pressure on broadcasters to get on the digital bus has never been greater.

David Maxson, CBRE, is the Principal of Broadcast Signal Lab, LLP, a consultant in broadcast engineering, spectrum monitoring and compliance, Cambridge, MA.

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Circle (12) on Free Info Card

New studio and public file rules

By Harry Martin

The FCC has issued a Report and Order altering the guidelines for the location of main studios and changing its public file rules.

Licensees may now select a main studio location that is within: (a) the principal community contour of any station of any service (i.e., radio or television) licensed to the community, or (b) 25 miles from the reference coordinates of the community of license.

Another new requirement of licensees is that they keep the public file at the main studio. Previously, the public file was required to be located within the city limits of the community of license, notwithstanding the location of the main studio.

Members of the public may now make telephone requests for documents in the public file. Telephone requests must be honored within seven days. The licensee must assist callers and provide information about what documents are in the public file. The licensee may charge to cover the costs of copying other documents requested from the public file and may withhold sending the documents to the requesting party until payment is received. The licensee is responsible for postage.

The Commission is rewriting its handbook entitled, "The Public and Broadcasting." Once the revised version is available, licensees will be required to keep a copy in the public file as well as to provide copies free of charge to members of the public who request them.

The Commission has also added new record-keeping requirements. A copy of the current station authorization and a copy of the current service contour map, together with any other information showing service contours and/or main studio and transmitter location, must be maintained. Additionally, licensees are now required to place in their public files copies of all applications filed with the Commission rather than only those requiring local public notice.

The Commission also made changes to its public file retention requirements. Under the new rules, issues/programs lists must be kept for a full license term, i.e., until approval of renewal is final. Certain documents, such as contour maps and authorizations, must be retained until there is a change. Political file documents are required to be kept for two years. However, outdated ownership reports and granted applications for renewal, assignment, transfer, or technical modifications (except contour maps and information about studio and transmitter location) no longer have to be retained in the file.

Ads for casino gambling now legal in more states

The US Supreme Court has declined to overturn a lower court ruling stating that a ban on state-sanctioned casino gambling is unconstitutional. The US Court of Appeals for the Ninth Circuit last year found that banning gaming ads in states where gambling is legal is a violation of commercial free speech. The Supreme Court has now declined to hear the appeal of the Ninth Circuit's ruling, thus allowing that ruling to stand.

Meanwhile, a US District Court in New Jersey also has concluded that the prohibition on broadcasts of gambling ads is unconstitutional. Additionally, the plaintiffs in the New Jersey case, which include the National Association of Broadcasters and Players International, have filed a petition with the District Court there urging that the federal ban be eliminated nationwide. The US Department of Justice has opposed this petition, and the matter remains pending.

However, a conflict among circuits exists. In New Orleans, the US Court of Appeals for the Fifth Circuit, recently affirmed its earlier decision disallowing ads for riverboat gambling, which is legal in New Orleans. The conflict between the Fifth and Ninth Circuits' treatment of this issue sets the stage for a further appeal to the Supreme Court, where the issue will have to be finally decided.

In the wake of the various court rulings, the FCC has announced that it will not enforce the rules against gambling advertisements in the nine Western states that make up the Ninth Circuit (California, Arizona, Nevada, Idaho, Oregon, Washington, Montana, Hawaii and Alaska) or in New Jersey. The Commission's rules remain in full force in all states outside of the Ninth Circuit and New Jersey. Furthermore, the federal cases do not have any impact on state laws governing lottery and gaming ads. Those laws currently remain fully in effect.

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

dateline

Commercial radio stations in the following states must file their annual ownership reports on or before December 1, 1998: Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota, and Vermont.

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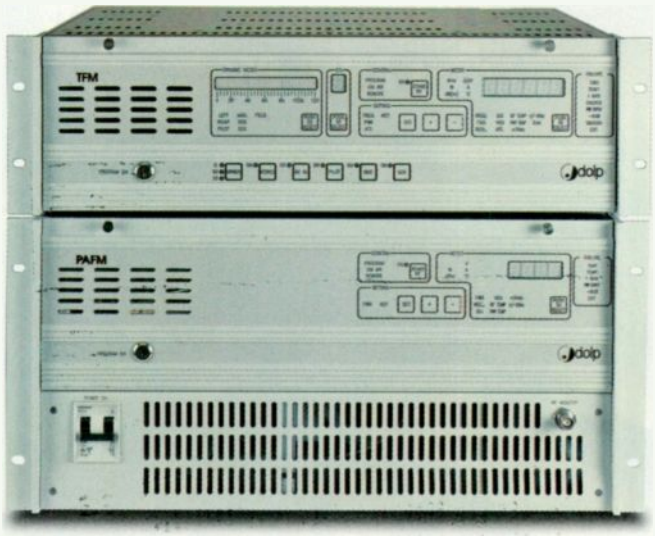

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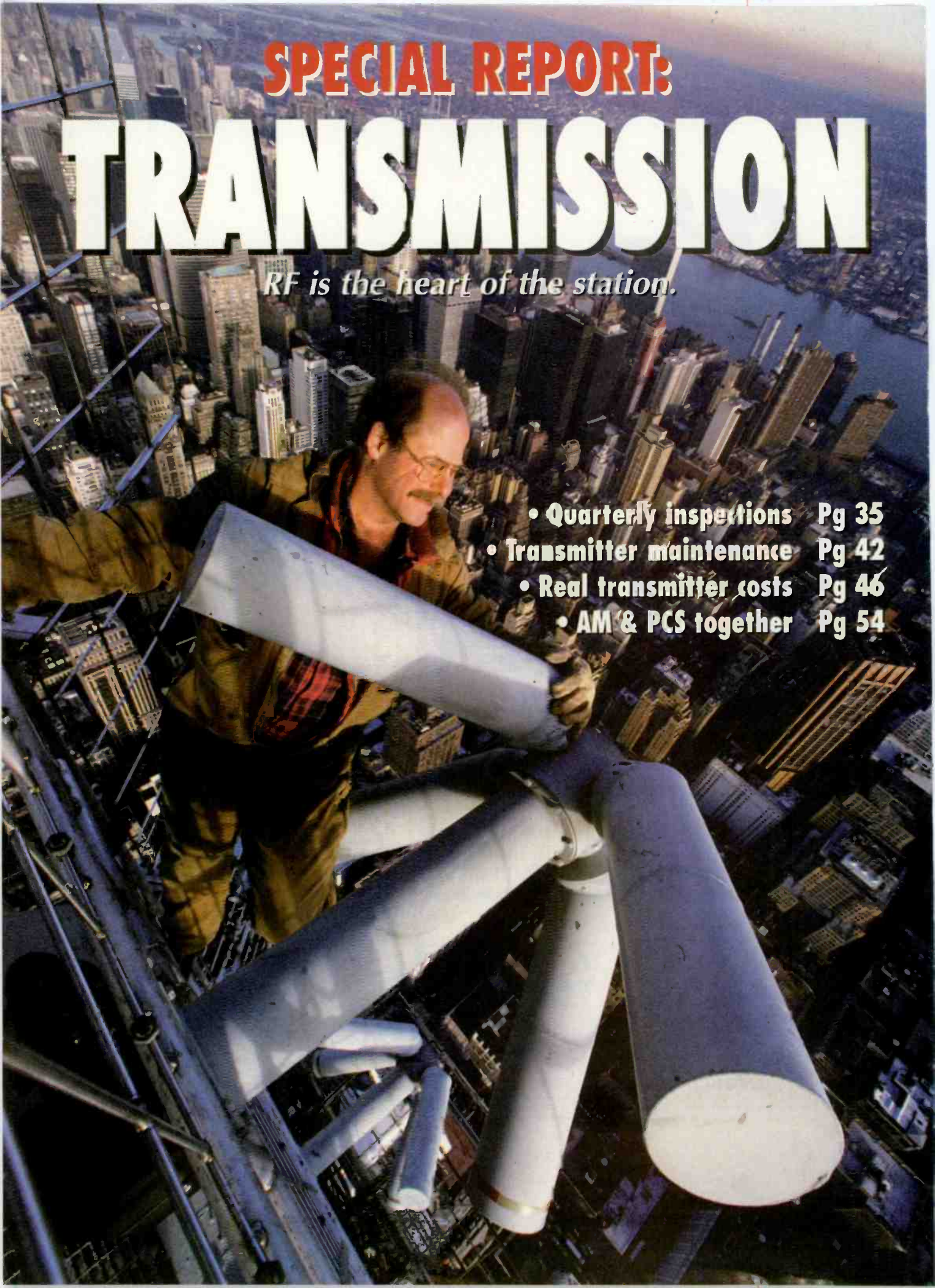

SPECIAL REPORT:

TRANSMISSION

RF is the heart of the station.

The quarterly inspection:
MAXIMIZING YOUR RETURN

By Mark Krieger, CBT

Turn a quarterly requirement into a fact-finding and problem-preventing advantage

Most broadcast engineers have at least a passing familiarity with the FCC's required quarterly antenna structure lighting inspection. Unfortunately, some of us perceive it as just another burdensome federal regulation and deal with it in the most expeditious manner possible. Instead of treating it as a chore, why not make it a maintenance opportunity? This may strike a familiar chord with you old-timers who are probably thinking, "Ah ha...preventive maintenance. Why I remember, in the good old days..." You're waxing nostalgic because there doesn't seem to be time for it anymore. With all the distractions we face daily, it really makes sense to use the required quarterly inspection as a focal point to save you time, aggravation and cash.

Requirements

Let's look first at what the FCC expects from a quarterly inspection: All lighting systems, automatic controls, and alarm systems are to be checked at least once every three months. This means visual observation of all lamps, proper operation of the automatic photo control, proper flasher rate, and an actual test of the automatic alarm system. The first three are fairly simple. Get your 10X binoculars or and make sure *every* lamp on the tower is lit when they are supposed to be. Check your lighting specifications and be sure that the photo controller is within limits. You'll need a light meter for this. If one is not available, be sure you err on the conservative side. Check your beacon or strobe flash rates to be sure they are in spec.

The alarm system can be a bit more difficult depending on the system you've inherited. On conventionally lighted towers where the beacons and obstruction lamps are on separate circuits, simply interrupting the feed to each is a fast check of the respective alarms. Just remember that the law requires the system to trigger an alarm if even *one* lamp is out. On many systems, the only way to accomplish this is sending someone aloft to pull a single lamp. While the simpler test is sufficient for most quarterly tests, the more precise test really should be done on an annual basis. This is also the obvious time to replace all the lamps on the tower, and therefore time to call your tower contractor. No lights or strobes? Read on. There are plenty of suggestions that apply to you as well.

The bond point from the hardline is only held to the tower with a clamp and should be brazed.

Seize the moment

Before you make the call to schedule a climb, take the time to consider the following preparation check list:

- Will I have to reduce power, change antennas or patterns, or go off-air altogether? If so, what other opportunities will that give me for maintenance and inspection?
- Does your tower contractor maximize the value of the climb? There are a lot of things that need attention up there. Make a list of inspection items for the climber. Some suggestions:

a. Check lightning rods and all bonding on the tower. Note the defects and repair them if time permits.

b. Check conduit and fixture weep holes for blockage and clear if necessary. This critical item is often overlooked. Make sure all gaskets are intact and in place.

c. Check all transmission line hangers, antenna mounts and fittings for tightness. Also take the opportunity to inspect transmission line seal points.

d. Visually inspect all guy points, including the condition of thimbles, dead-ends and clamps. Note the defects and repair them if time permits.

e. Make a general assessment of paint condition and structural integrity. A camera and a couple of rolls of film are worth a thousand words, especially if you have to sell management on bankrolling repairs.

- Don't overlook other items you've been considering. Replace any dubious coax jumpers and test questionable transmission lines. Now is your chance to do it.

SPECIAL REPORT: TRANSMISSION

Timing is everything

Scheduling tower and transmitter maintenance time can be a challenge. Tower companies are often heavily booked, and weather is a factor. When reduced power or outright downtime is involved, management must be consulted well in advance. The trick here is building a window to allow for contingencies. Make sure that things can be rescheduled quickly if problems arise. Quite often, the work will have to be performed at night. Be absolutely sure you will have adequate work lighting, both on the ground and up on the tower.

Make a list of all supplies and equipment required for the routine maintenance and for any repairs that may be required. Be clear with your contractor as to who is providing what equipment. Don't forget little things like hardware and cleaning rags. While requirements that stations maintain a spare tower light bulb inventory were done away with long ago, it is still a good idea to keep one of each type on hand. It is not unheard of for a contractor to bring only the exact number of new bulbs needed to relamp the tower, only to shatter one in a mishap. Having a new spare on hand can save time and money.

For those who lease

Many stations lease tower space. Even so, maintenance is still required. Keep an open line of communication with the tower owner or manager to find out when they will have people up there, even when you are not required to reduce power or shut down. Often, the people performing work for the owner can accommodate your needs in a cost-effective fashion since they are already on-site. In any case, don't lose sight of the fact that your antenna and line are your responsibility. You'll still need an annual inspection and you'll also need to verify that the tower owner is meeting his legal obligations regarding lighting and tower registration.

Back on earth

While on the ground, avoid the temptation to gawk at your tower personnel doing their thing while you ought to be doing yours. If any of your work involves being outside in the vicinity of the tower, be sure you're wearing an approved hardhat. Most tower contractors will give you an H.T. for communication while they are up. Keep it within earshot at all times. For the AM engineer on the ground, a climber on the tower is generally going to mean you are operating non-directional or have shut down. This gives you a chance to do the following things at the base:

- Thoroughly inspect and clean the ATU. Test all physical connections for tightness. This is vital, because ATU components undergo gross thermal cycling and connections *will* get loose and become a mess if not corrected. Clean all of the insulators and replace any that are cracked or broken.

Some corrosion is forming on the turnbuckles. Maintenance is required.

- Check the feed and ground bonds on the tower. Ground the feed before touching it. Ground bonds may be able to be repaired later, but any loose feeder will need to be repaired. This may require a brazing kit. If you don't have one or are not skilled in it's use, your tower contractor should be able to help out. Once again, plan ahead.
- Exercise all contactors by hand to check mechanical operation. This is the time to clean, lube and adjust.
- Check and clean all ball gaps. Again, ground the tower before touching the hot side of the gap. Don't adjust the gap unless you're sure of the proper spacing.

When you're finished with the ATUs, don't forget the phasor, if available. All of the above guidelines apply.

FM folks can't kick back either, there's plenty to check here as well. If RF exposure guidelines allow it, stay on at full power and have the contractor check all the coaxial line joints on the way up for hot spots. This is a good way to spot bad bullets. If you have extra cash, you can have this done more accurately with thermography.

Incidentally, this brings up an interesting question. Do you know what portion of your tower is within occupational RF exposure limits while at full power? What about low power? If you don't have a clear answer, it's time to have a qualified consultant help you generate a drawing that clearly delineates the safe areas of the tower under various operating conditions. This is for your protection as well as your contractor. There are real safety and liability issues here and you don't want to cut any corners.

For AM stations the issue is simplified. Don't allow a contractor on a hot tower, even if they insist on doing it. Just say no.

Once your tower contractor has departed and operations have normalized, there's still a lot of ground to cover. Head out to the guy anchors. Inspect all hardware for tightness and corrosion. Don't forget to check the ground bonding as well. While most AM towers may not have direct grounding from the guy wires due to sectionalizing, other towers generally will. The purpose of grounding the guy wires is to provide the lowest impedance path to ground and to protect the turnbuckles and terminating hardware from hot spots due to high transient currents in a lightning hit. A hot spot can cause damage or weakness in hardened steel components. Any corrosion on galvanized hardware should be cleaned with a wire wheel or brush and sprayed with a quality, galvanizing (zinc-rich)

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coating. You can get this from tower supply catalogs or an industrial supply house. Finally, don't forget to eyeball the guy wires themselves for signs of surface corrosion. There are several schools of thought on protective coatings for guys. Your tower contractor and tower manufacturer are good sources for a recommendation.

Once your tower contractor has departed and operations have normalized, there's still a lot of ground to cover.

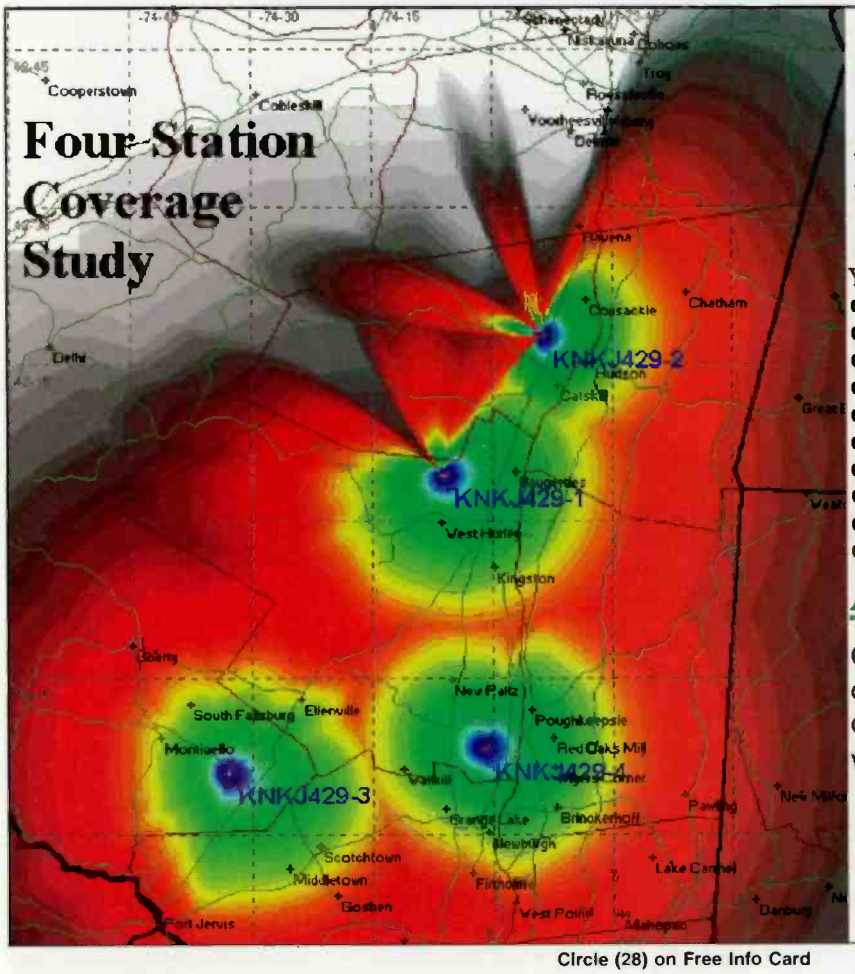
While you're at it...

So far we've limited our discussion to the tower and transmission path. But remember we're using our quarterly inspection as a springboard to check out everything at the transmitter site. So let's consider a few more areas.

The generator plant is your friend, especially if you have a remote site that relies entirely upon it. Remember that if your friend is well taken care of, your friend will take care of you. Here's the checklist:

- Check oil, coolant and battery-cell electrolyte levels. Verify the battery float voltage and adjust your charging system to optimize to your battery manufacturer's recommended voltage. This can be a tricky process and is one of the black arts of generator maintenance. You can also check each cell with a hydrometer. This will usually give you advance warning of a cell going soft.
- If your plant is for auxiliary use, test it under load. This is important for the health of the engine, but it will also reveal hidden problems. Check temperature, oil pressure, voltage and frequency under load to ensure they meet specified limits.
- Inspect any block or fuel heating systems to be sure they are operating properly.
- Inspect the fuel system including, tank, piping, pumps, and day tanks for function and leaks.
- Make sure you have enough fuel.

Don't overlook the physical integrity and safety of the transmitter site itself. You need to take a hard look at all the fences and gates to assure they are still adequately performing their function — keeping people (and sometimes animals) out. If a person were to gain access and be injured, your simple failure to periodically check the security fences could wind up being very expensive indeed. Remember that tower structures are legally considered "attractive nuisances" and must be secure in the eyes of the court. Signage is also important. In some states, you must "post" property in order to legally ward off trespassers. Be sure the legally required RF exposure, high-voltage, and tower registration signs are all posted and legible. Locks should be inspected before the onset of frigid weather to assure that no moisture is accumulating.



Eliminate Carts for $5,000

At last! A "cart" replacement system that ***works like carts***, but with digital audio quality that ***sounds like compact discs***.

It's Scott Studios' new Spot Box. It's the ***easiest*** hard disk digital system to use!

There are two parts: A triple-deck "cart" player on the left, and a "Cart Wall" pick list on the right.

The triple-deck digital player has everything you would ever want: Big green Play buttons, bright red Stop buttons, VU meters, large countdown timers, flashing End-of-Message signals, and large legible "cart" labels.

You can start each spot manually from the screen, from remote Start buttons (and run lights) on the console, or touch the Auto-Manual button to have Spot Box smoothly start the next deck itself.

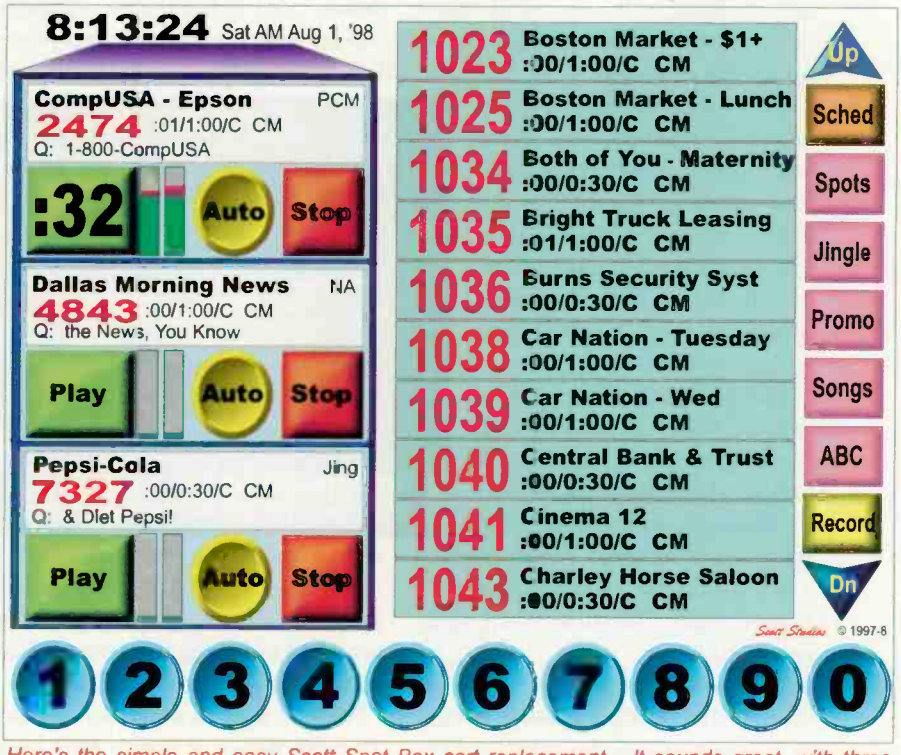
Spot Box is really easy to use. There's only the one screen, so jocks never get confused. Even though Scott Studios uses Windows 98 or NT, Spot Box works like carts, ***not*** a computer.

If you use a paper log, load any cut quickly with the blue number keys at the bottom of the touch screen, or type them in with a 10-key pad. Or, pick and play any recording by number or name from the scrolling "Wall of Carts" showing all your spots, promos and jingles in ABC or 123 order.

As an option, Spot Box can be paper-free. Simply import logs from your traffic computer by diskette or Local Area Network.

You get detailed printouts showing exactly which spots played and when. With the traffic import option, you see at a glance the comparison of schedule and air times.

If you have several stations, record a spot only once. There's no limit to the number of Spot Boxes or hard drives you can connect by LAN or WAN for additional studios and redundancy. Every spot can be instantly played in every studios' Spot Box. Recordings can be locked so they only play on designated stations, days and times.



Here's the simple and easy Scott Spot Box cart replacement. It sounds great, with three channels of uncompressed digital audio on three console channels.

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It's a fact: over 1,922 radio stations have 4,162 Scott digital workstations, including ***major*** groups like CBS, Chancellor, Disney/ABC,

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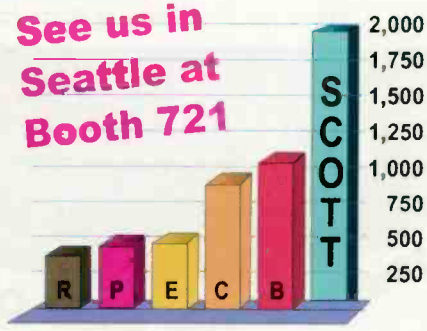

Clear Channel, Emmis, Citadel, Cumulus and many more.

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Circle (39) on Free Info Card

Metal fences around AM towers are required to be bonded to the ground system along with any metal doors on the tuning houses. Check these bonds for corrosion.

Fire extinguishers have a place at every transmitter site, as do first aid kits. State and federal laws generally require you to have both of them inspected at one-year intervals. Most states require annual inspection tags on extinguishers. Be sure yours are up to date.

Lighting is important, inside and out. Check all security and work lighting and replace bad bulbs and controls. Get a quality flashlight with at least one spare set of batteries. Hang or place it just inside the entrance where it's easy to find in the dark. You'll never regret it.

Don't forget the HVAC. Check *all* fans and filters, big and small. A shop vac is indispensable for keeping them clean. Make sure you have spare air filters on hand. If you don't have a maintenance contract on your AC systems, be sure to clean the condenser coils at least once a season.

Does your site have a sump pump? Is it running? This out of sight item is often *critical*. The best advice here is to simply replace it as often as your budget and common sense allow. It's not a bad idea to have an inexpensive bilge pump on hand as a backup.

Wiring troughs are fine, but not if you don't keep them dry. This one has seen deep water.

While you're dashing about doing all these things, it only makes sense to be making notes. Quarterly checklist forms that are customized to your facility will make this easy and eliminate oversights. Over time, a compilation of these records will build a history and assist you in tracking any troublesome trends.

Some parting thoughts

A word about the tower itself: The quarterly inspection is not a substitute for a full structural inspection by a *qualified* consultant. This type of inspection will establish guy tensions and intercepts, as well as tower plumb and true. If you are planning any changes you'll also need a wind load analysis. Opinions differ on just how often this type of inspection is necessary, but if it's been more than three years, it's probably the time to do it.

Think ahead and make the quarterly inspection a valuable tool in your pursuit for the perfect radio station.

Mark Krieger is an active SBE member and contract engineer in Cleveland, OH.

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SPECIAL REPORT: TRANSMISSION

TRANSMITTER MAINTENANCE

By Don Markley

Maintenance is important in any facility.

Far too many years ago, this author started work at a full-time AM radio station in a market that barely fell within the top 100. As the new kid on staff, the assigned hours were midnight to 8 a.m., with Tuesday and Wednesday off; a truly great shift. On the other hand, it worked well for a student and included sole or shared participation in transmitter maintenance.

The transmitter was a 5kW Westinghouse, originally installed in 1948. It was twelve years old when first faced by this author, but it looked as though it had just been delivered. Once each month, it was washed internally with soap and water. Periodically, the outside was paste waxed. It had about 1000 meters that allowed for monitoring of all the voltages. They were religiously maintained at their proper values and faithfully logged. All reasonable spare parts were carefully inventoried and stored. In those days, the high-voltage rectifiers were mercury-vapor types. New tubes had to be operated with only filament voltage for several hours to remove the mercury from the elements before high voltage could be applied. That was done in a spare socket, and the tubes were stored upright until needed.

A ledger was maintained in the operator's console (otherwise known as a desk with audio controls and metering, normally unused but important looking). *Everything* that had been done to the transmitter since it was installed could be found in that ledger. Whenever a failure occurred, all symptoms were detailed along with the pertinent meter readings and the necessary repairs. When someone new was hired, the first requirement was to read the transmitter's instruction book. The second was to read the ledger carefully. The immediate result of this was that everyone at the transmitter was familiar not only with its theoretical workings but also with every problem that had ever occurred. The final result was that when the transmitter did have a problem, repairs were accomplished very quickly. Unscheduled

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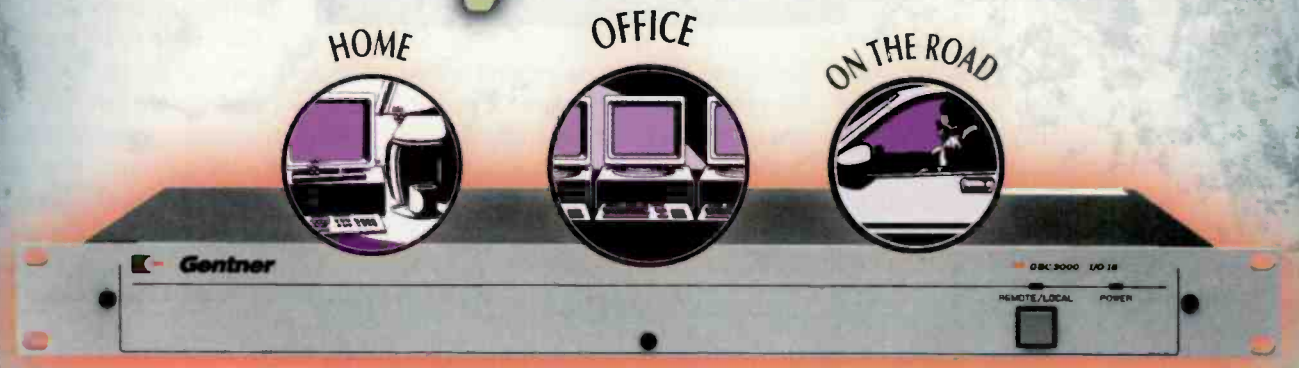

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downtime for the transmitter averaged less than two hours per year. That was for an all-tube transmitter. Let's face it, that kind of reliability is highly acceptable even for modern solid-state equipment.

It should be pointed out that the antenna tuning units were also kept clean and in good mechanical condition. The radials were all resoldered every four or five years. Nothing was allowed to grow within 20 feet of the towers. Everything was mowed, painted regularly and cleaned, resulting in a reliable and stable station.

A typical maintenance problem. The bonds and bolted connections on this feeder must be physically tested and examined.

That was then, this is now

Now, the situation has obviously changed. For one thing, there is no row of 8008s lined up at the transmitter waiting to be installed. Except for a few stations in the largest markets, there is no full-time staff at the transmitter. Most radio stations are lucky if there is one full-time technician with less than three stations to maintain.

However, it is still possible to find a well-maintained station here and there. One example is a station in Salisbury, MD. During a recent antenna project, the author had the opportunity to spend some time at their transmitter. While not manned on a full-time basis, one technician is assigned as the transmitter supervisor. It is his responsibility to see that everything at the transmitter site is properly maintained and adjusted. An old RCA transmitter was operating as though it was new. Every pilot light in every push button worked. Even those weird little meter relays all worked perfectly. The newest tube in the place had several years on it, yet the transmitter performance was perfect. The transmitter wasn't the only piece of equipment that functioned in this manner. Although much of the test equipment was old, it all worked as if new. This was simply the result of continuing, careful maintenance. By the way, the place was spotless.

The lesson to be learned is simple; if the goal is a stable, reliable station operating right up to the capability of the equipment, provide plenty of tender, loving care. For every piece of gear, operating parameters have been determined by the equipment's designers for proper perfor-

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mance. When these parameters are allowed to vary from the desired values, system performance falls off. Every part in the transmitting system is there for a specific reason. Therefore, every part should be kept in place, adjusted properly and, most importantly, known to the technician responsible for the system.

Proper care and feeding

Critical to the operation of any electronic system, especially high-power equipment, is cleanliness. Accumulations of dust and dirt reduce component cooling, increasing the failure rate and decreasing the system performance. Ultimately dirt accumulations will lead to premature system failure. Simply stated, if you don't keep the equipment clean and properly adjusted, it will go to that great porcelain convenience in the sky sooner than necessary. This could, and *should*, lead to the swift departure of those responsible for the servicing of such systems.

The answer is quite simple. First, and of extreme importance, the responsible technicians should learn about each piece of equipment in the system thoroughly. That means, at a minimum, carefully studying the instruction books. If available, hound the administration until those responsible are allowed to attend the factory school on major items. Then, get the place clean and operating properly. This usually requires significant hump busting when taking over a poorly maintained system. After that, the job really becomes simple. Maintain adequate air flows in all cooling systems and change filters religiously (it's easier and quicker than repairing overheated equipment). Once everything is properly adjusted, do the little touch-ups that will keep it that way. Actually, less work is required to maintain the systems in this way than if you let them go to pot and then have to repair them.

You *absolutely must* convince the management and programming gurus to allow *regular* scheduled shutdowns of the equipment. Pick one night a month, midnight or so until five or six in the morning, to go through the system. In the interests of safety, have someone there to help. During that period, it is possible to do the necessary cleaning and adjustments to put the system right again.

You are faced with two simple choices. Either plan for scheduled shutdown and maintenance *or* experience unplanned shutdowns, probably at the most inconvenient times. Of course the transmitter will still have an occasional failure that takes you off the air. But, if you maintain it properly, those failures will be at a minimum. The current mode of programmers seems to be to stay on the air at all times. That is a totally unreasonable approach to the technical side of the station. If no interruptions at all are desired, the station must have a standby transmitter and antenna to allow everything to be properly maintained.

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

A TRANSMITTER'S REAL COSTS

By Steve Epstein, CSTE

The purchase price of a transmitter is more than just writing a check.

The cost of a transmitter over its lifetime is based on a variety of factors, among them, initial purchase price, efficiency, maintenance and residual value. Beyond those factors are financial considerations, such as the cost of money. As engineers, the primary considerations are found in the first sentence. The other items can be discussed with your corporate accountant. One final consideration is the cost of being off the air, which is something to discuss with the GM and corporate management. Let's look at the technical issues.

- Purchase/installation price: It is fairly easy to get a handle on the purchase price of a transmitter — some companies even list them on their Web pages. However, don't forget those little extras that are part of getting that transmitter to your site and powered up; things like delivery, building modifications to get the unit through the door (or the roof),

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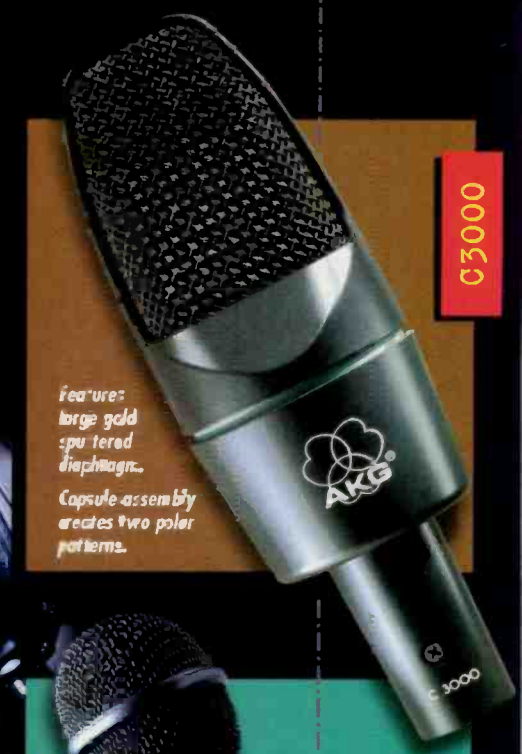

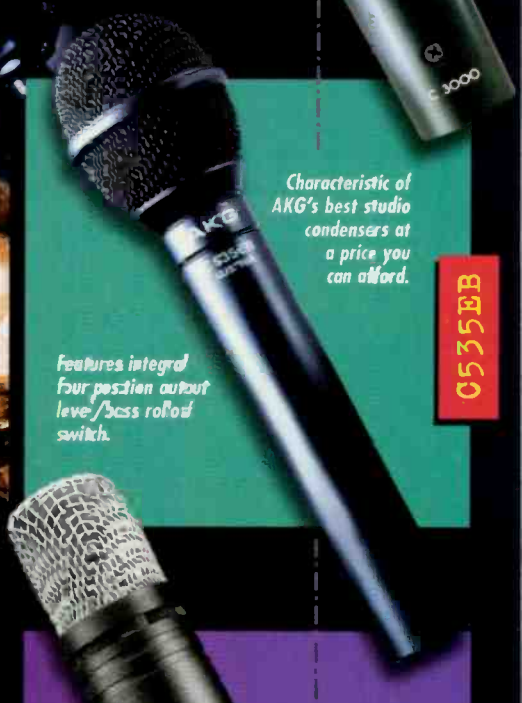

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forklift or crane rental, changes in electrical service and even changes in the building's AC requirements. Transmitter manufacturers can be helpful in providing information relative to these costs; they have been through it many times at a variety of sites.

Other issues such as RF plumbing and transmitter cooling must also be considered. These will vary from installation to installation. They will also be different if the new transmitter is a replacement for an old unit or will operate as the primary with the old transmitter as a backup. In the latter case, some switch-over equipment needs to be considered. If this is a replacement, will the changeover result in any off-air time?

Additional costs like installation and site preparation all figure in to the total transmitter cost.

• Transmitter efficiency: The efficiency calculation provided by manufacturers may only reflect the efficiency of the final stage. What you need to determine is total electrical load relative to the new transmitter. This includes the cost of running the transmitter and blowers, building air conditioners, if needed, and any other devices, such as monitoring systems, that are part of the new transmitter package. Getting a handle on these costs may be difficult, but like installation costs, the transmitter manufacturers can help.

• Maintenance costs: Good preventive maintenance will cost less than corrective maintenance (see "Transmitter maintenance," p. 42). Much of the reason for this is that problems can be caught and dealt with before major damage results. For example, a loose mounting on a power resistor can be corrected by tightening the clamp. If the mounting is left and gets looser until the resistor falls from its position and shorts out more components, the off-air time and repair costs will be significant. Preventive maintenance schedules should include inspection lists and a timetable for replacement of significant items, such as blowers, PAs and other items affected by time and use. You will also want to determine schedules (both maintenance and cost) for support equipment, such as heat exchanger motors, AC units, etc. All of these need to be included in maintenance costs, as do labor costs for the time required. Finally, many manufacturers have a suggested spare-parts kit. Consider buying the kit along with the transmitter.

• Residual value: We are on not quite ready for DAB in the US. So, considering that the rules for IBOC have not yet been fully written, this is not really a major factor.

It has been my experience that the additional cost of a high-quality product is more than offset by reduced maintenance and downtime over the product's life. In the end, you have to decide how much those factors are worth, because you, or your successors, will be the one at the transmitter site at two in the morning — skinning knuckles and shedding blood — not the corporate accountant or the GM.

Steve Epstein is the technical editor for BE Radio's *sister publications,* Broadcast Engineering *and* Video Systems.

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SPECIAL REPORT: TRANSMISSION

AM AND PCS AS NEIGHBORS:

Living and thriving with digital telephone towers

By Mark Heller

Work together and make it a profitable situation

PCS technology companies are almost constantly adding towers in major population areas and chances are your station is in a position to act as either an asset or an impediment to them. In case you're unfamiliar with the technology, PCS phones are unlike normal cellular phones in that they offer features like Caller ID on the handset, as well as digital clarity, making them sound like a standard wired phone. They rely on an Internet-like digital transmission cable to connect users, rather than jumping from one cell tower to another. Once I heard the difference and understood that some of these phones come with 205 various options including call forwarding, fax, missed-call list and voice mail, I was sold on the technology.

The host

WTRW Radio in Two Rivers, WI, is a 1kW AM station. It has recently signed a thirty-year lease with two PCS companies, thereby ensuring a steady income. The station also helped the PCS firms acquire proper building permits for a new tower by locating the new site within the shadow of its existing tower. Now, the two lessees are competing in the marketplace together from the same tower on the station's site.

The city fathers of the municipality (population approx. 13,000) in which the station's studios are located decided to tightly regulate the building

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Detail of the PCS tower's detuning skirt. The cost of detuning was paid by the PCS companies.

of new towers. Meanwhile, the WTRW tower site is immediately adjacent to the city limits, in the Township of Two Rivers, where town officials welcomed the added tax base. In the first year of operation, the tower and the two providers' equipment were valued at $700,000 and used no water or septic system to operate. That's the equivalent of having five houses built at $140,000 each with no need for garbage disposal, well water or other normal services expected with a residential area. Professional and serious contact with PCS company engineers convinced them that WTRW's tower site was superior due to its existing zoning and the fact that because of its location, there were few residents to complain about a tower in their backyard. The airport committee was happy as well. If these benefits weren't enough, the station's willingness to allow the detuning of the new tower to accommodate the existing tower cemented the deal.

The plan

WTRW owns the nine-acre site where it is located. Station engineers aggressively worked on a solution that would allow a new 195-foot tower, located 300 feet from the existing 239-foot tower, to appear nearly transparent to the AM facility. The key was to detune the new PCS tower. The detuning skirt — three wires extending from the new self-supporting tower that were tuned by a consulting engineering firm through a fixed and an air-filled variable capacitor — were paid for by the digital cellular firms.

AM stations can experience difficulties with new towers in close proximity. Directional AMs have concerns within a two-mile range, and non-directional AMs worry about towers within about a half-mile range. If left untuned, PCS' grounded towers can dramatically affect the coverage of the existing broadcast station. I know of one broadcaster who complained

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The tuning network on the PCS tower.

at hearings about cell tower locations. He never realized he could have benefited with a tower deal, not to mention better-quality wireless phone broadcasts from his sports remotes on the weekend.

The towers co-exist to each other's benefit. The underground electric and telephone are buried far away from the station's ground system, and the improvements to the land increased the value of the property. If either tower were to fall, the fall radius is great enough that the other would not be affected.

The new tower did not need to be painted or lighted, as it fell below the 200-foot level requirement for paint and lights, and was in the shadow of the existing AM tower which is lit and painted.

WTRW aggressively pursued this opportunity. The added rent is a plus for the station, which also adds income by renting a paging antenna to a Dallas-based paging company. Many small market broadcasters do not realize that their local banker looks at these types of leases as future earnings and that broadcasters can increase their borrowing ability with the new income. It is even possible to assign the rent checks to make a loan payment, as long as the PCS company is solid in its banking arrangements.

Good for everyone

Is it a win/win opportunity? It's better than that. It's a win/win/win because the station also landed a retail agent contract from the two renters. WTRW is now selling PCS phones from its offices. Since the station is open seven days a week, 24 hours a day, it has more available hours than the mall. The station receives a discount on the purchase of the phones from one client and gets a flat commission per activation from the other. Added to the incentive, the PCS companies allow for a modest co-op advertising plan, which allows $25 per phone to be used for advertising. Naturally, WTRW includes itself in the advertising buy.

Broadcasters shouldn't worry about interference from this technology. The 1900MHz frequency range is far above remote pick-up and studio-transmitter link frequencies. It's much closer to the satellite band than anything in use for broadcast feeds. Since the towers are fenced and unmanned, they simply become a silent partner with the existing AM station. There is no TV interference involved with PCS towers.

It's a safe assumption that PCS companies are going to pay rent to someone, so there's a great benefit in pursuing it. One of WTRW's nearby competitors passed on the opportunity to allow a PCS near his FM tower. He was worried about wind loading on his tower, and didn't realize these companies have the financial ability, in most cases, to construct a new tower suitable for all renters and future antennas. The value on his leases would have been more than $120,000 over twenty-five years.

This success story for WTRW is another example in how engineering can turn into a profit center for the station. With the bottom line being a concern for any station, finding ways to make each department an asset and not an expense is more important now than ever.

Mark Heller is president and general manager of WTRW, Two Rivers, WI.

The PCS tower is in the shadow of the AM tower, so paint and lights are not required.

WTRW owns a nine-acre plot which comfortably hosts both towers.

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REMOTE SITE CONTROL

Running a transmitter site in your absence is easy ...with the right equipment.

By Chriss Scherer, editor

When the FCC rules were changed to allow remote control of unattended transmitter sites, a new form of technical operations was born. Being able to monitor and control the basic transmitter functions without standing in front of the transmitter opened the gate to many new possibilities.

Remote site control today can be more integrated and offer more features than ever before.

Basic ideas

Remote control systems take two basic forms. Dedicated studio/transmitter systems consist of a studio terminal and a transmitter terminal connected full time by some form of communications link. Typically, a terminal has a display window to view the selected channel's telemetry information and controls for two relay functions, usually labeled *raise* and *lower*. These labels are from early applications where they were commonly used to adjust power or to turn a transmitter on or off.

The other application is a single-ended approach and became popular in recent years with the relaxed FCC rules on unattended station operations. Instead of a dedicated path and a unit at the studio, a single device is installed at the transmitter and accessed via a telephone line. The telephone keypad becomes the control interface. The same control and metering is available over the phone without having to be tied to a single location.

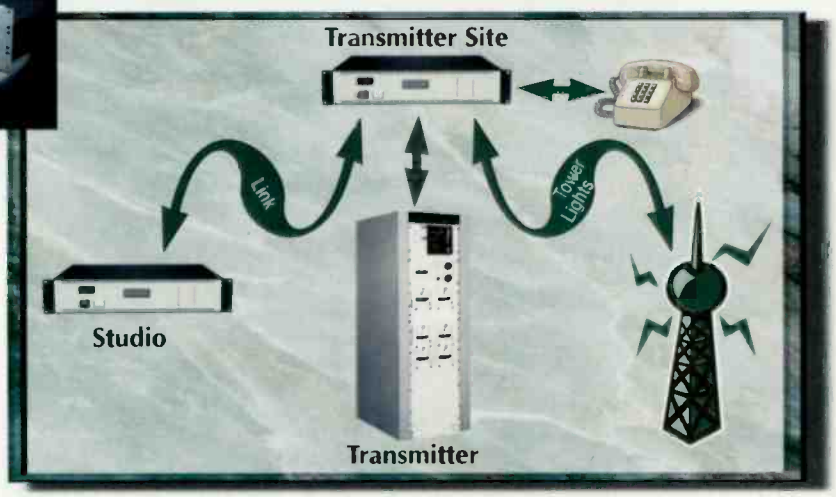


Figure 1. A basic transmitter remote site control system.

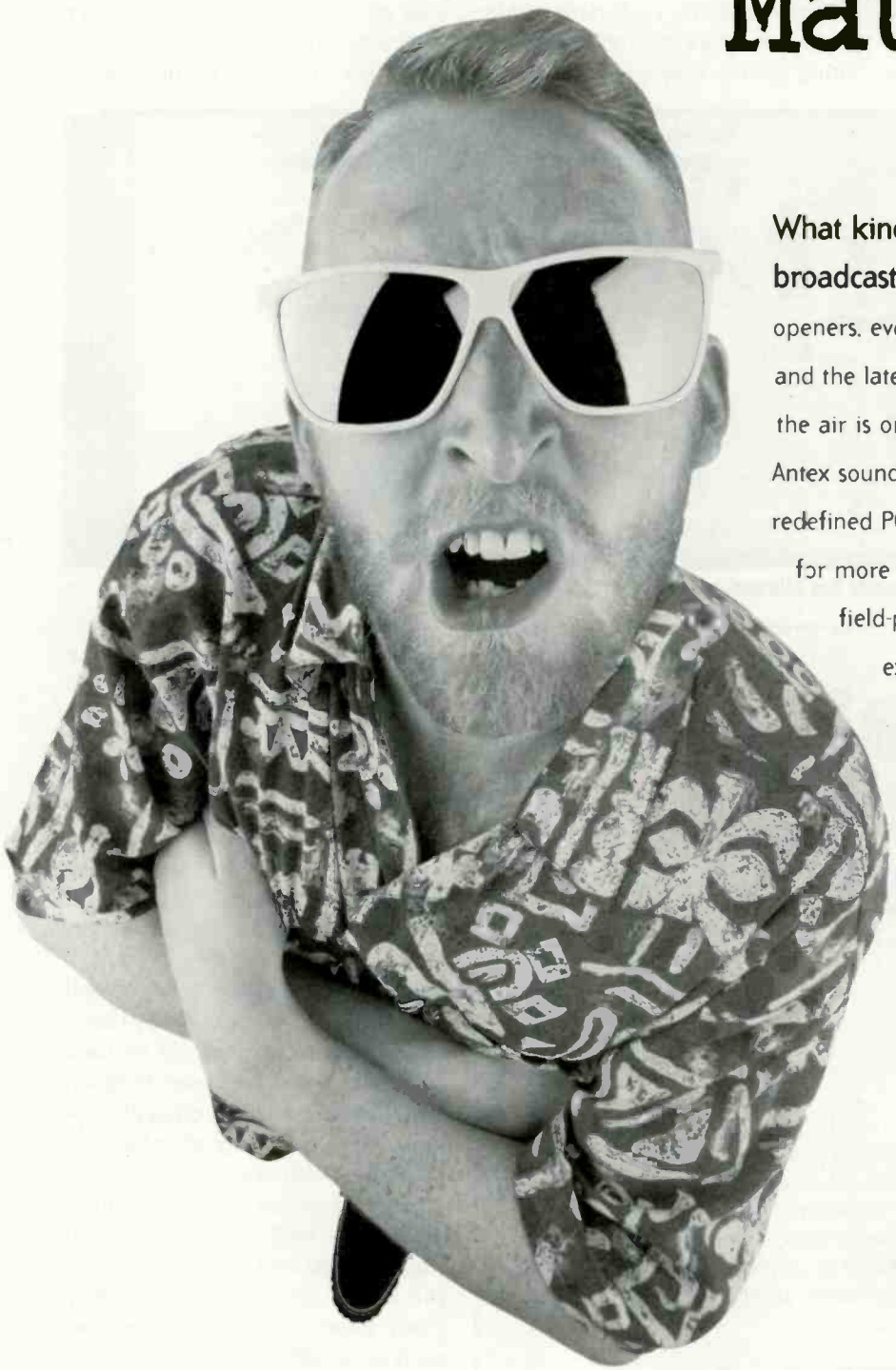
There are hybrids to these systems as well, but you can usually see one of the two basic designs was used in the initial design of the system. The interface may be dedicated hardware or software running on a PC.

Modems

Tying a studio and transmitter unit together offers many options. All communications paths can be broken into four-wire or two-wire systems. The simple names are accurate in their descriptions. (The names are applied with a balanced audio path in mind since the terms come from the telephone standards where they were first applied.)

Two-wire systems use the same, bi-directional path to communicate. Information is sent and received with the same connection. The units tied to this path must have a hybrid installed to sort out the sent and received information. The most common use of this path is a telephone circuit. The path may be equalized- or dry-copper pairs if the distance is not too great. For many remote con-

Does it Really Matter?



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trol applications, a dial-up POTS line can sometimes be used as a backup in emergencies. The advantage to this method is a simple installation. Only one path must be planned and maintained.

A four-wire path has discrete methods of sending and receiving data. The two paths don't have to be the same either. As long as the time delay difference is small, there should be no problems. The choices for four- wire paths are many and include RF, subcarrier, telco and other variations that work with the digital transmission technologies offered today. A four-wire system and discrete path mean no hybrid for the terminals. Another advantage is that each path can be chosen to work with whatever existing system may be in place. An added advantage is that if one path fails, the other may still operate. You may not have transmitter readings, but you still have positive control over the transmitter. This can help buy some time when a crisis arises.

Operations

All of the systems available offer metering inputs and control outputs. The metering inputs take a voltage sample, multiply by a conversion factor and then provide the result. These inputs can usually tolerate an input voltage of a few volts. If a higher voltage is available, some type of voltage divider must be installed. The output display can be calibrated to a linear or logarithmic scale and the conversion factor chosen to display in a specific unit (volts, amps) or percentage.

Control outputs may be open collectors or relay contacts. Many times, open collector outputs will be used to control relays for better isolation and current handling capability. In most cases, two sets of relays are associated with one channel.

Status inputs are common on most systems as well. Sometimes called *digital inputs* (with the metering input being considered analog), they easily show a binary state condition, such as on/off, high/low or normal/emergency.

Of all the systems offered, these elements are common to all of them. There are other features and capabilities that can be used in different ways.

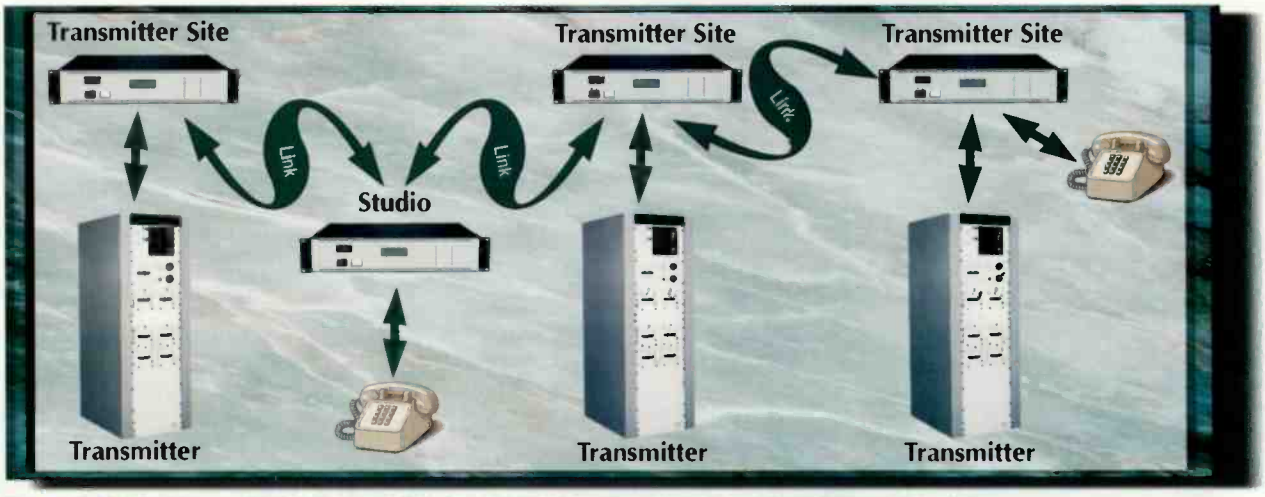

Figure 2. Networking multiple sites together has allowed greater control and flexibility for the system.

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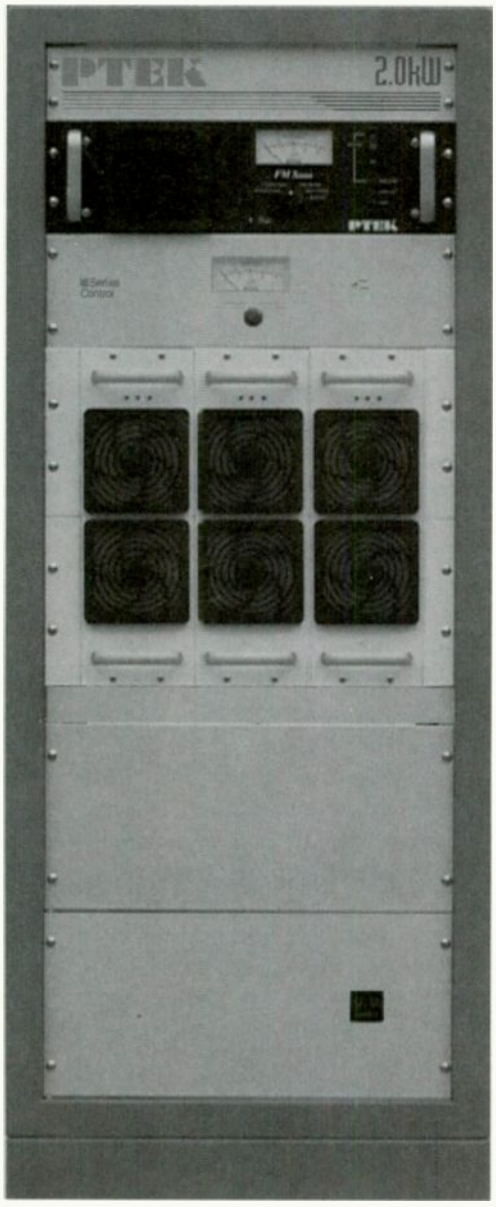

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Features and options

Dial-up control is a feature that gained almost instant acceptance. Even in dedicated systems, the ability to call in directly to the system to gain control or just check on parameters was welcomed. As portable phones came into common usage and the typical transmitter operator (air personalities, producers) became less involved in technical operations, the need for immediate answers in a crisis was obvious. With dial-in access came the ability for the system to dial-out when an out-of-tolerance condition arose. Sometimes the engineer knew there was a problem before the operator did.

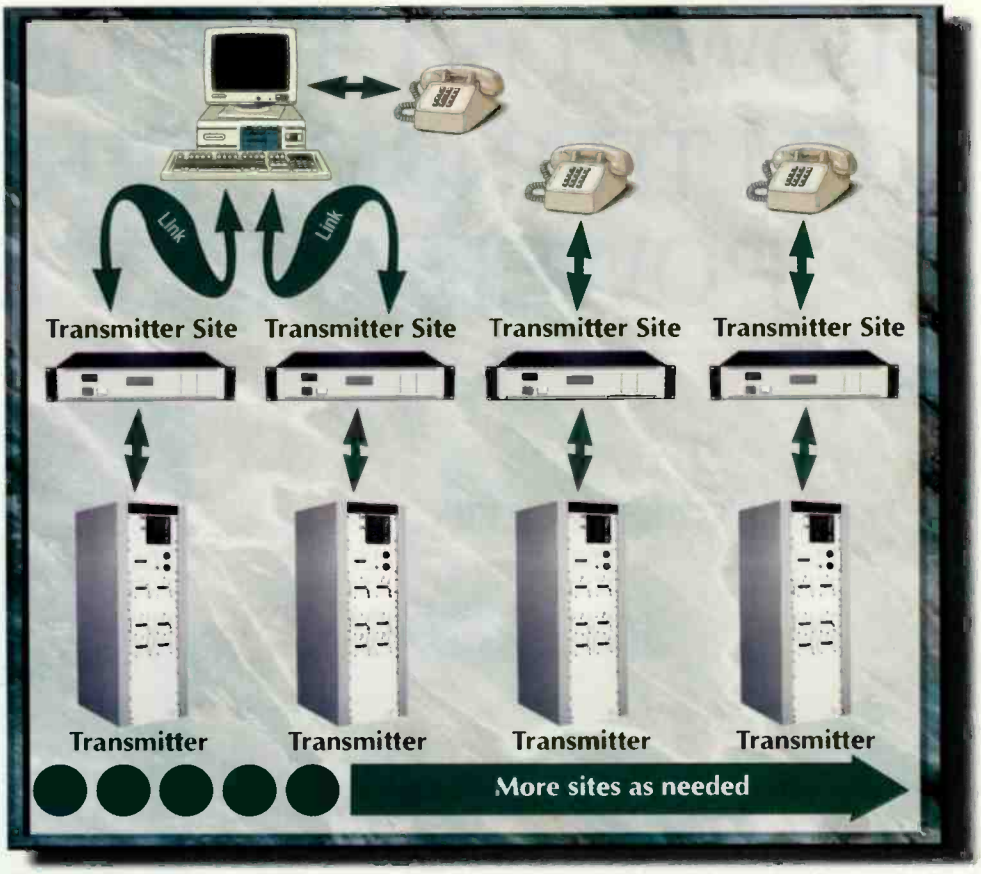

Figure 3. PC control can watch over multiple sites at one time. Connection to the sites can be fixed or temporary.

Basic dial-up controllers have been around for some time. When the FCC relaxed the remote control rules, several systems picked up on the basic DTMF controllers and introduced the common dial-up units we have today.

The biggest enhancement to dial-up control is voice prompt response. For some applications, beeps or tones may suffice to indicate current status. For more complex information — usually delivered much faster — a synthesized or sampled voice can report readings and alarms much quicker and with greater accuracy.

PCs and interfaces

Laptop computers have made advances in many technologies, and remote site control is yet another one. Setup and storage of system parameters is easily accomplished on many systems with the help of a PC. Some systems use a PC as the main interface. If voice-prompt dial-up isn't enough, how about dial-in capability that can automatically determine if you're calling from a phone or a computer? A voice prompt can only offer information on one channel at a time. A monitor display can show you many if not all the channels on your system at once.

One studio controlling one transmitter site was the normal situation at one time. Later, adding a second station or an auxiliary site became the status quo. With multiple stations sharing facilities and (usually) engineering staffs, tying multiple systems together became necessary. The ability to monitor and control multiple transmitter sites is also now quite common. Larger station group engineers and regional technical supervisors are able to check the status of any or even all of their sites at one time. With station technical staffs running leaner, this can help if you are out at site A working and site B pages you with an alarm condition. If the remote control systems are tied together you can quickly look at the parameters and decide if you need to go ASAP or if it can wait a short time.

Automation or automatic

Automatic control of many parameters is a common option. Again, with a leaner staff, sometimes a compromise must be made. Programs exist that can monitor the operation of the transmitter system and detect a fault. It can even be set to allow a minor alarm to occur a few times before acting.

Another welcome feature is automatic logging. Printing directly to paper or storing the data on a hard drive is a valuable resource for almost anyone. This gives an accurate, reliable means to pull up the data monitored at the transmitter site. Having a steady stream of data makes it easier to track tube performance and transmitter efficiency or help determine the cause of an equipment failure.

Remote site control has grown far beyond the basic operations it was originally designed for. Transmitters are not the only devices being controlled by them either. Integration into satellite receivers, RPU systems, security systems, standby generators and audio processing are all making the remote control system more useful. Some installations use both dedicated and dial-up systems for main and back-up uses to improve reliability.

Remote control systems are no longer limited by the tight constraint of FCC rules. The technology has escaped those constraints, and, as is the case in many other areas of broadcasting, further integration into the complete system is driving the designs and applications.

Automatic vs. manual logging

In an online forum, several engineers recently took part in an informal discussion of the pros and cons of automatic logging and having air personalities take transmitter meter readings. The opinions presented in the discussion were varied — as were assessments of non-technical staff abilities at each station.

Automatic logging offers an accurate record of all the events monitored by the remote control system. Because the remote control system handles the logging, there is no doubt that the data gathered is reliable. A human operator's readings may not be as precise. In case of a problem, the engineer can dial in (if the remote control has not already called out) and correct it.

On the other hand, an operator has the advantage of being there at all times, meaning that there is a set of ears there as well.

However, it is easy to get distracted during an air shift and forget to take a set of readings as needed. It would seem that automatic logging is a more reliable way to go.

Why not do both? Have the automatic logging occur as needed, but also have the operators take a set of readings at a pre-determined interval. This keeps a set of perfect readings available, but it also keeps the operators in touch with the equipment. You may never need to ask one of them to switch something for you, but if you do call in, he or she will already know how to change channels and press "raise," without first asking, "What's a remote control?"

REMOTE SITE CONTROL SYSTEMS

Keep your site running smoothly

Compiled by the *BE Radio* staff

Remote site control can be as basic as turning the final PA on and off, to as complex as complete metering, status and control for multiple sites with a graphic interface. The following is a listing of products available for remote control and remote control interfacing at your site.

The basic control systems are usually full-time, dedicated controllers and paths, or stand-alone units with POTS line dial-in access where the telephone keypad is the interface. There are hybrids of these two systems as well. Still other methods are detailed in the product descriptions below. Unless otherwise specified, all PC access to any product listed is via standard communications software like Procomm, Bitcom, Windows Terminal or Win95 Hyper-term.

All of the manufacturers here have websites with additional information available. Go to www.beradio.com and click on the Industry Links for direct access to all of their sites.

Broadcast Tools

DC-8A Dial-up remote control

A stand-alone, dial-in controller, the DC-8A has eight control outputs and eight status inputs with screw terminal connections. Up to eight digit password protection keeps it secure from curious callers. The unit can be configured for different applications, with settings for relay activation (duration of DTMF tone, latching, interlocking), tone acknowledgement defeat, stand-alone DTMF decoding, and individual status and control polling. The unit recalls relay settings on power loss and restore them on power up. The pager alert function calls up to three numbers upon activation of any or all status alarms and displays a preset telephone number and offending status input number.

PSC/B Programmable Schedule Controller

Up to 160 events can be programmed into the PSC/B to occur at specific hour/minute/second times on specific dates (as day/month/year) or repeating on a day of the week. Each event may control one of the 20 SPST relays and/or 32 serial custom commands. Relays may be set as momentary or latching. The unit's time can be synchronized with the external sync input, which includes a status LED, but does reference the 60Hz line for time reference and is stability rated at three seconds or less per month. Memory is maintained on power loss by an internal 1F capacitor. Other features include leap-year correction, 24-hour time format, the ability to program multiple years in advance, and password protection. Programming is accomplished via a non-dedicated PC running any standard terminal program. Connections are made via the WAGO clamp wire captive terminals. Optional rack mount adapters are available.

SCR-8A and SCR-8B serial remote controls

The SRC-8A is a unidirectional serial remote control that offers eight channels of opto-isolator wet or dry inputs and eight SPST relay outputs. A communications link can be made using most RF, wireline and fiber STL systems, or directly with US Robotics' Courier 1200 to 9600 baud modems. Two units are required for communication: the SRC-8/T transmitter and SRC-8/R receiver. The units are identical in shape and size. Connections are made with the WAGO clamp wire captive terminals. Communication is done with RS-232C or optional RS-485. Two systems can be linked for eight-channel, bi-directional control as the SRC-8B.

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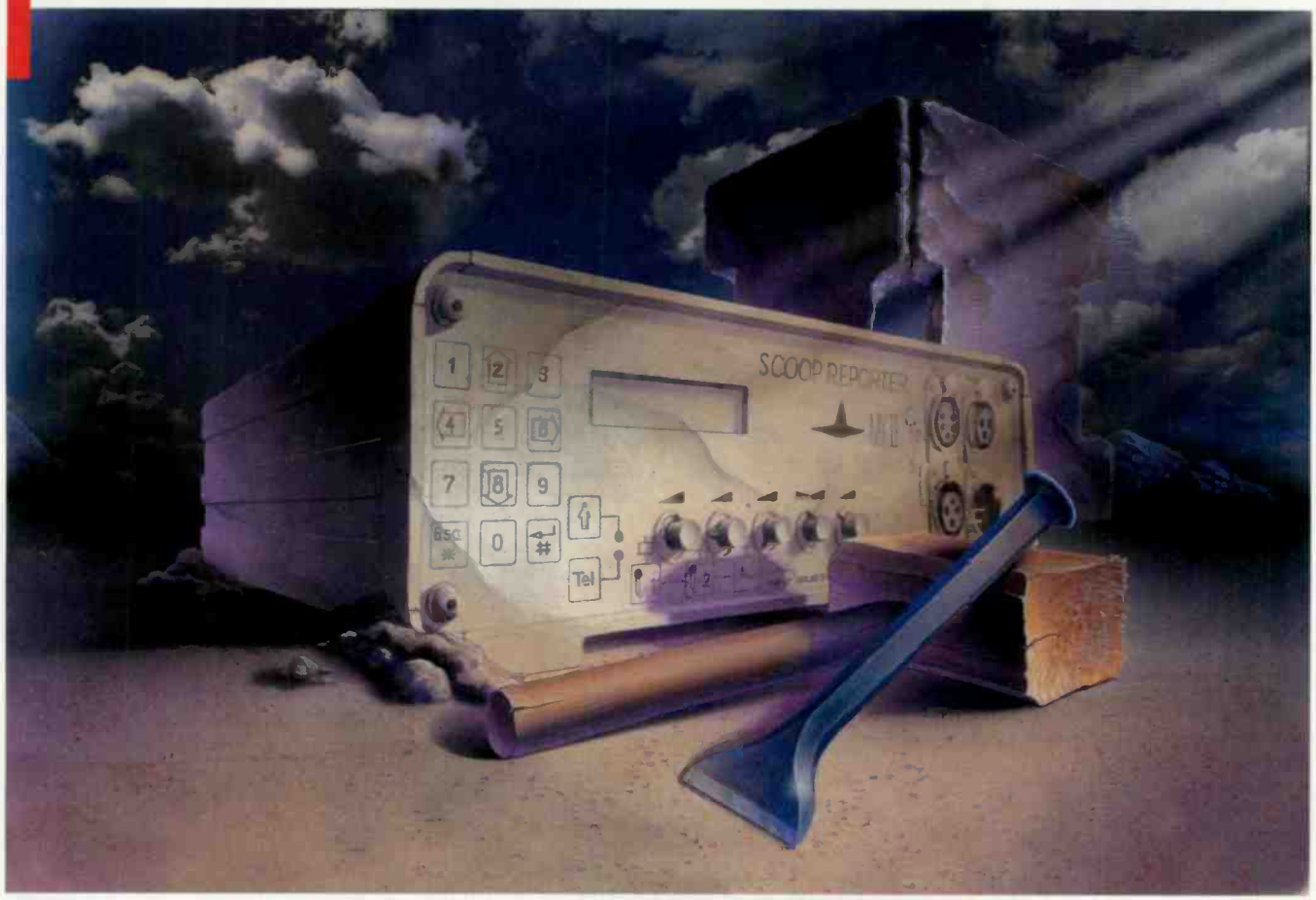
Rock solid remote connections
A.E.T.A. Scoop Reporter MKII



Are your remote connections important? You bet they are! Keep your live feed active with the highest standards possible. Use the new Scoop Reporter MKII manufactured by A.E.T.A. This new generation of P.O.T.S. (Plain Old Telephone Standard) codec supplies rock solid quality to all of your remote connections.

Tired of long delays in your remote? User-selectable delay modes down to 150 ms that are a standard feature on the Scoop MK II offer you a choice when it comes to bidirectional communications.

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REMOTE SITE CONTROL SYSTEMS

Burk Technology

ARC-16 System

This full-time remote control system has many options and offers 16 status inputs, 16 metering inputs and 32 control outputs (16 raise, 16 lower). The two-line, 32-character LCD readout displays the channel, site selection and associated metering. 16 LEDs show the status input readings. The front panel is designed to be easy to use, especially for non-technical operators. The basic system has one studio and one transmitter unit. Metering and status channels can be custom labeled for easier identification. One ARC-16 unit can be expanded up to 64 channels of status, metering and control. Options include the ES for dial-up control with a simulated voice prompt, studio control for status and control of studio equipment from any ARC-16 unit in the system, CDL computer control, AutoPilot automatic control and multisite capability. Up to four sites can be integrated into a combined hardware system using a variety of communications paths. AutoPilot allows up to 16 sites with full-time connections, or over 500 sites with dial-up connections.

800-255-8090 • 978-486-0081 fax • control@burk.com
Circle (251) on Free Info Card

CircuitWerkes

DR-10 Dial-up controller

This dial-up controller has 10 sets of relays, eight single-pole and two DPDT. Features include: selectable ring auto-answer; independent relay function for momentary, latching or interlocked operation; relay closure on leading or trailing edge of touch tone; up to an eight-digit password for control, with a separate password for listening functions; and four status inputs that can also control relays and dial out up to four numbers. Connections are made with screw terminals, and programming is accomplished with a standard telephone or DTMF encoder. In case of a power outage, the unit will retain its programming and return the relays to their last settings. An external audio input allows the unit to send audio down the phone line as well. An open collector output is also activated (momentary or latching) when the unit goes online for logging purposes. An optional rackmount adapter is also available.

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www.inovon.com

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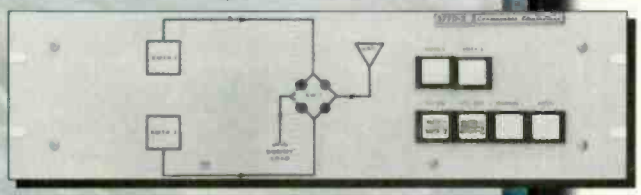
Continental Electronics

377D-2 Transmitter Control

Any installation with a main and auxiliary transmitter has to be able to easily switch either one on the air. The interconnections required between the two transmitters, a coaxial switch, dummy load and antenna system can be cumbersome to build from the ground up. The 377D-2 provides an interface with an easy-to-read status panel to switch transmitters and integrate the function into the remote control system. NiCd batteries hold the memory in case of a power failure. In automatic mode, the unit can sense a loss of RF and switch the other transmitter on the air. Also available is the 377D-1 combiner control, which is similar in appearance but used for combiner systems instead of main/alternate arrangements. The 377C-1A is an exciter switcher with a built-in dummy load for main/alternate exciter installations.



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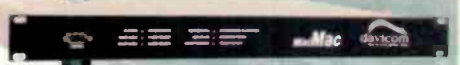
Davicom

Mini M-A-C

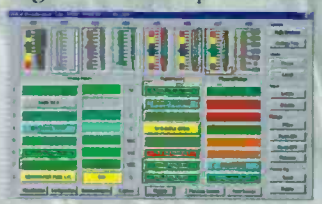
The Mini M-A-C accepts eight metering inputs, 16 status inputs, two audio monitor inputs, and controls eight relays. Minor and major alarm messages can be sent via voice phone, fax, pager or computer, depending on the programming. A serial port allows interfacing with additional equipment without having to add a second telephone line and modem. The Mini M-A-C can be programmed to automatically perform commands based on the status of one or several inputs, for example switching to a backup transmitter. Two software versions are available depending on the complexity of control needed.



Davicom (continued)

M-A-C System

The M-A-C System is based on the same approach as the Mini M-A-C but offers more I/O. Up to 32 metering inputs, 64 status, 16 audio monitor inputs, and up to 64 relays can be installed. The unit offers 16 RS-232 serial communication ports for external equipment. The menu driven software built into the unit allows the user to easily program complex operations such as automatic switching to a back-up transmitter, controlling the emergency power source, and monitoring VSWR of several antennas. A communication software package, MACOMM, which offers a full graphics interface for fast and simple operation, is also supplied with each unit.



MACNET

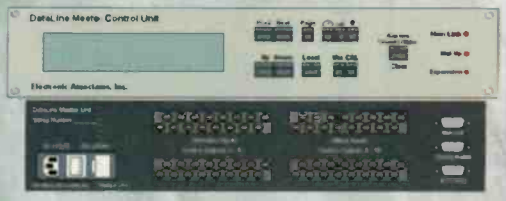
MACNET is a management software system that can be used to collect alarms and reports coming from the Mini M-A-C and M-A-C System monitoring units. It uses the MAPINFO graphical interface and its database is Microsoft Access-compatible. MACNET functions as a decision assistance tool for the operator. All decisions are made by the operator, but MACNET will promptly supply all the information required so that the operator will know exactly what is going on at the transmission sites. MACNET runs on Win95, all menus, sub-menus and reports are easily selected using the mouse, and all information is presented in a simple and easy-to-read graphical format. The database created for each site has the ability to set up multi-site tracking by city, state, region, country, etc., and can also possibly include stored engineering drawings for each location. The number of sites that can be accessed is only limited by the size of the PCs hard drive. Price is based on the number of M-A-C systems purchased.

609-653-1065 • 609-653-1075 fax
ejones@davicom.com
Circle (254) on Free Info Card

Electronic Associates, Inc.

DataLine Remote Control system

This expandable, modular control system starts at eight metering inputs, eight status inputs and 16 control relays. Expansion can be done in groups of eight metering and status or 16 relays. The master system is 2RU and each expansion chassis is also 2RU. It includes a Hayes modem for communication. The factory can pre-program the unit to your specifications before shipping. Field programming is also easily done with the RS-232 connection. Four timers (two *on*, two *off*) can be set for each month. The control site uses a PC running the DataLine or RF-Host software. Remote call-in automatically selects between voice/DTMF or computer. Remote call-out to assigned phone numbers has a speech announcement. Updates are provided free for the first three years of ownership.



RF-Host 2.0 8-site control program

The RF-HOST Multi-Site Controller runs on Windows and has a controller board with eight high-speed RS-232 serial ports. It will simultaneously display up to eight transmitter sites from a single control site computer. When control is active for an individual site, data processing and monitoring for alarms is continued from all sites. Individual sites may also be viewed for more detailed information.

RF-Manager/RF-Director

The RF-Director, with eight metering inputs, eight status inputs and 16 command channels, and the RF-Manager, with up to 128 metering inputs, 128 status inputs and 256 command channels, are identical in function and operation. An entire update is sent several times per second with any changes and alarms. This provides the studio with a real-time graphic display of the transmitter performance. Commands sent to the transmission site exhibit the same real-time response, and as a result are executed within a fraction of a second. Macros can be programmed to carry out routine operations like switching transmitters to simplify operator usage. Logging of all alarms is done by the transmitter and studio site computers.

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sales@elecassoc.com
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Moseley

MRC-1620

Designed for standard applications not requiring multiple site interconnection, the MRC-1620 has 16 metering inputs, 16 status inputs, and 32 control outputs. The internal modem works with dedicated circuits. All programming is stored in non-volatile memory. The front panel has color-coded control buttons for simpler operation, and a large area next to the status indicators for easy labeling of each indicator. Alarm limits (with a defeatable audible alarm), telemetry quality and system diagnostics are all easily seen from the front panel display. PC control is available with the Taskmaster20 software, which also allows enhanced display options, editing of programming and system labels, upload/download of MRC-1620 programming parameters and generation of a printed log.

MRC-2

An expandable system with control (studio) and remote terminals (RT), each remote terminal accepts up to 256 metering inputs, 256 status inputs and 256 control outputs. Up to 99 remote sites can be linked together and each RT may have up to eight communication circuits. The MasterController software emulates the control terminal and provides operators with added capability for time- and event-oriented control functions. Interface cards are available for satellite receivers, audio switchers and other devices.

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Sine Systems

RFC-1/B remote facilities controller

This dial-up system can control up to eight RP-8 relay panels for a total of 64 channels of control and telemetry. Control is done with DTMF tones. All reporting is done with a digitally recorded human voice. Tolerance alarms can be set and when an out-of-tolerance condition arises, the RFC-1/B can call out and report the problem. All connections are made with detachable screw connectors. Optional accessories allow communication to serial or parallel printers, an RS-232 output, and automatic control (both corrective and timed) and logging. A rack mount is also available.

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Complete web site information is available at
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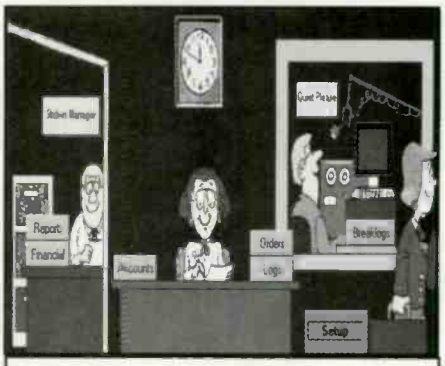

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Field Report

Harris Z5CD

By Hal Kneller

Heartland Broadcasting Corporation took over operation of WZZS-FM in 1996. Even though it first signed on only four years earlier, virtually all the equipment was purchased used, including a late 60s vintage 5kW transmitter whose manufacturer had long since gone out of business. Because the transmitter had a long history of reliability problems, it became obvious that a new transmitter was a necessity in the near future.

As owner and chief engineer of the station, I had the pleasurable task of selecting and purchasing the new transmitter. From reading brochures and trade articles, and after 10 years of satisfactory solid-state AM performance, I decided it was appropriate to purchase a solid-state FM transmitter.

Performance at a glance

- Broadband design
- Hot-pluggable modules
- Quick-start operation
- Microprocessor control
- Dual power settings
- Single or three-phase power

Harris already had a significant number of Platinum-series solid state transmitters in the field around the world, but the Z5 was a new product. I found that in addition to borrowing some technology from the Platinum, the Z5 had all the features I needed and wanted at a price just slightly above the cost of Harris' 5kW tube-type transmitter, the HT-5.

The Z5 has the cleanest internal layout of all the transmitters I looked at. While there are more RF output devices (MRF151) than other solid state transmitters, there is the advantage of less power dissipation per device. The heat sinks run quite cool to the touch, even at 6kW output. The IPA uses only one side of a regular dual-PA module, and that module will automatically switch to the other amplifier should the first side fail.

The TPO of WZZS is 4.2kW. There are eight PA modules in the transmitter, but it is possible to pull two PA modules (which are hot-pluggable) and have the transmitter remain at full power. If a third module is removed, the power drops to just under 80%.

The transmitter also contains dual power supplies. There is so much redundancy in the transmitter that a backup transmitter is almost unnecessary.

Good design

One design point I particularly appreciate is the "Z Plane" combiner. This is a PC-board combiner with direct module connections. Its straightforward design adds to the simple, uncluttered internal design by eliminating the rat's nest of connecting cables. The combiner also features automatic reconfiguration, which transfers maximum power to the antenna in the event of a module loss. The output of the A and B "Z planes" feeds the internal harmonic filter, with the center conductor at DC ground potential for lightning protection.

A clean and simple layout makes servicing the Z5CD much easier. The amplifier modules pull out for easy maintenance.

Except for the exciter frequency settings, there are no RF tuning adjustments anywhere in the system — it is broadband through the entire 88-108MHz FM band. The Z5 transmitter becomes a Z10 (10kW) by adding two more power supplies (there is room on the existing rollout drawer), another IPA, and eight more PA modules, which still leaves plenty of room in the cabinet. The transmitter occupies a space 28½" wide by 36" deep. It stands 72" high.

The solid state controller is also backed up in case of failure. If it fails, an on-board controller called "Life Support" takes over. Life Support has only minimum monitor and control, but it keeps the station on the air while the main board is serviced or replaced. The only areas that are not backed up with redundant systems are the relay contactor, the blower and the main circuit breaker.

The controller provides metering and monitoring points for status, temperature, voltage, and current, and even stores faults for later review. The fault light remains steady if there is a current fault, and flashes if the fault has cleared. There is also an RS-232 (DB9) port to hook up a computer.

The front end

At the heart of the transmitter is the DIGIT CD exciter. The second generation of this exciter has some added features not in the earlier model. The most notable is a signal generator for AM noise adjustments in the power amplifier. The Z transmitter's AM noise is already low (-60dB), but having the signal generator makes it easy to check. The DIGIT exciter can be fed with an analog composite or AES3 signal. The SCA #2 input in the AES3 module doubles as an emergency composite port. Although Harris claims it has reduced the specs, in the real world this emergency composite port outperforms most other composite exciters hands down. I won't go into any more detail here, but there are enough features on the DIGIT CD to fill its own Field Report.

There is some additional space in the cabinet where we have mounted our backup exciter as well.

When we installed the Z5, station employees immediately noticed an improvement in the station's sound though there was no change to the audio processing. The old exciter was only two years old, but the audio quality difference was very apparent.

The Z5 meets every one of its published specifications and in many cases greatly exceeded them. It even exceeded its published power consumption spec by several hundred watts. Part of this is due to the automatic efficiency adjustment in the transmitter controller. This adjusts the PA current-to-voltage ratio to create the best operating point for AC-to-RF conversion efficiency. This is a feature not found on any other transmitter.

The installation of the transmitter took only three hours, and that included installation of all the remote control functions. The setup was simple, and nothing is removed for shipment except for the power (IPA/PA) modules. All the connections for remote control, analog metering, and numerous status functions are on a terminal block. It can be supplied to operate on single- or three-phase power. The large schematics and clear instruction book, which have both been Harris trademarks for the last 20 years, are also included.

We are in Florida, lightning capital of the world. The transmitter made it through an entire lightning season with no failures of any sort. In fact, there have been no failures in the transmitter since it was placed on the air in May, 1997. As far as maintenance is concerned, I have only had to replace the air filters. I congratulate Harris on a very cleanly designed, reliable transmitter.

Hal Kneller is president and chief engineer of WZZS-FM, Zolfo Springs, FL. Contact him at kneller@sunline.net.

Editor's note: *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 of 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.*

New Products

Nearfield monitor
Tannoy

◀ **System 800A:** has excellent phase response and is capable of high sound-pressure levels without compression; accurate phase response delivers smooth and natural sound without the listening fatigue associated with more conventional multi-driver designs; addition of a high-quality bi-amplified, fully active amplifier to the System 800 increases dynamic capabilities by 6dB; frequency response is 44Hz – 20kHz.

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▶ **Courier V1.0:** records high-quality digital audio to a PC-MCIA hard disk, has graphical scrub-wheel editing, and will transfer audio via mobile telephone, modem and ISDN communication; designed to be robust, lightweight and easy-to-use; provides sophisticated, non-destructive editing facilities including a jog/shuttle wheel for accurate edits; the media can be slotted into an suitably equipped digital audio workstation for instant editing, and the recorded files are DOS and Windows compatible.

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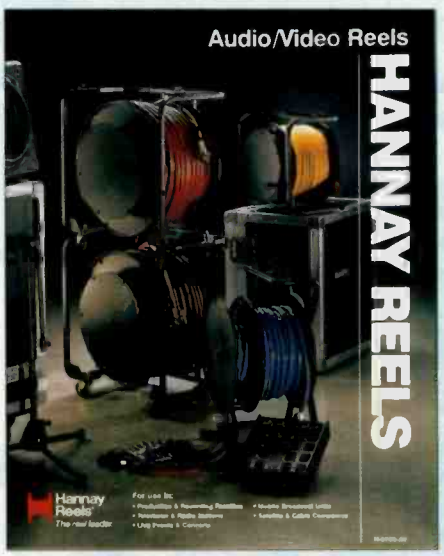

Catalog
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For direct links to these New Product manufacturers, check out **www.beradio.com**

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VIP Products

▲ **Vinyl decals:** long-term visual identification available in small quantities; features 3M decal material with up to 10 years of outdoor life; also available are design and/or prototype services.

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▲ **CD-3704:** four-drive, stand-alone system offers one-button operation and unattended duplication of up to 100 CD-Rs; separate accept and reject bins makes identification of successfully recorded media easy; Easi-Dat or Easi-Audio options can be added for importing from any digital master or analog pro audio source; Pre-Scan feature scans the entire master for any errors prior to burning; six-digit password feature prevents unauthorized operation.

800-220-1215; fax 610-458-9954
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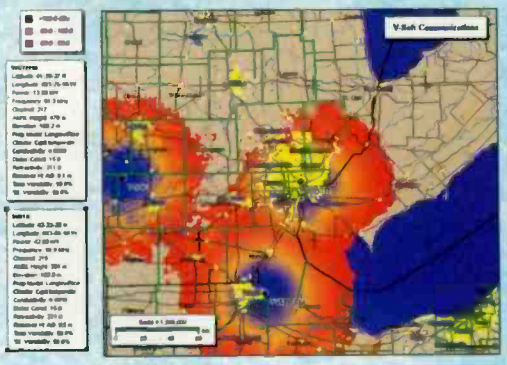
New Products



Propagation predictors
V-Soft Communications

◀ **Probe:** expert-level propagation program for Windows 95/98 and NT; propagation models include Longley/Rice, TIREM, Line-of-Sight/Shadow, and the FCC's new PTP method; supports multiple station coverage analysis; uses a 200MB block-level census database allowing a county-by-county population report for a signal level (including racial and housing unit information) for all coverage and interference studies; map information tool displays the coordinates, elevation and signal field-strength values at points on the map defined by the cursor; offers choice of displaying strongest signal or actual signal for multiple station studies.

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Earth-station antennas
Andrew Corporation

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Cable tester
Jensen Tools

◀ **CableMaster 1000:** gives you a compact cable tester which combines the functions of six testers in one; tests the pin-out of DB9, 15, and 25 cables, RJ-45 cables, and ST fiber optic cables; has built-in intelligence for comparing common PC cables, and room for three user-defined cable configurations; the fiber tester has a power bar graph for testing patch cords; includes a full 100 LED breakout box; unit can monitor via its DB15 port the activity of Ethernet networks; measures 3.5" x 2.5" x 11", 2.9lbs.

800-426-1194; fax 800-366-9662
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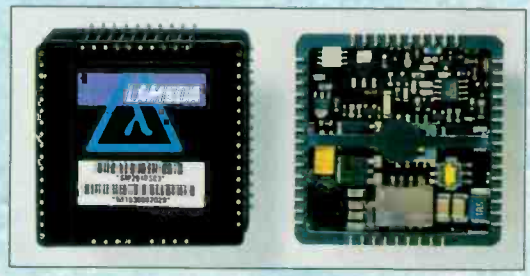
For direct links to these New Product manufacturers, check out www.beradio.com

New Products

20W DC-DC converter
Lambda Electronics



▲ **SM20:** features a low-profile (0.4" high), surface-mount package that facilitates tight card-pitch requirements; unique square design (46.48mm²/1830"sq.) ensures compatibility with existing SMT pick-and-place equipment, thereby minimizing machine error; other features include a 10ms start up for hot-plug conditions and remote on/off for complex systems-timing requirements.

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Circle (208) on Free Info Card

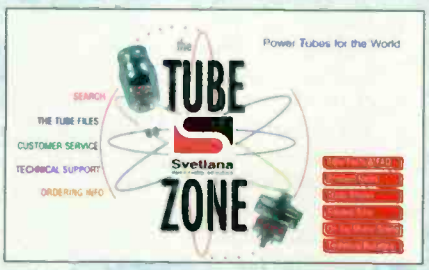
Audio processor
Cutting Edge

▲ **Omnia.fm.jr:** affordably priced FM audio processor is fully upgradable to the full-featured Omnia.fm; unit uses a three-band processing system in order to contain costs; incorporates digital and analog I/Os, a digital stereo generator, and the same user interface as the Omnia.fm; processing platform features modular construction with the ability to operate as many DSP modules as required by the processing software.

216-241-3343; fax 216-241-4103
Circle (209) on Free Info Card

Website
Svetlana

▼ **www.svetlana.com:** improved website offers Adobe Acrobat downloadable data sheets for Svetlana products; Tube Search section offers general characteristics on virtually every popular tube type ever made, allowing browsers to find out which types are still in production and which types can be substituted for others; online help and technical support are offered, including Svetlana Technical Bulletins.



256-882-1344; fax 256-880-8077
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News

SBE announces election results

The Society of Broadcast Engineers announced the results of its recently held national election. The four incumbent officers — **Edward Miller**, CPBE, president; **Troy Pennington**, CSRE, vice president; **Thomas Weber**, CPBE, Secretary; and **James (Andy) Butler**, CPBE, Treasurer – ran unopposed and therefore retained their offices.

Miller, elected to his second term, is currently the engineering consultant for PATLIN Electronics and a member of the SBE Board of Directors Executive Committee. He is a former two-term Board member and served as Futures Committee chairman for two terms.

Pennington, also elected to his second term as vice president, is the current chief engineer at WZZK-FM, WODL-FM, WEZN-AM and WEDA-FM in Birmingham, AL, and is also a contract engineer for WDJC-AM/FM. He served two terms as SBE treasurer and two terms on the Board.

Weber, elected to his second term as secretary, is currently the engineering maintenance supervisor at WISH-TV in Indianapolis. He served two terms on the Board and is the former chairman of the SBE National Sustaining Membership Committee.

Butler is the current director of engineering for PBS. In addition to his term as treasurer, he served as Industry Relations Committee chairman and was the Society's first executive director.

Eleven candidates vied for the six available seats on the Society's Board of Directors. The winners, along with a short bio, are as follows:

- **Raymond Benedict, CPBE:** More than 30 years of broadcast engineering in radio and TV; nine years in current position managing FCC-related engineering issues for Group W, now CBS Corporation; incumbent Board member.
- **Sam Garfield, CPBE:** Current vice president and co-founder of Technical Broadcast Consultants, a nationally recognized consulting firm; formerly chief engineer and group director of engineering for Beasley Broadcast Group.
- **Albert Grossniklaus, CBT:** Holds a BSEE had has been employed as a broadcast engineer for more than twenty years; current director of operations for WTHR-TV, Indianapolis; charter member of SBE Chapter 116.
- **Robert Hess, CPBE:** Presently director, broadcast operations and engineering, WBZ-TV, WBZ-AM, WODS-FM, Boston; incumbent Board member; current Finance Committee chairman.
- **Mark Krieger, CBT:** Former chief engineer of WGAR-FM (AM) for 13 years and now president of Krieger and Associates; senior member of SBE; current frequency coordinator and co-chair of local area EAS committee.
- **Jerry Whittaker, CPBE:** Current president of Technical Press; SBE and SMPTE Fellow; SBE Educator of the Year, 1992; SBE national vice president, 1993; author of 13 books on communications subjects.

The new electees will assume their offices at the Society's annual meeting, to be held this year in Seattle on October, 29.

CD Radio begins terrestrial repeater deployment

A further step towards the introduction of S-DARS was taken by CD Radio as they began deployment of its terrestrial repeater network in San Francisco. Work began in September and demonstrations should begin this month. Additional terrestrial repeaters will be constructed in other urban areas over the next 12 months to allow reception in areas where satellite signals will not reach. CD Radio plans to have its 100 channel satellite radio service available in the year 2000.

Business/ People

BUSINESS

Fidelipac recently announced that it has completed the sale of four Dynamax MX consoles to TeleSouth Communications for its studio expansion, bringing TeleSouth's total to five of the Fidelipac units. The Jackson, MS, production and broadcast facility expanded from four studios to eight.

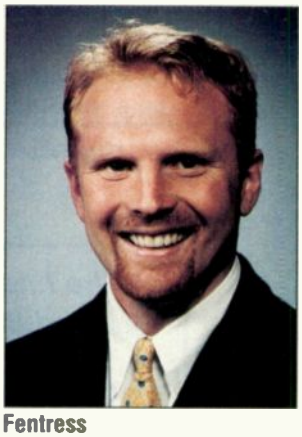
Davicom, which recently opened a US office in Egg Harbor Township, NJ, announced a change in that office's phone number. The US office can now be reached toll-free at 877-327-4832.

The Fitzgerald Theater in St. Paul, MN, recently installed a Series FIVE console from **Soundcraft**, Nashville, TN, to aid in production and recording of Garrison Keillor's *A Prairie Home Companion*. The console replaces a Soundcraft 800B desk originally installed in 1986.

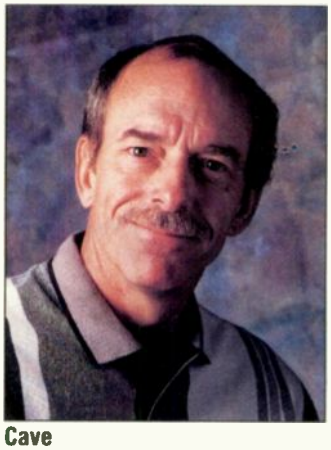
Independent Audio, LLC, Portland, ME, has been appointed as the exclusive US distributor for condenser microphones from Sweden's **Pearl Labs**.

PEOPLE

Brad Fentress has been promoted to director of OEM business for Sonic Foundry, Walnut Creek, CA.



Fentress



Cave

Stuart McRae has joined CBSI, Reedsport, OR, as national sales manager.

Also from CBSI, Jerry Brown has joined the company as regional sales manager based in Virginia Beach, VA.

Jerry Cave has been promoted to managing director of Hafler, Tempe, AZ.

BE Radio

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PRIMEDIA Intertec

Extending digital audio's limits

By Skip Pizzi, editor-in-chief

The term "digital loudspeaker" has been a kind of inside joke in the audio industry for some time. The amusement lies in the common knowledge among audio professionals that a speaker (or at least its acoustical piston/driver assembly) *had* to be an analog device, because it must convert an audio signal back into continuously variable sound vibrations that humans can hear.

Now it looks like it may be time to retire another bit of dated humor. The fully digital loudspeaker is now a reality, at least in the lab, and may be on the shelves within the next few years.

How it works

Unlike conventional speakers, which rely on a single transducer to reproduce all signals within a given frequency band, the digital loudspeaker relies on an array of many small transducers that each produce a small, fixed acoustical output level. Under control of DSP, these transducers are switched on and off in the number and frequency required to reproduce the audio waveform as an assembly of their individual square-wave outputs.

The fully digital loudspeaker is now a reality in the lab, and may be on the shelves in the next few years.

This concept has been around for awhile, and a variation of it is used in modern digitally modulated AM transmitters, which build the modulated AM carrier wave with an array of many small RF power amplifiers. But developers encounter a problem when designing digital transducers using traditional binary concepts.

Consider what happens in a binary system at the "place changes" (i.e., the order-of-magnitude shifts). For example, in 4-bit binary terms, if the value 0111 is advanced by one step, the value becomes 1000. This is an elementary change for processing devices, but in a binary transducer system, three smaller output devices (in the one's, two's and four's columns) have to switch off, and one larger-output device (in the eight's column) has to switch on. This transition may produce a noticeable glitch in the audio as the different transducers ramp up and down. For acoustical transducers, an interference wave is also generated from the phase errors encountered during this transition, exacerbated because the transducers are not located at the same physical point in space.

The key concept in successful digital transducer design replaces this binary approach with a *unary* one, in which all of an array's transducers produce the same output level. In other words, they are all like the one's column (or *least-significant bit*) transducers in the binary array, with no graduation of powers to handle higher place values. As the audio waveform varies over time, the number of transducers activated simply goes up or down in linear fashion.

The disadvantage of such a design is the need for many more transducers. Unlike a binary system where eight transducers with binary-weighted powers (1W, 2W, 4W...) could produce 256 discrete output levels, the unary system requires 256 equally powered transducers to provide the same resolution.

Nevertheless, just such a speaker design has been developed by a British company called *1...Ltd.*, using an array of 256 pulse transducers under the control of nine SHARC DSP chips. The eventual product will likely use a single, custom-designed chip, controlling a 1-ft square transducer array. Designers claim that the 256-step unary device can emulate the audio performance of 16 or 20-bit digital audio through the judicious use of signal processing in the speaker's DSP.

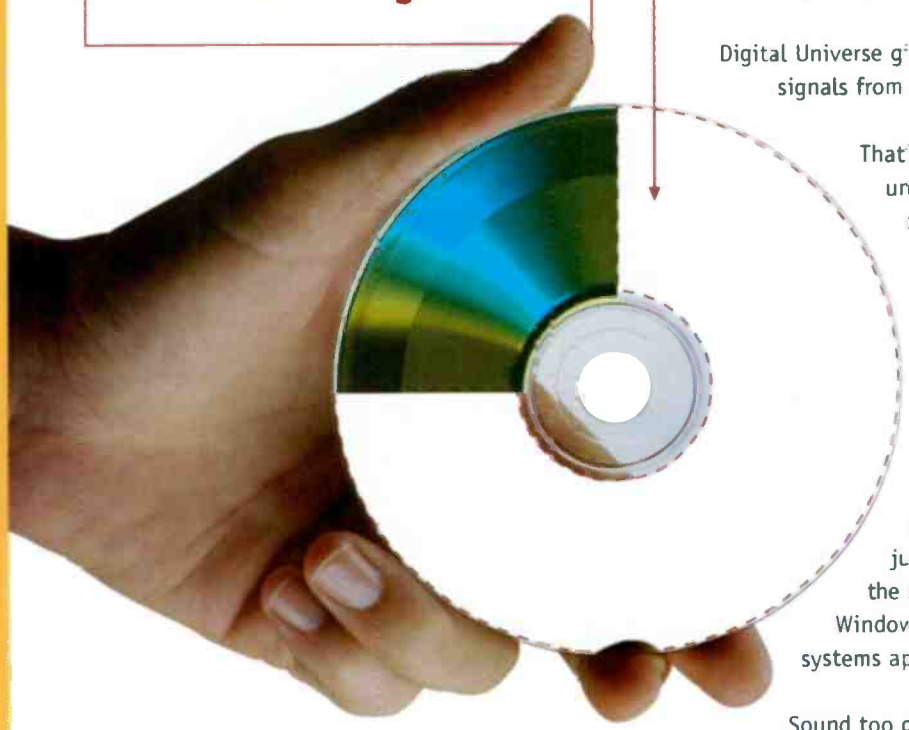
The transducers used in current prototypes are like the sounders in smoke alarms, the diaphragms of which move only a few microns when energized. A design goal for developers is a custom piezoelectric transducer with a longer "throw" of up to 20mm.

Advantages

Theoretical advantages include greatly improved power efficiency (perhaps 20 times better than traditional speakers) and small form factors, both of which could have significant value for portable or battery-powered systems. DSP control could also be programmed to correct for array or room deficiencies, providing extremely accurate reproduction relative to the fixed, electromechanical design limitations involved in conventional loudspeakers.

When combined with a wireless spread-spectrum digital receiver, the all-digital loudspeaker could revolutionize sound reproduction with radical alterations of traditional size, weight, accuracy and power parameters. Tomorrow's speakers may therefore be small, flat and super hi-fi, with some requiring no physical connections. The revolution continues...

How much audio does your digital system throw away?



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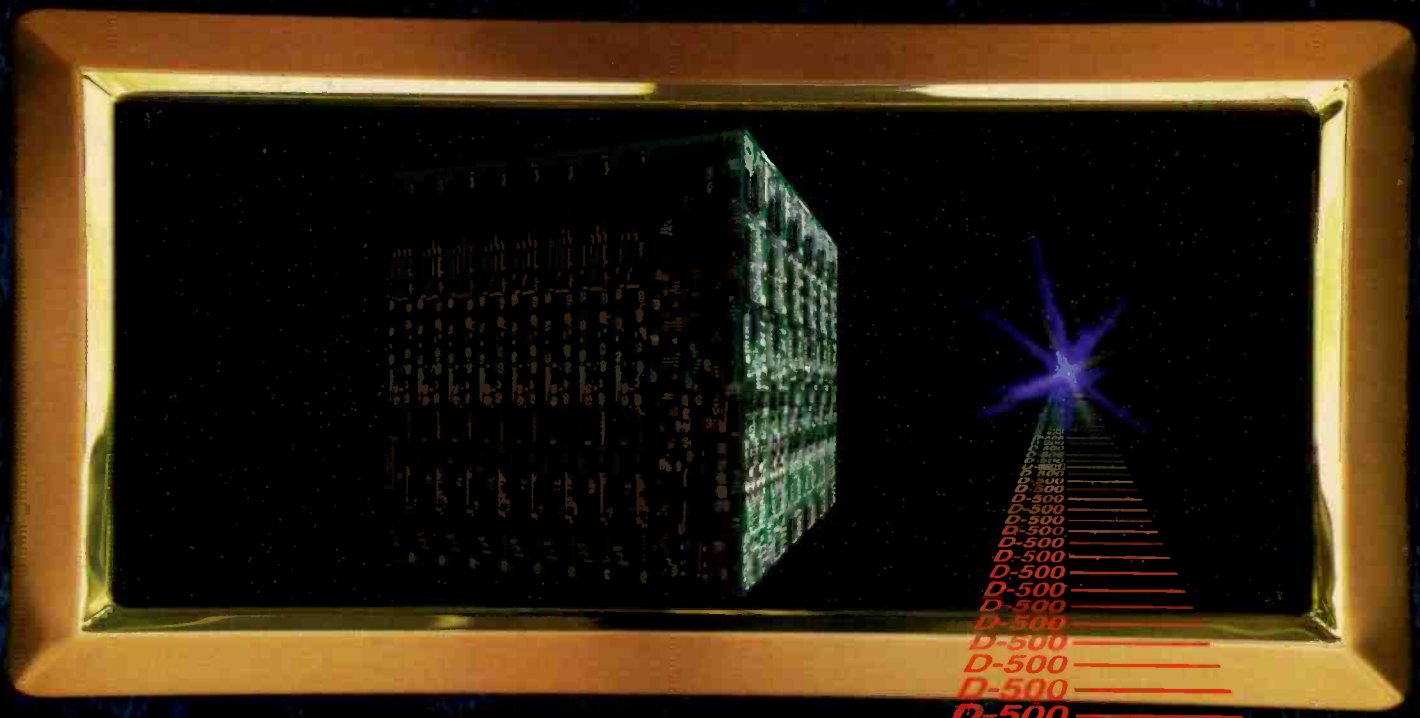

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