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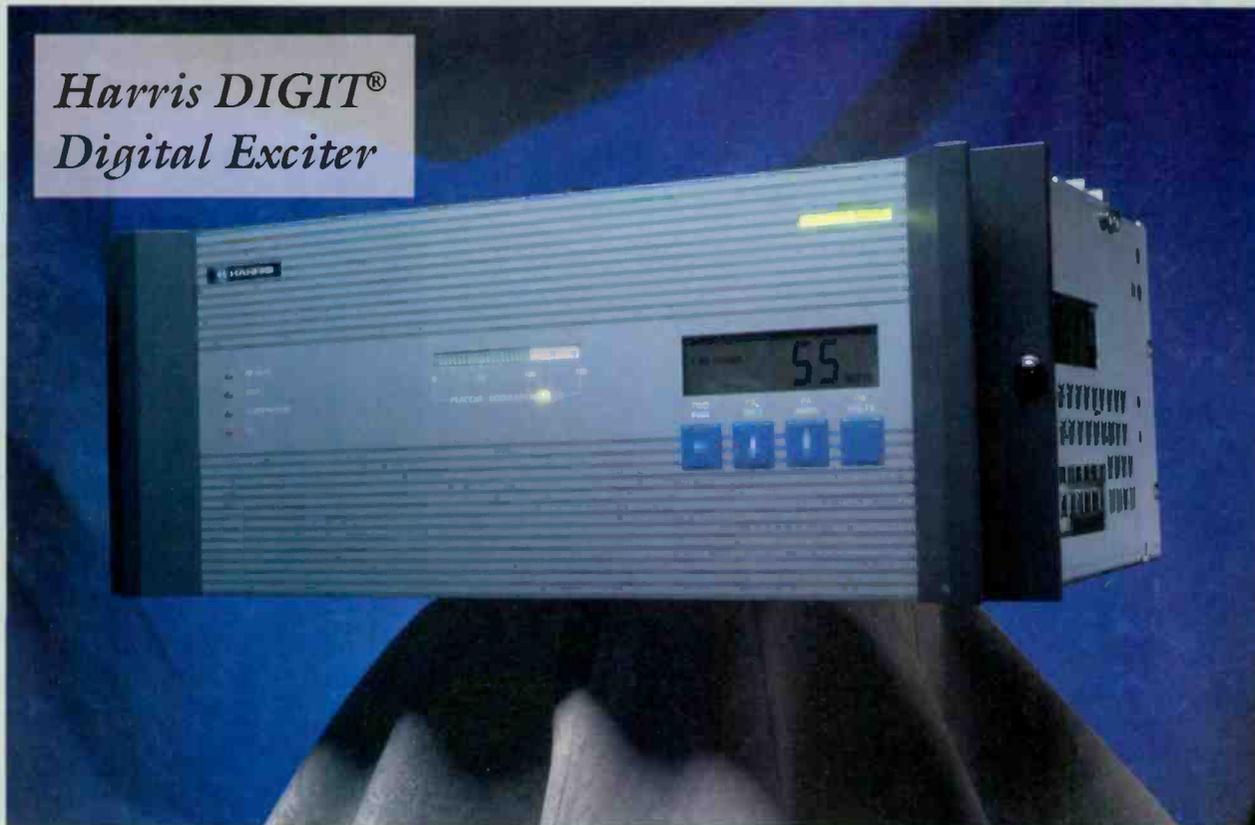
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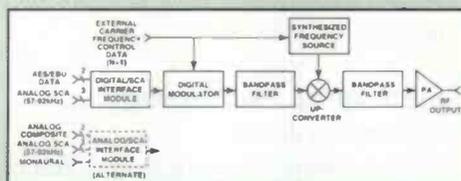
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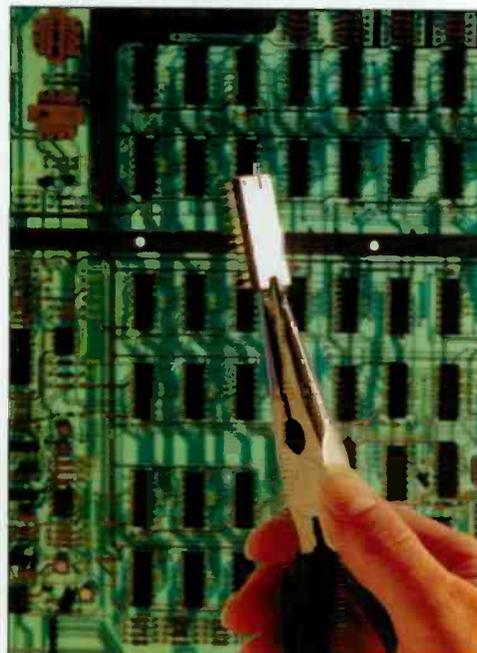
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ON THE COVER: Keeping things running smoothly requires the right people, proper skills and sufficient time to check under the hood. (Cover design by Stephanie Masterson, *BE Radio* art director.)



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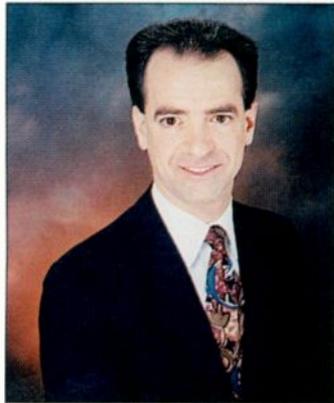
H A Harman International Company

Making history vs. becoming it

One of the buzzwords of today's computer industry is the *legacy system*, applied to any hardware or software that has been surpassed by current technology — in other words, anything that's more than about 18 months old. As broadcasting becomes increasingly computer-based, this phenomenon hits home: If the equipment that broadcasters use changes so quickly, doesn't this imply that the *users* need to change and upgrade their skills at the same pace, for the rest of their careers or else risk being relegated to the legacy bin themselves?

This problem doesn't just affect engineers and technicians; radio managers are also feeling the crunch of change. In the good old days, if you were a manager, all you did was organize people who were doing the same job(s) that you did earlier in your career. This was true throughout most industries, and it made management

training a fairly straightforward process. But today's managers are increasingly managing functions that they never actually performed themselves, and this unfamiliarity will only continue to grow. (Cartoonist Scott Adams credits this detachment as the source of much silliness in today's technical industries, which he lampoons so masterfully in his "Dilbert" comic strip.)



Clearly, the jobs in radio are changing (some jobs more than others), and the types of people who perform them are changing, too. Where do radio managers learn to deal with such shifts in personnel? Aren't they challenged enough just dealing with new competitive issues? And where do engineers and producers learn more about computers, as they must? Or, should managers hire computer technicians and try to teach them radio/audio operations? In either case, the process must allow growth into new areas without creating shortcomings in the ongoing traditional operations. Managers also need to avoid overburdening anyone with new responsibilities when staffers already feel that they're at their limit.

Perhaps the best arrangement is a *technology team* approach — a three-legged stool with traditional broadcast engineering, computer technology and technical management each handled by specialists. I've already seen this in place at some station groups, and it works

well. Managers hire (or retain existing) broadcast engineers to keep the transmitters and studios running, while creating new positions for computer techs who keep the computers and LANs operational and train staff in using computer applications. As all their work progresses, the broadcast engineers can't help but learn more about computers from the computer techs, and the computer techs learn more about radio and audio operations from the broadcast engineers. The managers pick up what they can from both technical specialists, and ideally, the techies learn something about management in the process. With the right people, it's win-win-win.

Meanwhile, managers can help the process along by sending their technology specialists to formal training classes, either to extend or update their area of expertise or to provide "cross-training" in other areas. Radio has always been quite interdisciplinary, and it's becoming increasingly so as computers, data transmission and multimedia elements enter the industry. Nobody can do it all alone, so you might as well build a good team. Today's consolidations may create the financial base and economies of scale to make this truly viable.

This issue of *BE Radio*, therefore, concentrates on radio's greatest assets — the people that make it happen. Is this odd for a technology-oriented magazine? I don't think so. No technology is worth much if it ignores the people who work with it. Radio's human resources aren't limited to its on-air talent. Without equally skilled folks in the technical production, operation and maintenance areas, no radio broadcast service will survive in the highly competitive media environment of today and tomorrow. If these technical talents are undervalued by broadcasters, they may simply move elsewhere, perhaps out of the broadcast industry altogether (as some already have).

The technologically based growth and change that radio faces will challenge everyone, managers and engineers alike. Make sure in your planning that you don't leave the people out of the process. In this business, the roles that human beings play are starring ones, and they'll never become outdated.

A handwritten signature in black ink that reads "Skip Pizzi". The signature is written in a cursive, flowing style.

Skip Pizzi, editor

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Growing your business

By William Fawcett

Good engineers don't always make good businessmen. A recurrent theme of this column has been to look at the "how-to" aspects of business organization and structure. Should you incorporate, what types of insurance do you need, and so on. Still, with all this advice, some find out the hard way that they are better off working for somebody else.

Organizational basics are fine, but the successful contract engineering firm must make decisions beyond that point — decisions that affect profitability and longevity. These decisions require more than structure; they require analysis and action.

The business mix

Determining your business mix and maintaining a flexible, open mind about the components of the mix may well determine if you sink or swim. The business mix may include which industries you will serve (the "macro-mix") and what your products and services will be (the "micro-mix"). (See Table 1.) The concept of a business mix is based on the time-tested principle of "not placing all your eggs in one basket."

THE MACRO-MIX (INDUSTRIAL ELECTRONICS)	THE MICRO-MIX (RADIO BROADCASTING)
Radio broadcasting	Field-service engineering
Television broadcasting	Turnkey installations
Cable broadcasting	Equipment sales
ITFS/MDS	Tower services
Cellular/PCS/Paging industry	Consulting (applications) engineer
Two-way radio industry	Audio/Studio processing specialties
Public address systems	Automation and digital specialties
Computer sales and services	Transmitter specialties
Telephone interconnect	Antenna and DA tuning
	Building trades - design/build

Table 1. Determining the elements of your business mix requires analysis of macro and micro factors.

Broadcasting has always followed cycles, and the field-service industry is directly affected by these cycles. For instance, in the years between the Docket 80-90 boom and the current mega-duopoly phase, there was a lull in new construction. Coupled with a time of recession, which brought a dip in advertising revenue, broadcasters were not spending a lot of money on engineering. During this period, some contract engineering firms branched out into related fields, such as telephone interconnect, computer and network installation or contract work with

the cellular industry. This is the basis for a "macro-mix."

Considering each component of your macro-mix, you must make even more decisions. For instance, in the broadcast-related field, some firms offer service only, while others attempt to make additional money on equipment sales. Other microcomponents may include consulting engineering (applications), turnkey construction, tower service and specialties, such as audio or RF.

Complicating your thinking is the fact that the "proper mix" is a moving target. What worked two years ago might not work today. A successful business must constantly analyze the current situation, look at future trends and make decisions. To really succeed, you must be willing to subjugate personal preference or gut instinct; look for those areas in which the money "comes easiest."

To sell or not to sell

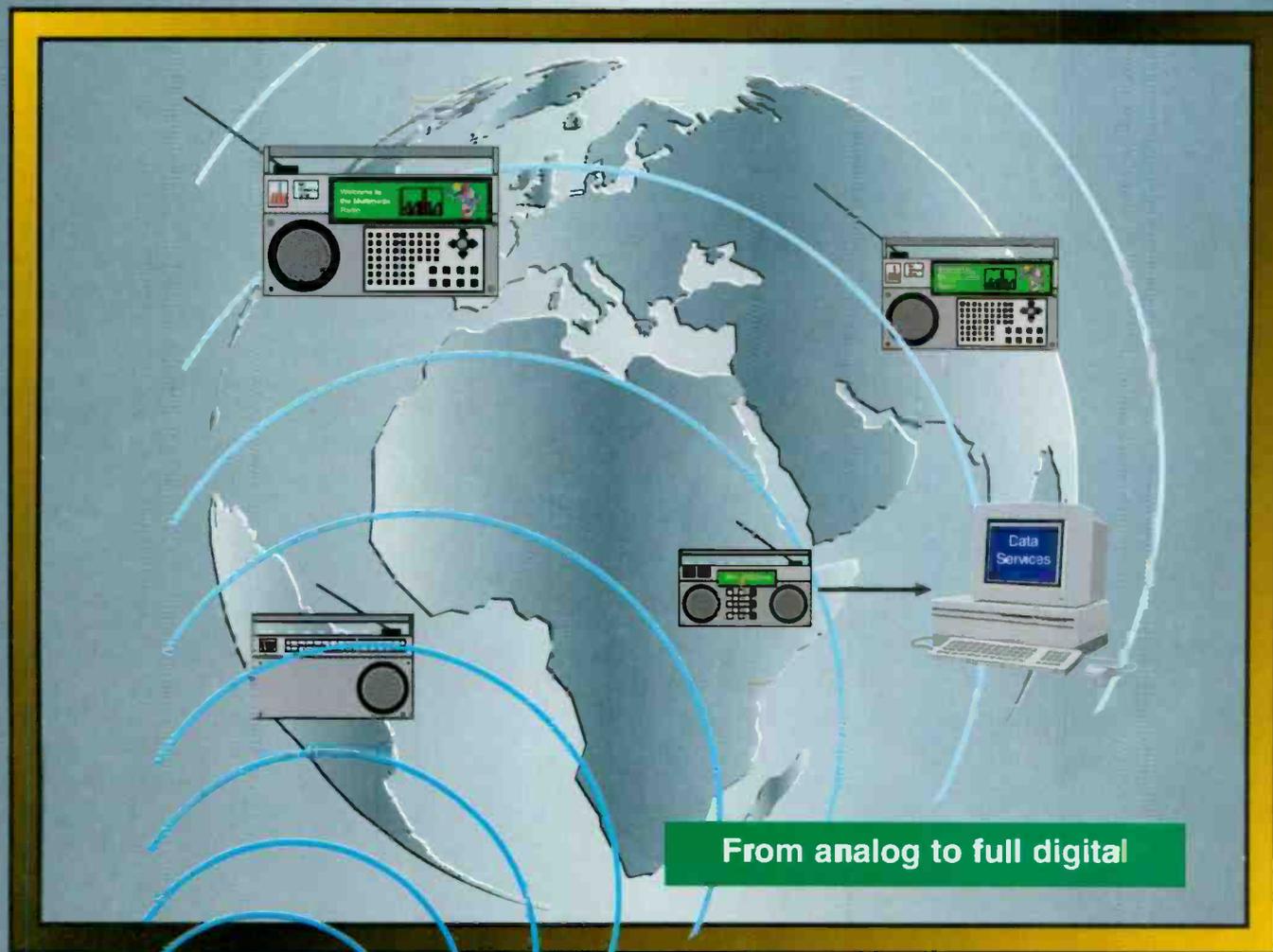
To understand some of the practical situations requiring analysis, look at one of the more basic micro-mix decisions. Some contract engineers serve as purchasing consultants to their clients. Others prefer to maintain more control, and hopefully more profit, by channeling all sales through their firm. Both paradigms have merit.

Not selling equipment allows the engineer to better present the perception of impartiality. This implies to your client that you are not making a recommendation based solely on your profit potential. Of course, that isn't always the case: Some engineers gain benefits from certain vendors for sending business their way. Such practices are not recommended.

To overcome this perception, however, a full-service contractor can offer several equipment options to the customer or allow the customer to price equipment separately (with competing bids) or simply operate in a "transparent mode." Operating transparently means establishing beforehand the profit margin that you will make, furnishing original invoices where necessary. For example, this might function as a "cost-plus-10%" arrangement.

To the customer, having a contractor turnkey the installation means they have one "point-of-blame" established. This eliminates the blame-shifting frequently encountered when dealing with multiple vendors. It also

Skywave 2000

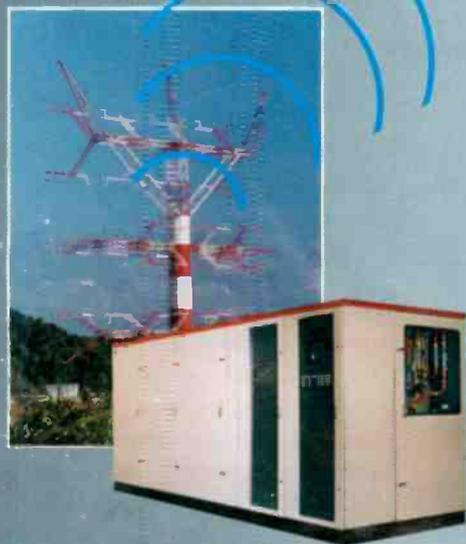


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Contract Engineering

allows the customer to maintain better control over completion dates, and it simplifies the purchasing process.

The difficult client will want the benefits of a sole source with the flexibility of shopping. Unfortunately, it doesn't work that way. A well-intentioned engineer may not meet a critical deadline because someone (the client) forgot to order a single 1 $\frac{5}{8}$ -inch EIA bullet. Worse yet, an entire tower crew may

have to be scheduled again because of material shortages.

The sole-source contractor also faces a much higher implied liability.

These decisions require more than structure; they require analysis and action.

If the customer buys from an equipment supply house, a warranty problem usually means replacement. The sole-source contractor will probably

have to absorb the air-freight charges and labor for reinstallation incurred in such replacements. Furthermore, the contractor is expected to absorb these costs while remaining competitive with non-servicing vendors. It is next to impossible to write a contract that will ab-

solve you from implied liability. Even if you could, your customer would probably still be unhappy.

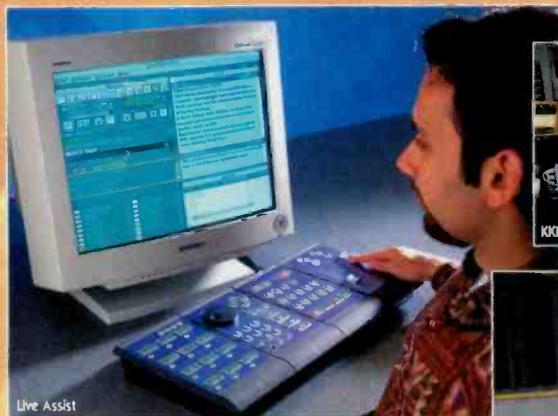
The contractor must also expend time and energy setting up accounts with vendors. Often, these sources will not be the manufacturer, but another non-servicing vendor who will exchange a deeper discount for a higher volume of sales. This is known in the industry as "two-stepping." With a little work, you can locate sources that will two-step small quantities at better prices than going direct. This occurs because you help them get their quantity level up to a lower-priced bracket. Furthermore, your credit rating may be better than many other potential end-users and vendors are well aware of this. In some cases, you may have to borrow money on short-term notes to finance a major equipment buy, but you'll receive a better price than your client might have been quoted directly.

The elements of your business mix may well determine if you sink or swim.

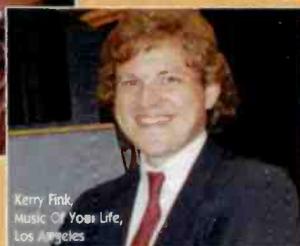
Conversely, you will then need to make good decisions regarding extension of credit to *your* customers. You might want to request up-front money from the client. (Often, your supplier will allow an additional discount to you for cash payment.) But is it possible to provide competitive pricing to your customer while absorbing a giant implied-warranty liability? That is the crucial element of this puzzle.

Continued on page 46

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Datacasting

By John Battison, P.E.

The radio wheel has made almost a complete cycle since Marconi's early transatlantic experiments. In those days, attention was focused on the future and growth of radio and using wireless communication to transmit news and business information, typically point-to-point. Transmission of entertainment was barely considered, and certainly its modern expansion and point-to-multipoint application was never foreseen.

Today, as radio's competition has increased, a trend has developed that in some ways returns to Marconi's original concept. Although point-to-multipoint entertainment remains a primary application of the radio broadcast chan-



Prototype receivers built by Sanyo, Sharp and Sony for the Digital DJ datacasting system.

nel, superimposed on it is non-entertainment, non-audio material — some of which is transmitted in point-to-point (addressable) fashion — which does not affect the primary audio service. It's called *datacasting*.

Some background

Among the problems involved in inserting data transmission into AM and FM broadcast services is that of interference to the main program channel. FM engineers have long been familiar with the whistles and squeals ("birdies") that can accompany programming on an improperly adjusted FM station with several subcarriers in operation.

An early form of what might be called datacasting was employed by FM and AM stations using their main carrier to transmit telemetry data for remote-control systems. This data reported the operating parameters of the stations' transmitters. FM subcarriers and AM baseband signals were used to avoid the cost of a separate TSL path for remote control.

FM subcarrier data transmission has been in use for many years and is exemplified by the early use of *Subsidiary*

Communications Authority (SCA) operation as a way of gaining income when FM was still a "Forgotten Modulation."

Datacasting using text transmission is also nothing new. In the TV environment, the BBC introduced *CEEFAX* more than 20 years ago, and in the United States, *Teletext* was offered by a few stations. In radio, before today's *Radio Broadcast Data System* (RBDS) was introduced, FM subcarriers were used mostly for paging and limited data transmission.

With RBDS's arrival, interest in data transmission increased, and for the first time broadcasters could add non-audio data intended to supplement audio programs heard by the main channel's listeners — so-called *program-associated data* (PAD). This trend may continue in the emerging move toward higher-speed FM data transmission. While FM rather obviously offers a wider bandwidth than AM for auxiliary data transmission, AM is not completely out of the running (more on this later).

Today's high-speed systems display their digital messages on small LCD screens. Some receivers look like a regular radio with a small screen between the two stereo speakers, while others use dedicated, pager-like receivers without audio capabilities.

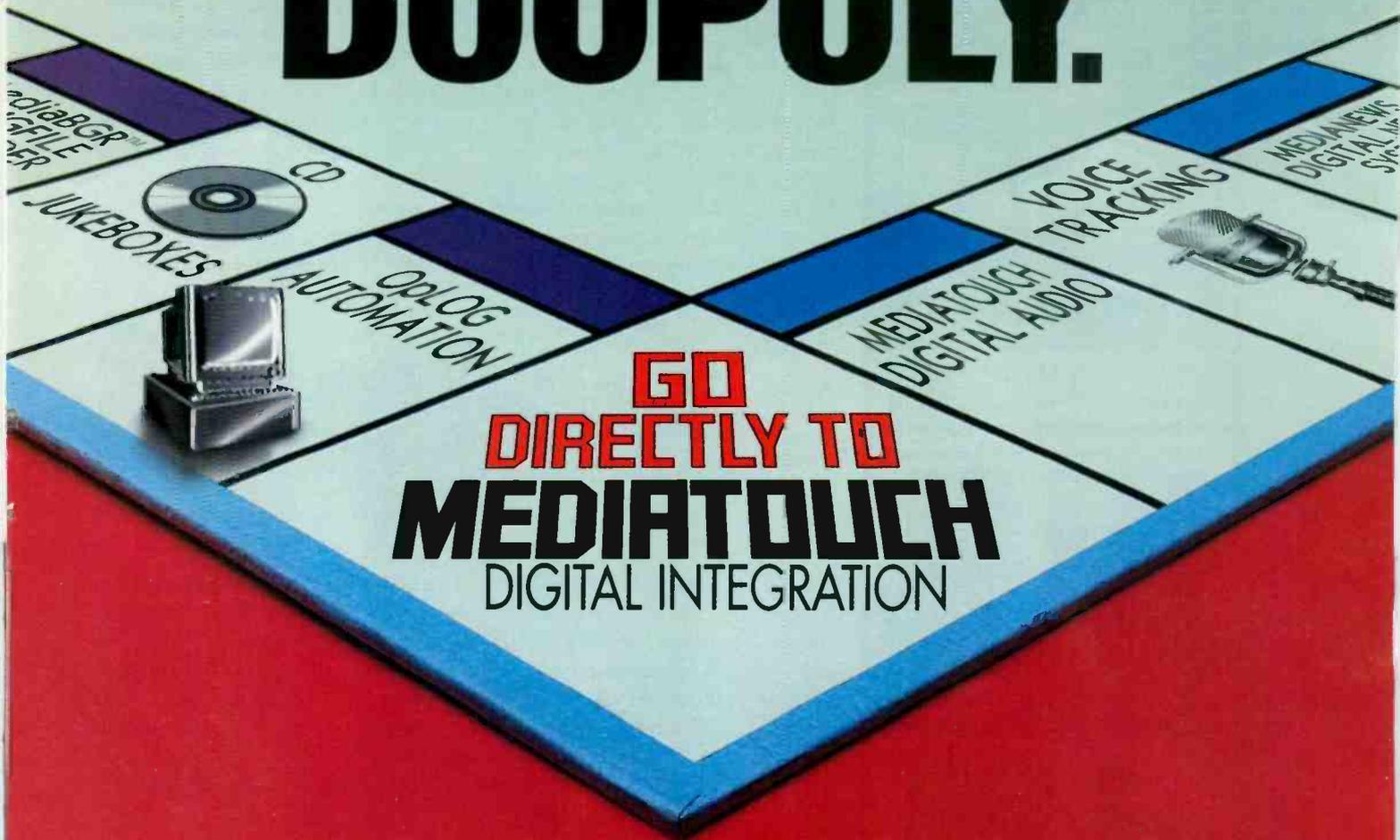
Standardization

A number of systems have been proposed for high-speed datacasting. Such a system would supplement the relatively low-speed (1.2kb/s) RBDS standard that has been established for U.S. data transmission on FM radio. This has raised the question of whether another standard for high-speed datacasting should also be set.

With that in mind, the NRSC has established a High-Speed FM Subcarrier Subcommittee to study the proposals and recommend a standard for U.S. application. Laboratory tests are being conducted at NASA Lewis Research Center in Cleveland (where DAB lab tests were conducted), under the stewardship of veteran engineer Tom Keller. Meanwhile, unilateral field tests (not under NRSC auspices) of various formats are under way in Seattle, Minneapolis, Atlanta and San Francisco.

Some proposed high-speed data systems intend to make use of an FM station's full subcarrier spectrum, replacing existing 67kHz and 92kHz data transmission services, but retaining compatibility with RBDS. Other formats may also retain compatibility with 92kHz services. This compatibility is one of the parameters to be included in the systems' laboratory tests. Other issues to be tested include signal-failure characteristics, reacquisition time, effect on main

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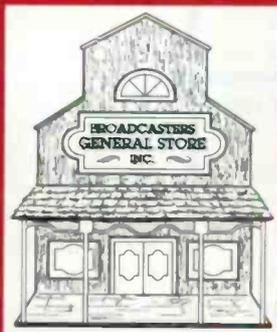


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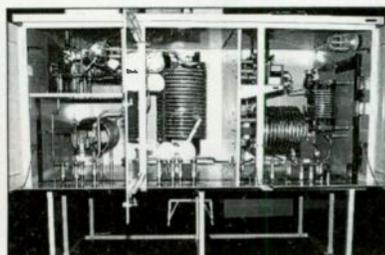
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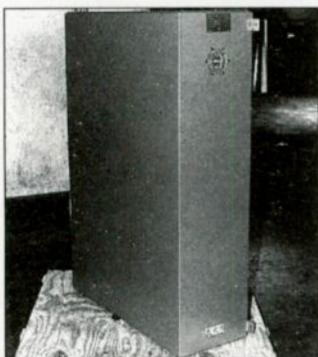
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audio signal (and vice versa) and adjacent-channel (first and second) compatibility.

Seiko HSDS

The *High-speed Subcarrier Data System* (HSDS) has been developed by Seiko. This system is already in operation for paging in a few markets and employs Seiko's advanced receiver technology, *Advanced Communications and Timekeeping Technology* (ACTT). The Seiko *MessageWatch*, a wrist watch/pager, is a direct implementation of this technology.

The regular FM-stereo pilot at 19kHz is used to simplify circuitry by referencing both HSDS subcarriers — a 66.5kHz primary and an 88.5kHz secondary — to it. (The primary is 3.5

is used for error correction. This is a form of parity coding resulting in a "frame" that is composed of parity bits and data. The lower the information rate, the greater the error protection (i.e., more parity bits).

Mitre STIC

The Mitre Corporation is probably best known as a think tank for high-tech federal projects. Its reputation in such areas of electronic wizardry as the Global Positioning System (GPS) made it a natural to develop the *Subcarrier Traffic Information Channel* (STIC) for the Federal Highway Authority of the U.S. government.

Under the government's proposed *Intelligent Transportation System* (ITS) the subcarriers of thousands of FM

SYSTEM	BASEBAND CENTER FREQ.	BANDWIDTH	USEFUL DATA RATE
FMSS (DIGITAL DJ/NHK)	76.0 kHz	15 kHz	6.8 TO 9.8 kb/s
HSDS (SEIKO)	66.5 kHz	20 kHz	10.5 TO 13.1 kb/s
STIC (MITRE)	72.2 kHz	15 kHz	7.5 kb/s

Table 1. Some parameters of the three high-speed FM subcarrier systems currently under test.

times the pilot and the secondary is 4.5 times.)

A duo-binary-encoded PSK differential modulation technique is used. Bandwidth reduction varies depending on the relationship between the successive bits. A code word is transmitted at intervals to provide a check on transmission/reception accuracy.

Digital DJ (DDJ)

The *FM Subcarrier Service* (FMSS) from Silicon Valley-based Digital DJ is an adaptation of the Japanese broadcaster NHK's *Data Radio Channel* (DARC) system. Once again, advantage is taken of using a subcarrier frequency related to the pilot tone — in this case 76kHz (4x pilot). This is modulated with 16kb/s data using a technique called *level-shifted minimum-shift keying* (LMSK) and injected at a maximum level of 10% (-20dB). The actual subcarrier modulation varies between 4% and 10% depending on the modulation level of the stereo (L-R) subcarrier, to minimize audible artifacts in the main channel audio.

A system known as *product coding*

transmitters around the United States could broadcast traffic and navigation data using STIC.

The system uses a 72.2kHz subcarrier for a 15kHz signal modulated with 18kb/s data. A variant of phase shift keying (PSK) modulation is used. This reduces modulation-amplitude changes and potential interference to other signals on the carrier.

Mikros System

The current round of testing considers only FM subcarrier systems. Another format has been proposed for use on AM stations by Mikros Systems Corporation of Princeton, NJ. The system has a slight similarity with USA Digital Radio's IBOC digital AM system in that both make use of the adjacent -25dB "wings" in the NRSC AM mask.

The proposed Mikros system is compatible with AM stereo because it does not use QAM. The latter is not required because the wide-bandwidth signals of digital audio are not being transmitted. Data is placed on four narrowband subcarriers, two each in

RF Engineering

the lower and upper sidebands of the AM channel. Each subcarrier can carry 2.4kb/s, providing a total capacity of 9.6kb/s. The system has been proposed to carry RBDS data for AM stations, which requires only 1.2kb/s. The remaining 8.4kb/s could be used for powerful error correction.

WCRB/Sanders

A more recent entrant to the IBOC DAB format wars might also have an application in datacasting. The system proposes the use of a single 40kHz-wide subcarrier, occupying practically the entire FM baseband remaining above the 57kHz RBDS subcarrier. With adequate data compression and modulation, this could be used for a DAB signal, but it might also be applied to a very high-speed auxiliary data service — on the order of 160kb/s or higher.

The system's developers point out that today's 28.8kb/s wired computer modems squeeze 12b/s/Hz out of a dial-up analog phone line. Multipath is not encountered in a wired phone line, but considering that half this performance (6b/s/Hz) might be achieved in a wireless application, a 40kHz subcarrier could provide a 240kb/s data rate. Even after conservative (rate 1/2) error correction, 120kb/s could be available for data programming.

The applications of such bandwidth could be myriad, including auxiliary (highly compressed) audio, PAD, third-party data or even the station's home page in a non-interactive form.

Much development and testing is required before this system is ready for testing, but it indicates where the leading edge of radio datacasting development now stands. Regardless of format(s), the worm is turning. Tomorrow's broadcasters may see a significant portion of their business moving to non-aural transmission.

Battison, BE Radio's consultant on antennas and radiation, owns John H. Battison and Associates, a consulting engineering company in Loudonville, OH.

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Down to the wire

By Leonard J. Charles

If you have not yet educated yourself about the new Emergency Alert System (EAS), you'll have to take a crash course — and soon. The EAS must be operational at all broadcast stations by Jan. 1, 1997. There isn't enough space in this column to get you completely up to speed, but what follows are some suggestions for finding the information you'll need.

First, contact your State Emergency Communications Chair (SECC). (If you don't yet know who your SECC is, contact the FCC's Bonnie Gay at 202-418-1228.) The SECC can tell you what your station's designation is in the new system and what sources you are mandated to monitor with your new EAS decoder. Although a minimum of two sources are mandated to make up your national and state web, most SECCs are suggesting additional frequencies to aid in your connection to local emergency sources.

You'll also need the frequency of your nearest National Weather Service (NWS) transmitter. It's another source that you'll want to monitor with one of your EAS decoder inputs. This is especially true if you live in a section of the country where weather events can contain life-threatening force. The National Oceanographic and Atmospheric Administration (NOAA, the parent of NWS) is busy upgrading facilities to attain 95% national coverage while installing equipment to transmit the *Specific Area Message Encoding* (SAME) headers preceding weather alerts. These codes are contained in FCC Part 11 EAS rules and will trigger your EAS decoder.

Local input

Chances are good that you or your station's engineer are a member of a local Society of Broadcast Engineers (SBE) chapter, or that you at least have a chapter in your area. Most SBE chapters are busy working on local EAS plans and, therefore, they have valuable information for you. This information will help you establish specific connections with local emergency sources so that you can inform your audience of any local non-weather emergencies as they occur. (The SBE also offers the *EAS Primer*, an excellent basic resource for broadcasters on EAS, and a book that should be on every station's reference shelf.)

Many local emergency officials are installing EAS

encoders on government channels, and they will deliver messages to your station already EAS-encoded and able to be relayed. You simply need to purchase receivers on their specified frequencies and interface their audio to your EAS decoder inputs. While you and your local emergency officials are currently limited to the event codes contained in Part 11 EAS rules, the FCC has promised an additional list of local event codes in an upcoming (third) *Report and Order*. To find an SBE chapter near you, contact Peggy Hall at the SBE National Headquarters in Indianapolis at 317-253-1640.

Surfing for data

Finally, if you have access to the Internet, you have the ultimate resource of EAS information at your fingertips. A recent World Wide Web search using the words "Emergency Alert System" netted more than 200 listings of sites containing information on various aspects of the new system. Among these are equipment manufacturers

who have sites describing their equipment in detail. Some of them solicit input from you on suggestions for future software enhancements.

Another site on the list is

the SBE at www.sbe.org, which has pages of EAS information updated regularly. This site includes links to the FCC rules pertaining to EAS and the entire listing of SECCs sorted alphabetically by state. There are also some EAS state plans that come back as part of an EAS web search. These are of particular interest to any SECCs looking for ways to enhance their own state plan.

Other listings are from some Internet service providers who seem determined to find a way to make the Internet become a valuable tool to emergency alerting during an actual event. These providers are interested in your input on that process. The Internet has been cited by some as a huge waste of time, but in the case of an EAS search, it can prove itself well worth the price of admission.

Leonard Charles is an engineer at WISC-TV, Madison, WI, and chairman of the SBE EAS Committee.

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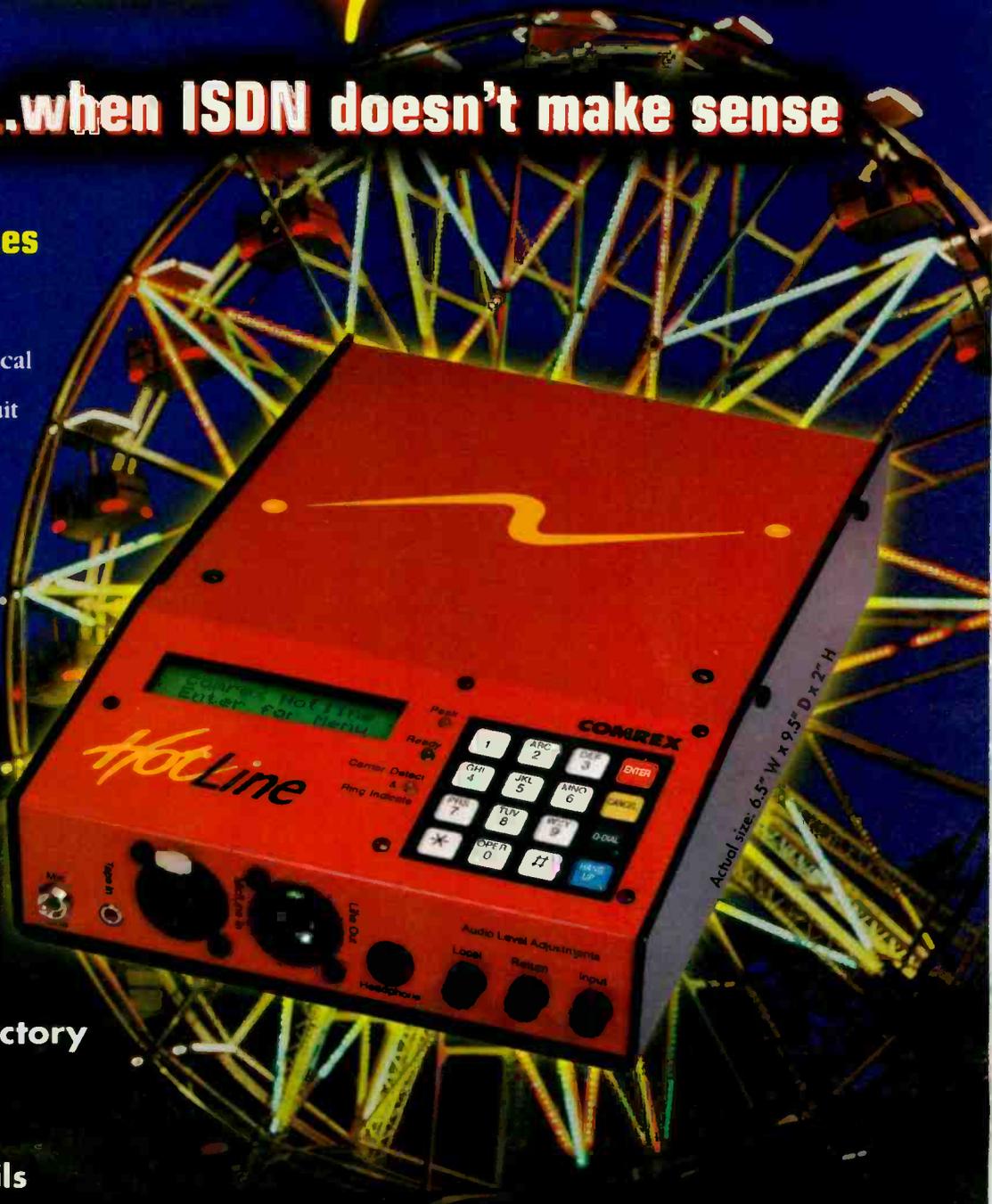
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Maintenance: The skill that time forgot

Who has time for maintenance anymore?

BY CHUCK LEAVENS

Maintenance? What maintenance? With the consolidation rage in full swing, it's a crisis-to-crisis work environment. Whether you're a radio manager, a contractor or a staff engineer, you're no doubt feeling that it's not like it used to be.

Between putting out fires in the studios and dealing with other "special projects" that have to be done *immediately*, a single transmitter emergency can throw the best-laid schedule off for weeks. Simply working more hours isn't the answer. Engineers and managers need a life, and besides, if you're fully rested, you make much better use of your time at work and are much more pleasant to be around.

The following are some tips directed at radio engineers to help them cope with the challenging and rapidly changing technical environment of the day. Many of these apply to today's radio managers, as well.

SURVIVAL SKILLS

Make lists and work from them. Always. Try it on a computer, try it in a notebook — big ones, small ones — write your own software, use shareware — whatever works for you. The point is to find something you can stick with.

For many people, even those who love computers and

writing software, keeping up with a "To Do" list in software can be a problem. They may start out well enough, but after a couple of weeks, they start letting it go. For these folks (and this may include most of us), working off a printed page is probably best. Of course, you can create the page on a word processor or scheduler, but print it out for your daily use. You may want to experiment and find what works for you over the long term. It's worth the effort and the time.

Find better ways to use your time. Try going to the parts store on the way to the station(s) or swing by the transmitter site on the way home. Be efficient with your time while you're there. (No schmoozing with the boys at the parts store — just get the stuff and go.) Sequencing tasks in this way keeps you focused. Of course, if something unforeseen occurs at any stop along the line, everything downstream can be affected by delays. So carefully plan the order of your stops.

Use resources better. If there are areas in which you have less expertise, use the talents of others to help. It's much easier to maintain something if you have the knowledge base. Many engineers have had so much experience with certain pieces of equipment that they haven't cracked open a manual in years. But what about newer technologies, such



Maintenance: The skill that time forgot

as hard-disk audio storage, DAT machines, ISDN and the like? One way to help improve your awareness is to get on Internet mail-list discussion groups that cover an area you want to know more about. There you can ask questions of others who might have more training than yourself. This is a way that you can gain faster insight to technology that may be new to you and can make your time much more efficient. It certainly beats hunting in the dark. If you can't find a group with your specific need, there are general ones that may still be of use. You'll often find a lot of opinions, and within it all is a great deal of useful information. Collective minds are certainly more powerful than an individual's.

Consider volunteers. It may sound crazy, but many broadcasters have been doing it for years. There could be a student who just wants the training and experience. No broadcast school or university can give a student as much practical experience as working beside an engineer for one day. Just tagging along is a post-graduate course in itself. (How many of you reading this right now were trained that way?) There may be a senior citizen who just loves radio and loves being active with it. Or find a retired engineer who still wants to be active a few hours a week. These hours can make a big difference. It can help take the edge off a busy schedule and expand your work output on a tight budget.

Design a maintenance plan and stick to it. You might schedule your maintenance by particular

rooms or by equipment type on certain days. It's your choice, but the important part is to find something you can remain consistent with. Experiment and find what's right. Creating a preventive maintenance schedule is not brain surgery, but it can be made impossible by an excessive workload or by overly optimistic time projections.

HEALTH AND WELFARE

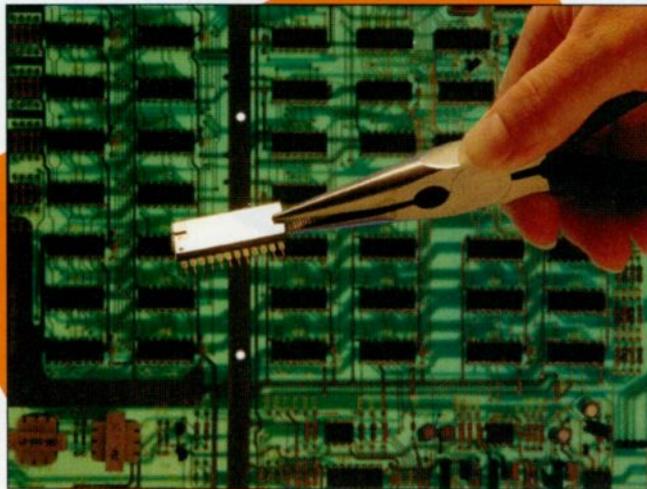
Take care of yourself physically. You may not be able to keep those washboard abs, but do protect your basic physical and mental health. When it is time to go home, go home. Spend time with your family. Have other interests. Watch the news. (Read a magazine.) Give your mind a rest from work.

Some engineers are so overwhelmed with work that they walk around delirious and don't even realize it. You can't be efficient if you don't have a rested mind. Set boundaries in your life and don't skimp on your sleep. In fact, it's a good idea to try building up a strong reserve of rest if you can. Those middle-of-the-night pages are unavoidable in this business, and they can upset your body rhythms for days. (You know the feeling.) Just like people who travel a lot and deal with jet lag, there's no substitute for a well-rested constitution in helping you bounce back quickly.

Even though you may not be nodding off at your desk, you may still be suffering from burnout. Watch for subtle warning signs. For example, have you ever found yourself having problems doing something that you've done repeatedly in the past without difficulty? Or are you tempted to devise new shortcuts to your procedures that you never would have used in the past? Or have you come upon something you did earlier and wondered what or why you did it? Don't cheat yourself or your employer out of your best work. Get yourself in the proper frame of body and mind to do the optimum work you're capable of doing.

Acting nasty or losing your temper is

another symptom of work overload, and it is one that can affect your professional status for a long time. It



may be useful to have an agreement with your employer(s) that allows you to let them know when you need a break. It helps a great deal to have these discussions before you ruin a business or personal relationship.

COMMUNICATIONS

What do you do with those folks who grab you in the hallway and want their project done right now? This can totally disrupt a maintenance schedule, but it may frequently happen to you. Naturally, there are some things you can deal with right on the spot and some things that you can't. When you can, solve the problem and get back to your schedule. When you can't do this, make sure you let the person know in some way that their project is important and you will get to it. And *do* get to it.

Whether it's something that requires more planning or additional equipment or parts or the time that the project needs just does not exist at that moment, let them know in a clear way what's going on. Listen to and consider their thoughts and feelings. Don't let them think that you just don't have time for them or that you don't care or that you are just mean and obstreperous. Bringing them in on your thinking in a calm, clear and reasonable way will usually generate understanding for *your* situation and buy you more time to finish one project before starting another. It also can help generate respect for

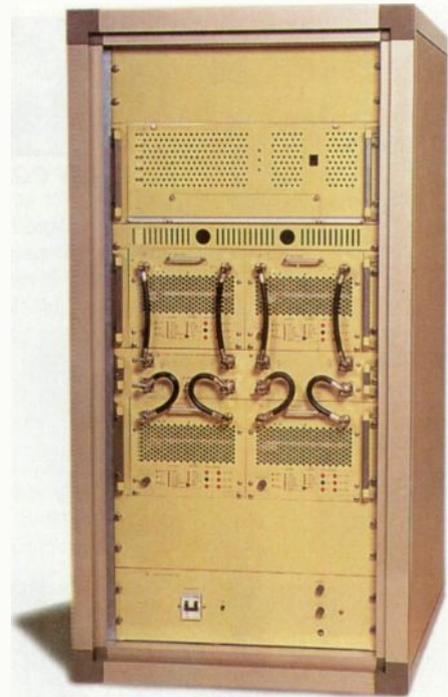
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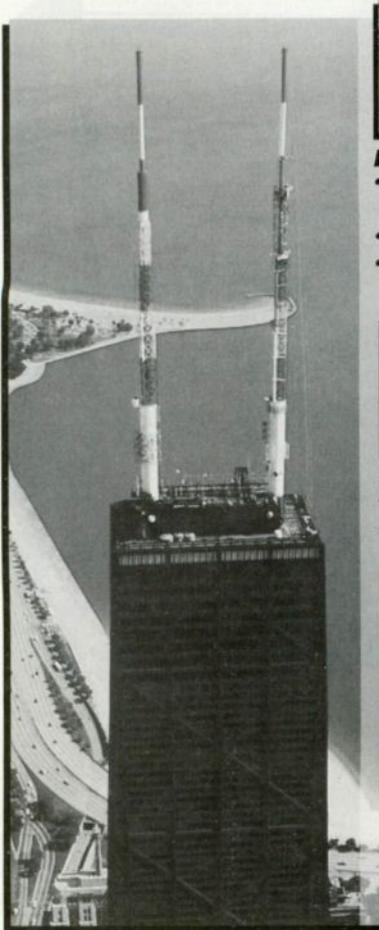


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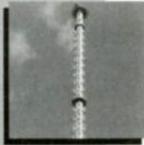
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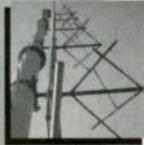
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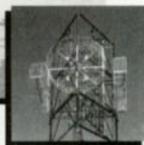
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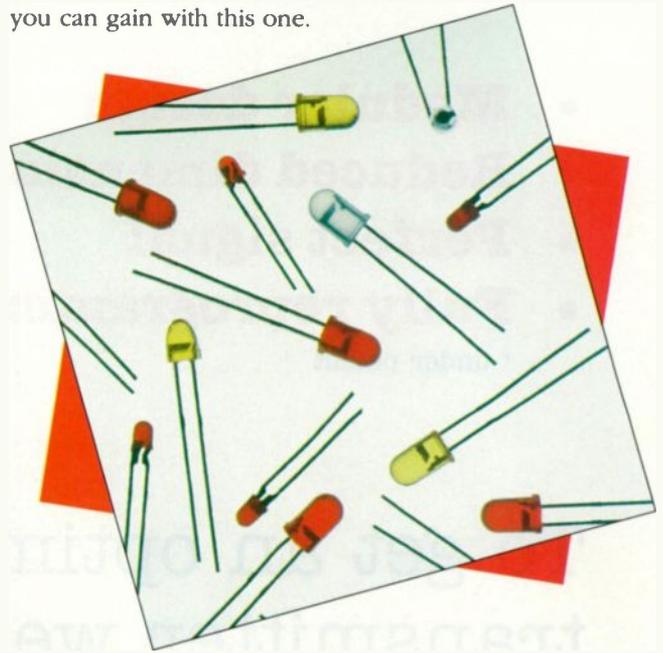
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**Maintenance:
The skill that time forgot**

your position and your work.

Be a communicator. Enough cannot be said for working on your people skills. Clearly defining the priority of projects and keeping people aware of their projects' status are of paramount importance. Make your "clients" a part of the process. Talk clearly and concisely; listen clearly and thoroughly. It's amazing how much you can gain with this one.



NUTS AND BOLTS

Another way to maximize your capabilities and minimize your stress is to have the right tools and test equipment on hand. Naturally, test equipment has to have better specs than the equipment it's testing; today that's a tough requirement to fill. Professional digital audio systems have such high performance that test gear must be absolutely topnotch in order to provide any useful data. These systems are out there, and they're quite nice — but not inexpensive. (Actually, considering what the latest audio analyzers can do compared to the test gear of not so long ago makes them incredible bargains in relative terms.)

You may not be able to keep those washboard abs, but do protect your basic physical and mental health.

Squeezing money out of a station's budget for test equipment has always been a hard argument, and no less so today. The move toward consolidated facilities can help, however. It's easier to justify sophisticated test gear (including a spectrum analyzer) for a shop that services five stations than it would be for a single-station facility. If you're a contractor,

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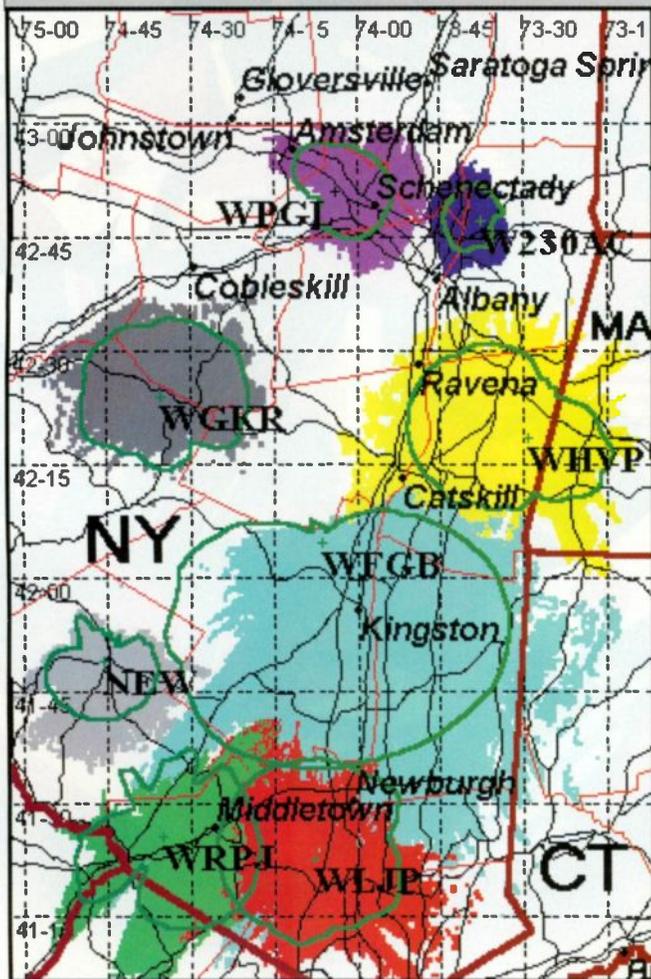
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Maintenance: The skill that time forgot

of course, the only one you've got to convince is your banker. But contractors must have the proper tools if they want to stay in business.

Some engineers feel that it's not technologically macho to send certain devices out of house for service. Avoid this outdated attitude. Stocking parts and manuals for everything in the facility — including non-mission critical devices that you only have a couple of in the facility — may just not make sense. Keeping a few spare products or boards on hand and swapping them out while the defective unit is out of house is OK. You're not being a techno-weenie to work that way for certain items. It's your job to keep the place running, and to do it cost-effectively. That doesn't necessarily mean that you've got to fix everything yourself.

SKILL BUILDING

If you're not already completely comfortable with computers (at least PCs), you should get there quickly. This includes operation and basic servicing. Some programming ability wouldn't hurt either (although for complex systems, such as workstations and on-air automation, a little programming knowledge can be a dangerous thing; leave this stuff to the code jockeys who created it). You may also be called on to do computer training from time to time, especially when new

Even though you may not be nodding off at your desk, you may

still be suffering from burn-out.

software is installed or a new ops/production staffer is hired, so polish those skills as well.

Recognize that knowledge never ends. Keep yourself sharp with continuing education. Take advantage of technical books, magazines, manufacturer training, professional society meetings and conferences, trade shows or even some college coursework. The engineer is a perpetual student.

Finally, if you are a member of an engineering staff or a contract engineering firm, consider that you are on a team. The best working strategy for the team has to be determined together. Maintain a positive attitude and open dialog among the team. Whether it's production rooms on Thursdays or DAT refurbishment on Mondays, good scheduling of service and proper upkeep of your facility is important. A good balance of preventive and emergency maintenance is the key to success.

Radio broadcasting is complicated and it's getting more so all of the time. Keeping a broadcast operation running is hard work. Good scheduling, open communication paths, proper tools and a healthy lifestyle are all necessary to do the job right.

Chuck Leavens is director of engineering for WDUQ-FM, Pittsburgh, and president of Leavens Engineering Associates.

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Designing studio infrastructure

What's behind the scenes can
make or break a studio.

BY CHRISTOPHER H. SCHERER, CBRE



Chances are that some time in your career you have been part of a studio design project, either from the ground up or a simple (when is it ever simple?) remodeling. Some elements of the studio are intrinsically given major attention, such as the mixing console and audio playback devices. Yet, there are many other items worthy of the same level of concern that rarely get it. These are the elements of a studio's infrastructure — the “unsung heroes” of facility design.

A successful studio project will have a well-detailed plan for its completion.

Good ergonomics (“human engineering”) adds greatly to the user-friendliness of a production control room.

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Don't overlook the items that can take the entire room down (or make it a nightmare to work in) because they weren't fully considered in the design stage. Among the most commonly neglected items in this category are studio furniture and layout, wiring, connectors and power distribution. They can each play a major role in the success — or failure — of your project.

FURNISHING THE COMPUTER-BASED STUDIO

Studio furniture is the foundation of any facility. It holds most of the equipment, and practically every other device in a studio will connect to it or pass through it. A good furniture layout will have everything in an accessible place for the operator, with enough rack, shelf or display space to accommodate all the tools and supplies needed for a successful broadcast.

Most people still prefer lower-profile control-room countertops so the operator is not surrounded by a cavern of equipment. This can also help monitoring acoustics. Determine early on if operators prefer to work sitting or standing, however. This will have an impact on the entire furniture design for control rooms.

The addition of video monitors to today's studios dictates a rearrangement of the space in front of the operator. A sturdy boom mount can allow flexibility of the monitor's placement. In some cases, video monitors can be semi-flush-mounted in the countertop and angled up for easy viewing while still being out of the way. Rack or cabinet mounting is also a possibility, but carefully consider the height of video monitors' placement. Viewing straight-ahead to slightly down is comfortable to most people. Placing video monitors too high can cause neck strain.

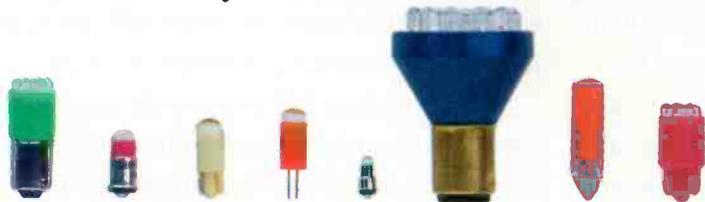
A QWERTY keyboard typically accompanies these monitors, and it usually needs to live nearby, even if it is only occasionally used. Undercounter drawers can put keyboards out of the way but still allow easy access. Be sure they will not be in the way of the operator's knees, both for human comfort and equipment longevity. If a mouse or trackball is required, its placement is also critical. Putting it in the drawer with the keyboard eliminates yet another item from the desktop, but the drawer will have to be large enough to accommodate both items. In many cases, however, the mouse/trackball will need to be accessible frequently, while the keyboard is needed only on rare occasions.

Another idea to reduce the clutter in front of the operator is a monitor switcher, which allows a single VGA monitor to be used with multiple computer CPUs. This lets the operator switch between displays from the news computer, the web browser, the automation system or other sources. In some cases, the sources to be switched may include VGA and NTSC video signals (the latter allowing the operator to monitor weather, news, videotext, etc., from broadcast or cable TV channels). Plan accordingly for any adapters that may be necessary to accommodate this.

When selecting a video monitor keep in mind that some are better shielded than others, and some have a louder



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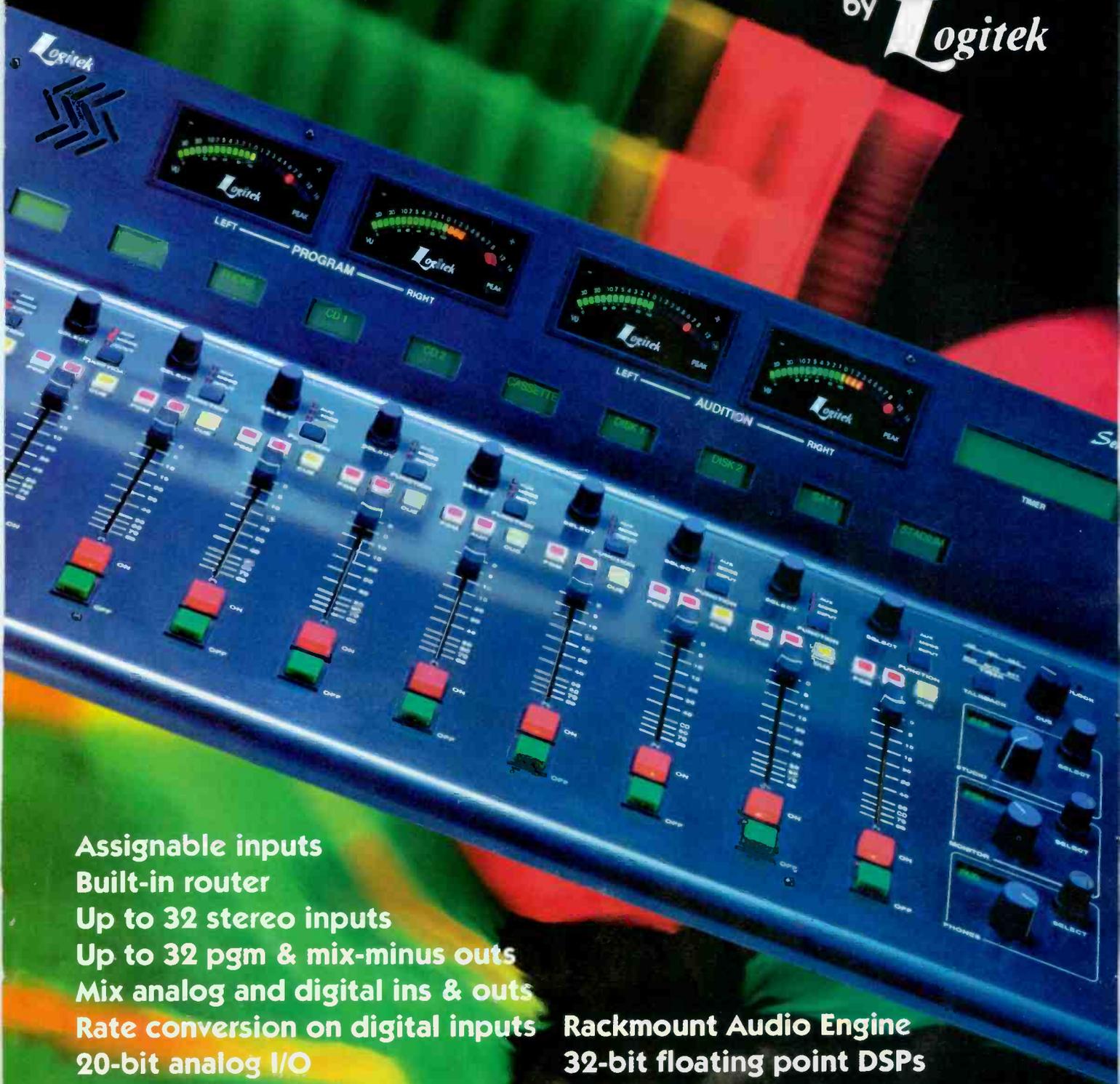
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Designing studio infrastructure

"whine," as well. With multiple monitors running in a control room, the added noise is a consideration.

Possibly the ultimate solution for video monitoring in the control room is the use of multiple flat-screen ("laptop-type") displays. Even touchscreens are available in this form today. They provide advantages in reduced size, electromagnetic radiation, heat, weight and acoustical effects. Unfortunately, they don't carry these reductions to their price tags. As with all other computer-related products, however, pricing is likely to im-

prove over time. Once they become only slightly more expensive than equivalently sized CRT-type monitors, they will probably become commonplace in the radio facility. For some installations, they may even be worth their current price premiums today.

the additional cables required. This adds cost to the installation (as much as \$1,000 per computer), particularly when multiple computers are used in each control room.

Nevertheless, the remote CPU approach is usually worth the effort. You probably spent a bundle to acoustically isolate these rooms and get their HVAC systems quiet, so why make them noisy (and hotter) if you can avoid it? Putting the CPUs in another area also allows software and hardware changes to be made without interrupting the operator. If a CPU fails, it's convenient to have a room to work in that's not on the air. With all

Computer clocks are notoriously unstable. Take a look at yours if you haven't for a while and see how far it has drifted. Studio master clock systems are far more stable and can be referenced to external standard timing references (or manually adjusted on a regular basis). They can be tied into your complete facility (including computers) so all systems are synchronized for recording of feeds, airing of programs, switching between in-house and external sources or changing of equipment settings (such as day/night patterns and powers for AM stations or daypart audio processing).



Sufficient rack space and wiring capacities are essential to flexible station operation.

prove over time. Once they become only slightly more expensive than equivalently sized CRT-type monitors, they will probably become commonplace in the radio facility. For some installations, they may even be worth their current price premiums today.

Yet another critical issue in computer-based radio studio design is where to put the CPUs. Will you house them in the control room or in a separate terminal/rack room? Both approaches have advantages and disadvantages. CPUs certainly do create noise and heat, and they take up more space in the control room. Locating them outside the acoustically critical areas eliminates these problems, but requires the use of active cable-extending systems. You also have to run

the CPUs in one room, it's also easier to tie them together for monitoring, control, troubleshooting or upgrades.

TIMING IS EVERYTHING

Time is another issue that is often overlooked in studio design. A broadcaster's program logs are worthless if an accurate time reference is not available. For stations that produce all programming locally, a free-standing clock is usually accurate enough, requiring only occasional adjustment. But for stations that join a network frequently, a master clock system is mandatory.

If you have a computer-based audio storage or automation system, you've probably learned that relying on the computer's clock is not a good idea.

SIGNAL PATHWAYS

When all you had was line-level audio and AC power, the rules were pretty simple: Just keep them apart, avoiding parallel runs. Today, you are adding data signals (either audio or control), LANs, RF sync and more DC control.

The old rules still apply with regard to analog audio. For the digital signals and RF/sync paths, good shielding is important, although more to contain the cable's own signals than to stop external signals from coming in. If space allows, keep all signal types apart.

Distribution of mic-level audio outside a studio should be avoided. Even within a studio, mic-level runs should be kept as short as possible to reduce interference. It's a good idea to plug the mics directly into a pre-amp in the room, then distribute as a line-level signal from there. The smallest amount of noise becomes a problem when amplified 50 or 60dB.

Routing of cables within furniture should also be planned before any cable is pulled. There are several different cable management systems out there, but even if you decide to use Telco-style D-rings, put them in first. Any holes within the furniture for routing should also be made larger than anticipated, because it is hard to drill around existing wiring. The proper type of cable for each application is also important. Considering the high-speed LANs that most stations will be using soon, CAT 5 twisted pair wiring is a good idea in any facility being planned today.

Patchbays were once commonplace in every studio. With audio routers becom-



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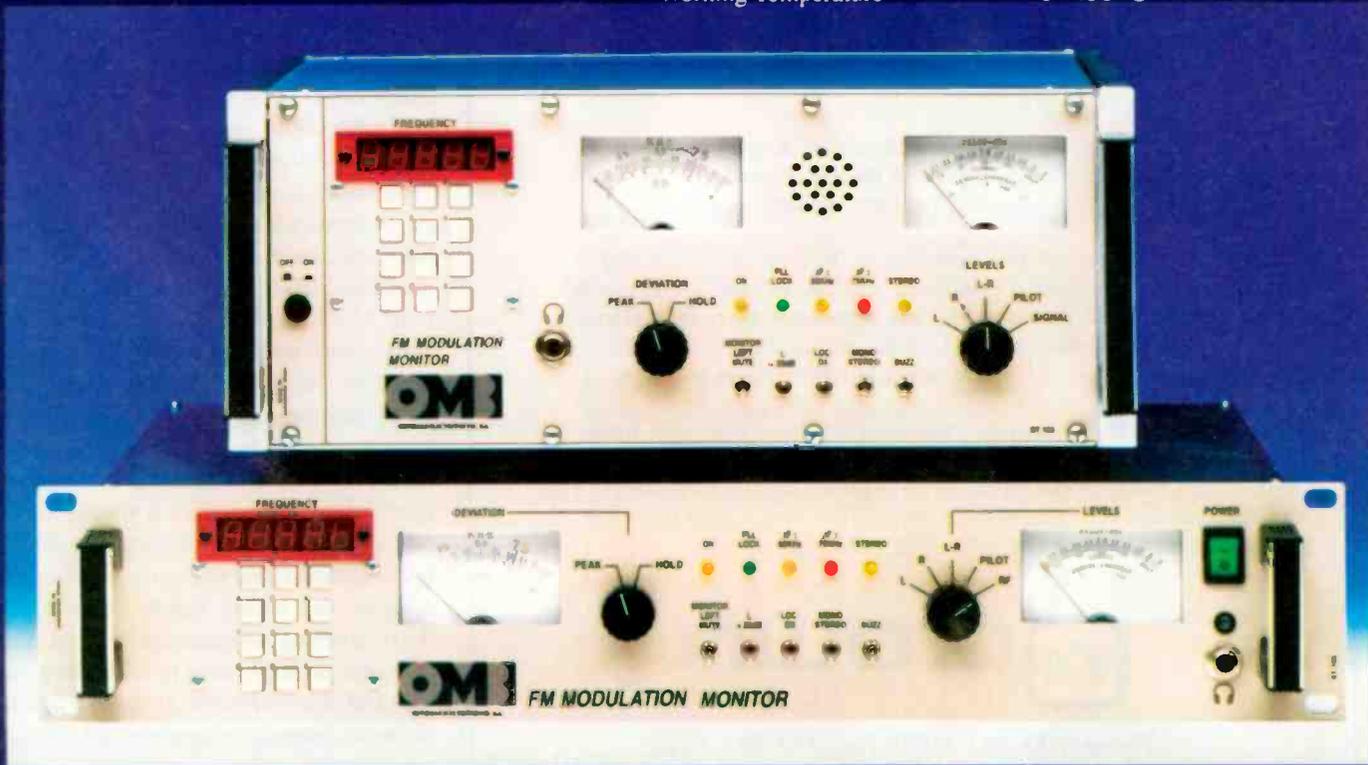
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ing more cost-effective and time-efficient to install, the popularity of patchbays has dwindled. Some people still like a patchbay to get them out of a bind. They are convenient for that reason, but most modern consoles have connectorized inputs, so the re-routing can usually be done at the console. Keeping a patchbay on your on-air processing chain (and perhaps elsewhere in your master control or rack room) is still a good idea

so you can get around problems quickly and usually unnoticed.

POWER

The need for good, clean power is critical on digital systems. At the least, surge protectors should be used on everything. An uninterruptible power supply (UPS) is a better idea, providing excellent protection and a short-term back-up power source. These systems can be designed to power the entire facility or

only key items by using several smaller ones throughout the facility.

Momentary power outages or voltage sags used to be of little concern with analog equipment, sometimes even going unnoticed. Digital systems are much less forgiving. Waiting for a computer to re-boot to get back on the air is at the very least frustrating, and often costly from commercial make-goods and tune-out by listeners. Some computer-based audio systems also perform considerable housekeeping before they come alive, like building file lists or checking links. This can take even longer than the typical two- or three-minute boot cycle. This is why a UPS on these systems is so critical.

To keep costs in check, the UPS does not have to be designed to supply back-up power for a long time. A few minutes capacity to last through the sag or let the generator kick in is all you need. If you don't have an emergency generator at your studio, the extra few minutes that a UPS provides can let the operator turn on a back-up audio source at the transmitter site (assuming the remote control and telemetry-link receiver are also on the UPS).

INTERCONNECTION

Wire is wire, right? Wrong. It may all be made of copper, but the characteristics of different wire types can affect the signals passing through them. You would never reliably pass RF through a twisted-pair audio cable, so don't make a similar mistake with digital signals or computer network hook-ups.

Analog audio should be passed on shielded, twisted-pair cables. If the run is long, low-capacitance wire should be used to minimize high-frequency attenuation. Running AES/EBU digital audio on standard analog wire will sometimes work, but the AES/EBU standard calls for a balanced, 110 Ω transmission system. This should be kept in mind when planning the studio runs. Any logic or signaling can also be done on twisted pair, but it should not be routed along with the analog audio. The use of coaxial cable will be dictated by your systems and facility needs. Even if you don't have any requirement for coax right now, it is probably wise to run at least one 50 Ω and one 75 Ω cable. As always, adding cables to a conduit is harder when they are already stuffed.

If it hasn't happened at your studio yet, the requirement for one or more computer

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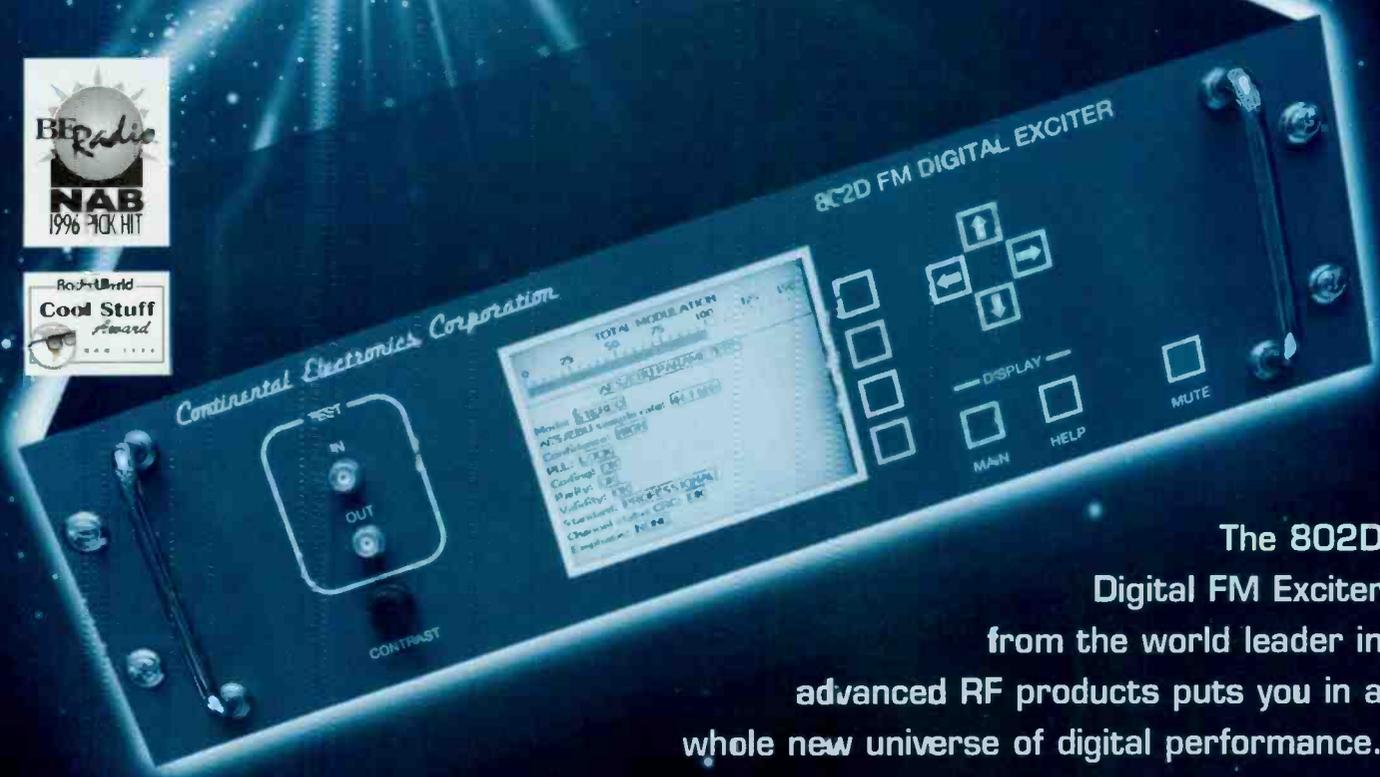


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Designing studio infrastructure

network connections in your studios will surely come up soon. Having one or more runs to every studio of the CAT 5 LAN cable discussed earlier is, therefore, recommended. If your office network is tied in to the Internet, this connection will also allow studio talent to access web browsers and E-mail (are you taking E-mail requests yet?).

Connecting the studio equipment to the facility's wiring is not a trivial matter, either. A bad connection can really ruin your day. If you have been careful through the entire process, don't fall short at the finish line. Part of any project's planning should include the ordering of enough connectors to cover the entire design. In the case of a rebuild, some connectors can be re-used. XLRs are usually easy to clean and re-attach. On the other hand, phone, mini-phone and RCA phono connectors generally do not survive a re-use well, nor do DB solder-type connectors. The skill of the solderer will affect this, of course.

One time-saving convenience is purchasing pre-made cable assemblies. There are several reputable suppliers to choose from, and all they need is your detailed plan for cable length, specification and connector type. In the case of critical cables, be sure to check on how they will be made. Don't assume that they know how you want it done. Again, a little planning and detail can go a long way in a successful project.

AFFORDABILITY

With any major project, budgets and



Making talent comfortable in the studio will produce more successful programming.

schedules bear heavily on the process. Careful planning with attention to detail will usually ensure a successful completion. Anyone who has done studio upgrade or installation projects can tell you all the mistakes they made the first time around. Often, they occur in those areas "below the surface" and among the lesser thought-of items.

Today's plans also have to consider the inevitable changes in broadcast systems that are certain to continue. Smart facility-infrastructure design will provide the capability to accommodate such change with minimal upheaval. It's one thing to replace a unit in the rack with a newer one, but it's quite another to have to tear out racks and run new wiring when

making that change because the original system design couldn't cope with the new unit's needs.

The best-equipped facility can be brought to its knees and rendered useless (or highly user-hostile) if its infrastructural elements don't provide it with a solid, yet flexible foundation.

Chriss Scherer is chief engineer of WMMS-FM, Cleveland.

Photos courtesy of WBUR-FM, Boston and Russ Berger Design Group, Dallas.

FOR MORE INFORMATION

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Audio monitoring in the control room

BY CHIP MORGAN

When considering the audio monitoring in a radio studio, you probably think first about the loudspeakers. Well, think again, and this time consider how monitoring is used for the production of programming in that studio.

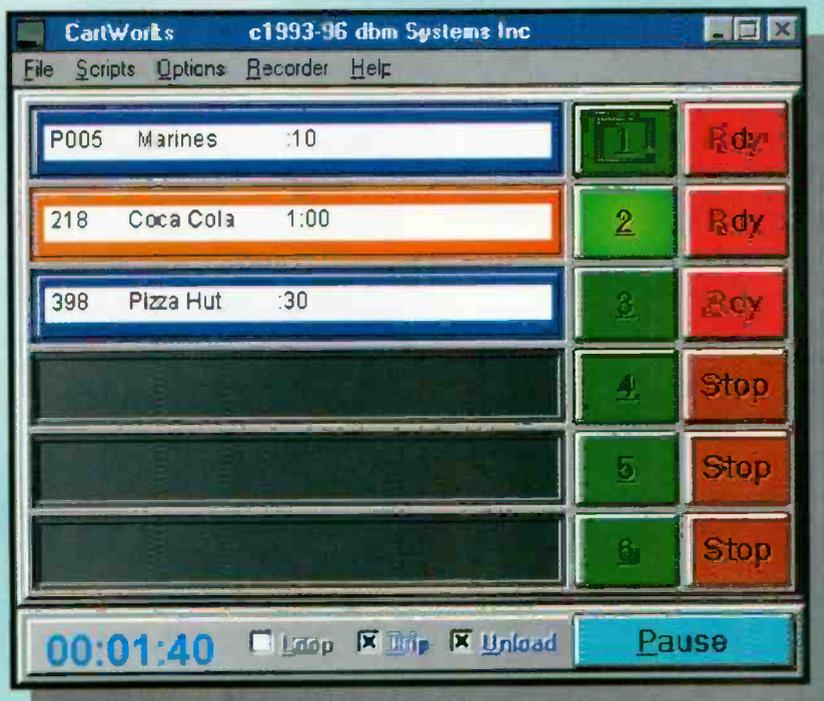
In many cases, the *headphone* monitoring system in a radio studio is much more important than the speakers. While on the air, announcers and DJs listen most critically to the station when they have their headphones on. They judge the station's audio by the way their voice sounds in the headphones. Psychologically, if it doesn't sound good in the "cans" it can't sound good on the air. Continued stress from poor monitoring conditions can cause fatigue that ruins an otherwise great performance.

When listening in this critical fashion, talent hears artifacts

of the STL system, the broadcast transmitter, the receiver used to feed the monitors and any interference encountered along the propagation paths — not the pure sound that is being sent from the studio. Of course, the concept behind such off-air monitoring has always been the desire to have the operator hear what the listener hears.

But, consider how musicians on stage or in a recording studio monitor their performances. They need to hear their instruments and/or voices clearly enough to know what they are playing. The musician also needs to hear the other players' parts, but not as critically. So there is a custom stage monitor mix for each musician, which includes the specific audio needed. Nobody on stage hears the actual house PA sound that is mixed for the audience. The same holds true in a

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recording studio. A specific "performer's mix" is used by each musician, and a different mix is fashioned for the end product delivered to the audience.

So why in broadcasting do we use a radio to monitor a live performance? This is like having a musician in a recording session listen only to the final mix, where his or her performance is reduced in volume as it is mixed into the overall sound.

There is one significant difference from this musician model

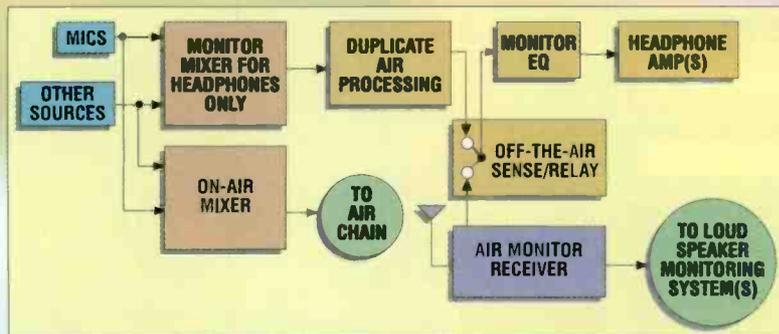


Figure 1. Block diagram of "Airgonomic Headphone" system.

in most radio applications today: "Combo" operation makes the DJ also serve as mix engineer, who is expected to set his or her mic level for a perfect mix on air. But often that's a level too low for the DJ to hear it well. In an attempt to solve this problem, the DJ turns up the headphone volume and/or runs the mic hotter in the mix than it should be. In some cases, the DJ may also move closer to the mic than appropriate, adding excessive bass boosting to the voice (from the mic's proximity

effect) and/or plosive ("p-popping") problems. This makes the lack of accurate headphone monitoring even more troublesome because it affects the on-air mix. It is a problem that is rarely acknowledged by stations in any substantive way.

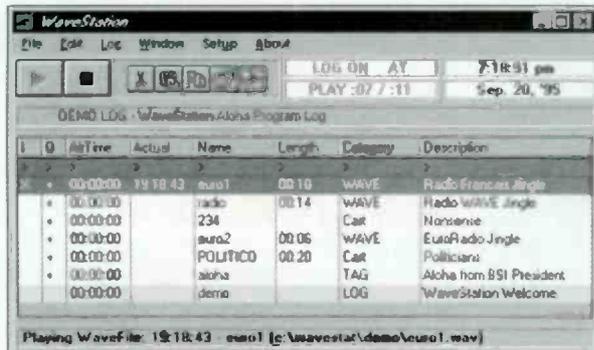
AN IMPROVED HEADPHONE MONITORING TECHNIQUE

Several years ago at Pirate Radio in LA, this problem was addressed when new studios were designed. One of the project's challenges was to make Scott Shannon's monitor system sound good to him in temporary studios while new studios were being built. The station had poor off-air reception, the studio had poor acoustics and the monitors drove Scott crazy.

The solution (a concept entitled *Airgonomic Headphones*) applied the idea of a custom monitor mix for the air talent. Studio mics and other sources were split into two subfeeds, one of which went to the air mix as usual, while the other went to an out-board mixer to set the balances for the headphone mix. (Alternatively, a single board with a post-fader auxiliary send could be used. The main program output feeds the air, while the auxiliary mix feeds the headphones.) The headphone mix is fed to a duplicate of the on-air processing and an equalizer, then sent to the headphone amplifiers. (See Figure 1.) Standard off-air monitoring should continue to be sent to all studio loudspeakers.

By adjusting the balance between the mics and the other sources, the relative loudness of the mics can be brought up

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to a level that sounds good to the DJ, but still is processed like the on-air sound. The equalizer can be adjusted to compensate for any response anomalies of the headphones.

A final touch adds a simple relay system to switch the headphones back to an off-air monitor when the transmitter fails (so the announcer knows if the station goes off the air during an announce break).

Although some may be concerned that this doesn't have the DJ listening to the exact air mix, remember the purpose of performance monitoring. What's important is an accurate monitoring condition *as perceived by the announcer/operator*. The announcer hears the mix as a combination of bone conduction, the headphone audio and leakage around the headphones. It's not a pure mixing environment. Running the right levels in this situation is a matter of experience in each specific studio, including listening to airchecks and trying to compensate — all while doing a mix and performing live on the air. This is a difficult, if not impossible task, so any technological means available to make it easier and more consistent for the announcer is worth exploring.

The announcer's monitoring system is one of the most frequently overlooked parts of a radio facility.

the headphone monitoring system to mimic the on-air processing without delay. Remember that the headphone sound doesn't have to be *exactly* the way it is on air; it just has to be usable as a reference.

The same delay problem can occur (or be worsened) by digital STLs, particularly the 950MHz-band units that implement data compression. Some of these can add significant delay, making off-air monitoring annoying or impossible.

This is why many stations have already moved to a non-off-air monitor feed for announcers' headphones. Because you may have to violate the tradition of off-air headphone monitoring to cope with the delay problem, you might as well solve the other problems with announcer headphones (i.e., adapting "performance monitoring" techniques) while you're at it.

The announcer's audio monitoring system is one of the most frequently overlooked or improperly designed parts of a radio facility. With a bit of work and some additional hardware, an enhanced monitoring system has great potential to improve on-air performance.

DEALING WITH DELAY

If your station uses a digital audio processing system, it may introduce a delay that is noticeable and perhaps bothersome to announcers. In this case, use an analog processor in

Chip Morgan owns Chip Morgan Broadcast Enterprises (CMBE), a broadcast design, systems integration and engineering firm based in Sacramento, CA.

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Aphex Air Chain

By John Caracciolo

Jarad Broadcasting owns five radio stations serving major East Coast markets. In 1994, one of our stations, WDRE-FM in Garden City, Long Island, changed its studio location and required a temporary audio processing system during the transition.

Aphex Systems offered to supply its *Air Chain* for the station's temporary use during this period. The Air Chain, made up of the Aphex *Aural Exciter*, *Compellor* compressor-leveler, *Dominator II* multiband peak limiter and *Digicoder* stereo generator, was presented by the company as a system that could provide increased signal, better clarity and separation, as well as less distortion and multipath. The station wasn't in the market for a new audio processing system, but simply needed something to bridge the facility move.

Features at a glance:

- High-quality analog audio processing with digital stereo generator
- Adds significant loudness without noticeable distortion
- Silence gate prevents "breathing" during quiet periods
- Retains substantial apparent dynamic range of audio signal
- Can extend effective usable coverage zone

gan to notice that Aphex's claims for the system seemed true. WDRE kept the Air Chain permanently, and another subsequently acquired station in Philadelphia was also converted to the Air Chain (where the same improvements were noted).

Spreading the word

Recently, WPAT-FM, a Class B station in New York City, was purchased by Spanish Broadcasting. The station's format has been converted from easy-listening to "hot salsa" programming. Right after the purchase, Dan Lohse, chief engineer for Spanish Broadcasting, contacted Jarad Broadcasting for a recommendation on a new audio processing system. Predictably, our response was the Aphex Air Chain.

Jarad worked with WPAT to implement the new processing system. The WPAT studios are located on 56th

Street in Manhattan, linked via optical fiber to a 5.4kW transmitter atop the World Trade Center. The studio is outfitted with two new Wheatstone consoles, with all recorded audio material supplied by digital sources.

In its easy-listening days, WPAT wasn't processed aggressively. With the Air Chain, the goal wasn't necessarily to do this either, but to simply jump out on the dial a bit in the competitive New York City market. Spanish music tends to be clean, with a lot of midrange from brass instruments.

The intent was to process the signal in a way that enhanced its dynamic range and kept it in the ballpark with the competition. In this market, you have to be loud, but certainly not at the expense of heavy distortion. The Air Chain provides the ability to do this. Stereo separation is also enhanced, without adding detrimental artifacts to the signal.

How the system works

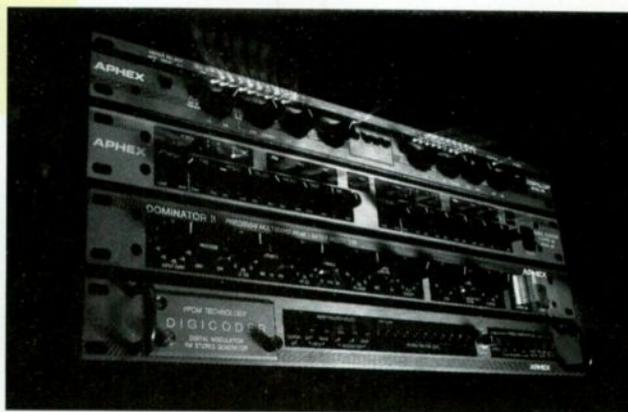
Jarad Broadcasting's expectations of audio processing come down to three primary factors: control, texture and loudness — in that order. With this in mind, here's a brief rundown on the products in the Air Chain and how each lends itself to achieving those three processing goals.

The *Compellor* compressor-leveler located at the studio provides the control. As a pre-processor, it supplies consistent sound that doesn't vary even if the source changes. It includes a built-in peak limiter that holds an absolute ceiling above

nominal level, while a *silence gate* feature prevents "breathing" or "swells" during program gaps. Its frequency-discriminate leveling applies a variable attack time to the signal.

The *Compellor* makes up for operators' level-control errors and supplies a clean, dynamic signal without overshoot artifacts. Even when you hit it hard, it remains clean. Its dynamic recovery computer accelerates compressor recovery under complex program to preserve natural sound on transients.

Nevertheless, from the first day the Air Chain was on the air during the transition, the station's staff be-



The Aphex Air Chain includes (from top to bottom) the model 320A *Compellor*, the model 250 *Aural Exciter Type III*, the model 720 *Dominator II* and the Aphex model 400 *Digicoder*.

Texture is supplied by the Aural Exciter, also located at the studios. This unique processor increases presence and clarity, as well as speech intelligibility. It includes a patented process called *Harmonic Generation* that increases audio signal bandwidth without increasing level and also incorporates single-ended noise reduction. Bass is also boosted by proprietary *Spectral Phase Refractor* circuitry.

In A/B experiments with the Aural Exciter, switching the unit in sounds like someone has lifted a blanket off of the monitor speaker. When it's out, the station gets audience complaints about muddy sound. This signal-brightening process also does not add audible distortion, allowing you to take maximum advantage of the third factor, loudness.

Perhaps most noticeable is the quiet. When there's a pause, you don't hear "swooshing" or other noise.

The Dominator II and the Digicoder reside at the transmitter site. The Dominator provides multiband limiting, with independent limiters for highs, mids and lows. It also maintains the full bandwidth and transparency of the signal. The peak ceiling is adjustable in 0.2dB steps over a 34dB range. It uses an automatic limiting threshold that varies the ratio of band-limiting to clipping over a 104dB dynamic range, and offers switchable low-to-mid and mid-to-high cross-over frequencies.

The loud, but clean, output of the Dominator II feeds the Digicoder, which some stations like to composite clip — although it's not recommended by the manufacturer. Nevertheless, you can clip this signal relatively aggressively because it's free of spurious output and intermodulation distortion. A pre-emphasis limiter in the Digicoder retains the loudness

without ruining the naturalness of the sound.

The Digicoder includes a low-pass filter and all its functions are remote controllable. Its *Parallel Path Digital Modulation* offers >70dB stereo separation and the unit is "RDS-ready." It is also a "set and forget" device. Once you've calibrated it, the unit stays stable and consistent, without any need for re-calibration.

Given this operational approach, it's no surprise that an improved

and more consistent overall sound quality is the result. Yet, at WPAT and the other stations using the Air Chain, what is perhaps most noticeable is the *quiet*. When there's a pause, you don't hear "swooshing" or other noise.

Effective coverage extension

After installing the Air Chain at WDRE (a Class A FM station), the station's staff noticed a surprising extension of coverage range. Letters



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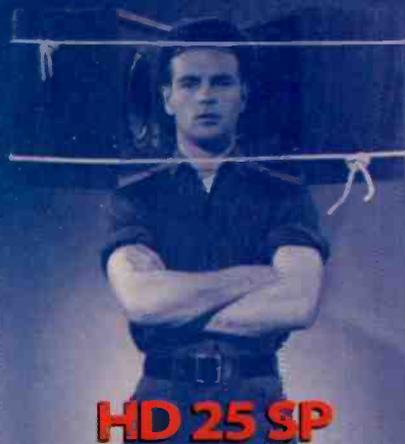
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Field Report

and phone calls immediately started coming in from new areas that were not only receiving the signal, but reporting stereo, multipath-free reception. In fact, a coverage gap in Suffolk County was eliminated and the station now covers almost all of Long Island.

At WPAT, a Class B FM atop the World Trade Center, a coverage increase is a bit more difficult to measure, because the coverage is quite large already. In this case, the desired result was not so much to extend the range, but to cover the entire area with a louder, more stable and listenable signal. Driving to some of the previous weak spots in the coverage area shows that they're no longer a problem — no dropouts, no interference and full stereo separation are

observed.

The Aphex Air Chain is a set of well-matched products that clearly lives up to the manufacturer's claims.

John Caracciolo is vice president of Jarad Broadcasting, Garden City, NY.

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 or consulting company.

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

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

FOR MORE INFORMATION

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Contract Engineering

Continued from page 8

Dispassionate analysis is required here. As a contractor, you may enjoy the control over a project that you gain in a turnkey situation. You might even stand to make a few bucks in the process. But you must look at where you make your easy money. If you are selling at competitive prices, profits on equipment sales (counting warranty costs) are likely to be in the 5-10% range. On the other hand, once fixed costs are met, every additional dollar you earn on labor charges might yield a profit of 33% after payroll is deducted. Knowing where to concentrate your efforts yields profitability and longevity.

This is not to say that selling equipment is a bust. What works here is a "mix." In some cases (e.g., state contracts), it is the only way to go. It could even be counterproductive to only turnkey on certain projects because your buying power (quantity discount) decreases with a lesser volume. In some cases, you stay

ahead of the game to let the customer purchase the major equipment directly, and have a great time billing them twice on an *à la carte* basis to reinstall an item that was dead-on-arrival. Don't forget that *supplies* (as opposed to equipment) often have a tremendous profit margin, and can be tacked on to a time-and-materials

billing.

To really succeed you must be willing to eliminate personal preference or gut instinct.

Each situation is unique; there is no single correct answer. Equipment sales was used as an example to show just how much thought must go into determining the proper mix. Look for a mix that emphasizes profitability while still maintaining enough diversity or flexibility to adapt to changing conditions. Broadcast engineers, of all people, should be able to look at hard data measurements (your financial books) and make logical decisions. You do it every day.

William Fawcett is president of Mountain Valley Broadcast Service, Inc., a broadcast engineering firm in Harrisonburg, VA.

Back to the drawing board for USADR

In-band on-channel (IBOC) DAB proponent USA Digital Radio (USADR) has announced that it is continuing its development of digital radio broadcasting technology with new funding and expertise. USADR is a five-year-old consortium of Gannett Broadcasting and Westinghouse/CBS that had submitted three IBOC formats for testing by the Electronic Industries Association (EIA) and the National Radio Systems Committee (NRSC), but withdrew them before completion of the tests.

Now another Westinghouse division, Westinghouse Wireless Solutions (WWS), is spearheading the renewed development of USADR's IBOC systems. Recent evaluations of the systems by WWS and independent third parties came to conclusions similar to those found in early rounds of the EIA/NRSC tests, primarily acknowledging interference and multipath problems. WWS expects that making IBOC work will be challenging, but possible, although significant development efforts remain. It also forecasts that the maximum usable data rate for audio programming on IBOC FM channels will be only 96kb/s, with little or no overhead remaining for auxiliary data (as long as IBOC signals must coexist with analog FM broadcasts).

Meanwhile, USADR will work with the NAB (and possibly with AT&T/Lucent Technologies, the only other IBOC proponent) to establish a new set of IBOC-only DAB tests, probably managed by the NRSC.

Declaratory ruling sought on 73.315b

The consulting engineering firm of Hammett & Edison (H&E) has filed a *Petition for Declaratory Ruling* to the FCC concerning potential abuses of Question 11 in Section V-B of Form 301, the application for an FM station license. The issue concerns Section 73.315b of the commission's rules, which states that a commercial FM station shall have a clear line-of-sight path from its transmitter to its city of license. The petition cites what H&E considers to be three particularly blatant cases in which an applicant has stated that it had such a line-of-sight path when H&E's evaluations indicate that it did not.

The petitioner claims that any such applicants answering "yes" to Question 11, Form 301 are filing falsified documents. Nevertheless, in one case when a competing station filed an objection to such a station's licensing, the FCC rejected the objection, saying that the petitioner should have filed its objection earlier at the construction-permit stage.

H&E claims that this action encour-

ages stations to answer questions on 73.315b falsely, because the commission will not verify an affirmative answer, and such a claim will insulate the station to later objections from other parties.

The petition, filed Oct. 7, 1996, has not yet received any official response or action by the FCC.

Satellite DAB auctions' proceeds earmarked

The U.S. government's FY 97 appropriations bill recently signed into law by President Clinton includes an estimated \$2.9 billion of revenue that is expected to be raised by auctions of S-band spectrum licenses for Satellite DAB. According to the legislation, the auctions must begin by April 15, 1997, and the funds must be deposited in the federal treasury by Sept. 30, 1997.

Proceeds from the auction will be used to fund operations of the FCC for FY 97, as well as the Commerce Department's National Telecommunications and Information Administration (NTIA) — including its Public Telecommunications Facilities Program (PTFP) and National Information Infrastructure (NII) projects. The revenue will also fund FY 97 operations of the Corporation for Public Broadcasting (CPB) and the United States Information Agency (USIA).

New Canadian DAB web site

The Canadian Communications Research Centre has established a WWW site on the subject of DAB. It includes a detailed description of the experimental Eureka 147 DAB system now installed in Ottawa that uses a distributed emission approach.

The site also includes an overview of current DAB status and plans in Canada, as well as other general information on digital radio broadcasting. Point your browser to www.drb.crc.doc.ca/ottawa.

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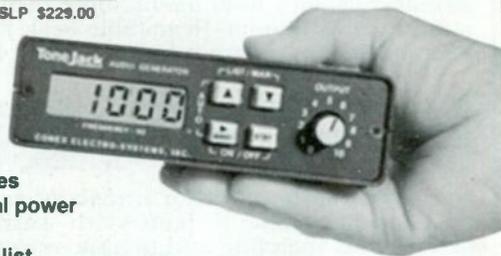
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Business/ People

BUSINESS

Working together, **SpaceCom Systems** and **Key-stone Communications** provided a solution for the lack of uplink space at the Democratic National Convention in Chicago. The two companies implemented a direct digital fiber link from the United Center to SpaceCom's Chicago International Teleport located in Monee, IL. Media companies used the multiple-channel fiber link to connect reporters on the convention floor downtown with their uplink trucks parked in the suburbs. The service allowed users to transmit video and audio both ways between the United Center and the Chicago International Teleport.

HHB Communications Inc., Portland, ME, formed a leasing alliance with The Republic Group, LLC, and will offer a financing program for the CEDAR audio restoration processor.

WMXV-FM, New York, was the 3,500th radio station to sign with **Digital Courier International**, a two-way digital audio distribution network. Members of the DCI

network can send and receive CD-quality programming across North America in less than one hour.

The Thomson-CSF subsidiary **Thomcast** won an order from Belgische Radio en Televisie Nederland (BRTN) for 14 Crystal DAB transmitters. The equipment will operate in the VHF band.



Thomson-CSF Electronics Belgium, which signed the contract on behalf of Thomcast, will be supplying in 1997 the world's first 1,600W DAB transmitter as part of this order.

Studer Professional Audio Equipment, Switzerland, has provided audio equipment to RAI, Italy; Korean Broadcast Systems; Radio Pilatus and Radio Svizzera Italian, Switzerland; RTL, France and Chinese Radio International.

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International Datacasting, Ottawa, Canada, is providing Mid America Ag Network, Wichita, KS, with a satellite digital audio system for distribution of four channels of radio network programming.

Hannay, Westerlo, NY, has released a new catalog that provides complete information and updated specifications on cable reels. For a free copy of Cable Reels Catalog (Form No. H-9420-C), call 518-797-3791 or fax 800-733-5464.

NetRadio Network has teamed up with **Xing Technology** to deliver customized music, news and information over the Internet. The first offering of the partnership is NetCompanion personalized content broadcast, which can be downloaded at www.netradio.net.

Sonic Solutions was honored with an Emmy Award for outstanding technical achievement for NoNOISE, its digital sound restoration technology.

Apple Computer Inc. and **Telos Systems** launched Audioactive, Apple's implementation of Telos' new Internet audio-streaming technology that introduces high-quality audio for the Internet. Audioactive is fully compatible with Macromedia's Shockwave plug-in and Shockwave audio standard, so web browsers who use Shock-

wave can automatically receive live Audioactive broadcasts. To hear samples and download the player, visit live.apple.com or visit www.audioactive.com.

AXCESS Global Communications Corporation completed its RDS paging network in the western United States and some 90 FM stations have entered into lease arrangements with the company. AXCESS Global's western service area includes Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

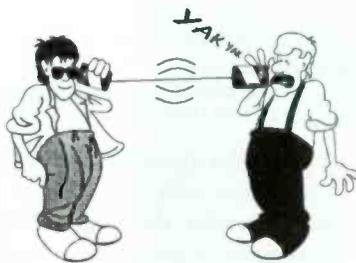
DG Systems, San Francisco, added the 5,000th radio station to join its digital distribution network. The company electronically links radio stations in the United States and Canada with advertisers, agencies, production studios, syndicators and music companies.

PEOPLE

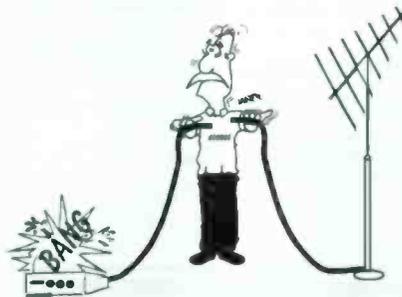
Rick Strage joined the sales staff for the digital studio systems group of Broadcast Electronics, Quincy, IL.

Griffith McRee, former president of The Synclavier Company, was appointed senior vice president/chief operating officer for AirWorks Media, Edmonton, Alberta.

Also, **Harland Kirby** joined AirWorks Media as vice president, sales.



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On-air radio console Audioarts Engineering

• **R-5:** an on-air console that delivers better than 16-bit digital audio performance and is simple to install; it has two pairs of Sifam VU meters for stereo program and audition, and all switches are LED illuminated for easy identification and low maintenance; features include the Audioarts' exclusive Simple Phone mix-minus feature that simplifies a station's multiple call-in operations, full-function tape remote controls, on/off button nomenclature and four microphone pre-amps.

315-452-5000; fax 315-452-0160; Wheatstone@aol.com
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Audio distribution amplifier Zercom Broadcast Products Division

• **DA-8S:** an audio distribution amplifier that offers 16 front recessed adjustments, removable rear terminal plugs and an external Zercom power supply; the DA-8S allows virtually transparent 2x8 or 1x16 DA in a standard rack mount (19"W x 1 3/4"H); the use of jumpers under the top cover allows conversion between stereo and mono, adjusting of audio gain and setting balanced or unbalanced input configuration.

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Studio furniture Spacewise

• **Delux series:** studio furniture designed with many features usually only available in high-priced systems; furniture in the Delux series features 1 1/2-inch thick top counter surfaces, raised solid oak trim around top counters, added trim on vertical edges, kickboards, heavy-duty rack rail systems with rear access and room in the two support pedestals for two PC audio systems.

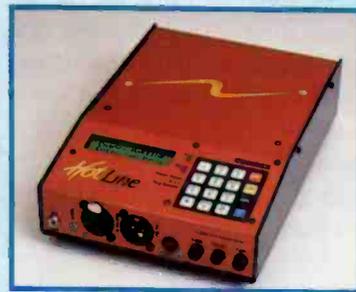
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• **Real Coverage maps:** full-color FM radio station maps that take into account the effects of terrain, interference and antenna performance; CMBE can predict coverage, as well as measure actual coverage using high-speed mobile data acquisition equipment.

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POTS codec

Comrex Corporation

• **HotLine:** the HotLine uses special audio coding techniques to provide up to 10kHz bidirectional audio over a standard, dial-up (POTS) telephone line; it is ideal for live remotes, news reports or other audio feeds in locations where ISDN is not available; two HotLine units are required for operation — one at each end of the line.

508-263-1800; fax 508-635-0401
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EAS encoder/decoder

Burk Technology

• **EAS encoder/decoder:** unit features full numeric keypad for quick positive control and an 80-character display shows status at a glance; a built-in printer simplifies record keeping and the weekly test is accomplished with the push of a button; EAS works with Burk ARC-16 and other transmitter remote-control systems; the computer interface accesses all functions; the EAS monitor receiver system includes four state-of-the-art receivers as standard equipment.

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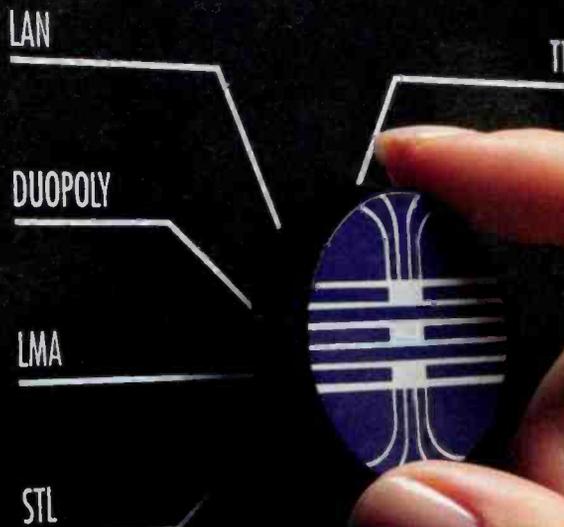
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New Products

Radio station furniture Wheatstone Corporation

• A line of furniture especially designed for radio stations; the furniture incorporates a highly stylized approach based on a curved style of architecture that uses a combination of hardwoods and laminates.

315-452-5000; fax 315-452-0160;
wheatstone@aol.com
Circle (156) on Free Info Card

On-air call-in software Digitronics

• **Screener III+ Talk Show:** software that allows on-air talent to maintain full control of the telephone lines in the studio or in the field; Screener III+ runs on a single PC-compatible computer connected to the on-air telephone system; calls can be selected from the field by pressing a button on the phone console.

602-817-1030; 602-831-5051;
RadioSoft@aol.com
Circle (171) on Free Info Card

Audio codec Digital Courier

• **Capella version 3.0:** an enhanced Capella audio codec on a PC card that extends performance; it combines audio capabilities, such as compression, decompression, storage, retrieval, transmission, reception and transcoding, on a single PC card; new features include crossfading, ancillary data, simultaneous copy port and audio port I/O.

800-909-7888; fax 604-473-5835
Circle (186) on Free Info Card

FM transmitter Harris Broadcast Division

• **Z10CD:** latest addition to line of Platinum Z FM transmitters; RF power amplifier modules use the same solid-state devices that have achieved an MTBF greater than 250,000 hours in Platinum FM transmitters; multiple, hot-pluggable modules operate in parallel, ensuring continued transmitter operation even if a module is removed.

217-222-8200; fax 217-222-0581;
broadcast.harris.com
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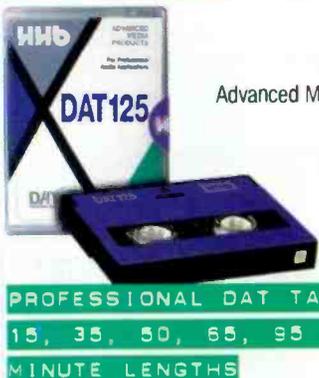


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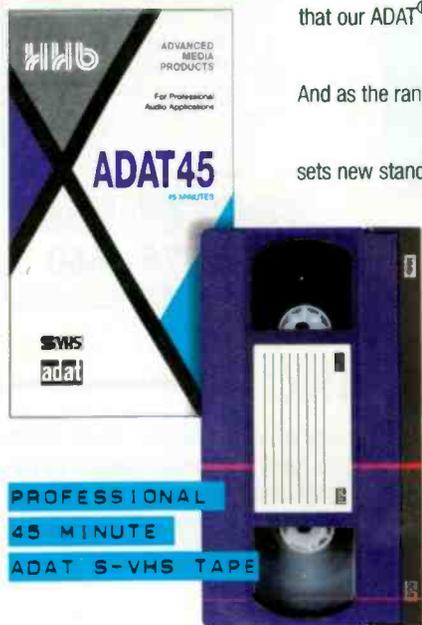


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New Products

Lubricant CAIG Laboratories

• **CaiLube MCL:** a precision lubricant formulated to lubricate conductive plastic and carbon-compound faders, switches and similar components; it replenishes lubrication lost on surfaces that have been cleaned with solvents or other cleaning solutions.

800-224-4123 or 619-451-1799; 619-451-2799

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Chassis for Pentium ATX motherboards

Industrial Computer Source

• **7308T, 7408T & 9300-ATX:** three industrial chassis for use with ATX form factor motherboards in harsh industrial environments; the chassis provide up to 135cfm of filtered external air — not preheated air from the power supply — directly into the card cage area to cool all cards, drives, memory and the processor.

800-677-7329; fax 619-677-0615; Industrial.computer@industry.net

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Encoder and decoder

Dolby Laboratories

• **DP503 encoder & DP524 decoder:** products that support Dolby AC-2, Dolby Digital (AC-3) and MPEG Layer-II algorithms from 56-448kb/s; the DP503 and DP524 are ideal for use in Dolby Fax ISDN remote post-production hookups.

415-558-0200; fax 415-863-1373; info@dolby.com; www.dolby.com/

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• **Teleservice:** a "fit and forget" remote monitoring and diagnostic service that automatically monitors UPS phone lines, transmitting UPS data to the MGE UPS Systems Customer Service Center; the service reports power disturbances or irregularities allowing the immediate dispatch of an engineer if a critical load is at risk.

714-557-1636; fax 714-434-7652; www.mgeups.com
Circle (165) on Free Info Card

**Oscilloscope
Iwatsu America**

• **Model SS-7840:** a 400MHz, four-channel, 10-trace analog oscilloscope; high-speed automatic setup affords optimum measurement conditions for repetitive waveforms; in addition, save/store/recall of up to 32 panel settings is accomplished via a simple function knob turn.



201-935-8486; fax 201-935-8533
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**DC power supply
HC Protek**

• **Model 3005:** a compact, single-output DC power supply covering an output range from zero to 30V, up to five amps; it offers precise current and voltage level settings and features two three-digit LED readouts for simultaneous monitoring of voltage and current plus an overload indicator; the instrument incorporates a special energy-saver circuit design for cooler, more efficient operation.



201-767-7242; fax 201-767-7343
Circle (170) on Free Info Card

**Outer jacket for cable
Gepco International**

• **GEP-FLEX:** a highly flexible outer jacket compound for the 618 (22 gauge) and 724 (24 gauge) series multipair audio cable; it is ideal for indoor and remote use, with an increased temperature range with cold weather properties to -60° C; GEP-FLEX has the UL-listed type CM rating required for permanent installation.

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Circle (155) on Free Info Card

**Call-in show interface
Prophet Systems Inc.**

• **Call-in show interface:** an innovative module that allows an engineer or talent to run a call-in show from any workstation on the network or from a modem at a remote site; the interface can easily be configured to connect to any telephone interface and delay unit on the market.

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Step reducers

Jampro RF Systems Inc. and Continental Electronics

• **RCTR series:** line of step reducers manufactured by Jampro RF Systems and distributed by Continental Electronics; the electrical performance of the RCTR Quik Step makes it virtually invisible when performing extremely low VSWR tests; the typical VSWR of a Quik Step is 1.02:1 or better over all five broadcast bands; power handling is limited to the maximum power handling of the type "N" connector for the frequency being tested.

214-381-7161; fax 214-381-4949
Circle (177) on Free Info Card

RF protective clothing Holaday Industries Inc.

• **Naptex RF protective clothing:** a shielding textile developed especially for protection within RF and electromagnetic fields, allowing personnel to work safely in ambient RF fields significantly above IEEE C.95.1-1992 MPE levels; it has a shielding effectiveness of up to 40dB at frequencies from 2MHz up to

UHF wireless mic receiver

Lectrosonics Inc.

• **UDR200B:** an advanced, high-performance, frequency-selectable UHF wireless microphone receiver; it is compatible with all high-end Lectrosonics UHF transmitters and offers 256 selectable frequencies, available in 100kHz steps for operation anywhere in the world.

800-821-1121; fax 505-892-6243
Circle (163) on Free Info Card



Digital radio input system

ITIS

• **D-WIN:** a universal interface for Eureka 147 DAB sources, with as many as eight channels on a single broadcast; the system accepts up to four synchronous audio or data inputs and four asynchronous data channels, outputting them in proper format to a WG1-WG2 bus for connection to a digital radio multiplexer, such as the ITIS D-MUX or to the next unit in the digital broadcast cascade.

312-222-1235; fax 312-222-1237
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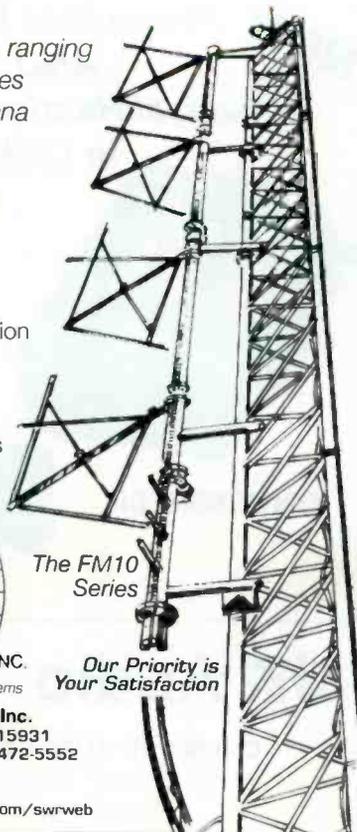
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Telescoping bottom-mount slides brochure

General Devices

• **Bottom Mount Slides brochure:** a six-page brochure detailing six types of telescoping bottom-mount slides designed for compression loading with capacities ranging from 75 to 1,500 pounds; included in the brochure is a detailed product description of each model, as well as a summary of possible applications.

800-626-9484; fax 317-898-2917
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MPEG audio compression software

QDesign Corporation

• **i-Media Audio:** software that provides real-time, studio-quality encoding using the processing power of a standard Pentium PC equipped with a Sound Blaster-compatible audio card; the 32-bit application is designed to allow audio encoding from a live or recorded audio source without any dedicated compression hardware.

604-688-1525; fax 604-688-1524; www.qdesign.com
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Cord reel

Reel-A-Pail Inc.

• **Cord reels:** reels built to withstand heavy-duty uses; with a simple turn of the handle, the cords or cable are quickly and safely retrieved into a specially configured pail that is easy to transport or store.

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10KW	FM	1970	Harris FM 10H3
10KW	FM	1976	RCA BTF 10E
20KW	FM	1974	Collins 831G2/Cont 816R2
20KW	FM	1974	Harris FM20K
20KW	FM	1967	Collins 830H-1B
25KW	FM	1980	Harris FM 25K
1KW	AM	1978	Harris MW-1
10KW	AM	1974	CSI T-10-A
10KW	AM	1980	Harris MW-10
10KW	AM	1976	Continental 316F
25KW	AM	1982	CSI T-25A
50KW	AM	1978	Harris MW50C3 (1100KHZ)
50KW	AM	1978	Continental 317C-1
50KW	AM	1973	Continental 317C
50KW	AM	1981	Continental 317C-1
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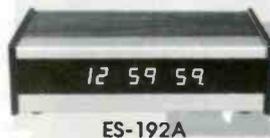
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•**AXS Pro Cart:** a software concept that replaces obsolete audio cart machines or earlier generation digital audio equipment; it provides absolute simultaneous operation of all the user tools; up to eight sources may air simultaneously, each with its own fader onscreen; AXS Pro Cart includes a complete digital audio production room and the Lazer Blade multichip digital audio editor.

800-334-7823 or 817-625-9761; fax 817-625-4975;
info@electric-works.com

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UHF wireless system

Vega

•**U2020:** a 100-channel frequency-agile UHF wireless system that consists of a half rack, diversity receiver and a choice of bodypack or handheld transmitters; it is designed to solve many of the problems associated with VHF systems; the U2020 system is available in two distinct frequency sets, from 746-764MHz and from 764-782MHz, providing a total of 200 possible frequencies.

800-877-1771; 818-442-0782; fax 818-444-1342
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Feedback exterminator

Sabine

•**FBX-2020:** a dual feedback exterminator that is an upgrade for the FBX-1802; the two-channel FBX-2020 automatically senses feedback, determines its frequency, and places a supernarrow notch filter precisely on the feedback frequency; the FBX provides more gain before feedback and automatic feedback control without damaging sound.

904-418-2000; fax 904-418-2001
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Electronic log reconciliation system

Custom Business Systems Inc.

•**Electronic Log Reconciliation (ELR) system:** a completely automatic system that handles inserted, deleted or missed commercials and compares aired time to what is allowed by contract and confirms copy that was aired with the contract, date and time specifications; ELR requires CBSI's Log Transfer and works with a growing list of automation and digital audio systems.

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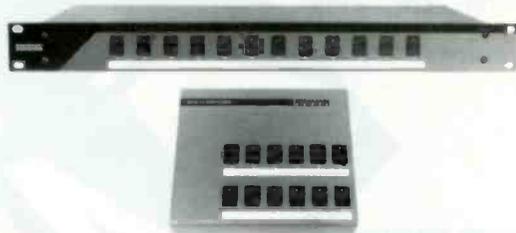
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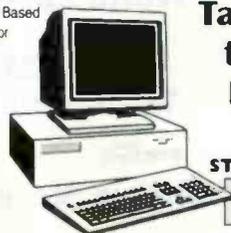
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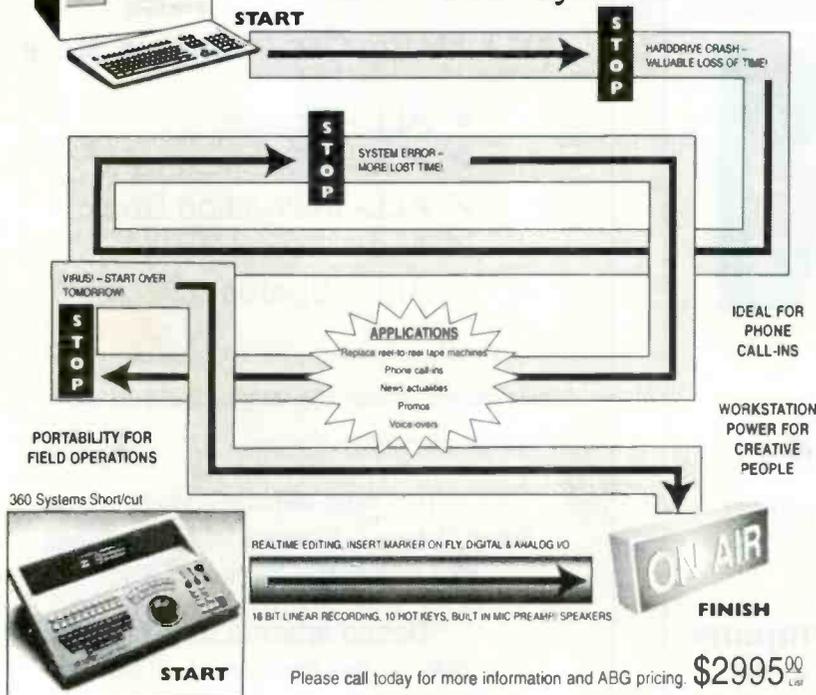
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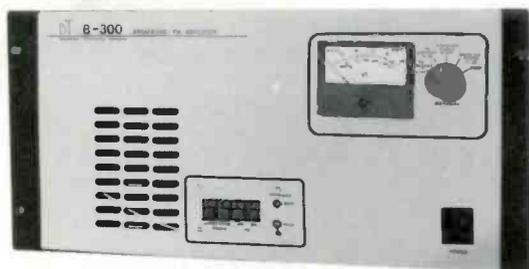
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