BE Radio®

January 1998/$10.00
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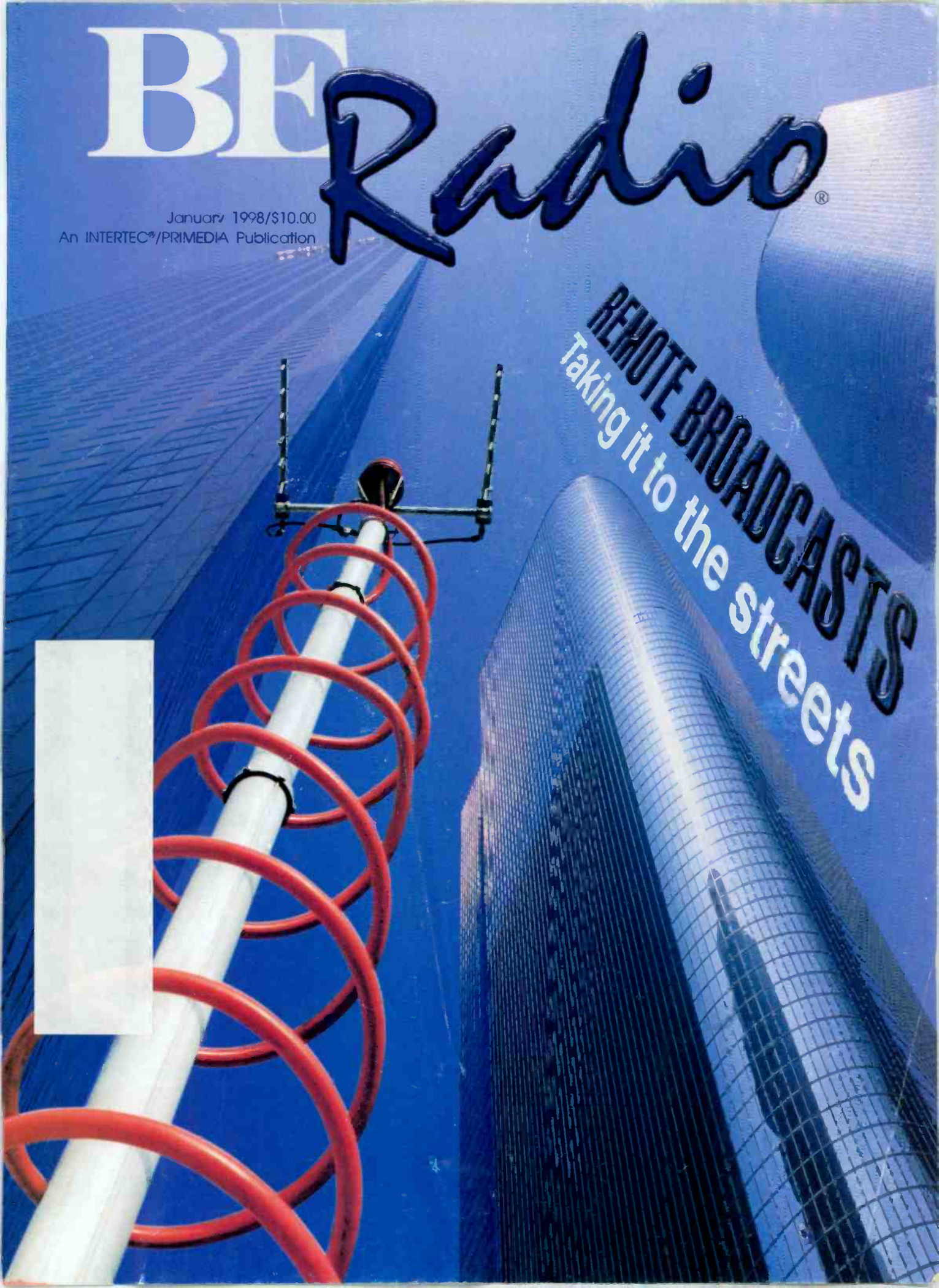
REMOTE BROADCASTS
Taking it to the streets



Pristine mic preamps, natural EQ, beaucoup exclusive features, astonishing headroom, an extra stereo bus... and tens of thousands of enthusiastic owners.

MS1402-VLZ®

"Great mixer. Really cleaned up the sound of my recording and has done a great job live mixing keyboards with the band and as my main mixer on solo and duo gigs." (J.S., Martinez, GA)

"Finally, a lightweight/compact mixer loaded with practical features that delivers clean, no-noise sound!" (R.B., Franklin, WI)

"Beautiful layout and the smoothest faders I've ever seen in a compact mixer." (B.L., Cedar Hill, TX)

"Great product. Clean sound. Live recordings are great! (D.L., Denton, TX)

"I really like the Control Room mixing and Alt 3-4." (R.P., Fort Lee, NJ)

"I am greatly impressed with the very low noise of the mic preamps." (T.T., Belair, SA)

"I really dig all the features you pack into such a small price. My 1402 was really easy to get into and use." (R.R., Murray, UT)

"I didn't believe the hype until I bought an MS1402-VLZ. NOW I believe the hype." (J.C., Toronto, ON)

"Sure like that 'stereo solo in place' feature. Also, headroom is great with lotsa presence." (L.S., Forest Grove, OR)

"You've heard it all before, I'm sure. Great product. Great price. Options and versatility out the wazoo, from hardware design right down to panel labeling." (J.H., Ithaca, NY)

"I really like the EQ points you've chosen and the EQ curves." (B.M., Lanseshore, MA)

"Plastic mixers can break easily. The MS1402 is made of metal!" (M.S., Shorewood, IL)

"I will be using the MS1402 to track all keyboards on MANDBWDWTTWEL* for Atlantic Records." (R.H., New York, NY)

*Major act, name deleted because we don't want to tangle with entertainment lawyers.

6 mic preamps. The same high headroom, ultra-low noise (–129.5 dBm E.I.N.) preamps used in our 8•Bus studio consoles.

6 mono and 4 stereo line level inputs.

2 aux sends per channel.

Low Cut Filter lets you use LF EQ without boosting mic thumps, room rumble, and P-pops, or losing audible low bass. Exclusive Mackie circuitry.

Trim with –10dB "virtual pad" and 60dB total gain range.

EFX to Monitor switch folds reverb or other effects back into the Aux 1 stage monitor feed. Another Mackie exclusive.

"The Alt 3-4/Mute is ingenious!" (B.L., Cedar Hill, TX)

"On my test run — a live acoustic show — I was impressed by the quiet and user friendliness of the MS1402-VLZ. The audience was also impressed with its crystal clarity." (F.A., Bloomington, IL)

"The 'RUDE' solo light is certainly that, but you never have to worry about leaving it on by mistake." (L.B., Winnepeg, LB)

"The Low Cut button is a big help in cutting boomy stuff when running a big bass and arch-top guitar live." (G.S., Kirkland, WA)

"The quality of the EQ is amazing! I was blown away by the tone and clarity." (J.D., Pomeret, CA)

"The MS1402-VLZ is great — excellent specs (I teach audio engineering) and really clever routing options." (J.P., Los Angeles, CA)

"What I heard when I hooked up my MS1402-VLZ was exactly what I wanted to hear. Nothing. Cleanest mixer I have ever worked with." (R.S., Fergus Falls, MN)

"The 1402 RULES! People all the time come and tell me how wonderful the sound is." (P.F., Cincinati, OH)

"It survived and played through a glass of iced tea spilled all over it at a fashion show for a very important client of mine. Show was perfect. Client paid. I'm buying more Mackie." (H., Houston, TX)

"I do work as a Senior Executive Producer for [major classical music label]. The MS1402 was highly recommended by several studio engineers." (S.E., NY, NY)

"Great product!" (C.B., San Francisco, CA)

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AFL/PFL solo mode switch.

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Below: A few of the 400+ folks who work at Mackie Designs in Woodinville, WA. 20 miles north of Seattle

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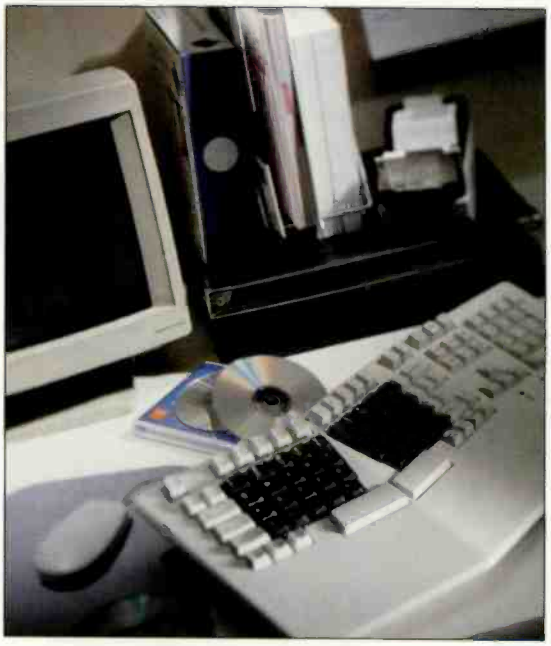

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38

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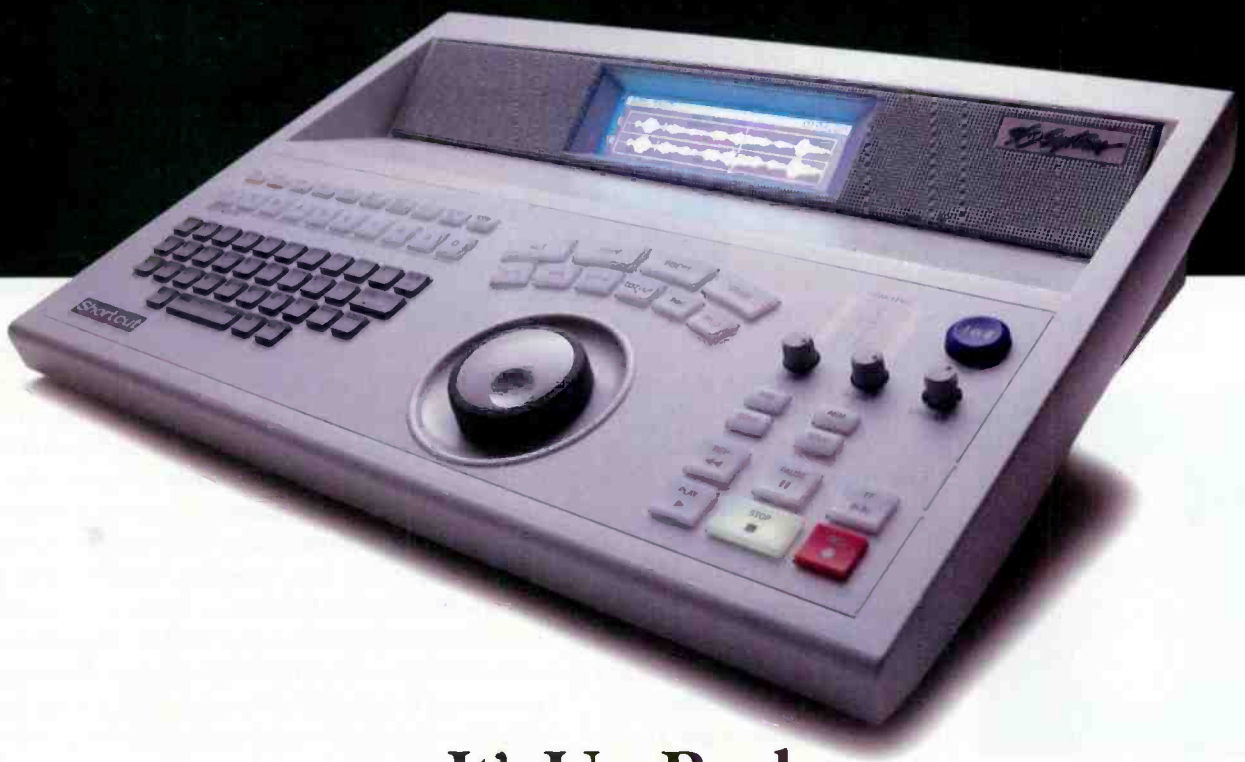
ON THE COVER: Making contact with the public. Remotes are a great way to get exposure for the station. Pulling them off successfully takes careful planning and the right tools. (Cover design by Michael J. Knust.)

The Short/cut™ Editor is your next tape recorder, edit block and digital delivery system.



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Editorial

Unnatural laws

The rapid pace of technological change is a blessing and a curse to nearly every company in business today. Some analysts credit it with being the "x-factor" behind today's unusually benevolent conditions in the U.S. economy. But keeping up with the competition can become an endless and debilitating race in a world dominated by software-based processes.

One attempt to quantify the nature of this change is the well-known "Moore's Law," which states that computer CPU performance doubles every 18 months. Based on post-industrial traditions or anything before them, this is an extremely unnatural phenomenon. Neither our physical constitutions nor our depreciation schedules can easily cope with this kind of transition. Our mental capacities yearn for respite after having just mastered a current-generation system, but it's not to be. The next wave has already launched, and the learning process must begin again.

"Every gain made by individuals or society is almost instantly taken for granted."
—Aldous Huxley

On the positive side, if "use it or lose it" applies to brain cells, this continuous exercise will at least keep our mental faculties in better shape. But this fast-replacement process can also engender a love of the latest for its own sake, creating a disposable society in which anything perceived as slightly outdated – including people – will be cast aside. So "stay current or else" is another, darker way to encapsulate the era.

It's easy to forget how much we all benefit from this relentless march, however. The amazing power and cost-effectiveness of today's computers allow many industries – including radio broadcasting – to harness massive capabilities, as long as the control interface is adequately designed and appropriately matched to the user.

Strangely, though, the unnaturalness of Moore's Law and its corollaries is rarely questioned. How is it that such an odd process was established and now seems inexorable? What drives this uncanny force? For the answer, consider another "unnatural" force, the nuclear reaction. Recalling physics, we remember that when sufficient excitation is applied to a critical mass, a chain reaction begins that results in a powerful release of energy, in either a controlled or uncontrolled fashion. Unless all the required elements are present in the correct proportions, nothing happens.

In our metaphor, the critical mass is brain power and financial investment by developers, with the excitation coming from healthy market demand. The latter energy can be aggregated from a variety of sources, but the material it is focused upon must be concentrated in a single place, otherwise the high-yield reaction will not occur.

The implication is clear. Moore's Law only applies when computer processing hardware development is concentrated into a critical mass of very few companies (i.e., Intel, Motorola, AMD – end of list). Yet the nature of computing, while requiring this near monopoly in CPU chip development, spawns a rising tide in a very large pool, allowing many other downstream parties to raise their boats (i.e., Compaq, Toshiba, IBM, Dell, Gateway 2000, Hewlett Packard... – the list goes on and on). It's dramatic proof of the value of the late twentieth century model of the open standard. Far from the oxymoron it might have seemed to industrialists a century ago, in today's multi-layered (or "horizontal") technology environment, this model serves both producers and users of computer hardware and software quite well.

Nevertheless, as James Cameron has noted in the promotion of his recent movie *Titanic*, it's just when you think something's impervious that you may be unprepared to react when the worst happens. That's the downside to relying on a single, massive infrastructure for the bulk of your economic momentum. So as we start another year riding high and unnaturally fast, enjoy the trip, but make sure you've got enough lifeboats.

Skip Pizzi, editor-in-chief

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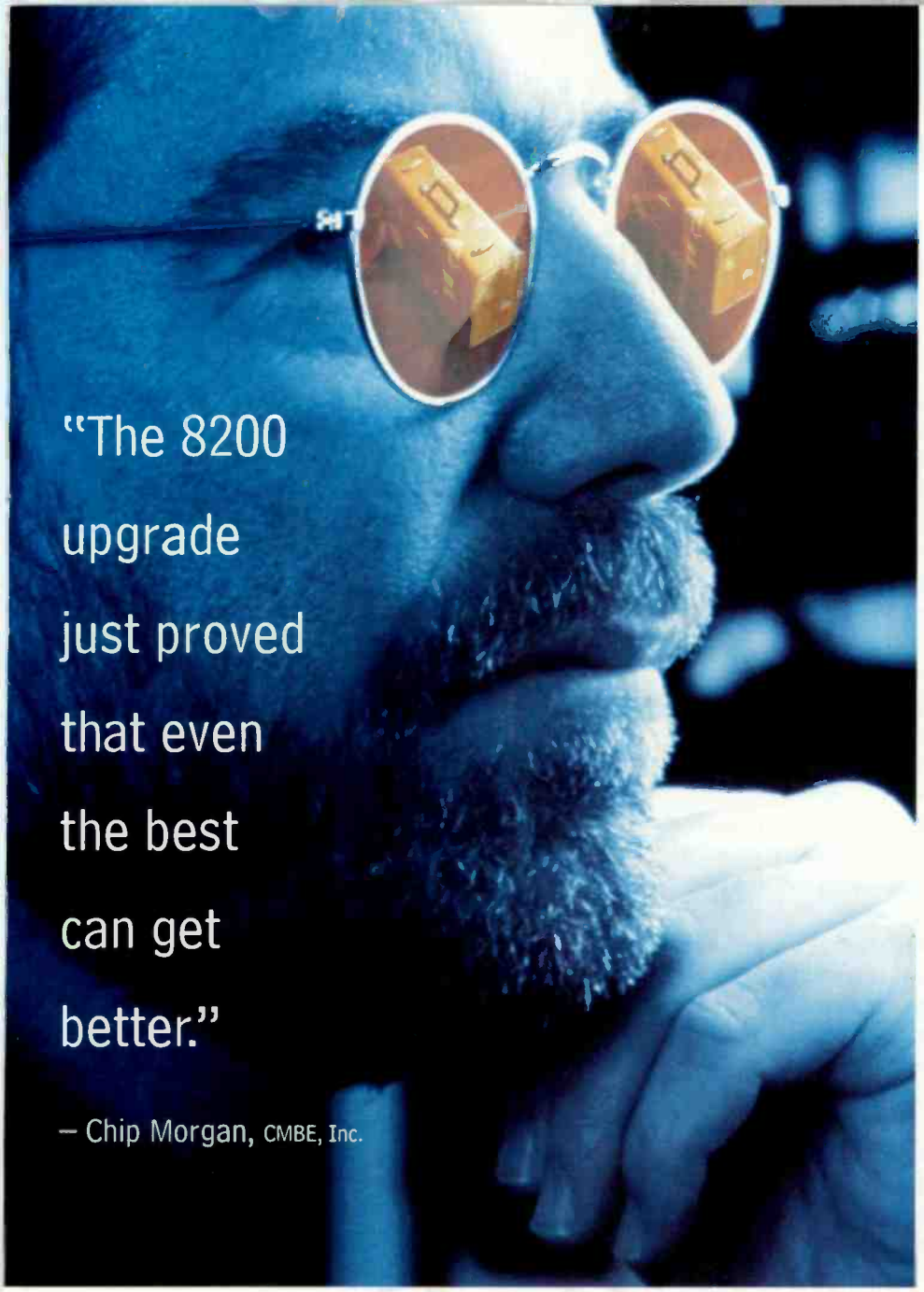

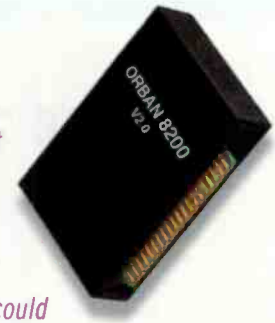

"You plug it in, it works, and you go. What more could a busy engineer ask for?"

FOR THE LAST 20 YEARS, Chip Morgan has been traveling the world with a single purpose: to design and fine-tune radio stations for the best possible signal and sound. So when someone with his years of experience and international reputation describes Version 2.0 as the best thing to happen since OPTIMOD went digital, it pays to hear him out.

"For power users, this is more than another upgrade, it's a slam dunk – with more definition, bigger bass, improved clarity and transparency, and the ability to increase loudness without typical distortion. That's great news for any station that insists on having the best DSP technology out there. The 8200 upgrade just proved that even the best can get better."

To order Version 2.0 for the OPTIMOD-FM 8200, contact your Orban dealer. And get ready to plug into a bigger, better sound.

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Circle (16) on Free Info Card

Viewpoint

There are 721 days remaining

I'm sure by now that you are well aware of the expected problems with the coming of the year 2000. Software and hardware changes and patches are being developed to overcome the obstacle that will be presented to many applications. Most of us will be fine as end users of home or office applications.

It's obvious that advances in technology are far beyond those expected 20 years ago. Even predictions and expectations made a few years ago have been easily exceeded. I don't mean to start everyone reminiscing about their first computer, be it a Tandy, Timex, Commodore, Apple or whatever, but it is amazing how far it has all come so fast.

Looking back at some of the quotes from the people who are now giants in the computer industry shows that there was not much future thinking even then. Ideas that the need for no more than a handful of computers worldwide or minimal hardware requirements (like 640KB of RAM) seemed so practical when they were presented. Now it seems almost comical to think of what was then considered high tech.

More and more demands are being placed on computer resources for new software or hardware. It's become a technology chase. The predictions for the future of the computer were very shortsighted, but fortunately there was room for growth. The computer industry was just beginning, so the rules had not yet been written. A software or hardware improvement can overcome a previous obstacle. The current actions of the FCC are showing similar short sightedness, but the long-term cure will not be so easy.

Congress seems to think they have found a perfect way to raise money by auctioning spectrum. This process has already bitten into the space used for television ENG in the 2GHz and 13GHz band, and now it has come downstream to the 455MHz band, biting into some RPU and TSL links.

Here we have the situation of an existing arrangement being snatched away. In some cases a minor retuning may help the radio station keep their RPU functional once it receives interference from a low orbit satellite, but the point is that the RPU band is already busy with activity from other wireless services, and now there's even more. As for our television brothers, they have to go to further extremes to overcome the loss with ENG equipment. Even more frequency coordination will be required of us because of someone else's idea.

When broadcasters apply for a license in the auxiliary service, there is a line asking if prior frequency coordination has been done. Most of us would not think of applying for a license without seeing what else is on that frequency. The FCC, on the other hand, is ready to just give it — no wait — *just sell it* away.

Technical insight while proposing these actions would probably keep some of the confusion down. A few weeks ago, I was flipping through television channels and came across an FCC meeting on C-SPAN. Besides being a cure for insomnia, I was angered at hearing the commissioners and staff members read reports that dealt with technical issues and struggle with some very basic technical language. The idea of requiring an engineer to be on the Commission is not a new one, but it was made obvious that it is certainly a good one, not just for technical accuracy, but perhaps pronunciation as well.

Congress seems to think that spectrum allocations are the way to raise money to cover the debt. The FCC is following along, seemingly without considering the shortsightedness of their actions.

Maybe we should go back to 64K of RAM and a green monochrome screen.

Chriss Scherer

Chriss Scherer, editor

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Hit the Road

Courtesy of WEKS-The Bear

Remote broadcasts have never been easier!

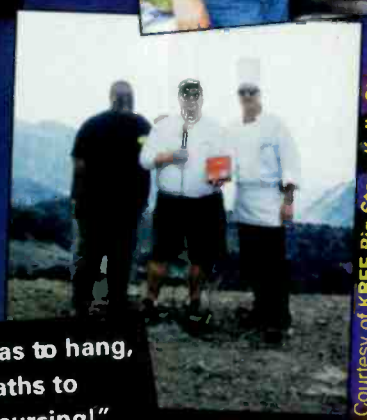
Sometimes it's impractical to install a special circuit like ISDN for a one-time remote, and often your RPU just won't make it. However, a plain telephone line is usually available and the HotLine delivers up to 10 kHz, two-way audio, on just one dial-up line. Want to sound great from anywhere, anytime? Hit the road with a Comrex HotLine.

"People thought the interview was being done in the studio!"

Courtesy of KTNN

Courtesy of Middleburg Broadcasting Network

"I didn't have to do my usual routine of pulling a muscle contorting my radio antenna to avoid (RPU) interference."



Courtesy of KBEE-Big Steve Kelly Show

...with the Comrex HotLine.

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Courtesy of Jason Gant — Ask the Computer Doctor Show

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Circle (17) on Free Info Card

Using computers in your business

By Kevin McNamara, CNE

Whether you are already in business for yourself or just thinking about it, one of the most stressful things you'll need to do (next to paying taxes) is to determine the tools necessary to efficiently run your business. This seems pretty basic on the surface, but a surprising number of businesses have failed for lack of it. A new business owner will tend to focus on generating income, leaving other key business functions to be dealt with when time permits. The net result is that the business does not grow and the owner ends up with little, if any, free time. Successful business owners have learned that spending the time and energy initially to implement the proper systems pays dividends in the form of increased productivity and general quality of life.

There are now over 12 million SOHOs (small office/home office) operating in this country. With a new SOHO business launching every 32 seconds, major technology equipment providers that courted medium and large companies in the past are now fighting for our business. This trend is also apparent in our industry, with engineers leaving in large numbers to form independent contract businesses.

Contract engineers can use computers for billing and parts inventory.

The proper selection and implementation of your computers is essential to grow your business. Here are a few thoughts that will help you with the process.

Analyze your situation

Ask yourself the following questions:

- What is important to the continued operation of your business? Maintaining good financial information and databases? Marketing? Engineering? (The answer should be all of the above.)
- What software is required to perform these tasks?
- How many people need access to this information (other employees, outside contractor, etc.)?
- From where do you routinely access this information (i.e. in the office or in the field)?
- Will your present hardware properly support the required software (especially operating systems)?

Software

The contract engineering business is service-oriented in nature. However, you may also sell (or resell) a variety of products. Excellent single entry bookkeeping programs are available to help you keep track of receivables, payables, payroll, inventory tracking and taxes. Some also allow you to categorize your expenses. These programs also provide you with reporting tools that can give you an up-to-the-minute profile of your company's financial health. One of the best available features is the ability to export data to a tax program, saving you the aggravation of manually sorting out your expense information. One piece of advice — engage the services of a local CPA to help you set up the system to match your specific business requirements. The majority of the canned accounting software was designed to handle mainstream businesses, such as those that provide a service (i.e. billable time) or those that sell products. If your company deals with both of these, be sure to choose software that can handle it.

Marketing is another vital area that can not be ignored. Hiring outside marketing organizations and using commercial printing is usually not financially feasible. A wide range of inexpensive publishing software is available that can produce commercial quality brochures. Most of the current word processing programs have publishing features integrated into them. You may also consider programs that allow you to save your work as an HTML document so that you can easily add your printed advertising to a web page.

Speaking of web pages, there are several inexpensive programs with graphic user interfaces that will help you create a web site. Several Internet service providers (ISP's) are offering low cost hosting services (under

Increase Your Footprint

Capture the Audience!
It's *your* Listeners. *Your* Viewers.
Make them *Stay With You!*
The *DBMAX*™ Digital Broadcast Maximizer gives you *the impact you need* to reach them!

The *DBMAX* is an innovative no-compromise digital audio processor with excellent sound features, that will interface with all analog and digital broadcast formats.

The *DBMAX* was developed in close cooperation with chief engineers at broadcast facilities world-wide, resulting in a combination of three powerful broadcasting tools in one compact, easy-to-use unit:

Transmission Processor:

- Transparent multiband on-air dynamics processing
- Expansion of the broadcast coverage area, by providing better signal to background noise ratio for all receivers
- Easily adapts to any broadcast standard - all pre-programmed and easy to set up

A Sound Investment!

Inserted as the final audio link in the broadcasting chain, the *DBMAX* maximizes your audio modulation. It provides excellent sound optimization in AM and FM broadcast as well as DAB and digital TV audio transmission. Here the *DBMAX* becomes the optimal Transmission Processor, ensuring a louder and more consistent signal, thereby expanding the actual coverage area. Better coverage means you get better ratings, which in turn makes the *DBMAX* extremely good value!

Outside Broadcast Tool:

- Louder, clearer and punchier signal
- Dynamic compression of spot/trouble frequencies (air conditioning etc.)
- Ensures that dynamic levels are within your station's standard
- Automatic Gain Control for unattended operation

Reliability You Can Back-up!

Years of research and experience in digital compression and limiting techniques for CD mastering have led TC Electronic to the development of the three-band *DBMAX* processor. Reliability and interchangeability is equally important for Outside Broadcasting, so we made sure the information you store on your PC-card will make any *DBMAX* run 100% according to your specific settings. In turn it makes the PC-card an ideal back-up media for your *DBMAX*.

Radio, TV & Film Post Production Optimizer:

- Louder, crisper, warmer, punchier, more subtle, more spectrally-balanced production – the choice is yours...
- Finalizes the material
- Makes it possible to check what the sound will be like after transmission

Put Yourself in the Place of Your Listener

Used as a Post Production Tool the *DBMAX* gives the production engineer the ability to hear exactly what the program material will sound like as received by the listener. The *DBMAX* allows transmission-settings to be copied to the production suites, enabling engineers with a *DBMAX* to listen to the final transmitted signal during the production phase. This way you can make sure your listeners receive the signal you intended them to receive!

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$40.00 per month). At the very least, you should have a company e-mail address.

Keeping track of your current clients and future prospects is made easy by using one of several contact management programs. Most of these programs contain databases that can be modified to suit your needs and can be linked directly with fax and e-mail programs in order to create a targeted electronic advertising campaign. You may also consider whether having the ability to produce computer-based presentations to potential clients will be necessary. Consider purchasing software that is bundled in an "office suite." These usually include word processing, publishing, spreadsheet, database, contact management and presentation software. Besides the obvious cost advantage, objects within each program can be linked to any of the other programs. This is a powerful feature if you routinely share similar data between programs. For example, if you create a spreadsheet with information that changes from time to time and use that information in your presentation, every time you change the data in your spreadsheet, the changes will also reflect in the linked presentation.

A wide range of inexpensive, Windows-based drawing programs are now available. Many of these programs will allow you to create a database from a predefined library of symbols and objects as they are placed on the page. They may also give you software tools to create your own defined symbol library, which can be very helpful when documenting the projects for your client. Will you work on projects that include other contractors (architects or engineering)? Be sure that the drawing program you select can import drawings in a .DXF (AutoCAD) format. This will make it easy to exchange and modify the blueprints.

If you will be producing FCC applications for your clients, *form-filler* programs make the task of filling out the various forms easy. Many can be programmed to make automatic calculations at the appropriate locations on the form. The FCC has begun to publish many of the forms on its web site (*www.fcc.gov*), and these can be imported directly into your program. The time required to locate new tower sites can be drastically reduced by using one of the many mapping programs that includes an external GPS receiver. You can run the program on your laptop, put the GPS antenna on the roof of your vehicle and get a real-time view of where you are. This is also extremely helpful if you will be running AM directional performance measurements in the field. Although not accurate enough to find specific points, it can help you find those streets that don't appear on the USGS map.

Selecting hardware

Selecting hardware will present a slightly more difficult decision, due not only to the expense involved, but to the almost certain short-term obsolescence of the equipment. Lately, a lot of attention has been given to the *total cost of ownership* (TCO) of the personal computer and related peripheral equipment. The TCO takes into account the total expense involved with the ownership of the system such as repairs, maintenance and upgrades. The question that we all think about when making a computer purchase is "what if I buy it now and the price drops?" Don't spend much time worrying about it, because the price is always going to drop. The more important point to consider is whether the equipment you're purchasing will operate with the next generation of operating systems. For example, if you're considering purchasing a new system now, you should spec a system that will take advantage of the features in the new Windows 98 operating system. Spend time to learn the hardware requirements for the operating system. The rule of thumb: plan on changing most of your hardware every 18 months. Why? Because certain peripherals such as back-up drives, upgradable modems, printers and monitors can probably be reused.

You should also determine where you need access to your computer — in the office, on the road or both. The time spent in airports and hotels rooms can be far more productive if you bring along a notebook computer.

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

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EAS one year later: Growing, dying or stagnant?

By Leonard Charles

Those who thought complete development of the Emergency Alert System (EAS) could happen in one year have probably returned to the planet they came from. After all, we are talking about the FCC, broadcasters, the cable industry, the emergency management community, consumer and professional electronics manufacturers, and the public all migrating to the same EAS page. That was a monumental challenge. So just what is the status of EAS right now?

Compliance

It's safe to say that almost all broadcasters have attained a solid level of EAS rules compliance. Most stations have done so by setting their equipment on automatic for those alerts they are mandated to relay, and then developing an adequate procedure for logging what needs to be logged. Besides logging, the only thing they really needed to teach operators for compliance was how to originate a Required Weekly Test. Is this any better than the old Emergency Broadcast System (EBS) system? Not really, except that the automated capability lessens the likelihood of panicky operators doing the wrong thing or nothing at all. As the "shakedown year" ended, reports of unsuccessful tests have become few and far between. The conclusion is that broadcasters, for the most part, are legal.

The cable industry is right now where broadcasters were about a year ago. It took until October 1997, long after the original cable deadline had passed, for the FCC to finalize that industry's EAS rules with the release of the Second Report & Order on EAS. The first cable deadline is now the last day of 1998 for large systems, and October, 2002 for non-exempt smaller systems. There are still sizable questions concerning cable and broadcaster EAS interaction but those involve television and won't be covered here.

Consumer participation thus far can be summed up by their reaction to a test on their favorite broadcast station. The phrase "what the heck was that" is still quite common. The positive thing to note is that the digital EAS audio bursts are not yet being ignored like the two-tone attention signal that was the EBS.

In the consumer electronics trade to date, Radio Shack is selling a weather radio that reacts to Specific Area Message Encoding (SAME), the NOAA version of EAS. This unit allows the user to soft set the location codes for up to fifteen counties. It will react to any alert, tests included, for any of those counties. Differentiation between a real alert or a test is shown by different LEDs that stay lit until the event's time period expires. The only other company marketing consumer EAS receivers is ASI Industries, an Iowa-based company. Its unit can be tuned to any area broadcast radio station. Any non-test EAS alert on that station will de-mute the speaker and light an alert LED. The speaker will again mute on the EOM code, leaving the alert LED to be manually reset. Test alerts will light a "test" LED without de-muting the speaker. It will also stay lit until a manual reset.

Two companies have developed professional EAS products. The Digital Weatherman III with EAYES option converts weather-wire copy to audio for broadcast with valid EAS coding to be fed to an EAS decoder. TFT, meanwhile, is beta testing its In-Home Alerting Device (IHAD) to aid the cable industry with the FCC mandate to provide a method of hearing-impaired alerting.

Is there more?

Is this it for EAS? Hopefully not. A few problems need to

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be overcome in order to return broadcasters to active local-system development from the EAS stagnation most have settled into.

NOAA Weather Radio (NWR) needs to develop messages that are more broadcaster friendly. Broadcast stations that have interfaced their EAS decoder to the local Weather Radio and have aired alerts directly from it are less than impressed by the messages. They're generally overstuffed with content, and the voices are tentative and monotone. They lag in time to the weather-wire movement of the same event. As a result, a lot of broadcasters have reverted back to their own weather alerts with their own announcers. Cooperative efforts between broadcasters and NWR personnel to correct this continue, but progress is slow.

Connection to local non-weather emergency sources has also proven more of a challenge than first thought. Once emergency managers become convinced that EAS can work for them, their budgeting process slows the enthusiasm and progress. Many of them have not yet been able to place the order for their EAS equipment. From the regulatory standpoint the FCC has done little to help the development of local EAS other than to encourage it. There are no mandates in the rules for local participation by either the broadcaster or the emergency management community. Early on, in response to concerns about the lack of local non-weather event codes in the rules, the FCC promised to append some to the list.

EAS Websites

- SBE EAS info
  http://www.sbe.org/eas.html
- The SBE petition
  http://www.sbe.org/eas_pet.html
- FCC Part 11 rules
  http://www.fcc.gov/clb/eas/rules.htm
- FCC EAS Orders
  http://www.fcc.gov/clb/eas/document.htm
- EAS Handbook
  http://www.fcc.gov/clb/eas/handbook.htm

The wait for those codes is nearing two years.

The Society of Broadcast Engineers (SBE) has identified many potential points of EAS improvement and has submitted a petition for rule changes to the FCC aimed at jump-starting further development of the system. The text of that petition is available on the SBE web site at *www.sbe.org/eas.html*. The SBE is anticipating a Notice of Proposed Rulemaking as the next step.

So the future of EAS appears to be back where it all began — in the hands of the FCC. Broadcasters are waiting for a reason to get back in the EAS development game.

Leonard Charles, CPBE, is information systems administrator at WISC-TV in Madison, WI. He also serves on the SBE Board of Directors and is chairman of the SBE EAS Committee. He can be reached by e-mail at lcharles@wisctv.com.

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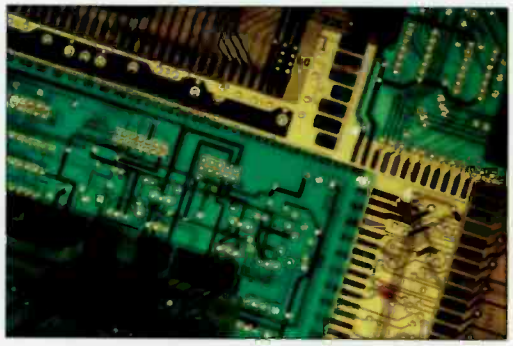
Upgrading to solid state

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

There comes a time when the decision to abandon good old reliable tubes and switch to a solid state transmitter has to be made. Sometimes the change is forced, as when the old, faithful tube transmitter blows its last power transformer; sometimes it happens when remodeling a station and modern efficiency is the watchword.

Changing over to solid state transmission makes a difference in many areas of station engineering. RF power tubes are expendable — that is they wear out. Over the course of a year or two the emission drops as the cathode loses its activity. Wise engineers keep spares on the shelf, but an unused tube will slowly become gassy, meaning that over time very small amounts of retained gas will be released, resulting in a soft tube when put into service.



Tube manufacturers recommend exercising tubes for longer shelf life. Unfortunately continued insertion and removal of large tubes from sockets tends to weaken tube and associated chassis connections. On the other hand, solid state devices are generally good for as long as 250,000 hours — short of a manufacturing weakness.

When a final tube blows, you're off the air until a new tube is inserted or, at least, the driver stage can be connected to the antenna system. Either way, there is a physical intervention. Solid state offers built-in backup capability, so that when a module blows, the remaining modules will keep you on the air with a barely discernible reduction in signal strength. This modularity is probably the biggest strength of solid state transmitters. Many manufacturers use the same modules for different stages (PA, IPA) to add even further backup capability.

Preparations

Over the years the old tube transmitter has been warming the transmitter room it will have attracted dust and insects. Clean out the rubble and trash that collects in cable troughs and low spots and give the whole place a thorough vacuuming. Make time to repaint the room and repair the broken window panes. If you don't have air conditioning, consider it as part of the project. If the budget will not allow it, plan at least for a good blower system to get rid of heat — solid state's worst enemy.

Remember that when working with solid state equipment, it is easy to cause damage with a static discharge. Ground yourself and use an anti-static mat before you start work on solid state components on the bench.

Check out the remote control interface panel before the new equipment arrives, and be ready to make the required connections. Be aware that sometimes a solid state interface switch/relay may require different treatment from isolated relay contacts. Take into account that a different method of accessing remote voltages and currents may be used and order the necessary interfaces.

Because there is less heating with solid state equipment, there should be less time required for maintenance. The lower operating DC voltages make for greater operator safety as well as lower cooling requirements.

Power requirements should be a little less than before, depending on the power of your new transmitter. It is a good idea to plan for the future and be sure the wiring is adequate and free of splices, removing this possible source of noise.

Your primary power supply is very important. Modern solid state equipment is unforgiving of AC power quality. Talk with your power company and ask for a clean line so that your transmitter is preferably the only load on that particular circuit. I once had a line with only our station (20kW transmitter) and a helium extraction plant on it. This sounds acceptable, but the compressors at the plant about 15 miles away produced 5% variations in power of 2- to 5Hz. The effect on the output was obvious.

Variation in power is not the worst thing that can happen to solid state transmitters — a dirty waveform with a lot of harmonics, spikes and spurs will make for a very unhappy transmitter. The power company may be able to provide a conditioned service. A lot more attention is being given to this aspect of power generation and it is surprising how much cooperation can be obtained. At the same time, cooperate with them and do the best you can to run with a unity power factor.

Surge suppression is very important for solid state transmitters. There are several types on the market. But just because the unit sits on the wall minding its own business, don't be fooled into thinking it is still working. Metal oxide varistors do tend to deteriorate as they age.

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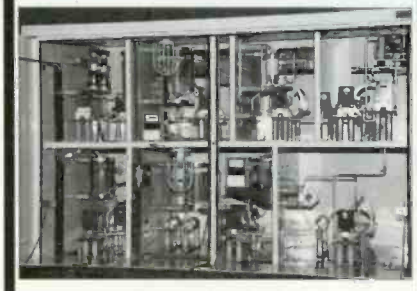

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	Collins 831G 20 kW, 3 tubes	Continental 816R2-C 20 kW, 1 tube
distortion	0.5%	0.08%
FM noise	-65 dB	-75 dB
AM noise	-40 dB	-50 dB
Stereo separation	30 dB	60 dB

Comparison of typical FM transmitter performance from tube based to solid state exciter and IPA.

Once installed with the new transmitter, check it regularly. It is also a good idea to replace the MOV's every two years to keep your protection going.

Check the plumbing

Be ready to change your coax routing. Check the new transmitter drawings to be sure your existing coax entry will connect easily to the new equipment. If you have wall-mount entry coax lightning protection, be sure the new cable routing will not place a strain on the coax. It may require ordering a new elbow or connector to reach the new RF output connector on the transmitter.

If you are going to a new AM transmitter, remember that modern high-efficiency solid state transmitters put more power into the side bands. Be sure that existing transmission lines can handle the total overall 100% modulation power and that ATUs and phasors are properly adjusted.

In the case of an older directional AM antenna it pays to run a careful impedance curve of the phasor input, and sometimes of each tower if there are any high Q radiators. The addition of impedance smoothing circuits to maintain a reasonably level value of R and X across the transmitted bandwidth can be very worthwhile in preventing distortion. PDM transmitters require an accurate 50Ω filter, and line impedances must be adjusted properly. It's a good idea to check line impedances with an inline bridge while awaiting delivery.

FM offers more opportunity for equipment mixing than AM. It is not common to buy a new oscillator/modulator for an AM transmitter, but many FMs dump their old tube IPAs, drivers and even exciters and drive the tube PA with new solid state devices. When such a change is made it doesn't provide much more space in the transmitter room than there was before — it might even demand some extra rack space. It may also demand some better air cooling or even air conditioning. Many older transmitters have solid state upgrade options available, so check with the manufacturer.

	Collins 820F 10 kW	Continental 316D 10 kW
Power consumption	30 kW	<18.75 kW
Floor space	5 square feet	10 square feet
Heat load to room	51,195 BTU (4 ton A/C)	12,798 BTU (1 ton A/C)
A/C power cost	$2,800	$700
Transmitter power cost	$21,024/year	$13,140/year

Heat and power comparison of a typical tube and completely solid-state AM transmitter.

Replacement with a new solid state FM transmitter will usually result in more floor space, possible rerouting of coax, and new connecting hardware. Once again, ambient temperature should be examined and steps taken to ensure that new equipment will not be too hot.

If you were brought up on tubes as I was, you may be going into solid state transmitters for the first time. I think that once you make the plunge into contaminated metal devices you will find life becomes a little easier. Good luck.

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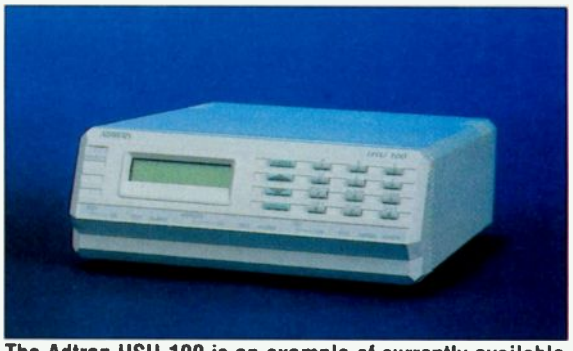
Beyond ISDN

By Skip Pizzi, editor-in-chief

As the use of ISDN service by radio broadcasters becomes common, a new telecommunications service that is perhaps even more appropriate for audio signal transport is on the horizon. *Digital Subscriber Line* (DSL) technology is the latest attempt by telcos to leverage the value of their biggest asset — the installed network of copper wire. DSL extends the capacity of standard twisted pair circuits, allowing them to carry digital signals at T-1 data rates and well beyond.

DSL accomplishes its speedy performance by implementing adaptive DSP at both ends of the signal path. This hardware compensates for the distortion inherent in long copper lines through the use of dynamic processing in complex, software-controlled terminal devices. DSL modems are therefore expensive, but mass production will create substantial cost reductions.



The Adtran HSU-100 is an example of currently available ADSL modems.

Path lengths for DSL are limited, but systems are designed to accommodate the typical telco customer-to-central office runs of 12,000 to 18,000 feet. Intermediate "repeater" amplification is not used by DSL. This allows the highly adaptive DSL modems to see each other directly, which is critical to their operation at such high speeds.

Variations on a theme

DSL is being implemented in a number of different forms. The most common to date is the *asymmetrical digital subscriber line* (ADSL), which provides high-speed service in one direction and lower speed service in both directions, plus bidirectional POTS service — all on standard copper telco loops (two twisted pairs). ADSL is intended for domestic distribution of on-demand video or Internet access, where the downstream (from the service provider to the customer) bandwidth needs are greater than the upstream (from the customer to the service provider) requirements. ADSL is being provided today at speeds of 1.5Mb/s downstream and 64kb/s upstream (plus POTS), although the format can theoretically provide up to 8Mb/s downstream and 1Mb/s upstream.

In contrast, *high bit rate DSL* (HDSL) is a symmetric service, offering from to 2Mb/s to 6Mb/s in both directions. Telcos have deployed HDSL as a replacement or upgrade for T-1 (1.5Mb/s) and E-1 (2Mb/s) lines. These older technologies also use existing copper pairs, but must be meticulously tweaked during installation, and "repeatered" every three- or four thousand feet. HDSL, on the other hand, requires no special line conditioning, no repeatering and can operate over standard 24-gauge copper for distances of 12,000 feet. With heavier gauge wire or other hardware enhancements, maximum HDSL distance extends to over 25,000 feet.

At the leading edge of this technology is *very high bit rate DSL* (VDSL), which offers extremely high data rates over shorter distances. For example, VDSL can provide 13Mb/s service up to one mile from the telco central office (CO), or up to 51Mb/s at 1,000 feet from the CO.

The development of DSL in so many varieties has led to the creation of a generic acronym for all types, *xDSL*.

Breaking the speed limit

POTS and ISDN are both dial-up services based on a 64kb/s switching fabric. Once at the CO, POTS service is handled digitally by telcos, using PCM coding at 8kHz sampling and 8-bit resolution – hence 64kb/s of data in each direction. The ISDN B-channel uses the same 64kb/s architecture.

It is not the copper wire but this 64kb/s switch architecture that sets the limits for data rates on telco lines today. Higher-speed transmission is only possible through inverse multiplexing of data across multiple 64kb/s circuits, an inefficient and fragile solution.

Therefore xDSL is designed to use telcos' existing copper wire plant, but not its standard switching architecture. xDSL lines are dedicated paths, typically connected directly to data terminal or networking equipment at customers' premises. In this respect they are similar to T-1 lines, although without T-1's use of multiplexed 64kb/s slot architecture.

This solves another growing problem for telcos — the increasingly long average connect time of switched circuits used for data communications. The issue is moot for xDSL because it uses a dedicated rather than a switched service model.

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Applications in radio

The asymmetric and dedicated nature of ADSL makes it ideal for backhaul from permanent remote sites. High-fidelity program audio and control data can travel *from* the remote site at a high data rate, while a mid-fidelity audio monitoring feed plus control data and communications can travel *to* the site at lower speed.

ADSL could make a good consolidated STL/TSL as well, allowing multiple hi-fi program audio feeds and remote control to the transmitter site, with telemetry and RPU audio return(s) from the transmitter site requiring a reduced data rate. (*See Figure 1.*)

Cross-town station-to-station feeds could use HDSL for high-fidelity audio. Future on-line audio services could also employ xDSL to feed multiple programs simultaneously from the broadcaster's sources to Internet servers located off-site.

Coming to a telco near you

ADSL is the telcos' answer to cable modems, so there is considerable incentive to move forward quickly with its deployment at an attractive price. To many industry analysts, an ADSL line's discrete and dedicated status, its intrinsic bidirectionality and its use of existing twisted pair cable make it more attractive than a cable modem for Internet access.

xDSL hardware is in the pipeline and service tests are underway around the US. Regular ADSL service has already begun in Silicon Valley, Chicago and elsewhere, with more to follow soon. Second-generation hardware enhancements are also emerging, including wireless systems.

Before long, radio broadcasters may find that xDSL makes up a substantial part of their telecom service profiles, providing useful, high-quality and cost-effective connectivity between their facilities.

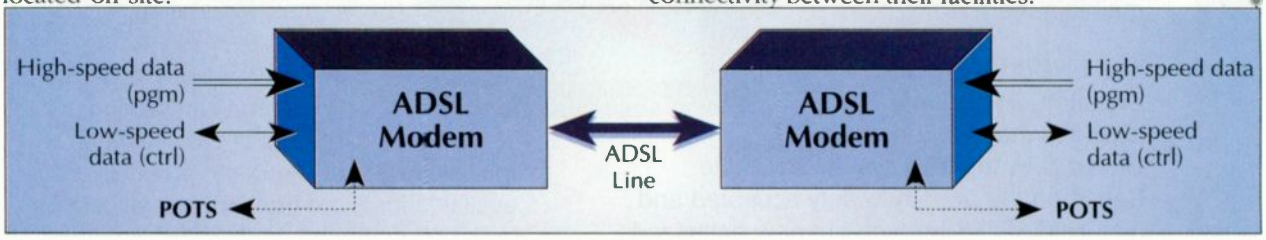
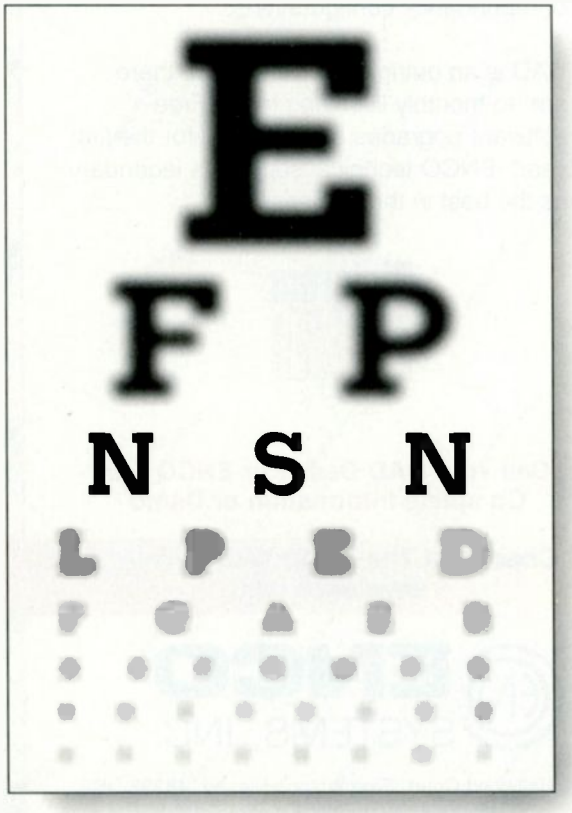


Figure 1. Using ADSL for an STL/TSL. High-speed data for one or more uncompressed digital audio program feeds travels unidirectionally from studios to transmitter site, while low-speed data for control/status and compressed RPU and IFB audio feeds travels bidirectionally. Communications between sites via POTS is also included on the circuit.



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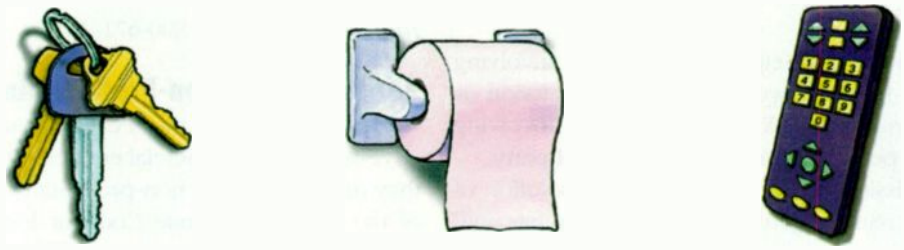

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Auction Rules Proposed

By Harry C. Martin

The FCC has proposed auction rules to resolve the mutual exclusivity among the 1250 pending applications for new radio stations. The Commission is expected to adopt the rules this summer and conduct its first auctions in the fall of 1998. Here are the highlights of the proposal:

- In cases where an entire group of mutually exclusive applications was on file by June 30, 1997, only those applicants who achieved cut-off status by that date would be eligible to participate as bidders. Additional applicants/bidders may be solicited by the Commission in situations where one or more applications was filed after June 30, 1997, even where the cut-off or window notice was issued before July 1.
- Groups of mutually exclusive applicants may settle their cases without regard to the settlement cap rules where all of the applicants reached cut-off status on or before June 30, 1997; applications filed after June 30 will be subject to the settlement caps, and settlements will be permitted only if the Commission decides to allow licenses in such cases to be awarded through settlements rather than auctions.
- In connection with settlements of cases involving groups of pre-July 1 applicants, the Commission is inclined to permit "white knight" settlements involving the award of a permit to a non-applicant third party.
- The Commission is proposing to defer resolution of basic qualifying issues regarding auction participants until after a winner is selected, and petitions to deny or to enlarge issues would not be accepted until after announcement of a winning bidder.
- An auction participant who has not previously filed a Form 301 "long-form" will not be required to do so unless it wins the bidding. Only a brief identifying form (Form 175) will have to be filed in advance.
- Winning applicants may not be required to certify reasonable assurance of transmitter site availability in their long-form applications. Instead, the Commission would rely upon strictly enforced construction deadlines to ensure speedy initiation of service.
- The Commission plans to set minimum opening bids for auctionable commercial broadcast licenses.
- A minimum up-front payment will have to be filed by each bidder with Form 175. The amount of the payment will represent a percentage of the projected value of the license as determined by the FCC.
- Within ten days after the FCC's release of a public notice identifying the winning bidder, the successful bidder will have to supplement its up-front payment so as to bring its total deposit up to 20% of the winning bid. The remaining 80% of the winning bid would be due ten business days after public notice that all challenges have been resolved and the CP is ready for grant.
- Consistent with prior law governing auctions, the Commission is seeking comment on whether it should extend bidding credits, reduced up-front payments/down payments and/or installment payment terms to small businesses, minorities and rural telephone companies.

New RF radiation worksheets

Consistent with its recently modified radio frequency (RF) guidelines, the FCC has issued a revised RF radiation worksheet which must be used in preparing future license renewal applications. If the worksheet standards are met, the licensee need only certify as to compliance. If the worksheet indicates further study is needed, more complicated engineering showings or measurements must be submitted with the renewal application. Further information can be obtained from the FCC at *radioren@fcc.gov* or 800-671-2233.

Verification of Non-Profit Status

In mid-December the FCC issued a public notice advising all noncommercial entities with FCC licenses that they must verify their non-profit status under Section 501 of the Internal Revenue Code or lose their exemption from annual regulatory fees. While December 31 was originally set as the deadline for submission of verifying materials, that deadline was suspended pending issuance of a more definitive public notice outlining registration requirements service by service. The new public notice will be published in January.

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

dateline

Radio stations in New York and New Jersey must file their renewal applications by February 2, 1998. Stations in Delaware and Pennsylvania must file their renewals by April 1, 1998. Commercial stations in the following states must submit their annual ownership reports by February 2: Arkansas, Louisiana, Mississippi, Kansas, Nebraska, Oklahoma, New York and New Jersey. Tower registrations are due by February 28 for towers in Idaho, Mississippi, South Dakota and Vermont.

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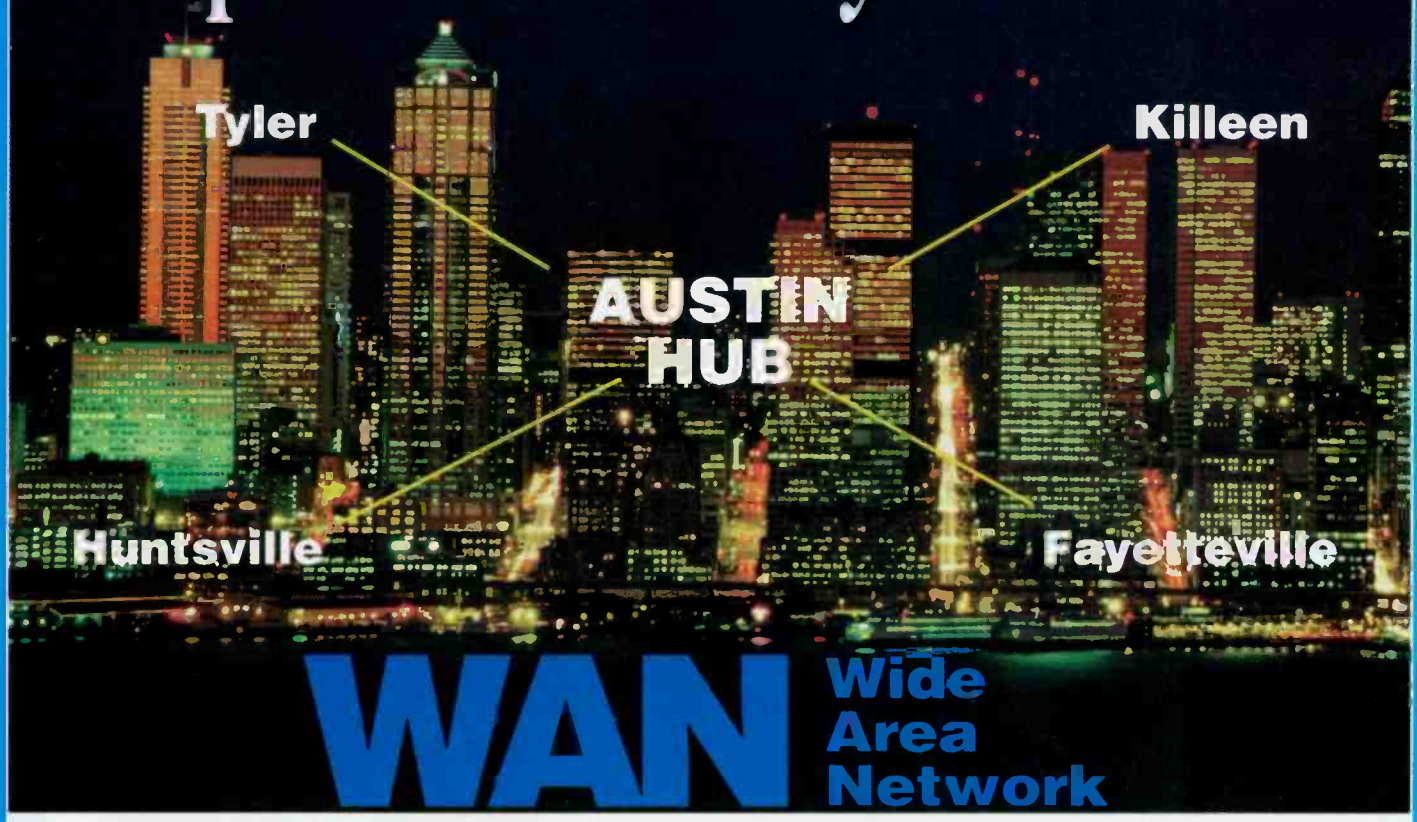

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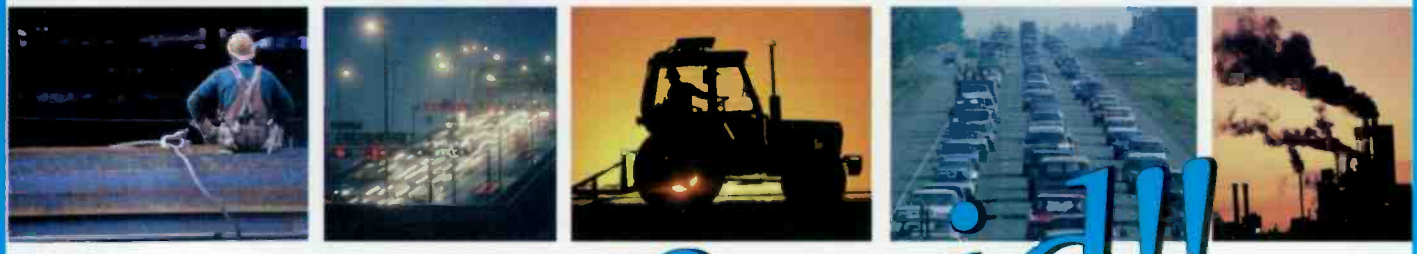

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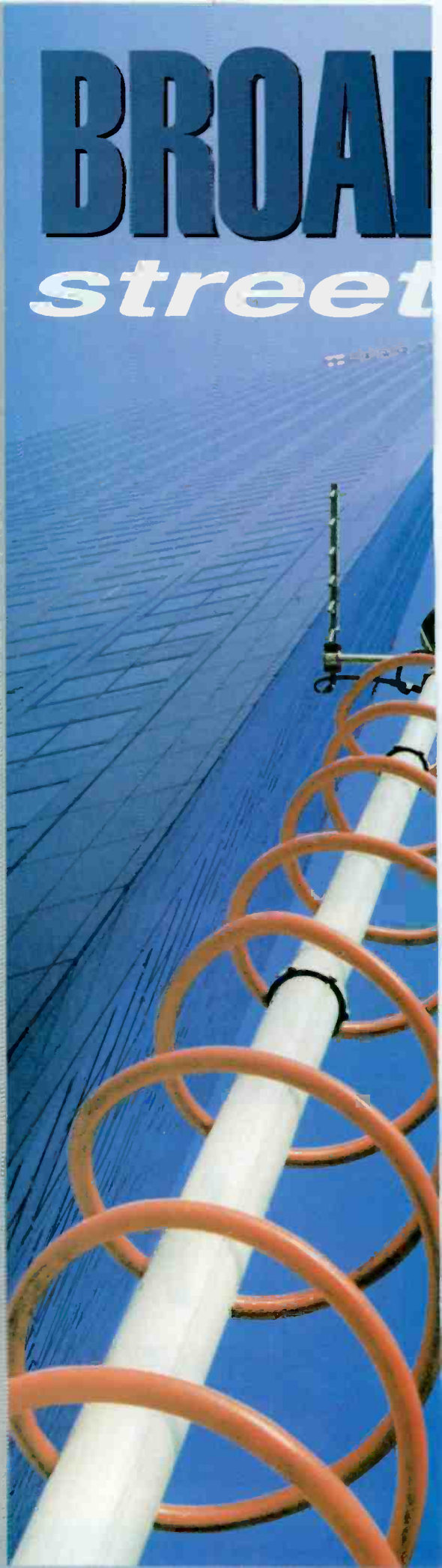
REMOTE BROAD

Taking it to the street

By Kevin Pratt



Extending the walls of the studio to go on the road needs care and attention to details.

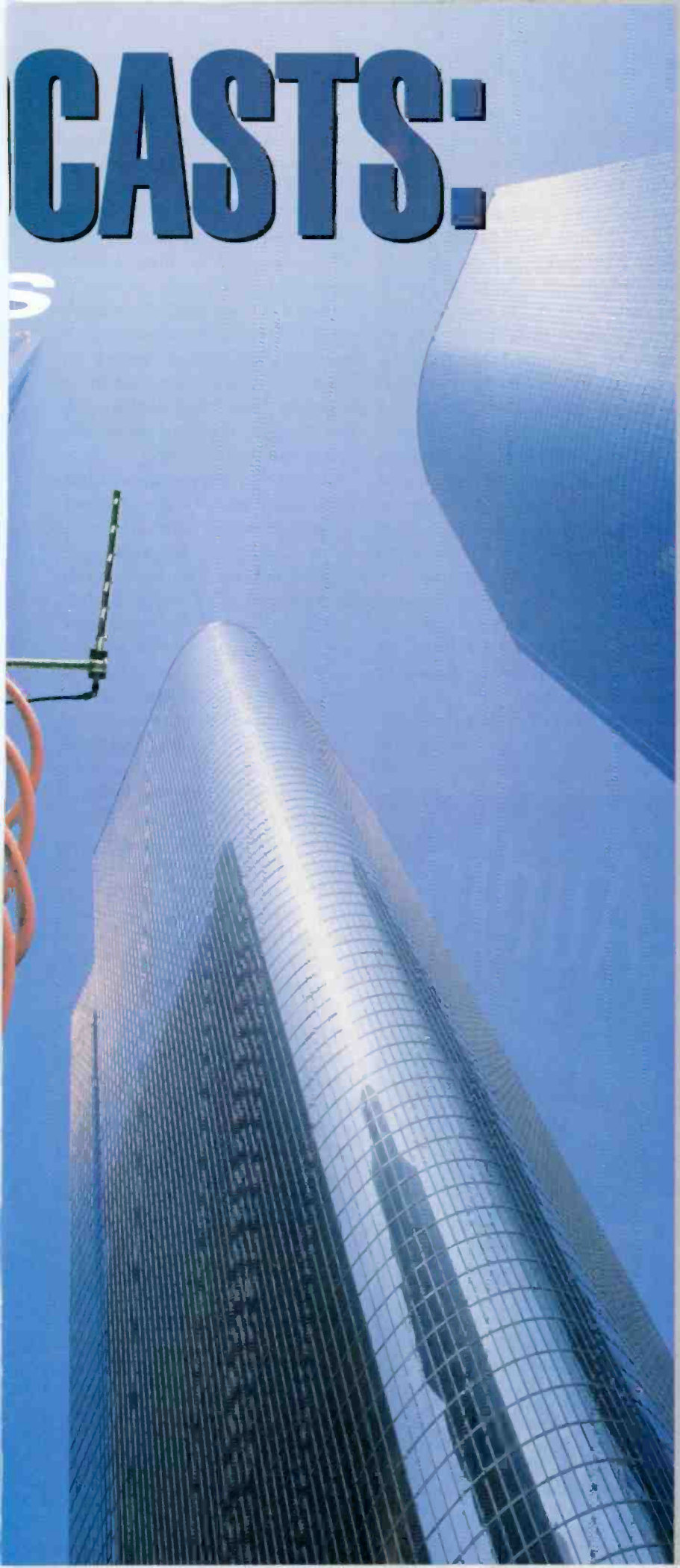
In days past, it was simple enough to use a phone and make a few promotional mentions. In the current competitive environment, market standards are demanding closer attention to the ways in which remotes are approached. Adapting to tight scheduling and maintaining flexibility to a wide variety of venues is becoming the normal expectation from sales staffs and clients.

Well-designed remotes tend to run smoother and adapt to changes faster than just getting some left over gear off the shelf and running with it. Flexibility in the layout now means being able to put the talent face to face with the public during the whole remote. Stations found the specialized remote studio trailers and RV's of the 70s and 80s seemed to be a good idea, but kept the audience one step removed from the station. Closer contact means closer identification with the station for the audience. Changing to meet this new audience perception and adapting to new technologies means changing the design of remote systems.

Designed well from the start

The design process starts with consideration of the types and frequency of remotes to be attempted. The needs of a station that only does call-in, or *spot* broadcasts are far simpler than full air-shift or complicated talk-format remotes. In other words, the amount of time the remote is on the air should dictate what equipment is used. Sadly, this isn't always the case. Many remotes are still done without consideration of the venue or communication needs, and poor programming is the result.

For years, talk formats have been springing up like wildflowers, and their needs are substantially different from music formats. With music, the equipment is geared towards simple spot broadcasts — one-minute with rapid-fire talent on the mic. Talk-shows require gear to be open 45 minutes per hour with caller interaction and a sound system loud enough to be heard by the show's participants.



If you're using a tuner to monitor and the host pauses to think, the background ambience is grabbed by the station processing and feedback is often the result. At the least, the background can become so loud as to make the caller hard to understand both in the headphones and on the air.

Approach remotes as a soundman, rather than an RF engineer. Look for the weakest link in the audio chain and adapt it for the best audio quality. As in the above example, the weakest link may not be the equipment in the broadcast chain, but it is still the engineer's problem.

Selecting the transmission

Well-designed remote pick-up (RPU) vehicles and receive sites are pretty common and often tend to be the strongest link in a station's remote. The easy ability to point and shoot a broadcast lets a station be anywhere anytime and really service their listeners and clients. Licensing a frequency is an easy process with the FCC, and the transmitters are low cost and have long lifetimes. Almost every market has a local frequency coordinator who usually offers good advice on frequency selection. Some RPUs offer built-in noise reduction and signal limiting. Simply adding a noise reduction system like Dolby B or C, or dbx Type II just before the RPU and just after the receiver can enhance the audio clarity noticeably. If this route is chosen, look into any onboard audio processing that can interfere with the companding process.

The phone company is a common resource and sometimes the weakest link. Loop lines and POTS are telephone standards that offer predictable reliability and quality. On POTS set-ups, frequency extenders are a reliable standby. Multi-line frequency extenders offer even better fidelity. Simple consoles and set-ups are a big advantage to frequency extender

plans because anyone can dial a phone number. On the receive end, autocouplers can be installed if not already part of the unit. Also, on many models a simple two-tone setup and fine tuning with one's ears is a quick way to an acceptable sound quality, while newer models offer automatic line set up. The three line models offer extremely good audio for sports and AM applications and are equally valuable for FM-voice applications. Their main attraction is ease of use and that POTS lines are available almost anywhere.

Taking advantage of packet data compression from computers, POTS codecs offer another alternative. These codecs function as modems modulating data in an audio carrier and offer a lot of features and flexibility for the price (See page 38.). A mic and headphones can be attached directly to a single unit, or more sophisticated mixing can be done outboard. However, just as in any high-speed modem connection, packet data loss occurs from analog interference, and this can mean dropouts on the air.

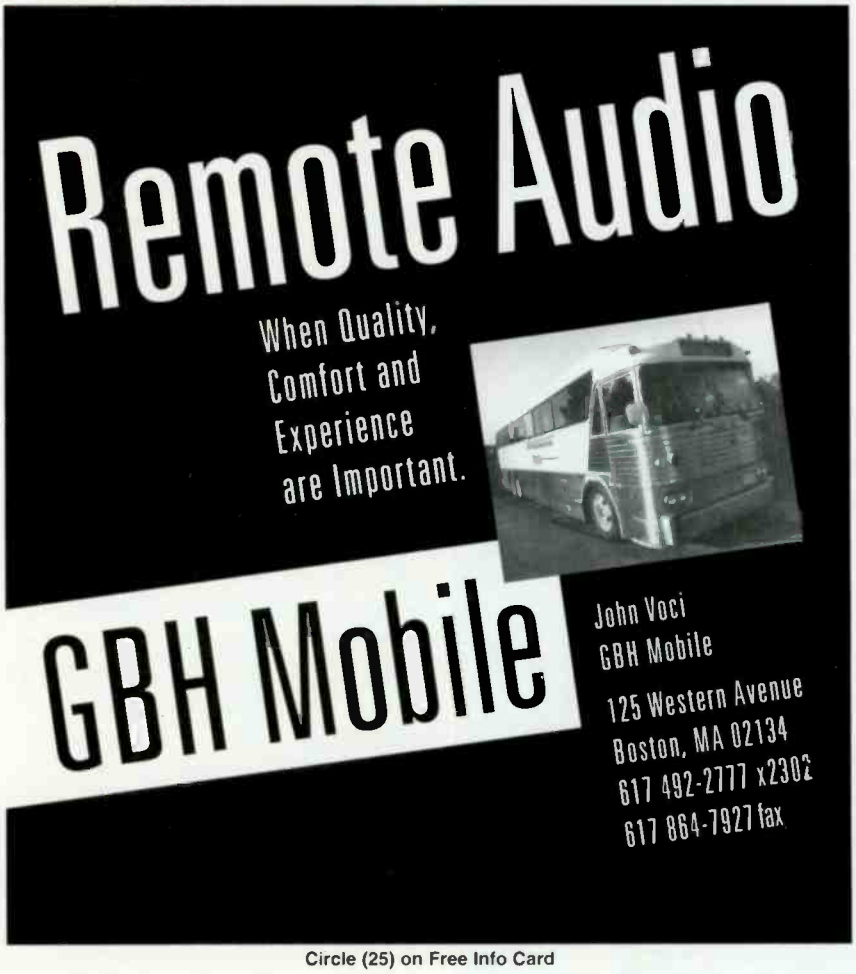
The main disadvantage of any telco-provided line is cost. If a broadcast is recurring from the same location on a regular basis, the time-and-distance costs and monthly access charges can become quite significant. A secondary problem is line noise from sources like storms, bad connections and even ground hums. All of these can cause phantom noises or dropout in the telephone path.

Satellite is another popular transmission type. The amount of time available is increasing each year and the cost has come down considerably. While major event providers like Disney and awards show producers have had this as an option, there is a move away from it because of the cost and coordination issues when compared to other available means. At your station, it may be common to use satellite programming, but sometimes people forget to reset channels after a broadcast. On some receivers, use of a channel can cause co-channel interference within the receiver, rendering more than one broadcast unusable.

Satellite also requires special handling on the part of a talent. There is a delay from the time that words leave the talent's lips to when it gets out on the air. Recently a station broadcast from the beaches of Cabo San Lucas, Mexico. The link from the site was via microwave to a nearby uplink site and was received in New York, and was then shuttled via ISDN to Sacramento. The delay was so long that the board-op had the talent record the ramp intros in order to replay them. There were other problems encountered with the setup. The microwave link had interference from wind and rain, and there were gaps in contact up to 20 minutes because of weak links. The reason for such an unusual path? No uplink truck was available, and ISDN at the site would have taken a year to install.

ISDN is, however, one of the easiest and best alternatives for most broadcasts. With a wide array of codec models, bandwidths and transmission standards, ISDN can be made to work in almost any situation. ISDN is not something that can be done at a moment's notice though. Planning location and installation of the ISDN circuit at the remote site can be quite an adventure. Even within a single city there may be several varieties of ISDN circuits available. Ordering ISDN can take 10 to 30 days, compared to less than a week for some POTS lines. Check to see if your phone company has a broadcast service group. They will typically give good advice and alternatives for your needs.

Just because a client has ISDN for



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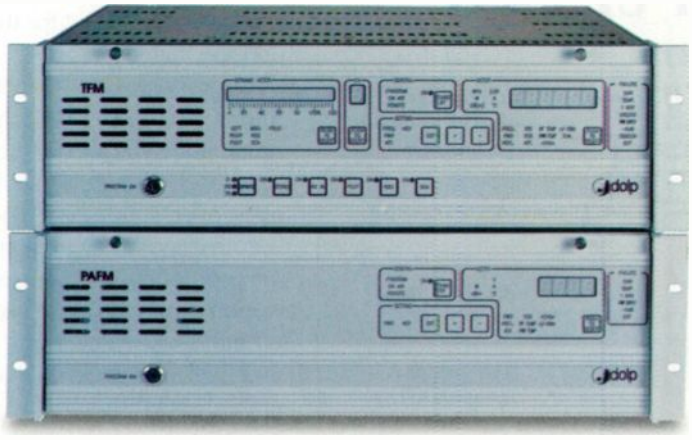

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their computer doesn't mean it is automatically usable by your codec. Even straightforward ISDN circuits can have anomalies, like requiring the area code to be dialed within the city. ISDN is in an almost constant state of upgrade and many resources on audio encoding and ISDN nuts and bolts are available. ISDN codec manufacturers are good about knowing the types of circuits to order, so consult them or their web pages.

The chief advantages of ISDN are full broadcast-quality links in both directions, low line costs and reliable connections. Installation cost for an ISDN line is typically less than that for three POTS lines. The monthly maintenance charge to keep ISDN is typically far less than a business POTS line. It may even be cheaper to pay a year of ISDN maintenance for an annual broadcast than to re-establish the line.

An older technology with a new application is *spread spectrum*. Direct-sequence spread spectrum uses a single carrier modulated with high-speed data. This method dates back to WWII. Frequency-hopping spread spectrum changes the carrier frequency in a predetermined pattern. Both systems can use proprietary methods of shifting, and enhanced A/D conversion makes inter-brand compatibility unlikely, but does increase the robustness of the signal. Both methods offer security from other broadcasts and intermittent sources of interference, and are also sold as backup STLs. They typically operate in the 2.5GHz range, which is still a pretty open spectrum and does not require any special licensing.

The downside is that spread spectrum is line-of-sight and needs its own high-gain yagi antennas to cover any appreciable distance. Additionally, the more spread the carrier, the shorter the distance available to broadcast. Very narrow spreads could go 30 or more miles, but are more susceptible to interference — even as subtle as trees. Wider frequency shifts can increase reliability but tend to reduce range to just a few miles.

Once a transmission method is chosen, you still must have a quality signal to send. From here, your best tools are alert ears. It is amazing how many times pretty buttons are chosen over good sound. Many times, a great sounding show can be done from standard four-channel mixers and high-quality mics. A microphone is probably the most important choice you'll make, since it begins the audio chain.

Getting audio

Auditioning a mic is simple: if it sounds good flat, it should sound good after all of the station processing. If you choose a mic that needs equalization to sound good, you've chosen the wrong mic. Rugged, dynamic mics like the Sennheiser MD421 or the Shure Beta series are very good for this application. Higher-quality studio mics can be used on remotes, but there is not much difference in how they sound on the air. It is a personal preference for the engineer and the talent.

For purposes of this article, mics fall into two categories for consideration: omnidirectional and cardioid. Typical road use will always favor dynamic mics over condenser types, so that debate is moot (mics get bumped and dropped often on remotes). Omnidirectional mics will allow talent to move off mic as they might in a studio, but they will also pick up lots of background noise. Background noise might be good at a small gathering, but go to the local fair or amusement park and it begins to sound like the talent is lost in the crowd. Cardioid mics offer better control of the sound because they reject sound from behind. This automatically gives more preference to the talent than the surroundings. The drawback to this is that if the talent needs to read a lot, they may have to change their mic technique. Not an easy task for some.

The choice of mixer is decided on by very specialized factors. In the earlier example of a station going talk, it was the careful choice and use of a mixer that solved most of the

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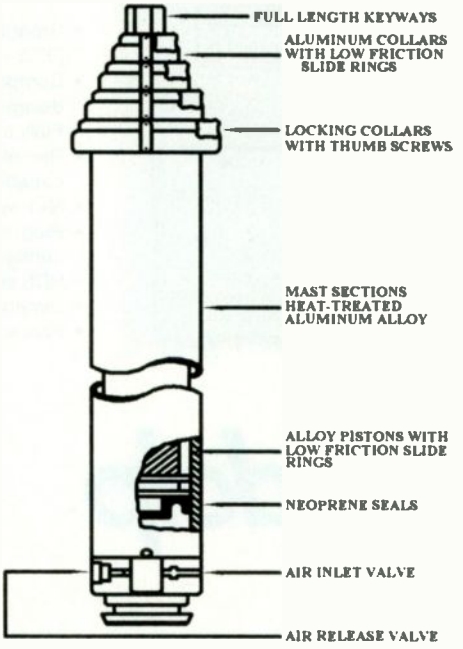

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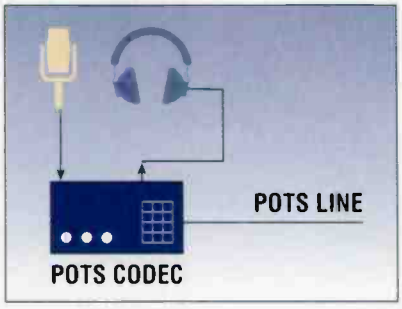
problems. First, a mix-minus IFB needs to be installed at the station. Mix minus is the establishment of a mix separate from program that contains everything generated at the station and excludes the remote input. Several manufacturers make small interfaces to put this mix in with a producer mic that activates by a push-to-talk ducking circuit. A simple autocoupler lets the remote dial in and establish two-way contact.

Many specific mixing functions can be created in the mixer. Several manufacturers make small, portable mixers with stereo outputs and two auxiliary mix busses. Some stations prefer the use of a broadcast studio console, but unless they are mounted to a frame or put permanently into a vehicle or trailer, they don't last very long on the road. Also, broadcast consoles tend to call for more table space and power than smaller road consoles.



To solve the technical problems with our example talk station, three distinct mixes — air, headphones, and PA — are created. (See Figure 1.) The talent mics are connected to the console and panned left to feed the air chain. Aux 1 feeds the headphone amp and aux 2 is part of the PA system feed (described later) and both are set to a nominal level. The input EQ is left flat. The air chain is set so that the mics are never off to the station so the talent can speak freely to the producer during breaks. Similarly, if a line device like a tape deck is needed, it is panned left and also sent to the headphones.

The IFB return is brought in through a line input channel and panned right. This keeps the IFB buss separate from the on-air or program buss. The IFB volume and aux 1 are set to be comfortable to the headphones and PA system without leaking back into the mics.

Aux 2 is a special mix that feeds a parametric equalizer. Only the mics feed aux 2. The equalizer then returns to the board through a line input and is panned right for the PA system only. A word of caution here, EQs are wonderful things, but they need to be used as little as necessary. In this example, they notch out problem ringing frequencies in any venue. Because it is a separate mix and return, the carefully chosen sound of the mics is not altered for the air chain, but it is modified to make the PA sound as natural as possible. The EQ'ed mic return is also never sent back into the headphones so as to not affect the talent's mic technique. A system has been created that is totally independent of the station. Profanity delay and air monitor interference are no longer factors.

After all of this careful preparation, a few additions have been made along the way. A compressor/expander is used to reduce the background noise during mic pauses so the caller can still be heard. Again, ears are the tool here and the amount of expansion is changed according to the venue noise and adjusted by listening to an air monitor. This example uses a dual compressor with a sidechain. ISDN and other digital transmission devices have a delay, so when the talent takes a phone call, the on-air phone system takes time to fully null — or worse — won't null at all because background levels are too loud. This creates a perceptible delay in the talent's headphones of their own voice, which is not apparent to the listeners. Sidechaining is the use of source A to affect change to source B through the compressor. In this case, the talent's voice is tapped from the compressor at a pre-compressed point, and this is inserted into the sidechain sensing input of the B compressor. The IFB feed is sent through the B compressor, which is then set for 10:1 compression and a threshold of –30dB. The attack and release times are set by ear to match the return start and end times of the talent's semi-nulled voice through the IFB return. The effect is that when the talent responds, the null is reduced in volume. The release is just enough for their voice to end before the caller starts talking again. If the caller talks while the host talks, there is enough of the caller volume to be heard in the headphones. Simply putting the compressor in bypass stops the effect for commercials and bumper music.

By comparison, a very straightforward design is best for a music format: Wireless mics into a basic four-channel mixer to a transmission device (typically RPU). Set the mix

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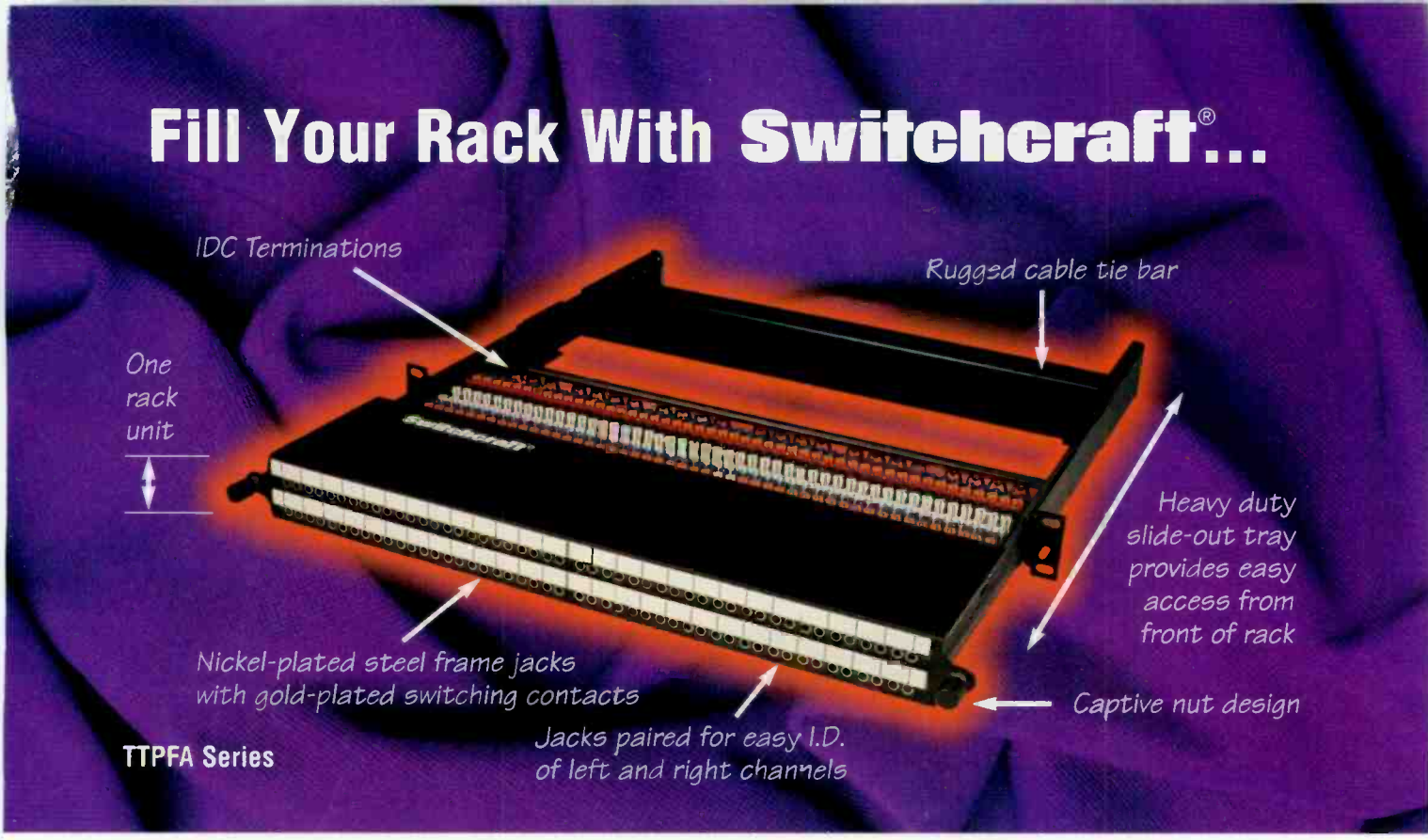

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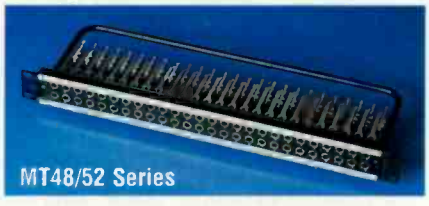

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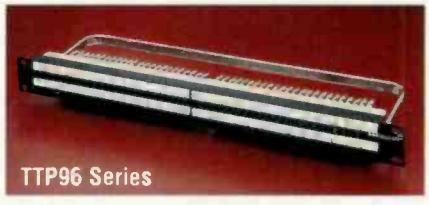

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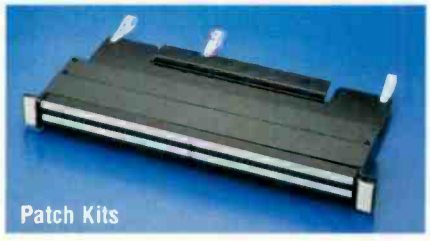

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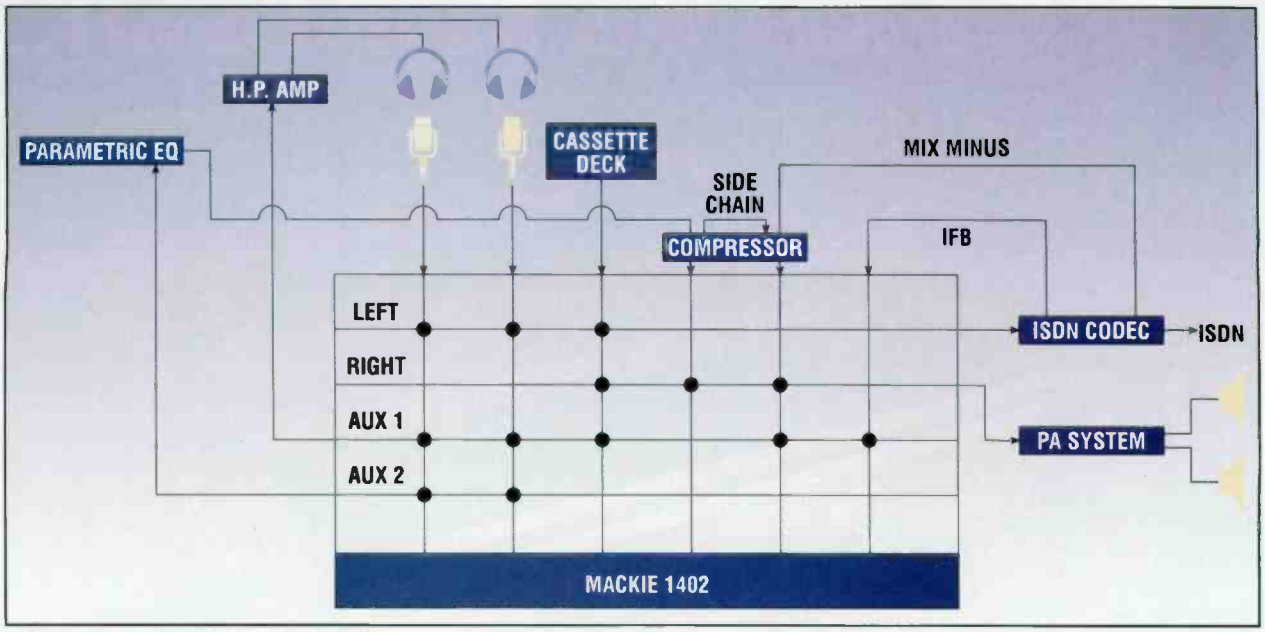

Enhanced remote setup at KHTK

levels and don't rely on the processing to compensate. Most four-channel mixers have a limiter built in, but be careful. Too much use of a limiter tends to thin out the talent voices. Additionally, distortion occurs at the higher volume settings, which does no good. Typically, these remotes are spot broadcasts to highlight a client and only account for two or three minutes of air time per hour, but they are no less deserving of attention to detail than a talk remote.

A different setup

Quite often, the same equipment used for a spot broadcast will be called upon to do a prime-time morning drive shift, and here is where your planning and choices make the most difference. With proper mic selection, all that is left to worry about is gain stages. Even though most equipment will show levels on VU meters, you should still listen closely at every opportunity. A reading of zero VU may look good and is supposed to have a common reference value of .775v into 600V, but it can be anything from –20dB to +16dB in reality, because of the averaging characteristics of the meter. Monitor each unit in the chain and adjust according to its input tolerance. Using a scanner to listen to an RPU is a basic start, while setting up a loop back of ISDN or codec-based remotes, through the audition buss of the air board, will let you hear exactly what is at the station. Any step taken to use your ears as the final test will improve a remote sound.

What good is the best design without some attention to detail? Road cases to protect your gear both inside and outside of vehicles helps their looks and their shelf life. You may not need flight-ready boxes, just something to keep the gear together and easily operated is enough. Even in the set-up, keeping cables neatly run and out of the talent's way improves the feel of a remote substantially, not to mention avoiding possible safety hazards.

One of the easiest ways to improve the look of a remote is to not rely on the client for anything. Carry tables, table skirts, chairs, sound systems, paper towels and anything else you might need to keep the looks top notch. Several styles of tents are available to help keep out the elements, and provide bigger bannering for the station. The benefit of a clean remote is that the client's perception becomes one of professionalism and respect for your abilities.

Sometimes you may be required to send to or receive special audio sources. If a band needs to be put on air or if a house PA needs to be fed, the engineer should be prepared. In the touring industry, the DI (direct input) box is used frequently. They work by taking an instrument, high-impedance or line-level output and transformer isolating it to a low-impedance, balanced mic level. Some models even handle speaker-level signals. This allows for ground-loop-free broadcasts and predictable input levels. DIs can be used to connect to house PAs because the signal will travel pretty easily up to 250 feet and go into any console at mic level.

Buying a generator and keeping it serviced removes the last obstacle to getting a remote on the air. Line-level devices tend to draw only 60% of their rated current, while variable-gain devices tend to draw about 40%. The current ratings tend to be for maximum volume or start-up current. Staggering startup either manually or with automatic relays will reduce your peak current draw. I've measured my draw for an FM set-up at 6 amps, but the equipment shows a peak of 22 amps. These vans can safely run with a 10-amp generator. Knowing this reduces capital costs and the weight load in the van.

Attention to audio quality, preparation for varying circumstances and an eye for aesthetics will always improve your success in the hardest task of all — getting asked back by a client for a second remote.

Kevin Pratt is Remote Engineering Coordinator for ARS radio in Sacramento. He can be reached at (916) 338-9242.

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POTS codecs:

By Chriss Scherer, editor

Analog connections and digital transmissions.

Dial-up phone lines have always been a key aspect of many remotes. The benefits of digital have made their way to dial-up telephones, giving the advantages of digital transmission, with the convenience of dialing a phone.

POTS CODECs have found a natural place in sports broadcasts, often replacing frequency extenders. Photo by Jeff Johnson, WVXU-FM, Cincinnati.

The term *POTS* has come into common usage recently. Plain old telephone service is what it stands for. A regular, analog dial-up line is what it means.

POTS lines are everywhere, the most common connection into the telephone network. For years the POTS line was the simplest way to transmit remote audio back to the station, requiring only a telephone coupler. The lost bandwidth was accepted in the trade-off of installation time and costs of a dedicated loop for the simplicity, availability and immediacy of a POTS line.

How did we get here?

It does not take long to get listener fatigue from an audio feed over a direct telephone line. The first attempt to improve the quality of a POTS line feed was the introduction of frequency extenders about 20 years ago. This required a complementary set of an encoder and decoder to take better advantage of the limited frequency response of a telephone line. The analog nature of the transmission scheme, however, was subject to any noise and line changes, and transmission was only one way.

With a range of 300- to 3000Hz, the limitation of a direct telephone line is obvious. There is just enough bandwidth to allow intelligibility of voice. The roll off of the low end makes audio sound hollow and empty, especially when listened to over a full-range (or at least fuller-range) audio system.

A frequency extender takes advantage of the logarithmic function of audio. By sacrificing a small amount of high frequencies, a comparatively greater amount of low frequencies can be recovered. By shifting the audio frequency higher, transmitting it over the POTS line and then shifting it back down to normal, an improved

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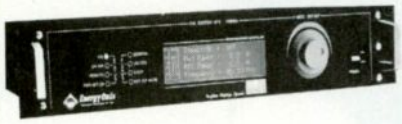

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POTS codecs

low-end response was gained. This process was enhanced with the introduction of two- and three-line extension systems that divide the audio into separate audio bands and then shift, transmit and recombine. Keep in mind this a simplified explanation of the process.

While a greater frequency response was made possible with these systems, they introduced their own problems, the biggest one being the addition of phone lines. Most sports remotes provide two telephone lines. Obtaining more than one telephone line for a last minute setup is a problem too. Multi-line frequency extenders also suffer from phase errors and the potential inability to synchronize the signals, especially when long distance lines are used. This is even more of a problem from another country.

Audio coding and bandwidth

Because we do not have unlimited bandwidth for transmission of digital signals, the encoded audio must lighten its load before transmission. Several encoding algorithms have been designed for various applications and transfer rates. Some are optimized for the data rates used in ISDN, and others have gone even further for the data rates available over a POTS line.

The ISO-MPEG-2 Layer I, Layer II and Layer III protocols were all designed for transmitting high-quality digital audio over lower (less than full) bandwidth carriers. When ISDN codecs were first appearing, these algorithms were optimized for 128kb/s and 64kb/s transfer rates. Telephone modems at that time were just entering the 28.8kb/s speeds — still too narrow for these signals. Many people believed that it would not be possible to squeeze any more data reduction into these signals and still have a high-quality sound at the end.

It was the limitation of modem rates that originally delayed the successful introduction and acceptance of POTS codecs. Even the first 28.8 modems had difficulty passing enough data to be useable. As the modems improved, so did the coding algorithms. Advances in coding for ISDN and other reduced-bandwidth media fueled the effort for even further data reduction.

The refinement of algorithms continued until it became possible to pass a signal with about 7kHz of bandwidth (and sometimes more) over typical connections around 28.8kb/s. Now the system existed to deliver reasonable fidelity over a POTS line, effectively shifting the industry's attention away from frequency extenders.

The first POTS codecs were introduced just about two years ago. Continued advances in audio fidelity and signal robustness have helped to make them workable solutions in remote broadcasts.

The data transfer rate directly affects the audio bandwidth. Table 1, which compares features of the various codecs available, shows the various bandwidths based on connection rates and how these can change. Most POTS codecs have the unique ability to establish their connection and then handshake to settle on the highest possible transfer rate for the best possible quality. If the quality of the line degrades, the units can negotiate and step down to a lower rate, usually with only a brief interruption.

The players

There are four manufacturers offering POTS codecs today. They are all similar in their function. But there are differences between them. The exact number of I/Os varies between units and most have built-in mixers. There is a small amount of digital delay that varies in each unit (depending on the encoding), and some kind of mix-minus backhaul must be mixed with the local audio for a headphone mix.

Depending on the size and scope of a particular remote, additional equipment can be tied into a system for more versatility. The use of an external mixer will be determined by your individual application.

Some manufacturers have also repackaged their designs into rack-mount equipment for studio use. These units operate much like their field design counterparts. All of the units are able to dial and auto answer calls.

Continued on page 44

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POTS codecs

Continued from page 40

AETA Scoop Reporter

One of the first POTS codecs available, The Scoop uses a coding algorithm called CELP (Code Exited Linear Prediction). The ITU recognizes this algorithm as G.728. CELP is a voice-modeled coding algorithm, reducing the amount of data by 10:1. The input section has three inputs. Mic 1 is a three-pin XLR, mic 2 is a five-pin XLR combined with the second headphone output. The Aux input and line output both have three-pin XLR and banana-jack connections.

The ability to run on standard D-cell batteries makes the Scoop Reporter work well in unfamiliar situations or

TABLE 1	AETA - Scoop Reporter	Comrex - Hotline	Marti - Smarti	Musicam - FieldFone II	Musicam - RoadRunner Plus
Weight (lbs.)	10	2.6	5.19	9.4	9.4
Size (in.) HxWxD	3.4 x 11.4 x 11.8	2 x 6.25 x 9.5	5.1 x 8.35 x 11.5	4.5 x 11 x 13	4.5 x 11 x 13
Power	AC, battery	External AC	AC, 9-18vdc	AC, 12 vdc	AC, 12 vdc
Inputs	2 mic 1 line	1 mic 1 line	3 mic/line 1 mic/int.	2 mic 1 mic/line	2 mic 1 mic/line
Outputs	1 line 2 headphone	1 line 1 headphone	1 line 3 headphone	1 line 2 headphone	1 line 2 headphone
Audio metering	3 stage LED	Peak LED	Audio LED	NORM & CLIP LED	NORM & CLIP LED
Contact Closures	0	2	2	4	None w/ POTS
Encoding	CELP/G.728	Proprietary - perceptual	G.722, Layer III	"enhanced" Layer III	"enhanced" Layer III
Dialing presets	4, redial	Redial	10	256	256
Coding delay (ms)	30	120	250 (G.722) 375 (L-III)	400	400
Modem	V.34/28.8	V.34/33.6	V.34/33.6	V.34/33.6	V.34/33.6 external

Table 1. Various features of Pots codecs

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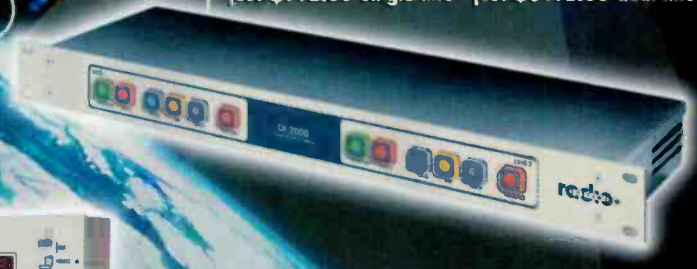

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POTS codecs

in fast setups. All an operator really needs to get on the air is a phone line connection.

The Scoop is the only unit not using a perceptual coding algorithm. The CELP algorithm was designed for voice, so applications with excessive background noise or music may not yield the best results.

Comrex Hotline

Comrex offers the Hotline in two packages — a portable desktop case and a 2RU rack-mount chassis. The internal electronics are identical, with the rack mount being designed for studio use and the portable case for the road. The Hotline does not include a built-in mixer, but does have the monitor mixing capabilities to adjust the levels between backhaul and local audio. An external mixer can easily be interfaced for more flexibility in its use.

The Hotline uses a proprietary encoding algorithm that is based on the same perceptual coding fundamentals as the MPEG standards. Comrex felt that Layer II and Layer III work well for applications with higher data-transfer rates, but opted to design their own algorithm for POTS applications.

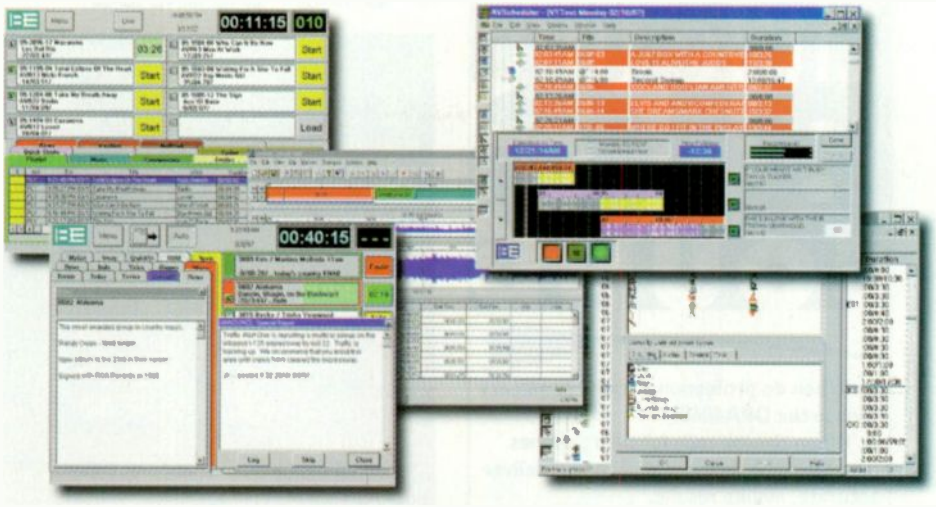
Marti Smarti

The Smarti boasts four inputs and three headphone outputs. It is able to communicate in G.722, Layer III and analog. In extreme cases where a digital connection cannot be made, audio can be passed through the Smarti in a completely analog mode, acting as a telephone coupler. Any of these operating modes can be selected during active connection without dropping the line.

The Layer III algorithm can be adjusted to make a trade-off between higher audio quality or better frequency response, with the settings made before a telephone connection is established. The size of the data pipeline is established by the connection rate, but the user can allocate the bits for the best sonic compromise for each situation.

The Smarti also offers a data path within the datastream of 2400- or 9600 baud for additional signaling. Both baud rates take away from some of the available space for audio. At 9600, the effect can be

You



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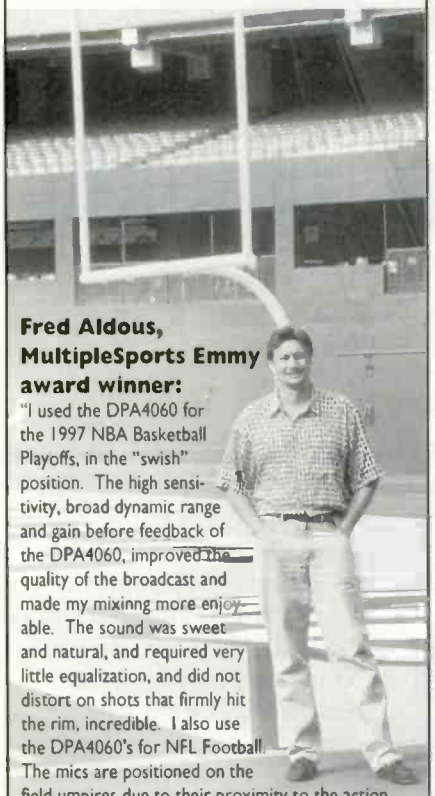

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POTS codecs

	Scoop Reporter	Hotline	[illegible]	FieldFone II	RoadRunner Plus
Frequency response:	In kHz	In kHz	In kHz	In kHz	In kHz
33.6 kb/s	N/A	10.0	[illegible]	10.2	10.2
31.2 kb/s	N/A	9.3	[illegible]	9.5	9.5
28.8 kb/s	8.5	8.6	[illegible]	8.8	8.8
26.4 kb/s	7.7	8.0	[illegible]	8.1	8.1
24.0 kb/s	7.0	7.0	[illegible]	7.2	7.2
21.6 kb/s	6.3	6.5	[illegible]	6.6	6.6
19.2 kb/s	5.7	5.8	[illegible]	5.8	5.8
16.8 kb/s	5.2	5.6	[illegible]	5.1	5.1
14.4 kb/s	4.3	5.4	[illegible]	4.4	4.4
12.0 kb/s	3.6	4.5	[illegible]	3.6	3.6

Table 2. A comparison of frequency response for POTS codecs.

noticeable, but it's hard to tell at 2400 baud.

Musicam USA FieldFone II and StudioFone

The FieldFone II and StudioFone are similar in functions, the difference being portability. The FieldFone II is a second generation unit of the original FieldFone, and while its latest software release will work in older FieldFones, some of the enhanced features are not supported by the hardware. Unique to the FieldFone is the Sound Shaper, which allows the user to adjust the audio encoding (from the receive end) for best quality.

The FieldFone II uses a variation of the Layer III algorithm, called *Enhanced Layer III* by Musicam. This gives the FieldFone (and RoadRunner Plus) the widest frequency response of any of the codecs at connect rates over 21.6kb/s. There are also 256 locations for speed dial settings — exceedingly more than any other codec.

Musicam USA RoadRunner Plus

The RoadRunner Plus, an enhanced version of the original RoadRunner, allows the ISDN terminal adapter to be removed and an analog card installed, which then connects to an external 33.6 modem. A software setting is changed to activate the new hardware. This gives users the flexibility of changing hardware to suit the individual situation of each broadcast, and an upgrade path between POTS and ISDN. The cost of a single RoadRunner Plus is also less than two separate (one for POTS, one for ISDN) codecs.

When the RoadRunner Plus is configured in POTS mode, it functions very similarly to a FieldFone II. The control layout is identical on the two units, but the four contact closures are not available on the RoadRunner Plus when it is used in POTS mode.

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EXHIBITS: April 6–9, 1998

CONFERENCE: April 4–9, 1998

Las Vegas, Nevada USA

Aphex FM Pro Model 2020

By Andy Laird

As first shown at the 1997 NAB convention, the Aphex Systems FM Pro Model 2020 won a "Pick Hits" award from *BE Radio* Magazine. Why an award for an analog audio processor? Because the FM Pro blends the best features of both digital and analog audio processing with innovative control features into one complete package.

The digital control system provides access to a thorough array of control features that include individual parameter controls, selections of presets, programmable memory presets, day parting and security. The system also provides repeatability of settings, remote control software and an available digital I/O option.

Performance at a glance:

- Modular construction
- Flexible adjustment
- Remote control software
- Day parting
- Digital I/O option

The package

The FM Pro requires only two RU for mounting. Popping off the cover reveals side-supported modular boards plugged into edge connectors on the frame. This very dense construction is cooled from one side across to the other by a filtered fan. No clearance above or below the unit is needed. The basic unit is configured as an analog I/O system with slots open for options. Option packages add an AES3 I/O, a pre-emphasis limiter and a pre-emphasis limiter/stereo generator.

Audio I/O connectors on the back panel are XLR for analog and digital, a chassis-isolated BNC connector is used for composite out and a DB9 for RS-232. All I/Os are RF suppressed.

The front panel from left to right consists of eight ten-segment bargraph meters, two for reference input level, one for leveling gain or gain reduction, four for multiband compression gain reduction and one for limiter gain reduction. There are twenty individual LED status indicators indicating selected modes within the unit. A spin dial is used with the menu system to control parameters. A liquid crystal display shows the operating menus and messages, with six navigation buttons to the right of the screen used to operate menus, enter settings and escape from each function. At the far right side there is a 1/4" TRS headphone jack with select buttons for monitoring I/O.

Setting Up

All parameters are software controlled except for the composite output level. Initial global parameters need to be established to match the processor to your station. These are then saved so that any factory preset can be called up matching your desired configuration. From this point, changes can be made and saved as a user-defined preset.

Reviewing the global settings will reveal some of the interesting features in the FM Pro. They are all located under the Processing Menu.

The I/O Menu controls the basic operating level settings. There are provisions for external devices to be inserted after the leveler and before the multi-band processor. Also, the analog input is automatically selected if the digital input bit stream is corrupt.

The Pre-emphasis Limiter Menu (if installed) controls its operation. The filter is adjustable for 50- or 75 microsecond use. The 75 microsecond pre-emphasis is split, 25 microseconds before the input of the multiband and 50 microseconds in the pre-emphasis limiter.

AES Status (if included) can be set for different transmit rates as slave, 32-, 44.1- or 48kHz. Day-parting schedules and a security password can be entered at any time.

A peek inside

Several of the blocks have unique features that have been introduced by Aphex. For example, the Leveler has eight support systems, including a Silence Gate, Dynamic Verification Gate (DVG), Level Rate Control and some new tools. They include:

- **Sticky Leveling** — allows you to set a window within which leveler gain movement will freeze. If the input level is above or below the window, gain will move.
- **Jump Ahead** — adjusts the leveler attack time to *fast* for a moment if the leveler has increased the gain substantially and then gets hit with a loud signal.
- **Attenuation Lock** — lets you freeze the leveler gain reduction between 3- to 15dB. Once an input level moves

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above your setting, the greater level will pass with no further gain reduction to the next stage.

- **Gain Lock** — freezes leveler gain increases from 0- to 15dB. If you have had to set up a processor with the input references set to the sweet spot but didn't want all that gain bring-up, this fixes it.

And now, the results

I spent three days in the lab just listening and learning how to adjust this complex processor. The control system is intuitive. It didn't take long to be able to punch through menus and adjust the sound I was focused on at that moment. The remote software makes great use of the Windows GUI — not just bells and whistles, but in very practical ways like graphical displays of crossovers and multiband levels. Adjustment mistakes are easy to spot. Parameter files can be saved and loaded from diskette. There are also some fun "try this" buttons. The I/O switched monitor jack on the front deserves mention. It makes it easy to refer back to program input for a comparison to processed sound.

My initial set-up was with current rock music. After some work, I was able to get great sound, loud and clean with good control of event to event loudness. In two more of our stations the formats and competition conditions required different settings, but I felt the end results were equally impressive. In all three cases, my station got excellent loudness and bass, good punch and intensity, along with clear unclouded midrange and highs.

Our FM Pros are each configured differently. One is analog in with composite multiplex out. The second is analog in, AES3 out to the main transmitter and multiplex out to the aux. transmitter, and the third is being used with AES3 I/O.

Aphex spent about two years designing and perfecting this system. Besides achieving performance people have grown to expect from Aphex, the intuitive controls make sense to a station engineer. This is not just a collection of previous Aphex stuff in one box. This product contains new thinking focused on helping contemporary radio stations develop a competitive, unique sound.

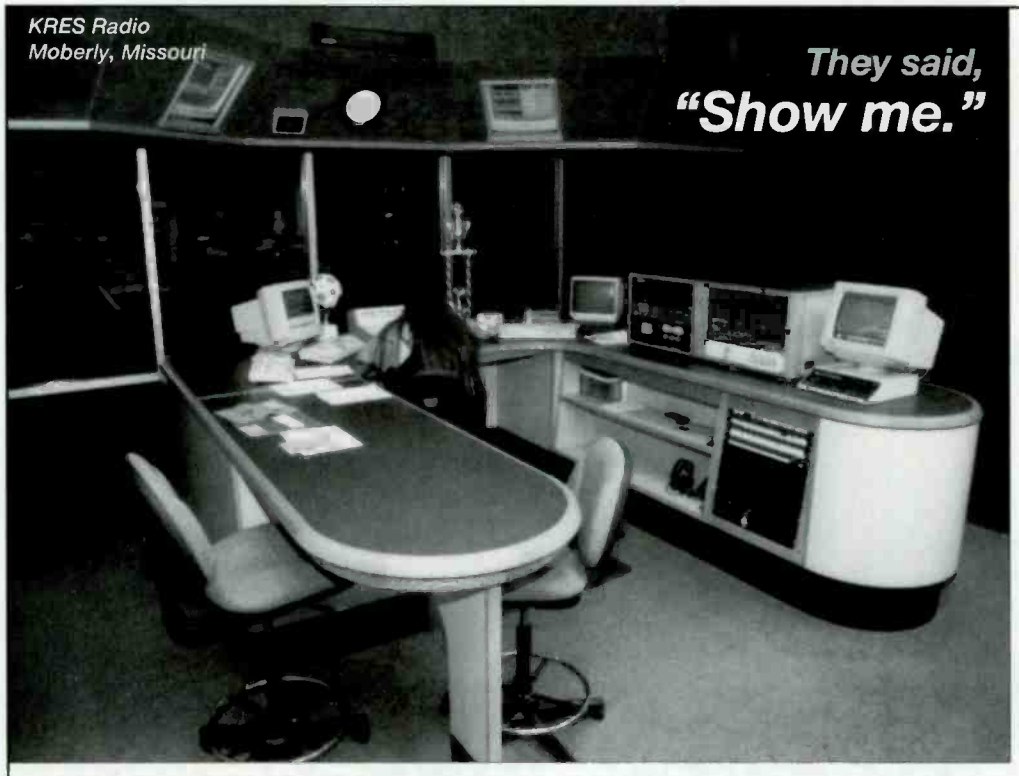
Andy Laird, CPBE, is vice president of engineering, Radio Group, Heritage Media Corporation, and is based in Santa Clarita, CA.

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 Circle (154) on Free Info Card



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New Products

Digital audio console
Harris Corporation

▶ **DRC2000:** second-generation digital audio console has the look, feel and operation of an analog console, but provides the advantages of a field-proven DSP architecture and software; offers 16 fader/11 AES3 (22 mono) inputs and a dedicated dump button for use with a delay option; user-definable fader layout allows any input to be assigned to any fader via internal DSP routing; EQ, gating, pan and compression functions can be assigned by channel and set-up; also features a built-in mix-minus.

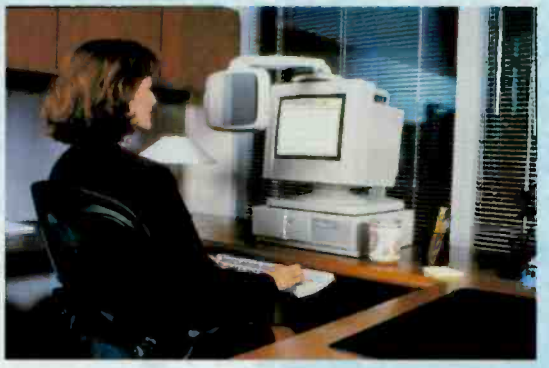
800-622-0022; fax 765-966-0623; www.broadcast.harris.com
Circle (200) on Free Info Card

DAW upgrade
Orban

◀ **Audicy:** as this digital audio workstation succeeds the company's DSE 7000FX as the sole workstation in the Orban product line, the company is offering DSE users an upgrade path; upgrade kits, available with a DSE 7000FX controller trade-in, include the Audicy software, console, standard-length cables, console power supply and retrofit mounting kit.

510-351-3500; fax 510-351-0500;
www.orban.com
Circle (202) on Free Info Card

PC screen magnification
Bausch & Lomb



▶ **The PC Magni-Viewer:** magnifies on-screen information 175%, offers multiple adjustments for customized monitor viewing and allows PC users to automatically position themselves in an ergonomically correct work posture; ideal for professionals who need to be able to increase the amount of information displayed on screen by reducing the font size; completely adjustable two-piece magnification system features a 19.5" x 15" 360° rotating swivel arm that extends over the top of the monitor and an adjustable, precision-ground and polished 6" x 8" acrylic optical lens that weighs only 25oz.

800-771-1168; www.bauschvision.com
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Circle (32) on Free Info Card

New Products

Passive dehydrators
Environmental Technology

▶ **RCD-1 passive dehydrator, RCD-2 passive self-pumping dehydrator:** uses no power to dehydrate up to one cubic foot of waveguide or coaxial cable; multiple units can dehydrate larger volumes; offer emergency backup to larger systems without using expensive and limited emergency power; contain a blend of silica gel and activated alumina desiccants that will not cause corrosion due to excessive saturation.

219-233-1202; 800-234-4239; fax 219-233-2152; www.ehcknobs.com
Circle (204) on Free Info Card

Light-touch controls
Electronic Hardware Corporation

- **70 Series:** shaft-retention mechanism requires no set screws; features molded knob body, twin-torsion spring bushing, split-bushing housing, release lever and a lever-access port.
- **Pull-to-Hold, Push-to-Lock:** low-cost locking push-on knob features a molded knob body, sliding fit-on component shaft, component MTG nut and a fixed-knob base.

516-752-1950; fax 516-752-1971; nyknob@aol.com
Circle (203) on Free Info Card

SADiE update
Studio Audio and Video Ltd.

◀ **SADiE V3.03:** update of Octavia and SADiE digital audio workstations features a nine-pin window greatly enhancing control over the remote deck; new window also allows the deck to perform an automatic punch-in and punch-out on the armed tracks, and the edit can be previewed and reviewed; other new features include phase reverse and left/right channel-swap functions, a feature that avoids the re-recording of material into the system and is especially useful when working with incorrectly recorded M&S encoded audio; both are real-time features that can be optionally displayed as buttons on the channel fader; as with previous releases, the software will be available on the SADiE web site.

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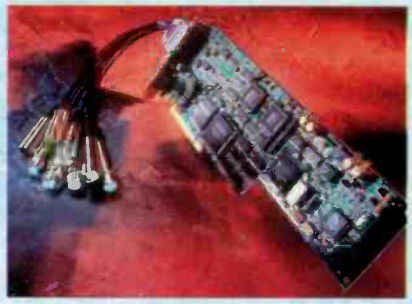
New Products

Four-channel PCI digital audio adapter



Antex Digital Audio

▲ **StudioCard:** PCI-based digital audio adapter with four tracks of studio-quality audio, 18-bit sound and real-time digital mixing capability; StudioCard is a 32-bit memory-mapped board that delivers less than 0.003% total harmonic distortion and 92dB dynamic range; components include a programmable 32-bit 40MHz DSP and pro-quality connections such as four independent balanced I/Os (+4dBu or -10dBv) and AES/EBU or S/PDIF digital I/O; offers a compatible MIDI port and sample-accurate synchronization via SMPTE, MTC and external word clock.

310-532-3092; fax 310-532-8509;
www.antex.com; info@antex.com
Circle (209) on Free Info Card

Mixing console

Sountracs

▼ **Topaz 12-4:** features three-band EQ, two aux sends, four mono mic/

line inputs and two stereo FX returns; has all of the features of the Topaz 1204 plus ten phantom-powered mic pre-amps with three-band EQ, two aux sends and a solo, mute, group assign and fader; the Topaz 24-4 provides all the features of the Topaz 14-4, plus ten additional mic pre-amps.

+44 (0) 181 3888 5000;
fax +44 (0) 181 388 5050
Circle (215) on Free Info Card

Maselec Master Series-Prism Sound

▶ **MEA-2 equalizer:** unit offers four separate equalizer sections for each of the two channels; stepped controls enable precise adjustment and the exact re-creation of previously used settings; combines high-quality electronic design with equalization characteristics that have been optimized through listening rather than measurement; also offers 84 discrete frequencies per channel in overlapping bands, and all sections are switchable between a shelving characteristic and five different peaking filter bandwidths.

• **MLA-2 stereo compressor:** designed to deliver exceptional noise and distortion performance while maintaining smoothness and transparency in operation; has a large input gain control that is likely to be the most often used, providing a drive control that increases gain and compression depth as it is rotated clockwise; variation on conventional stereo linking avoids excessive ducking that might otherwise result from transients appearing on predominantly left or right channels; attack and release behavior is also new and has been developed as a result of extensive listening tests; because it handles the human voice well, it is suitable for music vocals and other high-quality voice applications.

201-299-7790; fax 201-299-7759; www.prismsound.com
Circle (212) on Free Info Card

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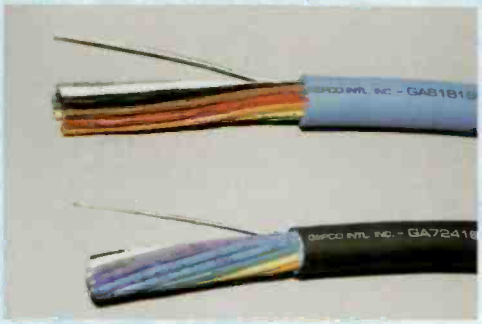
FAX ON DEMAND: 615-227-2393 www.sinesys.com

Circle (45) on Free Info Card

New Products

Audio cable
Gepco International

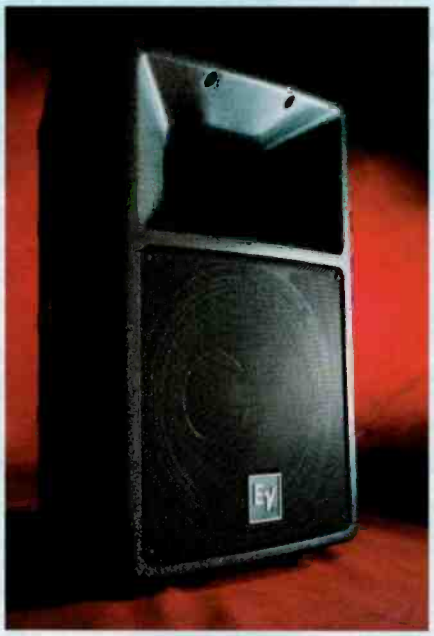
▼ **Gep-Flex:** consists of a highly flexible outer jacket compound surrounding the 618 (22 gauge), 724 (24 gauge) and 803 (26 gauge) series multi-pair audio cable; for easier installations, cable jackets are now identified with alphanumeric surface print inverted every inch, and pair jackets color-coded to the base-10 resistor color code for increased functionality; features tight-lay, stranded, tinned-copper conductors to provide increased flexibility while reducing strand fraying; the conductor and pair drain wire are the same gauges for uniformity and simplification of termination; each pair is 100% shielded and jacketed with the shield bonded to the pair jacket so users can strip both in a single operation.



312-733-9555; fax 312-733-6416; www.gepco.com
Circle (207) on Free Info Card

Sound system
Electro-Voice

▶ **System 2000:** builds on the original-concept System 200, adding new lightweight, large-format loudspeakers and a full-featured powered mixer; also incorporates Ring-Mode Decoupling (RMD), offers better vocal clarity and instrumental definition, and eliminates the need to re-EQ when the volume level changes because the tonal balance remains consistent at all levels; PSX2000 mixer offers a 1000-watt amplifier (500 watts/channel @ 4Ω) and internal limiters that prevent clipping, two 18-bit stereo digital signal processors with 100 reverb, echo, plate, delay, chorus and flange effects, as well as ten balanced mic inputs and 14 line inputs; six mic/line channels are equipped with three-band EQs with sweepable mids and inserts for external processors.



800-234-6831; fax 616-695-1304
Circle (211) on Free Info Card

MiniDisc recorder
Otari Corporation

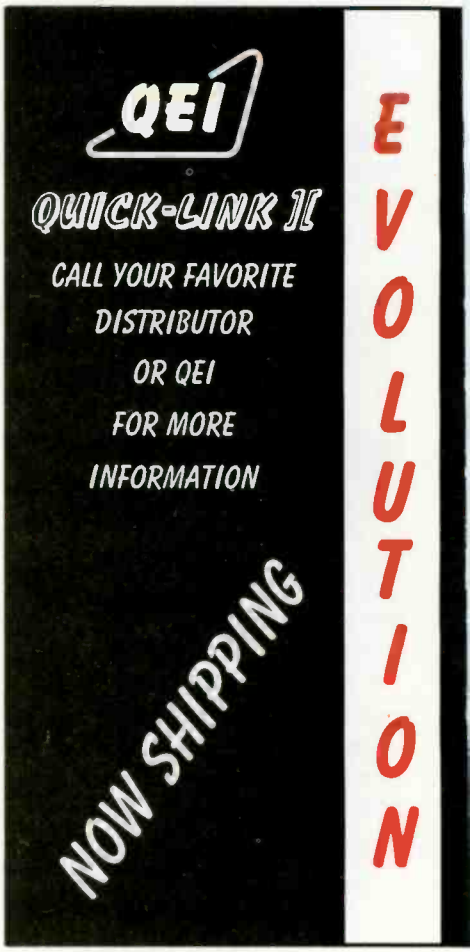
◀ **MR-30:** features an automatic recording start function which starts recording upon detection of input, automatic track numbering and universal table of contents (auto or manual mode), and up to five cue points per track can be written and edited after recording; offers 74 minutes of stereo recording and 148 minutes of mono recording time, along with a full range of on-board editing and programming functions; pitch control of 69.9% in 0.1 steps. AES/EBU and SPDIF inputs, along with analog (balanced XLR and unbalanced RCA) connectors, to allow for easy digital or analog inputs; output options include AES/EBU and SPDIF, as well as IEC958 (coaxial).

800-877-0577; fax 415-341-7200; www.otari.com
Circle (213) on Free Info Card

Software synthesizer
Sonic Foundry

• **Reality:** Sonic Foundry will begin marketing Seer System's *Reality* along with its Sound Forge audio software package; a professional synthesizer that runs on a Pentium-based PC, *Reality*, when complemented by *Sound Forge*, allows an audio developer to create a new sound, to manipulate it as desired, and then make it useable in a variety of formats, including CD and those enabling audio on the Web.

608-256-3133; 608-256-7300; www.sonicfoundry.com; www.seersystems.com
Circle (201) on Free Info Card



New Products

Remote mixer

JK Audio

◀ **RemoteMix 3x4:** allows three microphone inputs for sports or live remotes; headphone switches allow selection between the mixer, main phone or monitor phone; three balanced XLR female mic inputs accept either mic or line sensitivity; mix output is sent directly to a male XLR and separate control sends mix down the phone line; microphone mixer XLR output to digital CODEC or ISDN converter; monitor section can be used as call screener; rotary switch selects between four phone lines, while Add and Drop buttons seize and release the phone lines; line status is displayed via LED readout.

815-786-2929; fax 815-786-8502; www.jkaudio.com

Circle (214) on Free Info Card

Catalog

Specialized Products Company

▶ **Fall '97 Catalog:** this 378-page catalog features tools, tool kits, cases and test equipment for every service application in the telecom, computer, LAN, fiber optics and wireless industries; more than 100 standard tool kit are featured that are designed for installation, field service and repair applications; tool cases can tool pallets in assorted styles and materials are stocked with selected assortments of high-quality, name-brand tools; any standard tool kit can be modified to suit your specific application or budget, and for unique requirements, custom tool kits can be built form scratch to exacting specifications; SPC also offers a large selection of high-density, reusable shipping containers.

800-866-5353; fax 800-234-8286;
www.specializedproducts.com;
SPC@specializedproducts.com

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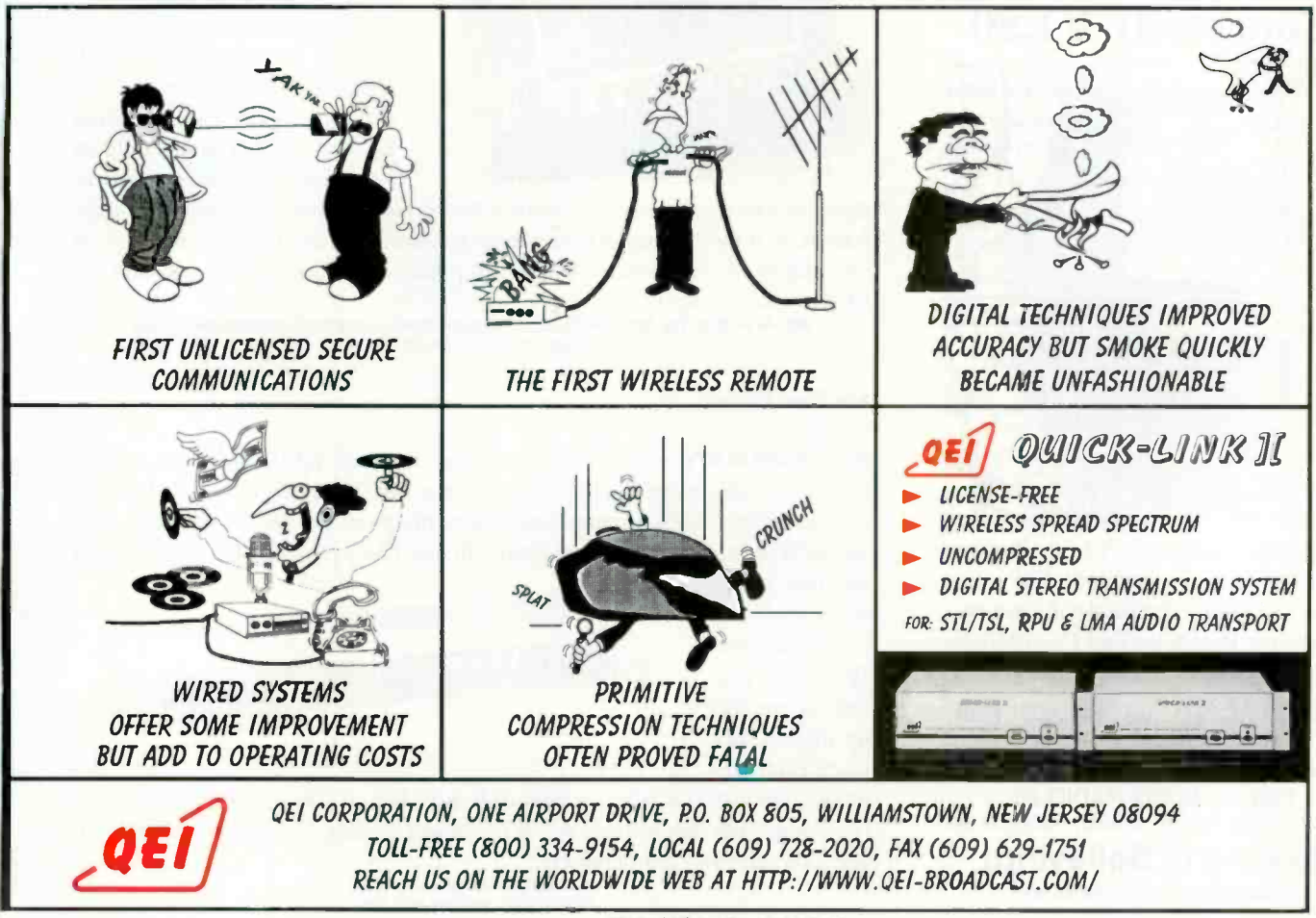

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New Products

Tapeless Audio Directory
SYPHA

• **Tapeless Audio Directory Sixth Edition:** designed to help in the initial selection of tapeless systems for almost every professional audio application, from PCMIA-based portables to completely automated systems for overnight broadcast; covers not only all existing systems, but those soon to be launched; listings include comprehensive technical and operational specifications, future development plans, customer support, typical configurations and costs, and supplier details for North America, Europe and Asia/Pacific; a comprehensive explanation of terminology is provided, with useful tips for potential purchasers.

+44 (0) 181 761 7042; +44 (0) 181 244 8758; sypha@compuserve.com
Circle (210) on Free Info Card

Tower parts guide
Pirod, Inc.

• **Tower Parts and Accessories Guide:** updated for 1998, the catalog details the complete line of tower parts and accessories for broadcast, microwave, PCS and cellular; features the latest in anticlimb devices, universal side arm mounts, non-penetrating roof mounts, cellular/PCS sector mounts; includes drawings and parts specifications for thousands of products, including antenna mounts, guy components, maintenance and safety equipment, grounding materials, lighting systems, engineered components and hardware.

219-936-4221; fax 219-936-6796; www.pirod.com
Circle (208) on Free Info Card

AC power distribution
Equi=Tech

▶ **ER 1R:** balanced-power device handles 1kW and 8.3A; features ten receptacle outlets and is available with EMI-RFI filtering and super-isolator options.

541-597-4448; fax 541-597-4099; www.equitech.com
Circle (216) on Free Info Card

Color stereo display
DK Audio

◀ **MSD600C/MKII:** now available with a color display and a VGA monitor output: new display offers a brighter image with double back lights and a contrast ratio improved by 100% making the image more readable from long distances and allows complex audio signal to be read without viewer fatigue; VGA output allows the unit to drive an external monitor for studios that prefer to monitor audio on a larger screen, or if monitoring from a remote location is desired; fitted with 3 DSUB connectors — one each for RS232 and power connection, audio I/O and the VGA monitor output.

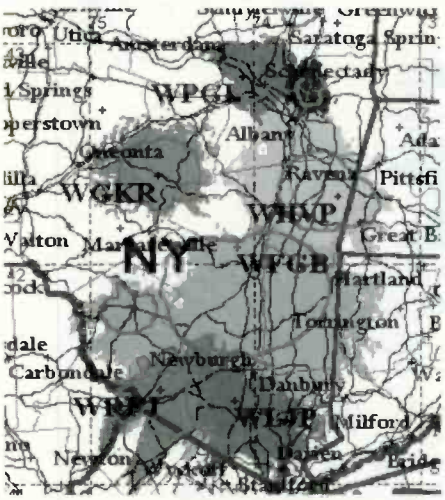
805-373-1828; fax 805-379-7578; www.tcelectronic.com; tcus@tcelectronic.com
Circle (218) on Free Info Card

Mic/line mixer
Intelix

▶ **8002MCB-FP:** an 8x2 mic/line mixer for field production and remote broadcast vehicle applications, the unit is a one RU, eight-channel, dual bus mic/line mixer with compressor/limiter, phantom power, headphone amp and LED metering; new design brings all mic/line pads and trim controls from the rear panel to the front, allowing users to reconfigure mixers on the fly, even in rack installations where rear access is inconvenient or impossible; in addition to its redesigned front panel, the unit features AC or DC power, linking, average/peak metering and bus selectors per channel.

608-831-0880; 608-831-1833
Circle (222) on Free Info Card

ComStudy V1.50



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Circle (47) on Free Info Card

New Products

CD Recorder
Otari Corporation

▶ **CDR-18:** features on-board digital sampling rate converter so digital source audio with a sampling rate

other than 44.1kHz — such as 48kHz DAT, broadcast satellite or DVD (32kHz or 48kHz) — can be recorded automatically to 44.1kHz; by separating the audio and digital circuits inside the unit, distortion is lowered over a broad range and channel separation and level linearity are improved; stable recording and playback is facilitated by supporting the CD-R media with a turntable-type disc drive mechanism, reducing vibrations that can adversely affect recordings; uses one bit-type A/D converters which minimize zero-cross distortion and reduce non-linear distortion over the entire frequency range.

800-877-0577; fax 415-341-7200; www.otari.com
Circle (219) on Free Info Card

Audio file converter
Waves

• **WaveConvert Pro:** allows access to the native processing power of Waves plug-ins in Mac or PC environments; allows encoding of high-quality RealAudio files in batch mode and the enhancement of RealAudio and Shockwave files through special pre-processing filters; compresses files to ADPCM format; demo version can be downloaded at (PC)*www.waves.com/download/WCPDemo.zip* or (Mac) *www.waves.com/download/WaveConvert-Pro_demo.sea.hqx.*

800-264-0109; WaveConvert-Pro@kswaves.com
Circle (220) on Free Info Card

Fader controller
TC Electronic

• **Wizard Finalizer Master Fader:** allows fades to be performed via remote control directly in the output section of the Wizard Finalizer three-band dynamics processor; keeps signal in the digital domain even while performing fades, thereby making analog faders obsolete when going directly to DAT or CD-R — thus, there is no interference with the pure sounding digital processing of the Finalizer.

805-373-1828; 805-379-7578; www.tcelectronic.com; tcus@tcelectronic.com
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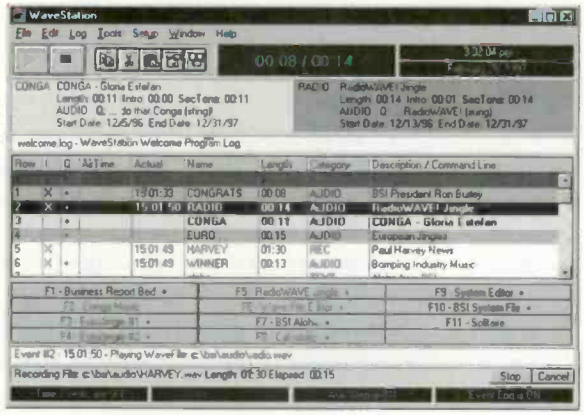

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Little LEOs threaten RPU band

The FCC is looking to allocate spectrum in the 455- to 456MHz band for use by low earth-orbit satellites, commonly called "Little LEOs". That frequency range is commonly used by broadcasters for remote pickup (RPU) and transmitter-to-studio links (TSL) and, as such, the band is already congested with use. The SBE and NAB have prepared comments to the proposed rule making.

The FCC issued a Notice of Proposed Rulemaking (ET 97-214) to allocate spectrum in the 455/456MHz and 459/460MHz areas for Mobile Satellite Service non-voice, non-geostationary satellite services (NVNG MSS) adopted during the 1995 World Telecommunications Conference.

The use of the 455/456MHz band characterized in this NPRM is being contested by the SBE with examples from the extensive frequency coordination effort already in place in most markets either through or with the cooperation of local SBE chapters. The NPRM allows for a Little LEO to scan for free spectrum before transmitting its signal, but the frequent RPU usage on many frequencies in this band cannot easily be detected and protected. Further SBE comments discuss the occasional special uses of frequencies for sporting or major news events, and even emergency STL usage as detailed in Part 74 of the FCC rules.

SBE proposes Emergency Alert System rule changes

After several months of review by a specially appointed committee, the Society of Broadcast Engineers (SBE) has submitted its Petition for EAS Rule Changes to the FCC. The petition is the result of intensive Committee information gathering from SBE members and industry representatives beginning in early 1997.

The Petition, written to address problems being encountered in real world EAS operation, addresses several avenues of proposed rule reform, including:

- Changing the required test window from monthly to quarterly;
- Removal of the two-tone attention signal mandate (though with a recommendation that it be left in place in areas where there exist consumer receivers set to de-mute upon two-tone reception);
- Reduction of the required modulation level for EAS tones to one more attainable through standard processing;
- Requiring location code verification for all tests and alerts, including the EAN/EAT, and the addition of an "entire country" location code;
- The addition of a higher-functioning text protocol; and,
- Procedural definitions for key stations that are part of a group of stations using common EAS equipment.

In addition, the Petition urges the FCC to form an appropriate effort or officially support existing efforts toward the goal of restoration of the EAN Network, to include a cancellation code for each event code in the current tables and for each code that will be added, and asks that the FCC encourage and facilitate EAS participation at the local level.

Lucent Technologies demonstrates new digital algorithm

Lucent Technologies/Bell Laboratories recently brought its new PAC-4 digital algorithm to Electric Lady Studios in New York. PAC, short for *perceptual audio coding*, makes use of audio masking, the process of eliminating non-essential audio parts that are out of the frequency range of the human ear.

The PAC-4 algorithm can transmit CD-quality audio at 96kb/s and near-CD quality at 64kb/s, the capacity of one ISDN channel. Earlier versions of PAC transmitted at rates of up to 160kb/s. PAC-4 can use significantly less bandwidth than its predecessor while still delivering real-time, high-fidelity audio. The new algorithm can deliver high-quality audio (suitable for speech) in mono with bit rates as low as 16kb/s, and is also useful for sending audio in real time over the Internet.

The demonstration included background discussions presented by Bell Labs' research engineers Peter Kroon, Fred Juang and Deepen Sinha, as well as a presentation by David and Mark Moulton, of Moulton Laboratories. This demonstration was a first for most of the engineers, because it was not an academic lecture but a demonstration to potential users of the PAC-4 algorithm.

Mark Moulton, who has a background in psychological and educa-

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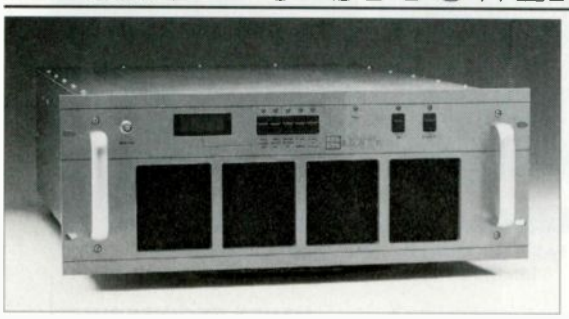

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tional measurement, spoke about the advanced double-blind listening tests used in evaluating PAC. Moulton used a Rasch mathematical model to evaluate the statistics gathered in the testing, and spoke briefly on how it proves the validity of the figures.

David Moulton then played a sample test of audio, featuring mostlymusic cuts. A sample test form was distributed and many agreed the PAC-4 did deliver stereo audio exactly like that of the reference CD.

—contributed by John Landry, CBRE, audio technician, ABC Radio Networks, New York

RTNDA hails House vote

Two recent moves in the U. S. House of Representatives brought praise from the Radio-Television News Directors Association (RTNDA) for their implications in electronic newsgathering.

The House voted to repeal a rule allowing subpoenaed witnesses to request that cameras and microphones be removed from public hearings. Barbara Cochran, RTNDA president, testified in front of the House Rules Committee that the rule was biased against electronic media and prohibits the public direct access to governmental proceedings.

In an earlier development, the House moved to safeguard the use of radio frequency scanners in newsroom operations. The bill as originally written was intended to deter the increasingly popular practice of eavesdropping on private conversations, but, because it didn't specify limited frequencies, would have made it illegal to monitor or divulge information gathered over frequencies allotted to commercial mobile radio services. Furthermore, the technical implications of manufacturing scanners that could filter out every CMRS channel would make the use of scanners ineffective and costly.

The bill's sponsor, Subcommittee Chairman Billy Tauzin (R-LA) introduced an amendment to the original bill limiting the frequencies which cannot be intercepted using scanners to those assigned to cellular and PCS. Tauzin emphasized that the bill was not intended to ban the use of police, fire or emergency service scanners.

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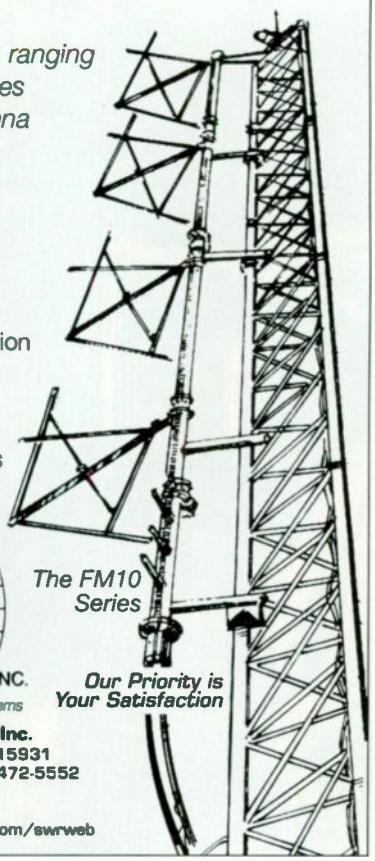

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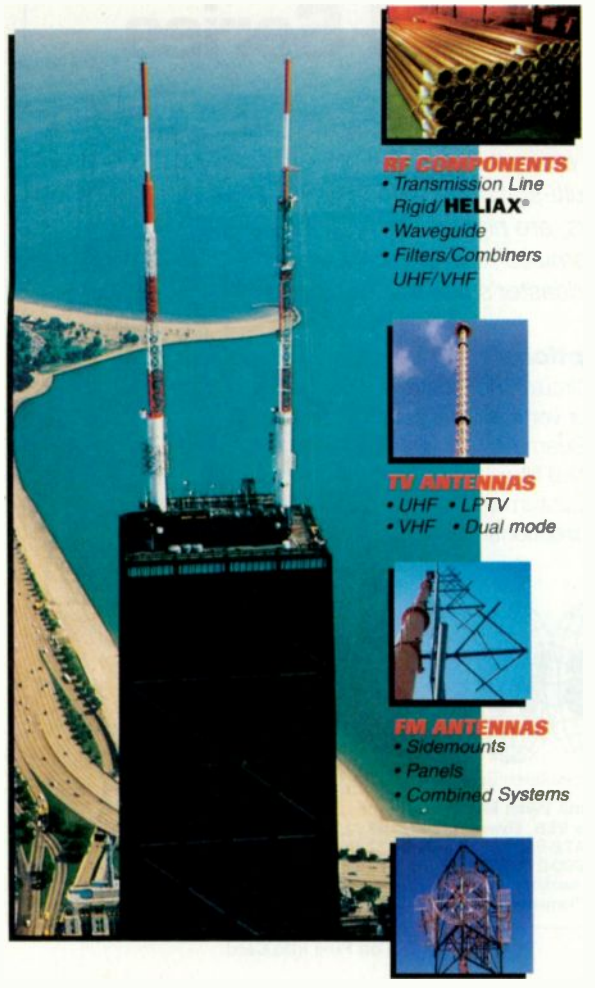

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Business/ People

BUSINESS

Broadcast Electronics has acquired two products from **Telfax Communications** — the GX440 phone line interface and the TalkPort dual microphone mixer. Both products will be handled under the **Marti** line. Broadcast Electronics was also recently awarded ISO 9001 certification by the American National Standards International organization.

The Cassini spacecraft, launched by a Titan IV/B Centaur rocket, was monitored with equipment provided by **Intraplex.** A combination of T1 lines and advanced multiplexing allowed the continuous monitoring of the rocket's vital signs before, during and after launch from data sent to mission control in Cape Canaveral and then relayed to Denver.

Radio Free Asia has installed nine **Yamaha** 02R digital consoles and four 03D consoles in their new Washington, DC studios. Programs created here are broadcast to China, Tibet, Burma, Cambodia, Laos, North Korea and Vietnam.

Mackie Designs and **IVL Technologies Ltd.** announced a partnership to provide the IVL Vocal Processing and other proprietary algorithms as software plug-ins for the Mackie Digital 8-Bus mixer.

T.C. Electonic, after the recent expansion of its facilities in Westlake Village, CA, has released the Finalizer *Plus* — the next generation of the Finalizer. T.C. has also announced an upgrade program through which existing Finalizer owners can upgrade to the features of the *Plus*.

360 Systems, Westlake Village, CA, announced the installation of three of its Instant Replay hard disk audio players and one Short/cut audio editor at the KABC/KLOS facility in Los Angeles. The station will use the newly installed units to record and edit its popular "Mark and Brian" morning show for syndication.

Digital automation company **Broadcast Software International** (BSI) has released converters to provide the BSI standard digital labeling to owners and purchasers of music libraries from **TM Century** and **Halland Broadcast Services**. The labeling allows audio file transfers to imbed descriptive information within the audio file. The conversion utility is being provided free to TM and Halland users and the companies.

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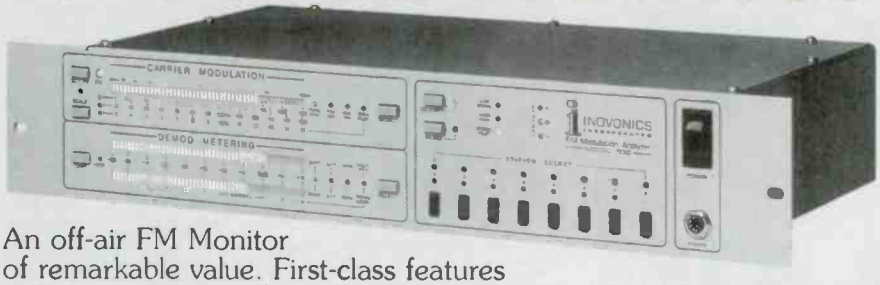

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Business/ People

An agreement between **HHB Communications** and **SADiE** offers new file interchange capabilities between the HHB Genex GX8000 multi-track MO disk recorder and SADiE DAWs.

The Canadian Broadcasting Corporation and Master FM Limited have awarded a contract to **Itelco USA** to provide five 800 watt L band transmitters for a complete turn-key installation. The model T702E DAB transmitters will be the highest power solid state DAB transmitters in the world, and will operate from the CN Tower in Toronto.

PEOPLE

Robert B. Blasen has been appointed president and chief executive officer for Comstream Corporation, San Diego.

Michael W. Britner has been promoted to vice president of business development for Lawrence Behr Associates, Inc., Greenville, NC.

Francis M. Flood has assumed the role of president at Gentner Communicatons Corporation, Salt Lake City.

Richard Byrne has been named marketing director for Logitek Electronic Systems, Houston.

Don Patrician has joined Maxell Corporation of America, Fair Lawn, NJ, as vice president of marketing and sales for the Consumer Products & Professional Division.

Rick Gentry has been promoted to national sales and marketing manager for Hafler, Tempe, AZ.

New Websites

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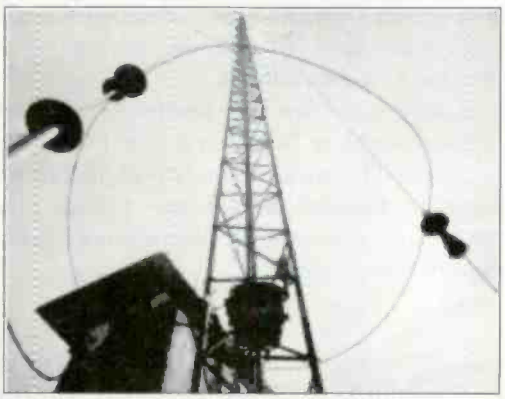

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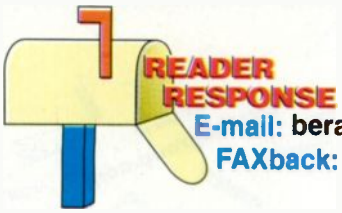

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Prepare to be boarded

I commend to your readers the audio tape of the Pirate Radio session at the 1997 NAB Broadcast Engineering Conference. In it, Beverly Baker, chief of the FCC's Compliance and Information Bureau, states, "We are currently aware of over a hundred pirate operations on the air," but then admit that CIB is only "actively proceeding" against fourteen of those stations and will only be "dealing [with the others] as they come up on the priority list."

One has to wonder exactly what, short of active jamming on aeronautical or police requencies — or perhaps a White House communications complaint — could possibly be a higher enforcement priority than unlicensed broadcast stations? Licensed broadcasters pay the FCC application and user fees, plus they are subject to a plethora of "public interest" obligations. In short, they are heavily regulated. In return, the FCC's obligation is to ensure that scofflaws who don't bother to obtain a license are promptly shut down. That's what the U.S. Marshals are for, and search and seizure warrants.

And if the CIB hesitates to bust a particular pirate station because a renegade federal judge thinks 40 years of case law don't apply to her, then the CIB should take a lesson from history: Al Capone was sent to prison for tax evasion, not murder or booze running. By allowing Steven Dunnifer and his ilk to operate, the FCC is condoning violation of the National Environmental Policy Act (NEPA) by failing require those stations to demonstrate compliance with RFR standards. That offense surely is not protected under the First Amendment.

One pirate may cause little interference, but a thousand pirates cause chaos. The FCC needs to fulfill its half of the compact with broadcasters and direct the CIB to mind its Compliance function. Broadcasters shouldn't be expected to pay annual user fees for services not rendered or for spectrum not protected.

Dane E. Ericksen, P.E.
(former FOB inspector)
Senior Engineer
Hammett & Edison, Inc., Consulting Engineers
San Francisco

Mr. Ericksen's letter was originally received in late April 1997, but, because of space limitations, could not be printed until now. Since this letter was written, Richard Lee, a former Marine, has replaced Beverly Baker as Chief of CIB, and stepped-up enforcement action against certain unlicensed pirate FM broadcast stations has occurred.

More on consolidation

I appreciated the article by Chip Morgan in the November/December issue regarding consolidation of facilities.

What wasn't mentioned was that there is now a whole new level of consolidation possible — consolidating multiple stations in many different communities by tying the business and operational aspects together via the Internet.

With a single production department, a single programming department and a single traffic department serving multiple stations, whole new levels of operational savings can be achieved.

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John F. Schad
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These are the basic functions of an Intranet, which are becoming more common as well. While there are cost advantages in combining the operations into a single, centralized location, there can be problems from the creative side, and some last minute changes or additions are not possible or are very inconvenient. A hybrid approach may be more suitable in some instances.

Response to a letter

I often read but seldom reply to any of the letters in your fine magazine but the two in the Nov/Dec issue prompt this response.

I was recently called upon to look at a somewhat massive PA system and found loop after loop in the audio system — mains, monitors, you name it — all feeding back onto itself in various configurations. I asked the guy responsible for the system what he did and why. His answer was "it sounds better this way and I get more gain." Faulty logic, indeed. I suggested going back to the basic path of microphone, preamp, mixer, EQ, power amp and loudspeaker. The poor guy was amazed how good it sounded.

I have seen and done many of the same things in radio

Continued on page 71

Reader Feedback

Continued from page 66

stations — piling boxes on boxes looking for the "golden sound" that the PD wanted. I seem to always remember that a simple, clean path is the best. I'm not sure it makes much difference if you're talking analog or digital, but with digital you get to shoot yourself in the foot quicker and surer than you might with an analog system.

Look to the basics we all learned many years ago. There's a reason our predecessors did the things they did and we should not scrap their wisdom just because someone claims to have a newer, thus better, box on the market. If we apply some forward bias to the gray matter, we might improve our lot without separating the men in the corner offices from too much of their green. They usually like that kind of thing.

Heck of a good article by Battison on RF grounding also. That should be a keeper for lots of guys.

Keep up the good work.

James L. Sorensen
VP & Sr Engineer
Cottrill & Holland, inc.
Ft. Lauderdale, FL

In the case of audio, it's always your ears that will be the judge. But you're right, James, you should not lose sight of where you've been or where you're going.

Telco woes

I read with interest your article on Talk Radio in the Sept/Oct issue. The idea of using some of the enhanced line features is good, but care must be taken. Some of the central offices (CO) given over to the media for callers are stripped of all features so the large number of calls can get through in the fastest time.

Our general manager wanted to create a geographic database from the caller lines, so I tried to get caller ID on the call-in lines. The Ameritech business office was all too ready to sell it to us, but getting it to work was a totally different story. After about three months of rhetoric, I finally had an Ameritech person come out to the station and look at this problem first hand. We found out that although the CO and their switch could handle the enhanced features, the choke line exchange we were given had been stripped of its features. The caller ID box would not work on any of the lines in the choke exchange, but operated beautifully on any other exchange from the CO.

By the way, the fellow that answered the burning question was an engineer at the CO. It was one of these "Oh, I thought you knew that," routines. The business office at Ameritech still doesn't catch on.

Al Kazlauckas
WZAK/WZJM/WJMO
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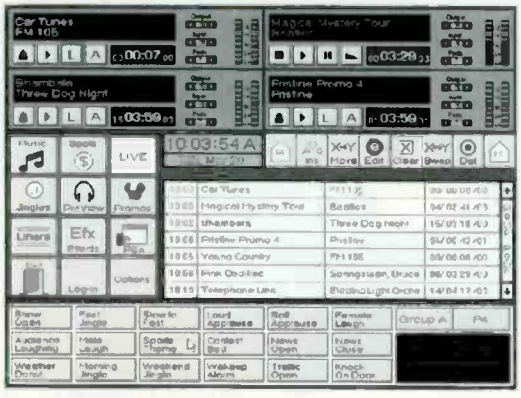

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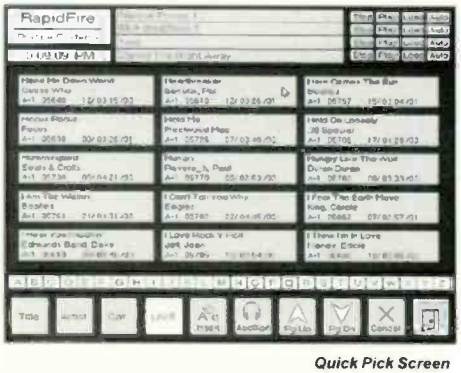

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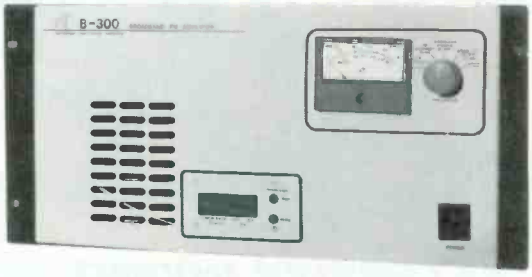

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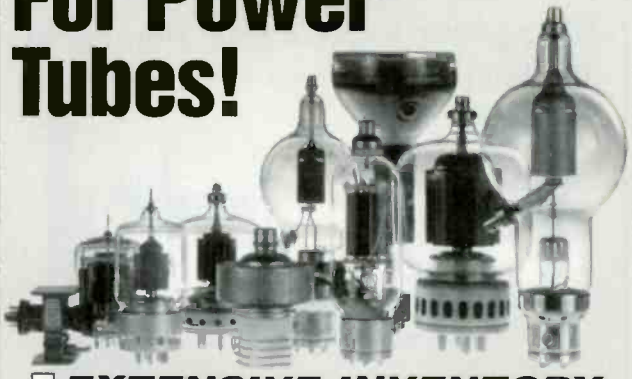

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Will webcasting become a true competitor to broadcast radio? On-line radio has grown beyond downloading sound files to become a continous stream available to any net connection.

Feature Story — Processing on-line audio

We process our air signals for that signature sound, why not put the same trademark on audio delivered over the web?

Contract Engineering — Maintaining computers

Keeping all the computers up to date and running at top performance is important for the investment of money and data placed in them.

Managing Technology — Establishing your facility's Intranet

Go through the steps to successfully create a station's Intranet to keep all the departments working smoothly.

RF Engineering — Transmission line pressure: Nitrogen vs. Air

A look at the strengths and weaknesses of each of these methods will be discussed, along with recommendations on deciding which is best for your facility.

Next Wave — IP Multicast: Radio of the future?

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The monitor menace

By Skip Pizzi, editor-in-chief

Most radio control rooms in use today were built without the slightest consideration of *video* monitoring. Yet many of these rooms are now being rudely colonized by CRTs displaying TV (weather radar, cable news channels or security cameras) or computer video.

The problems go beyond the space these monitors take up or the difficulty in finding optimal placement for them. They also draw a lot of power and generate significant heat, and because they are often placed close to microphones, the acoustical oscillation and RF interference they produce can be picked up. An announcer's voice bouncing off the screens can also reflect into nearby microphones, creating unpleasant colorations. Short of rebuilding the control-room cabinetry, it's nearly impossible to adequately retrofit four or more of these behemoths (even 14" models) in an already cramped radio control room, as many stations are now trying to do.

There's gotta be a better way

One relatively simple solution comes as an adjunct to CPU-remoting (i.e., the terminal equipment and cables that allow a CPU to be placed in a separate room from its keyboard, monitor and mouse to reduce control room noise). These extender kits are now available in forms that include a variety of switching matrices. For example, a single keyboard/mouse/monitor can be switched to access any of four different CPUs.

Unfortunately, this approach is not always satisfactory because it doesn't allow full-time, simultaneous control and observation of all CPUs, which many operators desire or require. In these cases, another relatively inexpensive (albeit labor-intensive) approach borrows from TV anchor-desk design by countersinking monitors in cabinet tops, wall panels and ceiling soffits. Less critical monitors can be rack mounted. This may leave the need for only one or two exposed monitors on spring-loaded, articulated arms.

Note that some computer monitors cannot be operated safely inside a cabinet, and some don't like to be mounted at an angle. You'll also have to be careful about spilling liquids or dropping heavy items onto exposed monitors mounted in the countertop. If touchscreens are involved, their notorious problems with dirt accumulation on the screen are only magnified in such arrangements.

The FT15 from Sceptre is one of the latest crop of flat-screen computer monitors

Call in the crystal cavalry

The ultimate solution may be the LCD or plasma display — the flat screen. These devices produce crisp, brilliant images in a far smaller, lighter, cooler-running and quieter form factor. Recent LCD designs offer screens about two inches thick that weigh only 10 to 12 pounds for a 14-inch display. Earlier problems of image quality and viewing angle have been largely solved, but one major obstacle remains — cost.

Flat screens currently cost at least five times more than a tube with an equivalent display size. This is no surprise when you consider that a 1024x768 flat screen contains over two million individual LCD cells. Nevertheless, it wasn't very long ago when this cost differential hovered around 10:1. While laptops have been the only mass-production engine driving down the cost of flat screens, larger models (up to 42 inches) have recently been introduced for the home theater market. This may accelerate the price reduction process and create a viable market for larger-than-laptop screens.

Yet even at today's prices of $2,000 to $3,500 for 14- to 15-inch displays, the benefits of flat screens may make them worthwhile to some radio stations. Also consider the operating cost advantages of flat screens that come from their lower power consumption and reduced cooling requirements. This could pay back some of their cost differential over time, along with possible reduced maintenance costs from flat screens' alleged higher reliability. In any case, prices will continue to fall.

The flat screen is yet another promising technology from the consumer marketplace that has special value to radio professionals. Consider it in your pursuit of the perfect computerized control room. It can help you ward off the assault of the video monitor monster.

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