Supplement To:
BROADCAST® ENGINEERING
BE Radio
March 1994

COVER STORY

Radio highlights of NAB '94:

It's time once again for the industry to gather in Las Vegas. This year's show promises to be bigger and better than ever, so you'll welcome John Collinson's helpful preview. It points out all the NAB '94 agenda items of importance to radio attendees.

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Chasing the Cowboys:

Winning the Super Bowl wasn't the only superlative part of the Dallas Cowboys' 1993-'94 season. The team's radio coverage has also gone all the way, presenting listeners with a close-up, CD-quality stereo sound. Audio specialist Bennett Liles reports from the Georgia Dome.

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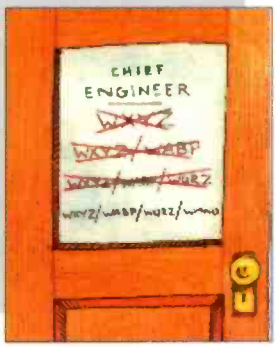

Duopoly: Sign of the times:

Broadcast attorney James Kirkland explains the rules of the road for multiple-station ownership and joint operations, with special emphasis on the pot-holes. A related article from Dennis Ciapura provides some tips on handling personnel matters during station consolidations.

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Special Report: pg.14

Audio format cost analysis:

Choosing a new audio recording format is no simple matter. Laura Tyson compares hardware and media costs (and some other operational issues) for all the new formats.

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Circle (1) on Reply Card

EDITORIAL

Listener's Choice

I received a letter from a friend in response to my "Industry Forecast" in the January issue of *Broadcast Engineering* magazine. John complained that my use of Rush Limbaugh's phrasing was perhaps inappropriate. He said that the broadcaster is "mean-spirited" and pompous, also ill-informed. "I mean, here is a guy who doesn't think the ozone layer is thinning.", said the reader.

Thanks for the feedback John, but let me offer a different perspective on radio broadcasting.

Readers may note that Infinity Broadcasting was recently fined $400,000 because of FCC rules violations on four separate days in August, September and October 1993. According to reports, the $400,000 does not include the $1,278,750 in fines that Infinity faces for past violations of the commission's indecency rules.

When I'm in the New York area, I'll sometimes briefly tune to Stearn's show, to see how gross he really is. It usually takes about 10 minutes for me to be so sick of his so-called humor that I tune to another station. Here is a radio host that is so vulgar that the commission has fined his company almost one-half of a million dollars! Yet, he remains on the air—just as does Rush Limbaugh.

There are thousands of program choices on the air every day in this country. That each radio listener can have a choice of station programming that matches their needs is one of the beauties of our broadcasting system. Although you or I may not agree with Stearn's (or Limbaugh's) approach or delivery, others may enjoy it. That's why radios have knobs.

Every radio listener has the ability to make instantaneous choices in radio entertainment. If you don't like the product, other options are available and merely a quick twist of the knob away. That's the way it should be. Let the listener decide and yea for the American broadcasting system.

NEWS

FCC cracks down on stations for EEO violations

The FCC handed down a total of $318,750 in fines to 22 radio stations last month for alleged violations of minority hiring rules. Individual station fines ranged from 18,750 to 37,500. The stations were all up for license renewal, and most were also given probation-like short-term renewals subject to future reporting. One other AM/FM licensee faces a renewal hearing into its hiring practices and possible false reply to an FCC inquiry, which could result in a $250,000 fine and/or license revocations.

The actions represent a new, tougher enforcement stance on minority hiring. The commission's Equal Employment Opportunity rules specify that licensees must demonstrate a record of recruitment practices for women and minorities when filling vacant positions.

NPR chooses new digital satellite system

National Public Radio has chosen San Diego-based Comstream Corporation to provide custom digital audio transmission equipment for its second-generation satellite interconnection system. Digital upgrades to the network's existing analog system (established in the early 1980s as the country's first satellite-interconnected radio network), will be installed at about 350 downlinks and nearly two dozen uplinks around the United States next year. The new system will use the *ISO/MPEG Layer 2* (formerly MUSICAM) data-reduction algorithm.

With this decision, NPR becomes the first major network to employ ISO/MPEG Layer 2 coding, breaking step with most other radio networks (which use Scientific Atlanta's SEDAT system). Another unique design element calls for satellite receivers to provide all audio outputs in three forms: analog, AES/EBU-format digital or undecoded ISO/MPEG Layer 2.

The new system will support transmission of multiple audio channels at individually selectable data rates, with automatic data-rate detection at the receiver. Supported data rates range from 64kbit/s to 256kbit/s, with mono, joint stereo or discrete stereo modes offered. The system also includes a dedicated 64kbit/s data channel and optional program encryption.

Inauguration of digital service will begin in late 1994, with existing analog transmission shut down after all stations have the new digital equipment, expected by mid-1995. The digital service will use the same satellite (Galaxy IV) as the current analog system, so no additional antennas or dish repointing will be required. When fully implemented, the new digital service will double the public radio satellite system's channel capacity from 12 to 24 simultaneous programs. Significant audio fidelity improvement is also expected.

BE Radio

Radio highlights at NAB '94

The Bottom Line: *Radio is in the midst of a major revolution. Consolidations, digital broadcasting, RBDS and new competing technologies are reshaping the very nature of the medium. New opportunities also abound in this revised environment, and today's broadcaster must stay current with a fast flow of developments to remain successful. NAB '94 provides the perfect forum for that process.* $

The paving of the information superhighway is well under way, and part of it undeniably leads through radio land. NAB '94 can help you map out your facility's route to a profitable future.

This year's prime industry conclave is scheduled earlier than usual, running Sunday through Thursday, March 20-24, 1994. Like most of NAB '94's events, the Broadcast Engineering conference will be held at the Las Vegas Convention Center.

Of course, the other big attraction is the exhibit floor. The NAB expects 65,000+ attendees to spend their time visiting the 800+ exhibitors who will occupy about a half-million square feet of space at the show.

As in previous years, the Society of Broadcast Engineers (SBE) will present the technical sessions on Tuesday. (Beginning next year, *all* technical sessions at the NAB Broadcast Engineering conference will be a joint effort of SBE and NAB.) The SBE will also hold its membership meeting on Tuesday afternoon. The traditional ham radio reception will take place Wednesday evening at the Las Vegas Hilton.

IEEE is breaking some new ground this year by sponsoring a half-day *Digital Transmission Tutorial* preceding the Engineering Conference, on the morning of Saturday, March 19. This session will present a detailed examination of digital transmission and modulation techniques, robustness, and test methods for various digital transmission techniques.

The conference will open on Sunday morning with a keynote address by Jules Cohen, P.E., followed by concurrent sessions dealing with ISDN/T1 transmission and data broadcasting for radio. Sunday afternoon's papers will cover the popular topic of digital audio workstations and storage systems.

More than 800 exhibitors will occupy about a half-million square feet of space at the show.

On Monday morning, things start off with the All-Industry keynote address by FCC's new chairman, Reed Hundt. Later morning sessions cover digital audio processing and management issues. The digital audio processing session includes a number of hot topics, such as improved on-air signal processing, progress toward the fully digital air-chain and the effects of audio processing on data-reduced digital signals. Monday afternoon features a session on tower and support equipment, followed by a panel on RF radiation issues.

Tuesday (SBE Day) begins with papers on diverse areas of AM/FM improvement. The new EBS will occupy the afternoon session. The day ends with a session on the growing world of contract engineering.

The annual Engineering Achievement awards luncheon will be held on Wednesday. Morning technical sessions will include an FCC/Industry Technical Panel and a status report on DAB testing. Further coverage of DAB resumes after the luncheon with presentations from format proponents. A concurrent session will cover satellite and auxiliary services. Satellite DAB is among the topics considered in the latter.

The program concludes on Thursday morning with a session on radio transmitter maintenance presented by representatives of several transmitter manufacturers.

Check the following for a full listing of presentation titles.

NAB '94 BROADCAST ENGINEERING CONFERENCE Technical sessions (Radio)

SUNDAY, MARCH 20

9:30 a.m. - noon: Data Broadcasting - Radio

- Implementing the Differential Global Positioning System: How Your Station Can Participate
- The High-Speed Subcarrier Data System: Putting a Pager on Your Wrist
- The Development and Design Profile of an FM Multiplex Data Broadcasting System for Mobile Reception
- Cashing in on IVHS: Bringing Federal Highway Department Dollars to Your Station
- Direct Data Delivery Using Existing SCA Technology
- Teaching an Old Subcarrier Some New Tricks

Collinson is a satellite uplink engineer for Home Shopping Network, St. Petersburg, FL.

Introducing ADX, the first digital production system designed for the real world of broadcasting. A world where time is of the essence, change is the rule, last minute is routine, and creativity is the competitive edge!

ADX is a fully integrated system which combines the creative flexibility of digital recording and editing with the speed and intuitiveness of a fully automated production mixer. Instead of simply storing audio elements and their edit decisions, ADX also recalls and recreates the mixing and processing talent of the producer.

Just imagine having the ability to precisely replay complex multitrack production work the way you mixed and equalized it yesterday, last week or last month! Think of the creative time saved when a change or update is requested in an otherwise perfect mix.

Plus, the ADX is unencumbered by the architectural limitations of first-generation workstations and is designed to grow and expand with your needs. Even the basic system has more standard features than anything before.

And like all PR&E products, ADX is a powerful tool optimized for the fast and furious demands of broadcasting and backed by world-famous PR&E support. Call today for information on ADX, the next generation of digital.

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DESIGNS THAT MAKE THE DIFFERENCE

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9:30 a.m. - noon: ISDN and T1 Transmission
• Overview of Industry Commercial Delivery Over ISDN
• Network Cost vs. Bit Rate and Audio Quality
• ISO/MPEG Layer III Coding and ISDN
• Selecting a Terminal Adapter
• The NBA, Changing from Switched-56 to ISDN
• Integrating ISDN and T-1 With Satellites for Program Backhaul
• Understanding New Alternatives for ISDN and T-1 Transmission

1:00 p.m. - 5:00 p.m.: Digital Audio Workstations and Storage
• Strategies for Choosing and Using Digital Audio Workstations for Production
• A Cost Analysis of Digital Storage Alternatives
• Configuring Personal Computers as Digital Audio Workstations for Broadcast
• Technology that Pays: Evaluating Digital Alternatives
• A DAB-Ready, Non-Transcoded Audio Transport System
• A New Device for Digital Storage

MONDAY, MARCH 21

10:30 a.m. - noon: Digital Audio Processing and Systems
• Maintaining a 100% Digital Path from the Studio to the "On Air" RF Signal
• State of the Standards: Coding and Connectivity
• Utilizing Second-Generation Transmission Processors for Audio
• The Interaction of Audio Processing and Low Bit-Rate Coding for Broadcast Applications

10:30 a.m. - noon: Managing in Broadcast Engineering
• Managing UST's, MSD's, and other Federally Regulated Environmental Matters
• The Americans With Disabilities Act and Broadcast Facility Design

1:00 p.m. - 3:30 p.m.: Towers and Other Transmission Support Equipment
• Understanding and Preventing Guyed Tower Failures Due to Anchor Shaft Corrosion
• Controlling Corrosion on Broadcast Towers: A Subject You Can't Afford To Be Rusty On
• Inspection, Maintenance, and Troubleshooting of UHF/VHF/FM Antennas, Transmission Lines and Waveguides
• Performance of a Transmission Line Having a Rigid Outer Conductor and a Corrugated Inner Conductor

3:30 p.m. - 5:00 p.m.: RFR Update
• Six panelists from the industry and FCC discuss the latest in RFR regulations

TUESDAY, MARCH 22: (SBE DAY)

9:00 a.m. - noon: AM/FM Improvement
• Technology to Extend the Life of High-Power Vacuum Tubes
• Broadband Implementation of Physically Short, Highly Top-loaded Anti-skywave Antennas
• AM Antenna System Tune-Up
• Modern Practical Techniques for Installation and Repair of AM Antenna Ground Systems
• FM Diversity Reception Systems
• Preparing for the Multicast Environment in Radio

1:00 p.m. - 3:30 p.m.: The New EBS System
• Testing New Technologies for Emergency Alerting Systems
• This Is No Longer A Test
• Cable TV and the New EBS
• User-Friendly EBS

3:30 p.m. - 5:00 p.m.: The Business of Contract Engineering
• Avoiding the Pitfalls in Contract Engineering
• Sound Business Practices for Contract Engineers
• Jumping Through the Hoops: Tips for Keeping Your Contracting Business Legal

WEDNESDAY, MARCH 23

9:00 a.m. - 10:30 a.m.: FCC-Industry Technical Panel
• Six panelists from the FCC and industry will discuss legal and regulatory issues

10:30 a.m. - noon: DAB I
• Multipath Propagation Test Results and Implications for DAB
• NRSC/EIA DAB Test Report

2:00 p.m. - 5:00 p.m.: DAB II
• NASA/VOA DAB System Update
• DAB on Trial: Eureka 147 - The System With A Future
• AT&T DAB System Update
• Amati Communications DAB System Update
• USA Digital Radio FM DAB System Update
• USA Digital Radio AM DAB System Update

2:00 p.m. - 5:00 p.m.: Satellite and Auxiliary Services
• How the New FCC Ruling for Earth Station Antennas Will Impact Broadcasters
• Direct Broadcast Satellite Sound

THURSDAY, MARCH 24

9:00 a.m. - noon: Radio Transmitter Maintenance Workshop
• Representatives of five major transmitter manufacturers will share tips and techniques, and answer questions on all aspects of radio transmitter operation and maintenance.

NAB '94 Radio Sessions at a glance:

<table>
<tr><th colspan="2">Sunday, March 20</th><th>Monday, March 21</th><th>Tuesday, March 22</th><th>Wednesday, March 23</th><th>Thursday , March 24</th></tr>
<tr><td rowspan="2">A M</td><td colspan="2">Opening Session Engineering Keynote</td><td colspan="2">All-industry Keynote Address</td><td rowspan="2">AM/FM Improvement</td><td colspan="2">FCC/Industry Technical Panel</td><td rowspan="2">Radio Transmitter Maintenance Workshop</td></tr>
<tr><td>ISDN & T1 Transmission</td><td>Data Broadcasting (Radio)</td><td>Digital Audio Processing</td><td>Managing Broadcast Engineering</td><td colspan="2">DAB I</td></tr>
<tr><td rowspan="2">P M</td><td colspan="2" rowspan="2">Digital Audio Workstations and Storage</td><td colspan="2">Towers and Other Transmission Support Equipment</td><td rowspan="2">The New EBS</td><td colspan="2">Engineering Achievement Awards Lunch</td><td rowspan="2"></td></tr>
<tr><td colspan="2">RFR Update</td><td>DAB II</td><td>Satellite and Auxiliary Services</td></tr>
</table>

Okay, say you meet the right girl, take her home to meet your family, get down on your knee in front of everyone and plead with her to elope and spend an eternity together frought with romance, passion, and lifelong commitment, and suddenly she says: "I can't. It'll violate my parole."

You Feel:

1. *Justifiably confused.*

2. *Grateful for the honesty.*

3. *Like you bought a Unity 2000.*

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Chasing the Cowboys

Bennett Liles

The Bottom Line: *As listeners' aural tastes improve, high-quality radio sports presentation provides an important new opportunity to capture audience attention. Today's ISDN services, wireless microphones and creative mixing techniques make this possible in an increasingly cost-effective manner.* $

Whenever and wherever the Dallas Cowboys take the field, the action is picked up live from Sweetwater to Somalia on nearly 100 stations of the KVIL-FM Dallas Cowboys Radio Network.

Blending microphone technique borrowed from TV sports with corporate data communications gear, this radio coverage — provided by Midcom of Dallas — not only feeds color and play-by-play to KVIL and its network, but it puts listeners on the field with the players. Their secret (until now) has been the creative way they combine multiple parabolic microphones for on-field sound gathering and ISDN (Integrated Services Digital Network) for remote backhaul.

Advantages and challenges of ISDN

It makes little sense to go to great trouble or expense in picking up actual game sounds if they become a 3.5kHz telephone call during backhaul transmission. After several years of good notices on the revolutionary promise of ISDN and related systems for business users, there has been little fanfare on its high-tech trickle-down to broadcasters. Although ISDN is readily available in Western Europe and in parts of Asia, North America is still making do with its less-capable and more-expensive cousin, Switched-56. (For the type of setup used on the Cowboys broadcasts, *two* Switched-56 lines would be needed instead of a single ISDN circuit.) In this country, ISDN largely remains a technology looking for applications (hence its alias, "Innovations Subscribers Don't Need"). Getting it set up on the road can be tricky so rule number one is to plan ahead.

Because of differing tariff arrangements around the country, one-time commercial installation costs can vary from approximately $100 to more than $500 and can take two or more weeks to arrange. Many areas still lack local expertise in this field, which places more of a burden on the broadcaster. For stereo sports coverage, order a Basic Rate ISDN line. (See "Circuits," December 1993.)

Telco's twisted copper pairs from the stadium to the local switching office must have their inductive loads (loading coils) removed to accommodate the digital signal. If the line to the telco central office is more than about three miles long, repeaters enter the installation picture and can generate a certain amount of good old American red tape (and therefore, more time and money).

U.S. ISDN is still in its infancy with deployment only beginning in earnest for most telcos within the last year or so. In many areas, classes on ISDN for local installers are still in the planning stage. For the time being, when you take ISDN on the road, be prepared for anything.

Nevertheless, ISDN is generally worth the trouble. Anyone who has ever had to dodge blimps, thunderstorms and local architecture with a Ku-band uplink would love to just pick up a telephone and feed the signal back if the same sound quality were available. Speed is another advantage of ISDN. For radio crews, anything requiring more than an hour's strike time often is not acceptable. At this speed, a portable uplink becomes a ball and chain.

One of the parabolic microphones used on the field to create the stereo sound of Dallas Cowboys radio broadcasts. Both the microphone and its operator's headset feeds to/from the control booth are wireless, allowing easy movement along sideline.

Liles is an audio engineer at Georgia Public Television, Atlanta and a freelance writer on broadcasting and aviation. Respond via the *BE* FAXback line at 913-967-1905.

There's a Right Way

"I did it right from the start with Computer Concepts' DCS."

I don't sweat when it comes to our spot-heavy morning drive or complicated LMA formats. The reason is simple: First I did my homework. And then I bought a DCS hard disk system from Computer Concepts. In fact, I bought several.

I smile at the thought of multiple program formats and satellite automation, live and live assist. I laugh at complex spot rotations, two-channel crossfades with simultaneous recording and networking to traffic—they're no problem for the DCS.

And Computer Concepts customer support is terrific. Their software experts can even troubleshoot my DCS and upgrade the software remotely, via modem.

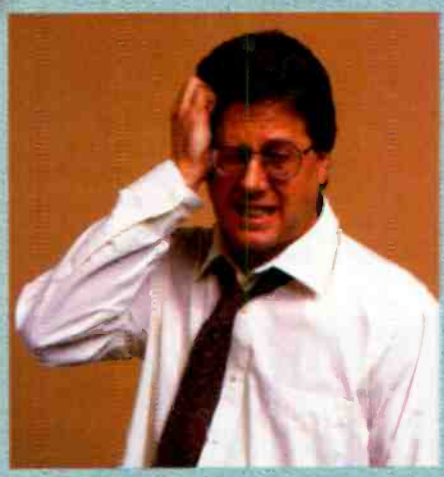
No wonder Computer Concepts DCS has turned hundreds of stations into happy customers. I'm glad I'm one of them. Oh, I almost forgot. The price was right, too.

I thought I'd impress HQ by buying the cheapest hard disk system I could find. After all, they all look the same! Their promises sounded good and I wanted to believe.

I found out promises come cheap. But their system wasn't really cheap—not once you added up the little "extras" it took to do the bare minimum. And it still couldn't do all the things our station really needed.

I found out the hard way, at 3 AM when the system we bought crashed. And in morning drive, when missing spots meant dollars down the drain. When I finally reached customer support, they said they were working on software they thought would fix my problem, but they weren't sure when it would be done. Guess what I told them?

Now I know better. We're getting a Computer Concepts DCS. I learned a costly lesson: Get it right the first time. Call Computer Concepts first.



"I should have bought a DCS in the first place."

and a Wrong Way

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The setup

Two vertical, castered racks roll Midcom's booth equipment into the press box at away games. Once their lids are removed, an Amek BC-2 mixing console (in a third case) is connected to them. The audio board has been extensively modified for setup and striking speed. Instead of separate lines running into rear-mounted XLR connectors, several 12-pair cables run into a custom port built into the side of the mixer. Direct channel outputs are hard-wired through one of these cables to serve communications needs. Microphones, wireless microphone receivers and other inputs are assigned to dedicated channels on the board. All of these components are snapped together using four AMP circular plastic connectors.

Creative miking for radio football is a great idea although its budget clearly has yet to come.

While one Midcom technician sets up the announcer stations and the wireless microphone receiver antennas, the other dials up KVIL, Dallas on the ISDN line. As a CD plays through the mixer, KVIL's auto-answer ISDN terminal hardware answers at the station. Immediately, the same CD-quality stereo audio comes back to the control booth, on the same line, with the KVIL producer's talkback on the left channel. Only the return signal's slight delay distinguishes it from the CD player's output on the booth monitors.

Terminal hardware

Although ISDN service may not be available everywhere yet, the equipment you need to connect to it is. Vendors that have been supplying large firms with corporate data communications gear are beginning to sense marketing opportunities for this same hardware in the broadcast industry. The ISU 128 terminal adapters used on each end of KVIL's line were provided by Adtran of Huntsville, AL, as a test of the concept. So far, there have been no problems.

This type of digital interface usually involves several different pieces of equipment. In this case, the components include the *codec* (which converts analog audio to a digital, data-reduced signal), the *inverse multiplexer* (combining multiple ISDN circuits into a single, wider bandwidth path), the *network termination unit* (sometimes referred to as an NT-1, a standard interface required at every ISDN hookup) and the *terminal adapter* (the equivalent of the telephone instrument providing call management, signaling and routing).

A small field package holds the terminal adapters (top) and digital audio codecs (bottom) used to backhaul 20kHz stereo audio from the stadium over a single Basic Rate ISDN circuit.

Midcom's particular choice of interface gear has some advantages. A CDQ 2000 codec from Corporate Computing Systems uses ISO/MPEG Layer II (MUSICAM) audio data compression and incorporates an inverse multiplexer as an integral part of the codec. It supports eight different, user-selectable output data rates. Meanwhile, the Adtran ISU 128 units combine the functions of terminal adapter and NT-1 in one small chassis. These consolidated features become even more helpful in the field.

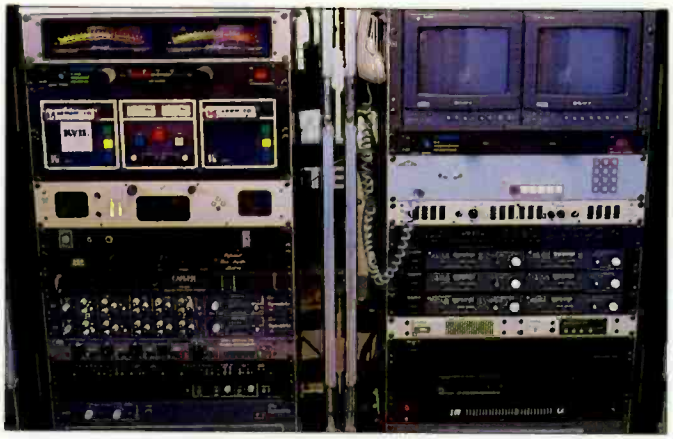
The creative side

The other star of this road show is its miking and mixing technique. In gathering sound for televised football, parabolic microphone operators routinely brave the sidelines just to get the quarterback's count call to match his camera close-up. Meanwhile, up in the booth, the typical radio crew slings an EV-635 mic over the rail so that the stadium will not disappear when the announcers use their cough switches. Creative miking for radio football is a great idea although its budget clearly has yet to come.

Stereo sports audio for radio need not worry about matching the stereo image to changing camera angles.

That old attitude crumbles in the face of this brave, new approach. Four wireless parabolas are used, two to a sideline. During the game, one microphone on each sideline follows the line-of-scrimmage up and down the field. These microphones are panned hard left and right bringing the listener sounds from the field of play as the quarterback might hear them. The stereo image stretches from sideline to sideline across the width of the field as an end-zone camera shot would look. Unlike television, however, stereo sports audio for radio need not worry about constantly matching the stereo image to changing camera angles so a consistent, realistic sound field can be presented.

The other two parabolas are panned center and pick up general sideline sounds. These mics are eased in and out of the mix as action dictates focusing primarily on the Dallas coaches and players. This miking and mixing technique can put listeners closer to the action than they could ever get at the stadium, even in the most expensive seats. To avoid acoustical phas-



Two rolling vertical racks contain most of the audio and RF equipment that goes into the control booth.

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Circle (7) on Reply Card

The setup uses frequency-agile wireless microphone systems in the UHF and VHF bands.

ing problems, no two parabolas are brought up together when they are physically close to each other on the same sideline. The crew has tried a few surround-style experiments by mixing the two scrimmage-line parabolas with one microphone's polarity reversed.

In addition to the four parabolas, the referee's wireless mic (using the more interference-prone VHF frequencies) is also brought up for penalty calls.

Between the Cowboys' game against Atlanta in November and the Super Bowl, ISDN rates decreased by more than 70%.

Although broadcasts on the network's flagship KVIL-FM, Dallas, are broadcast in stereo, the other stations on the network carry the Cowboys in monaural. About half of those stations are FM, however, and the network's 15kHz mono distribution circuits provide those stations' listeners with a sound quality superior to the average sports broadcast. Back in the stadium control room, while the crew works hard for an exciting stereo mix, the fact that most of the network's audience still listens in mono is not forgotten. Mono monitoring is only a push-button away, and it is frequently checked.

Wireless microphones

When using wireless systems on the road, frequency coordination is a myth, and frequency agility is a must. An RF spectrum analyzer will grow a forest of green spikes just before game time as every wireless microphone, intercom and IFB in the stadium is fired up. With better systems, if a roving microphone wanders out of receiver range, instead of picking up RF trash, the receiver soft mutes the output. The wireless receiver on these systems will gate open again only when it senses the transmitter's pilot signal.

This allows some useful flexibility to the broadcast crew. A reporter/announcer stationed on the sidelines wears a wireless microphone, which is fed directly to the control booth announcers' headsets for communication purposes. The reporter's microphone system is also equipped with a push-to-talk switch. The reporter can act as a field spotter for the announcers when he is not on-air and provide useful and reliable communication without technician intervention. If the reporter's wireless link fails, the announcers' headsets are not filled with noise.

To provide a monitor feed for those down on the field, the announcers' microphones and an IFB channel are fed to the sidelines crew via 450MHz belt-worn radios equipped with headphones.

When interference is encountered on a wireless microphone frequency, the frequency agility of each wireless system allows it to be reassigned to any of 94 slots within UHF TV channels 64 through 69.

Easy striking

For road games, most of the broadcast crew travels with the team charter flight and they need to be able to strike their gear in fairly short order. Sensible road case design and consistent packing technique allow the control booth and the on-the-field crews' strikes to happen fast.

These techniques may stimulate similar developments for other types of radio sports coverage.

The real key to such a quick strike is the heavy use of RF systems. The speed at which this crew gets its sophisticated setup in and out of the stadium would only be a dream if traditional cable-pulling were involved.

The price of success

Ironically, as ISDN gradually makes its way into every press box and high-quality digital backhaul becomes more popular, those RF setups will face increasingly crowded airwaves in stadiums. More radio remote crews will soon be using the technology and the techniques already in place on the worldwide Cowboys Radio Network. The cost for ISDN service also continues to drop precipitously. For example, when the Cowboys played the Atlanta Falcons in the Georgia Dome last November, ISDN backhaul to Dallas cost $700. On their next trip to the same stadium for Super Bowl XXVII, ISDN costs were only $190 — a decrease of more than 70% within about two months.

Beyond costs and conveniences, the most impressive element of this kind of coverage is its sound.

Beyond costs and conveniences, however, the most impressive element of this kind of coverage is its *sound*. Listening is like standing on the field in the middle of the play. These techniques really wake up radio football, and they may stimulate similar developments for other types of radio sports coverage.

Acknowledgment: Thanks to Mike Simpson, Jay Wallace and Alan Stiebing of Midcom, Dallas.

➡ *For more information on the equipment discussed in this article, circle (105) on Reply Card. See also "Coders & Decoders, Digital Audio," "Digital Terminal Equipment, Modems," "Microphones" and "Mixers," on pp. 52-56 of the 1994 BE Buyers Guide.*

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BE Radio

Audio format cost analysis

By Laura Tyson

The Bottom Line: *It may happen tomorrow or five years from now, but every radio facility will face the cart-replacement decision. Many issues are involved, including the station's programming format — now and in the future. Although there are some compelling reasons to replace your analog equipment with digital systems, it is important to decide which reasons apply to your situation, and when to make the switch. A comparison of features and costs is a good place to start.* $

Whether you're ready to retire your cart machines or you're building new studios, you've undoubtably confronted the difficult issue of which new system(s) to select for audio storage and playback.

Immediately, several critical questions come up: Are digital systems mature enough to fill this role? If so, with so many different digital systems available, how can a broadcaster be sure a given system will remain current or even be around five years from now? Is now the right time to move to digital systems? Properly maintained, cart machines can easily last for another few years. Blank cartridge tape and shells will remain readily available for some time. Few formats have enjoyed the 30-year run that the analog cart has had. Is it necessary to abandon this tradition yet? Eventually, you will probably find you cannot afford *not* to do so.

Consider the following issues:

•*Sound quality:* Despite all the hype, the appeal of CD-quality audio becomes a minor point in this discussion. Everything else held equal, it's unlikely that a station using analog carts is losing share to the station using digital playback sources. To the listener, the difference is probably insignificant, as long as the analog machines are well maintained, aligned, and the carts are in good shape. Those last caveats are important, however. Analog systems are subject to wide variations in performance, and it's these types of distortions (wow-and-flutter, high-frequency rolloff, dropouts and monosum phase cancellation) that your listeners will hear and notice.

•*Simpler operation:* Many digital systems eliminate cumbersome removable-media management, and/or incorporate "smart operations," such as salvo playback, automatic record-start audio sensing and automatic kill-date detection.

•*Lower maintenance:* Digital systems require far less maintenance, most of which involves hard-disk housekeeping, LAN policing and keeping hardware clean. Most repair involves board or device-swapping. The actual number of operating devices may also be fewer than in an equivalent analog facility.

•*Cost savings:* Digital storage is now

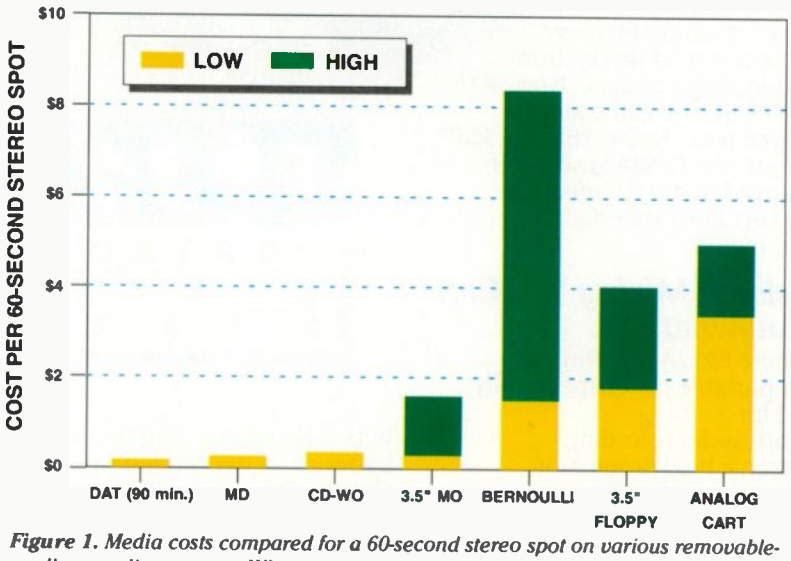

Figure 1. Media costs compared for a 60-second stereo spot on various removable-media recording systems. Where capacities allow, multiple cuts per carrier (up to the full capacity of the carrier) are used for calculation of cost-per-spot. High/low variations result from different hardware formats, media densities and optional use of data reduction. In each case, best possible fidelity option and bulk media pricings are used.

Tyson is a digital product specialist for Broadcast Supply Worldwide, based in Blairstown, NJ. Respond via the *BE* FAXback line at 913-967-1905.

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cheaper than analog. Figure 1 shows the average cost of a 60-second spot for various formats. Also remember that analog carts are typically replaced or rewound after 500-1,000 plays, whereas most digital systems support millions of record and playback cycles. Hardware costs of digital systems are also comparably or lower priced than analog systems. (See Figure 2.) For a radio station building new studios, it probably makes no economic sense to purchase analog audio storage equipment.

•*Physical space requirements:* Digital storage systems generally take up less space than analog equivalents, especially when hardware and media storage space are considered. (A hard-disk system replacing multiple cart machines and all their carts provides huge space savings.) Some systems can also eliminate (or reduce the size of) the air studio's mixing console. For LMA and duopoly operations, multiple programming services can originate from a single studio.

•*Integration/automation:* Digital systems allow consolidation of a studio's operation into fewer devices, and ultimately allow any studio at a station to be flexibly configured via software for any application (e.g., on-air, production or news). Shared access to a central server minimizes the need for duplication of storage media and cuts down dubbing time. Some systems interface with scheduling/traffic software and allow automated playback and logging. Most can also interface easily with CD, tape or satellite-delivered programming. These systems can unify and manage many previously separate tasks.

Hands-on vs. hands-off

Perhaps the biggest single issue among those just discussed is the question of *removable* or *fixed* media. Each type offers vast differences in operation, cost and flexibility.

Of course, removable-media systems offer the more familiar approach, given the years of experience broadcasters have had with the analog cart machine. To play a spot or a song with such a system, the media is loaded into a machine, played, and then removed. Many digital replacement systems deliberately imitate this style of operation. This type of hardware often appeals to large-market stations where drastic changes of studio hardware can cause staff mutinies. Digital cart machines offer the same tactile feel as an analog cart machine. Examples of removable media include 3.5-inch floppy disks, Bernoulli disks and magneto-optical (MO) disks (of both 3.5-inch ISO and 2.5-inch Mini-Disc [MD] formats). DAT and recordable CD might also qualify.

Few formats have enjoyed the 30-year run that the analog cart has had.

Although these systems can offer reduced maintenance and higher audio quality than analog cart machines, they may not provide the full integration benefits of some fixed-media digital systems. They represent a more direct replacement to the analog cart machine.

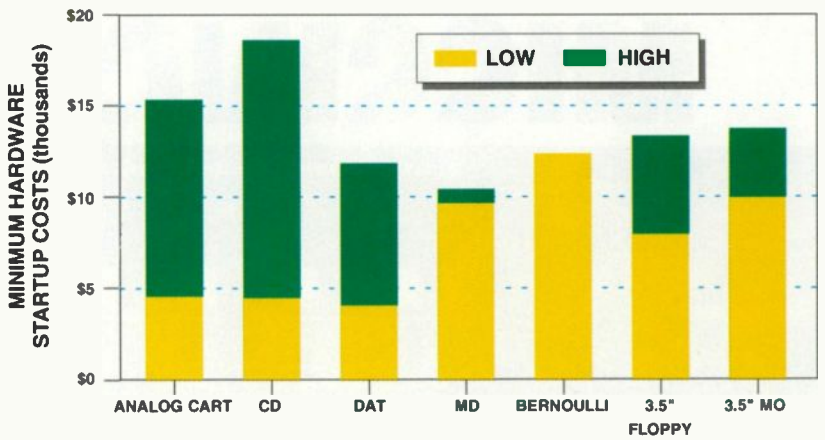

Figure 2. *Minimum startup hardware costs compared for various removable-media formats. Cost calculations are based on prices of three playback and one record/playback device (or four devices, if no play-only model is available), except for Bernoulli, where similar functionality is provided by only three decks. Manufacturers' suggested list prices are used. High/low variations result from different manufacturers and models.*

Among removable-media systems, two different storage approaches are possible, each with divergent consequences:

•*One event per disk:* Traditional analog carts have nearly always contained one event per cart. Even in the case of multiple, rotating spots on a single cart, the operator loads each cart to play one event. Many digital cart machines maintain the same one-event-per-cart relationship. This type of operation most closely emulates how analog cart machines are used. Operation is labor intensive, but familiar and perhaps a bit more streamlined than using analog carts.

•*Multiple spots per disk:* Some of the removable media in use with digital cart machines has storage capacity beyond a single 30- or 60-second spot. The greatest advantage to recording multiple spots per media unit is cost. As Figure 1 shows, the cost of a 60-second spot is dramatically reduced if the storage potential is maximized. Imagine throwing away all your 30- and 60-second analog carts and replacing them with "carts" that record an hour or more of audio. Instead of 80 carts each containing a single PSA, one "cart" holds them all. Although the cart library is reduced, the amount of handling is not, however. Instead of loading and unloading 80 different carts 80 different times, the operator still loads, cues and unloads one "cart" 80 times.

Access to the multiple spots on a single carrier is another major issue in this operational mode. Hardware must allow a fool-proof way to select individual spots. Consider also how many spots can be placed on a single carrier before operator confusion/frustration or access-time problems arise.

Some multicut systems offer true *random access*, allowing two different events to be played consecutively from the same carrier, with no delay between. Other hardware prohibits this because of the delay in cuing time from cut to cut on a single carrier. This affects the arrangement of audio cuts on the carriers as well as the number of playback devices required in the air studio.

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broadcasters. Unlike removable-media systems, operators never handle the storage media. In most cases, spot selection and control is done through software. Programming can be scheduled in advance, and simply triggered by the operator using the *live-assist* mode, or operation can take place in a continuously automated fashion in the *walkaway* mode. Although these systems are often referred to as "cart machines" or "cart-replacement systems," this is inappropriate terminology because they typically include important additional functionality.

Hard-disk-based storage systems represent the majority of fixed-media systems available. Some hard-disk systems involve proprietary, dedicated devices, but most are PC-based. Because most functions are based on software, these systems' capabilities are quite flexible. Networking multiple hard-drive systems provides another option, either in the form of a centrally located server with multiple branches, or as a peer-to-peer serial network.

A stack of CDs in a jukebox can be thought of as a mass-storage platform, operating like a fixed media system.

Recordable CD

A special case among removable-media systems involves the CD-WO (CD-write once) storage format. Once a CD-WO is fully written to *Red Book* standards (see "New Audio Recording Formats," February 1993), it can be played back on any regular CD player. In this case, CD-WOs can be freely intermingled with regular CDs (containing music) in a CD multiplayer *jukebox* system. This stack of CDs, once assembled in a jukebox, can be thought of as a mass-storage platform operating like a fixed-media system. A major difference is the unerasable nature of CD-WO, however, which does not allow the same media to be reused when a spot expires or requires an update.

Access time is also a problem on some CD systems, because the access time of a CD jukebox does not allow back-to-back events from the same machine. Some of the more recent CD jukebox systems minimize this problem by incorporating twin players, allowing back-to-back events to be programmed from the same stack of CDs. Careful scheduling is still required to avoid both players in the jukebox requiring access to the same CD at the same time.

Shop carefully

The options available for digital media also present an array of costs for initial hardware investment. Figure 2 illustrates some general cost ranges for various removable-media formats. These figures assume that a basic startup complement includes three playback machines for the on-air studio and one record/playback machine for the production studio. The exception is the Bernoulli system, which can access multiple events on a single disk seamlessly. To provide equivalent operation to other systems (including overlapping), only *two* machines are required in the on-air studio.

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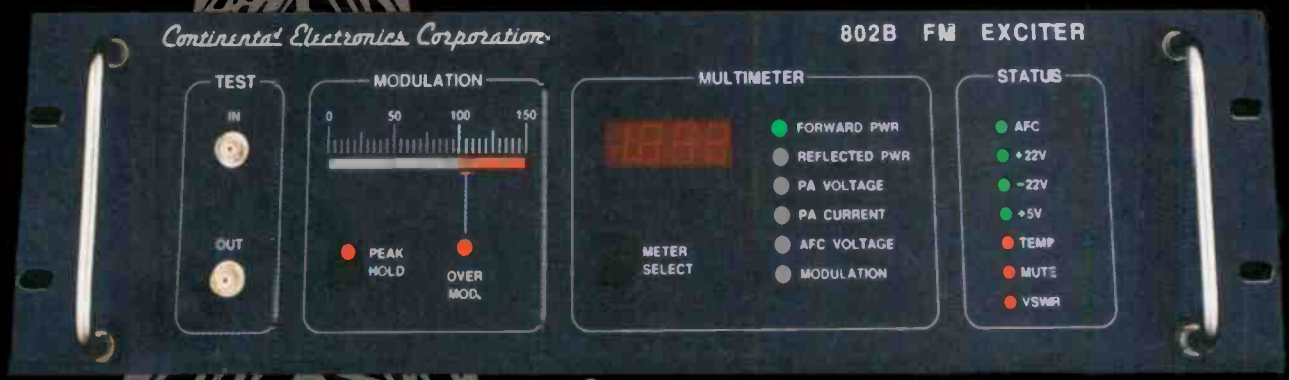

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Fixed-media system hardware costs are harder to identify in any meaningful way because of the variation in platform, hard-disk and networking configurations that are possible. Comparison of fixed and removable-media hardware really becomes an apples-and-oranges exercise when you factor in the additional features that can be easily included in many fixed-media systems (such as automation and integration to traffic software).

Even what seem to be elementary comparisons are complicated by the number of interacting variables involved. For example, the 3.5-inch floppy-disk media used by several systems may require HD (1MB), ED (4MB) or TD (13MB) diskettes, depending on the system and the length or fidelity required. (User-selectable sampling rates are offered by many systems, trading high-frequency response for extended record times. Some systems also double their storage capacity when recording monaurally, while others do not.) Data reduction adds another layer of variation: floppy disk and MD systems require it; CD-WO and DAT systems don't provide it; and 3.5-inch MO, Bernoulli and some hard-disk systems offer it optionally. Quantity pricing can also have a dramatic effect on removable media cost.

Media *reuse* further complicates the calculation. Some systems are simply not reusable, such as CD-WO. Others are nearly infinitely rewriteable in a flexible, non-linear fashion, while still others are like carts in that they are rewriteable but in a linear fashion. (The latter case implies that an individual cut can be rewritten on a multicut carrier, but the new cut can run no longer than the cut it replaces.)

Regarding hardware, most removable-media systems offer record/play and lower-priced playback-only devices (just like cart machines), but some formats are only available in R/P configurations.

The best way to get a handle on all this is to decide what your facility's ideal audio storage needs are first, and then compare hardware and media costs for the systems with capabilities fitting your design criteria. Consult your colleagues or manufacturers' references for their experiences with these systems, as well. The process is cumbersome and complex, but there is hardly a more important decision in your facility's future. Armed with the right information, you should be able to make an appropriate choice.

Editor's note: The next issue of *BE Radio* (May 1994) will include a detailed look at digital cart machines in the "Radio in Transition" column.

For more information on cart machine replacement systems, see "Recorders, Audio," p. 56, and "Playback Automation," p. 72 of the BE Buyers Guide.

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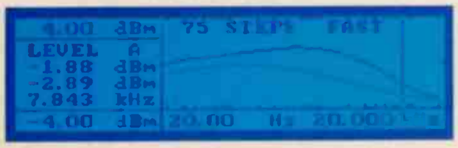

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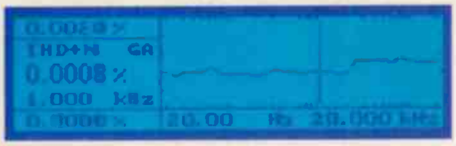

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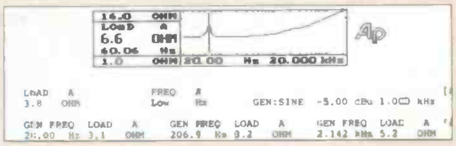

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BE Radio

Duopoly: Sign of the times

James A. Kirkland

The Bottom Line: *It's been nearly two years since the FCC liberalized its station ownership rules, and the radio industry continues to reshape itself in response to the changes. Improved business operations can result if broadcasters understand and follow the revised rules of the road.* $

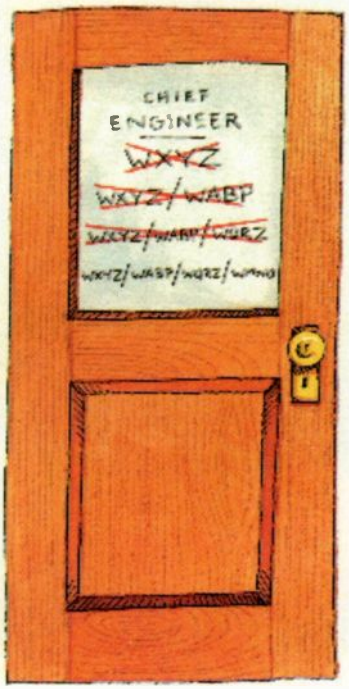
Those in the radio business hardly need to be reminded of the tough economic realities facing the business, which stem only in part from a persistently sluggish national economy. As the number of radio stations exploded in the 1980s, and more competing media chased limited advertising dollars, station revenues were increasingly squeezed harder and harder. An increasingly popular strategy for coping with these realities focuses on station consolidations — both local and national — to gain operating efficiencies and improve the bottom line.

Options for consolidation range from relatively limited joint sales arrangements, to broader agreements involving programming and management of independently owned stations under contracts (known as *local marketing agreements* or LMAs), to outright acquisitions.

The FCC has been aware of conditions in the radio marketplace, and in a major 1992 rulemaking it took significant regulatory steps to permit greater consolidation by relaxing its national and local ownership rules. The commission also clarified its policies with respect to LMAs and other consolidation arrangements.

FCC radio ownership rules

Prior to 1992, the FCC's national ownership rules permitted common ownership of up to 12 AM and 12 FM stations. In the initial decision of its 1992 radio ownership rulemaking, the commission substantially increased these limits to 30 AM and 30 FM stations. Under pressure from Congress, which expressed concerns about excessive concentration, the commission backed off and ultimately settled upon a national ownership cap of 18 AM and 18 FM stations. In September 1994, these limits will automatically increase to 20 AM and 20 FM stations. In addition, a single entity can hold a non-controlling interest in an additional three stations in each service (AM and FM) if those stations are controlled by minorities or by small businesses.

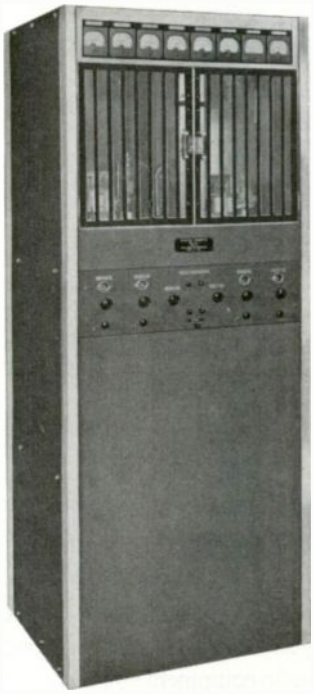


With respect to local ownership, the commission's former "duopoly" rule prohibited a single entity from owning two same-service (e.g., two FM) facilities with overlapping service contours, but allowed AM/FM combinations. Under the new rules adopted in 1992, the commission adopted a 2-tiered system. In markets with 14 or fewer stations, one entity can own up to three stations with no more than two stations in the same service. The number of stations a licensee can own in such markets, however, cannot equal or exceed 50% of the total number of stations in the local market. Thus, for example, a company that already owns an AM/FM combination in a market would not be permitted to acquire additional stations if that market had six or fewer stations. In markets with 15 or more stations, a licensee can own up to four stations with no more than two stations in the same service. In addition, the commission imposed a local audience cap for this tier. The total combined audience share of a single licensee cannot exceed 25% of the market at the time the application for consolidation is filed unless the parties can convince the FCC that excessive local concentration will not result from such a combination.

The FCC recently solicited comment on a petition for rulemaking seeking liberalization and clarification of its local ownership rules as they apply to smaller markets.

Continued on page 26

Kirkland is an attorney and a member of the law firm Mintz, Levin, Cohn, Ferris, Glovsky & Popeo, Washington, DC. Respond via the *BE* FAXback line at 913-967-1905.



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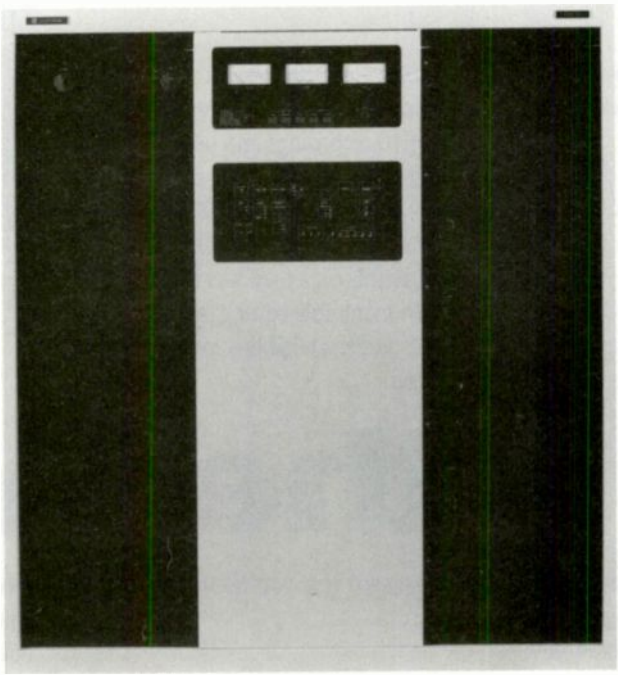

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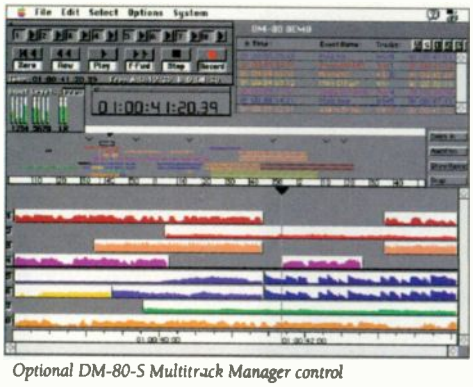

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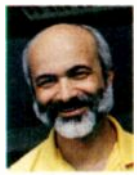

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Continued from page 22

Joint ventures and LMAs

In its radio ownership decisions, the commission also reaffirmed its policies allowing separately owned radio stations to function cooperatively in terms of advertising sales, technical facilities, formats and other aspects of station operation. Each licensee must still retain ultimate control over important aspects of its station operation and programming, however, and must comply with the Communications Act, the commission's rules and policies and the antitrust laws. The commission noted that operational joint ventures are generally beneficial to the radio industry and to the listening audience because they enable stations to pool resources and reduce operating expenses without necessarily threatening competition or diversity.

The commission did, however, adopt new restrictions on joint programming arrangements. The commission determined that same-service radio stations that serve substantially the same geographic area can simulcast no more than 25% of their programming during an average broadcast week. In addition, if more than 15% of a station's broadcast hours per week are programmed by another station in the same market, the programmed station is counted as an "owned" station of the licensee that provides the programming when calculating local radio ownership limits. The FCC also required that agreements providing for programming of one station by another station in the same market must be filed with the commission. (The commission refers to these arrangements as *time brokerage* agreements, although they are often considered by the industry as simply a form of LMA.)

The FCC also reaffirmed certain prior policies and requirements. In past decisions approving LMAs (including agreements involving the use of broadcast facilities for up to 24 hours per day, seven days a week), the commission has emphasized that control must be retained by the licensee. Contractual provisions preserving such control must be written into those agreements.

Other joint venture requirements

As a general matter, the commission has required that the licensee employ the general manager of the station, who must report solely to the licensee, and further requires that the licensee retain ultimate control over the policies, programming and operations of the station. The commission has also stated that the licensee must specifically retain the responsibility to: 1) pre-empt, suspend or reject programming; 2) air its own station identifications; 3) maintain its own main studio within its principal community contour; 4) maintain its own public inspection file and cover local community issues; and 5) comply with the political programming laws. These clauses should not be viewed simply as "FCC boilerplate" because they grant legal, enforceable rights to the licensee that could be exercised. Moreover, refusal to honor these provisions, if brought to the attention of the commission, could be found to constitute an unauthorized transfer of control.

Because the licensee retains such broad legal rights to control station operations, anyone planning significant investments in joint operations should have a basic comfort level with prospective licensee partners. The FCC has also permitted liquidated damages clauses if licensees should exercise their retained termination rights, although these damages may not be so excessive as to deter licensee control.

Finally, a licensee who has leased most or all of the time on its station for an extended period of time may be particularly vulnerable to challenge at renewal time, on the ground that its minimal record of service may not entitle it to the normal renewal expected by a licensee.

These caveats do not appear to have significantly diminished interest in joint ventures and LMAs. Stations considering such arrangements should nonetheless keep them in mind as they go forward. This new environment for radio ownership offers many business advantages and can result in strengthened operations if proper care is exercised.

Duopoly: A manager's check list

By Dennis R. Ciapura

Although it is logical to view duopoly station mergers on the basis of anticipated financial performance alone, the human element is a less predictable factor, and one that must be considered if paper projections are to become reality. Sales forecasts won't come true if the combined sales force is not properly motivated to take best advantage of a new duopoly opportunity. Similarly, expected operating-expense reductions from staff downsizing won't be fully achieved if the retained employees aren't sufficiently motivated to take on the additional workload.

Making a duopoly scenario work as planned is a particularly difficult management challenge because it takes place under the worst possible conditions: People are losing jobs, and those who remain often feel that they should be additionally compensated, a process that is rarely included in the plan. There is also the inevitable insecurity and volatility that comes with any change, and few things in the radio business have any greater disruptive impact than a duopoly merger. This hardly creates the ideal environment in which to build a winning team — and thus the engine of a winning duopoly.

Fortunately, if the planning process considers the operating cultures of the involved stations, the likelihood of encountering difficulties that might impair the combo's business plan is greatly diminished. Planning for the transition must go well beyond rate cards, traffic systems and coverage maps — it must deal with the human fabric that ties it all together. The following is a duopoly check list based on the experience of many duopoly operators.

Anticipate the problems

1. *Anticipate the difficult nature of duopoly deals:* Pre-contract confidentiality makes it difficult to prepare the staffs of either station for the inevitable operational changes and the need to keep the acquired station's performance up between contract and closing exacerbates the problem. Tension will build as "takeover day" approaches.

2. *Be prepared to handle typical pre-closing concerns and perceptions:* Employees at both stations will recognize the fact that some jobs will be eliminated. At the acquiring station, the most frequent concern is, "The employees at the other station will work cheap and take our jobs." Meanwhile, those at the acquired station think, "They're buying us, so our jobs will probably be the ones that go." In the sales department, a common sentiment is, "New account development doesn't make sense because somebody else might get my list anyway."

3. *Develop a strategy to address post-closing concerns and perceptions:* As the consolidation of operations proceeds, two employee perceptions inevitably develop: "The company is improving its profits by increasing

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our workload," and "Because the company is saving a fortune by consolidating operations, some of the savings should be paid to the people who are taking on additional workload." Also, account executives resist selling combo because they are comfortable in their established selling mode. If the formats are quite different, serious culture clashes may develop. Acquired employees may be uncomfortable with new company policies and procedures, and consolidation of facilities may also be problematic. Location, parking, telephone systems, etc. may suddenly be presented as urgent problems.

Take positive steps to ease the transition

1. *A pre-closing joint sales arrangement or LMA may be invaluable:* This helps maintain productivity during the "limbo" period, which is in the best interest of both buying and selling parties. Acquired account executives will strive to prove themselves. It also relieves some of the pre-closing anxiety, affords the opportunity to assess account executive performance before takeover, and presents an early example of the stations working together.

2. *Arrange for merger-announcement meetings with both stations' employees:* Ideally, both selling and acquiring parties should be represented, and the seller should endorse the buyer. Resist the temptation to provide too much assurance about job security. The staff will feel they have been misled when the terminations come, and management credibility will be seriously damaged. Offer instead a simple explanation of the changes in the industry that have necessitated combining stations to keep them viable (thereby keeping the greatest possible number of people employed), and commit only to try to keep as large a staff as possible, consistent with the economic realities of the times.

3. *Make the necessary changes at closing and get them done with:* Terminations that are spread over time create lingering morale problems, which may affect productivity and/or result in the loss of key people. Know exactly what your staffing requirements are before closing. Decide which terminations will be buyer's and which will be seller's when the deal is negotiated and execute them promptly and decisively.

4. *Schedule an informal evening station event as soon as possible after closing:* This helps to break down cultural differences and gives station management an opportunity to form a rapport with the new employees. It also helps to put the unpleasantness of the past aside and establish a positive environment. Trade-out the event and make sure that everyone knows it's a trade-out.

5. *The management bearing of the local GM is critical to a successful transition:* Make sure all department heads understand the station's business plan and quickly establish or re-establish regular weekly department-head meetings. Be sensitive to complaints, but firm in direction, and do not entertain compensation negotiations. The GM must not fall into becoming the ombudsperson of the employees and must always present a positive attitude to every station employee.

Personnel issues inevitably present the most difficult element in station consolidations. Following these procedures can minimize problems and maximize benefits for the consolidated operation's staff and licensee. ❑

Ciapura is executive vice president of Noble Broadcast Group, San Diego.

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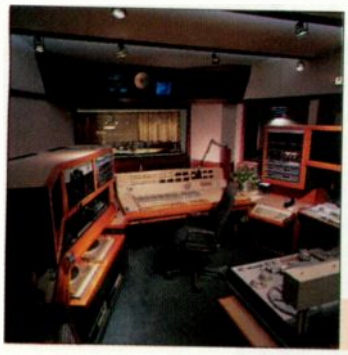


New directions in microphone design

By Bruce Bartlett with Jenny Bartlett

New microphone developments have much to offer radio broadcasters.

Microphone developers never seem to rest. Many of their recent product introductions are aimed at radio broadcasting applications. Among these are mics designed for announcing, panel discussions, news, sports and radio drama.

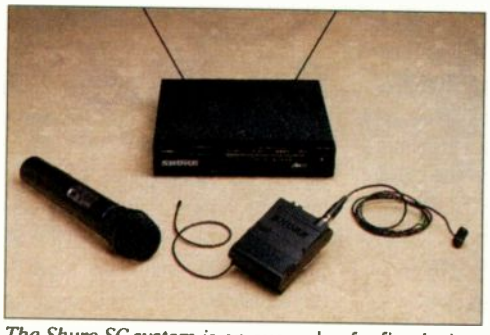
This overview will consider how new microphone developments improve upon past performance in each of those common radio applications.

Microphones for announcing and voice-over

For announcer applications, the most common types of microphones are these:

- Large diaphragm cardioid (or switchable-pattern) condenser
- Multiple-D cardioid dynamic
- Large diaphragm cardioid dynamic with adjustable frequency response

In the *large condenser* group, a trend toward lower-cost mics is developing. For example, the AKG C-3000 uses a new diaphragm design that costs less to manufacture. The mic includes multiple polar patterns and a bass-rolloff switch. The Neumann TLM-193 keeps its price down by omitting some bells and whistles. In this no-frills model, the attenuator pad and rolloff switches that are found on most other Neumann designs are left out, and the mic's pickup pattern is fixed in the cardioid mode. You give up some versatility, but on a mic that is dedicated to announce-use only, this may be a reasonable trade-off for the reduced price. Other lower-priced, cardioid-only, large-diaphragm condensers are the Audio-Technica AT 4033 and Beyer MC-834.



The Shure SC system is an example of refined wireless microphone design.

Another model combines the best of old and new. The AKG C414B/TLII uses a mic capsule of 1950s vintage, while the electronics are state-of-the-art and transformerless. The mic offers four polar patterns, a pad, and a bass rolloff. Transformerless output is also featured on a brand new large diaphragm, 3-pattern microphone from Audio-Technica, the AT4050/CM5.

Several other manufacturers (Astatic, Groove Tubes, Stedman and Manley) have also developed new large-diaphragm condensers worth looking into.

Multiple-D mics are commonly used for announce applications. The special construction of these mics uses multiple rear sound-entry ports, placed at several different distances from the diaphragm. This greatly reduces *proximity effect* of the microphone. (Proximity effect refers to the overemphasis of low-frequency sound when the mic is placed close to the sound source.) This design philosophy also reduces plosives ("p-pops") and handling noise.

The latest trend in multiple-D mics involves the use of new magnetic materials, such as *neodymium*. An example is the Electro-Voice RE27N/D. Neodymium magnets are more powerful than traditional alnico designs, so these mics can be up to 6dB more sensitive. The resulting higher output reduces mic-preamp noise, producing a quieter and more natural sound.

Another traditionally popular announce mic is the large-diaphragm dynamic cardioid (such as the Sennheiser MD421 or Shure SM-7).

Bruce Bartlett is a microphone engineer and technical writer for Crown International, Elkhart, IN. Jenny Bartlett is a freelance technical writer. Respond via the *BE* FAXback line at 913-967-1905.

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These mics generally have a flat response for distant sounds and a moderate bass boost for close work — an effect that many announcers use to their advantage. A bass rolloff switch is usually included to reduce the proximity effect if it is not desired. Larger diaphragms are less prone to problematic proximity effect, however, and these mics are also less likely to produce plosive problems than smaller-diaphragm directional mics. Newer versions of this style are becoming available with neodymium magnets, such as the Electro-Voice RE38N/D.

The Nady 950 is another wireless microphone system appropriate for use by radio broadcasters.

Panel discussion

A common setup for the roundtable or panel discussion application employs several multiple-D mics on booms. Again, the recent use of neodymium gives these mics a higher output level. An alternative approach finding some recent favor uses boundary mics in this situation. They prevent the "phasey" sound of comb-filtering, which is caused by table reflections and the pickup of one voice by multiple, spaced-apart microphones. One omnidirectional boundary mic in the center of a round table picks up the same amount of indirect sound and noise as eight cardioids placed on stands at normal miking distances. The latest models of boundary mics, such as the Crown PZM-30D have switchable high-frequency response — boosted for extra clarity, or flat for a natural sound. Another new model from Neumann (the GFM 132) has a wide-range response and extremely low noise.

This application can also be served by using a group of cardioid boundary mics. In this case, each person is given an individual mic or every two people share one. These mics can be fed to an automatic mic mixer (such as the Audio-Technica AT-MX341 or Shure FP-410) that attenuates all the mics that are not in use. The resulting sound is much clearer than if all the mics were on at once. Some new models of cardioid boundary mics, such as the Crown PCC-170GT have an internal gating circuit, so this same effect can be achieved when using an ordinary mixer. Other manufacturers have also introduced boundary microphones of omni or directional design, including AKG, Audio-Technica, Shure and Schoeps.

News gathering

The standard hand-held mic for news announcing and interviews is an omni dynamic, often with internal shock-mounting insulation added. Examples of this include the well-

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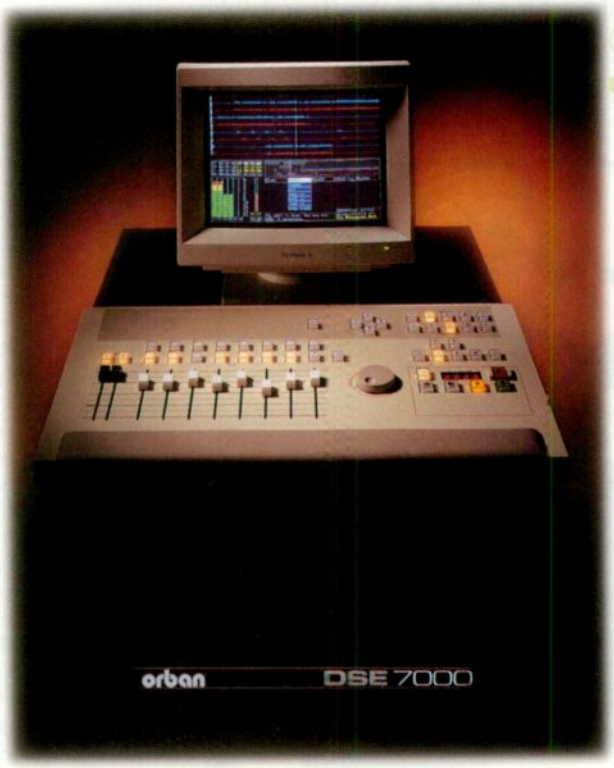

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known Electro-Voice RE-50 and DO-56, and the increasingly popular Beyer M-58. Neodymium also is found in new designs of these microphones, such as the Shure VP64.

Omni microphones inherently possess the same benefits that the multiple-D technique tries to provide to directional mics — no proximity effect, reduced plosive and wind-noise effects and low handling noise. If an omni mic is placed close to its sound source, as it often can be in radio, it rejects background noise and ambience almost as well as a cardioid mic. In fact, the advantages of a cardioid or other unidirectional mic are outweighed by its drawbacks when used up close. The omni gives equal or better sound quality for less money, as long as the sound source is close. Try an omni mic in such situations — including DJ/announcer positions — if you haven't before. You'll probably be pleasantly surprised. (For studio applications, try a small-diaphragm *condenser* omni, such as those from AKG, Audio-Technica, Bruel & Kjaer, Neumann, Schoeps, Sennheiser or Shure.)

Low-cost, single-point stereo mics have become quite popular for news and sound-gathering work.

Another new approach for interview applications is the *wand-style* microphone. These designs, such as the Sony ECM-510 and the Audio-Technica AT859B, use a small, omnidirectional condenser capsule (similar to a lavalier mic) at the end of a thin tube about a foot long, with a wide handgrip at the connector end.

Low-cost, single-point (or *coincident*) stereo mics have become quite popular for news and sound-gathering work. These microphones can provide excellent, mono-compatible stereo for considerably less cost than earlier single-point stereo models. They are compact, lightweight, battery- or phantom-powered, and relatively easy to use in the field. Some examples are the AKG C522MS, Audio-Technica AT-825, Beyer MC742, Crown SASS-P MKII, Josephson Engineering's Jecklin Disk and sphere, Sennheiser MKE44P, Shure VP-88 and Sony ECM-MS5. Most come with a handgrip. Some of these mics are XY or near-coincident, while some are MS. They're ideal for interviews plus ambience in stereo, or just for collecting ambient sound.

The *stereo shotgun* is another relatively new design, typified by the Neumann RSM 191. It combines a side-facing bidirectional capsule with a front-facing short shotgun. The two patterns are matrixed in an MS configuration. A stereo pickup with the reach of a short shotgun results. This mic is ideal for stereo news gathering in areas with high background noise levels.

Another new design among shotgun mics (this one a mono design) eliminates the need to choose between the advantages of a short tube's more natural sound and a long tube's tighter pattern. The AKG CK68ULS is a long shotgun mic that can be switched to short-tube operation at any time. The short tube is good for close-up interviews in noisy environments while the long tube can be used for more distant pickup. Electro-

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Voice also offers its RE45N/D, a short-shotgun *dynamic* mic with integral hand-grip, unique among today's shotgun-style designs. The dynamic transducer eliminates the need to power the mic, which is especially welcome to news reporters who desire consistent, simple operation.

Sports

For sports announcing, a headworn mic is generally best. The latest models in this class are lightweight and provide high-fidelity audio. Examples include the Countryman Isomax, Crown CM-312 or Sennheiser HMD224X. In these models, the mic is placed on the side of the mouth to prevent plosives and other breath sounds.

If background noise or PA feedback are severe, you can use one of the new differential or noise-canceling headworn mics, such as the AKG Q34 or Crown CM-311. These isolate the announcer from crowd noise or traffic-copter noise, yet sound natural. Crowd reaction and sound effects at sporting events are best picked up by one of the stereo mics discussed earlier, while the boundary mics previously mentioned can be used for close-up, on-the-field effects, such as foot sounds, ball bounces, car passes, golf-ball hits and so on.

Wireless microphones may also be useful in sports applications. (See "Chasing the Cowboys," pg. 6.) Recent developments in this area include less-expensive and/or higher-performance designs from a number of manufacturers, including Audio-Technica, Beyer, Lectrosonics, Nady, Ramsa, Samson, Sennheiser, Shure, Sony, Telex and Vega. Longer battery life, smaller size and other operational conveniences have also been incorporated in many of these new models. (See "Production," February 1993.)

The Audio-Technica AT4050/CM5 is a new and versatile large-diaphragm, switchable-pattern condenser microphone.

Radio drama

The coincident stereo mics mentioned earlier can also work well for dramatic productions. Typically, a group of actors read their lines in a semi-circle around a single stereo microphone. The mic accurately conveys their distances and lateral movements.

For headphone listening, *binaural* productions can be even more striking in their realism. The best microphone tool here is the *dummy head*. It has two mic capsules mounted in the ear canals of a mannequin head. Current models (Neumann KU-81i, HEAD Acoustics HMS II) are equalized to give a flat perceived response. This is necessary because the diffraction of the dummy head causes peaks and dips in the response. The equalization compensates for these effects.

It's obvious that microphone companies have been busy producing new models with lower cost, higher fidelity and greater convenience. Check out what's new in microphones to see how they can improve your station's productivity and sound. ■

➡ *For more information on microphones, circle (102) on Reply Card. Also see "Microphones," p. 55 of the 1994 BE Buyers Guide.*

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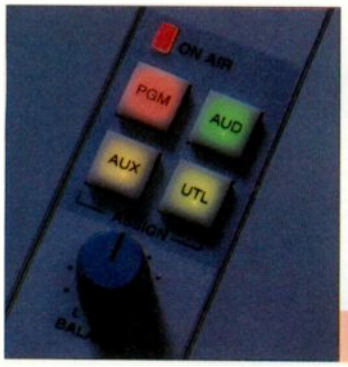

EIA testing of digital radio systems to begin

By Randall T. Brunts

The systems face off in their first comparative tests.

Comparative evaluations of proponent digital audio radio (DAR) systems will soon be under way at the Electronic Industries Association's DAR Subcommittee's test laboratory. The facilities for these tests have been established at the National Aeronautics and Space Administration's (NASA) Lewis Research Center in Cleveland.

The seven proponent DAR (also referred to as digital audio broadcasting or DAB) systems will be subjected to rigorous testing procedures that will culminate in the recommendation of a DAR system (or systems) to the FCC. The proposed systems (and their methodologies) are as follows: AT&T (in-band, adjacent-channel), AT&T/Amati Communications (in-band, on-channel [IBOC]), Thomson Consumer Electronics for Eureka 147/DAB (new band), USA Digital Radio FM Implementation No. 1 (IBOC), USA Digital Radio FM Implementation No. 2 (IBOC), USA Digital Radio AM (IBOC), and Voice of America/Jet Propulsion Lab (new band, direct broadcast satellite). Amati, Thomson/Eureka and VOA/JPL have each submitted two variants of their formats, so testing will actually be administered to 10 separate systems.

Brunts is the EIA's Digital Audio Radio (DAR) Subcommittee Chairman.

Testing of individual systems will begin after test preparation procedures have been completed and audio test materials have been selected.

The DAR proponent tests will be conducted in the eight foot by six foot Supersonic Wind Tunnel Office and Control Building at the NASA Lewis Research Center in Cleveland.

The test scheme

Testing at Lewis will address the issues of DAR systems' sound quality, their immunity to multipath and other interference, the possibility of their introducing objectionable interference to other services, their ancillary data capacity, and their degradation characteristics at reception area thresholds. The Lewis tests will also measure the digital signal quality and performance of all DAR systems, and the compatibility with existing services of in-band DAR systems.

The first phase of testing will evaluate objective signal quality and signal failure and it will also consider multipath, co-channel and adjacent-channel impairments by determining threshold of audibility (TOA) of impairments and point of failure (POF, when the signal is no longer listenable).

The audio output of the digital receiver tests, including any impaired signals, will be digitally recorded and sent for expert subjective listening tests to be conducted at the Communications Research Centre's (CRC) Subjective Quality Assessment Laboratory in Ottawa, Ontario, Canada. Digital recordings will be made at the output of the analog receivers during in-band compatibility tests for subjective evaluation by industry experts.

Testing schedule

The testing process is divided into the following major segments:

1. The seven proponent systems are installed and demonstrated in the test laboratory.
2. Each of the proponent systems is interfaced and calibrated.
3. Audio test materials are auditioned for the choice of most critical examples to be used in the quality and impairment tests.
4. Digital transmission tests are conducted for quality, signal failure

Specific tests

A. Calibration and stability checks of proponent and test bed equipment (repeated throughout process)

B. Signal failure characterization
1. Noise
2. Co-channel interference
3. Multipath and noise

C. DAR performance quality with other impairments (7 tests)

D. DAR-to-DAR interference with no other impairments: Co-channel, first- and second-adjacent

E. Repeat test D with multipath added for FM systems, Rapid fading added for AM system

F. DAR-to-analog interference with no other impairment: Co-channel, first- and second-adjacent

G. Repeat test F with multipath added for FM systems, Rapid fading added for AM system

H. Analog-to-DAR interference with no other impairment: Co-channel, first and second-adjacent

I. Repeat test H with multipath added for FM systems, Rapid fading added for AM system

J. Signal re-acquisition time (interleaving test)

K. Transmission quality tests
1. Selection of critical audio samples
2. Recordings made for CRC subjective listening tests

L. IBOC-to-host analog interference

M. Host analog-to-IBOC interference

N. Multiple spurious (10.7MHz IF spacing tests)

O. FM subcarrier performance tests (Repeat tests F.-I., L.-M. with various FM subcarriers added)

Table 1. *The specific RF transmission tests to be conducted on DAR proponent systems at the Lewis Research Center.*

characterization, performance with impairments, DAR-to-DAR with and without multipath, and signal reacquisition.

5. IBOC compatibility with existing services and other system-specific tests are conducted.

Table 1 details the specific tests to be conducted at the Lewis Research Center.

VHF characterization tests

The results of VHF channel characterization testing, conducted as part of the DAR testing process, will help quantify VHF multipath propagation characteristics of the FM channel for realistic testing of the in-band FM DAR system proponents. (See "Re: Radio," September 1993.)

The measurements, completed in Salt Lake City, provide information on channel-reflection time delay and magnitude for the EIA DAR Subcommittee. This data will be central to the creation of control parameters for the multipath channel simulator that will be used during the Lewis Research Center testing.

The Salt Lake City tests were conducted along measurement paths in four distinct city environments — Urban Business (industrial/commercial), Suburban (residential), Rural (parkway/highway) and Terrain-Obstructed Paths. Among the tests' goals were the establishment of benchmarks for multipath characteristics likely to be encountered (in reception of VHF transmissions with FM-channel bandwidths) in the following three areas: *reflection delay times* expected, *receiver motion* expected, and *spread of reflection delay times* expected.

The data collected from the Salt Lake City VHF characterization tests will be used to create control parameters for the Hewlett-Packard multipath channel simulator that will be used for the Lewis tests. During these tests, each proponent system will undergo a 30-to-60 second "path" test in simulations of multipath in each of the four environments just listed. The systems will be subjected to a range of speeds and occasional stops as well as other variables.

The DAR testing process at Lewis Research Center will generate a technical report on the laboratory tests for review by the EIA DAR Subcommittee and the National Radio Systems Committee (NRSC) DAB Subcommittee.

Following the Lewis and the CRC tests, another round of evaluations will take place involving *field testing* of over-the-air DAR broadcasts. After the report from this phase has been reviewed by the subcommittees, the final DAR recommendations will be issued.

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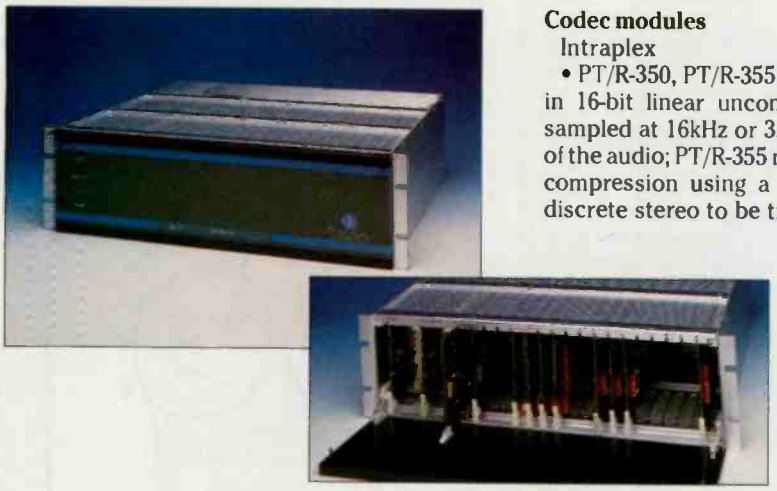

Codec modules
Intraplex
• PT/R-350, PT/R-355: program transmitter and receiver modules that transmit in 16-bit linear uncompressed format; can transmit 7.5kHz or 15kHz audio, sampled at 16kHz or 32kHz; eliminate compression on the transmission section of the audio; PT/R-355 modules incorporate the CCITT J.41 standard for moderate compression using a 14- to 11-bit digital encoding scheme, allowing 15kHz discrete stereo to be transmitted with half of a T1 circuit.

Circle (150) on Reply Card

Firmware upgrade for Digital Audio Workstation
Roland Pro Audio
• **Version 2.0:** firmware that upgrades the DM-80 with more than 40 new or improved features, such as audio profile display on the DM-80 R remote controller, group move, enhanced backup functions, recovery of unused memory, fader grouping, mixer snapshots and threshold editing; users of the DM-80-S multitrack manager system will receive a 2.0 software upgrade similar to the firmware, offering the ability to control up to four DM-80 rack units for a total of 32 digital audio tracks that can be controlled from a Macintosh computer interface.

Circle (160) on Reply Card

Enclosures/workstations
Equipto Electronics

• **Electronic enclosures:** five lines of vertical racks and sloped-front consoles, plus two lines of workstations and a line of instrument cabinets; enclosures include EMI/RFI shielding from FCC through TEMPEST and three product lines that pass military specifications for 810D and 901 shock and vibration tests; seismic-hardened enclosures tested through zone 4 are available.

Circle (152) on Reply Card

Station to transmitter link
Intraplex
• **Intralink STL+:** a fully integrated STL packing for transmitting uncompressed, linear stereo audio on T1 lines; transmits CD stereo signals without compression, using 16-bit linear coding; dynamic range is greater than 90dB; optional modules include return feeds, compressed audio, and data and conventional voice circuits.

Circle (151) on Reply Card

Digital network
Dolby Laboratories
• **EDnet:** uses T1 service over WilTel's fiber-optic network to allows users to record, mix and evaluate soundtracks remotely, avoiding costs and geographical limitations of satellite linkups.

Circle (155) on Reply Card

Surround technology
Dolby Laboratories
• **4-channel Dolby Surround:** adds a front center channel to the left and right channels to sharpen sound perspective and improve dialogue clarity; a rear surround channel adds ambience and heightens special effects; requires only minimal hardware to decode Dolby-Surround-encoded broadcasts and video recordings of Dolby Stereo films.

Circle (156) on Reply Card

Quality, Value, dB-CART...

Quite a bit has been written about audio quality, length of recording, central vs. distributed storage. Finally there is a digital cart machine system that combines all of these features in a package that is surprisingly affordable, fully upgradable and so easy to use that your on air talent will think that it was custom designed for them. dB-CART.

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Digital aural studio-transmitter link
Dolby Laboratories

• DSTL: **all-digital 4-channel unit (DP5503 transmitter** and DP5504 receiver) conveys four program channels and two RS-232 data channels in little more than 400kHz of bandwidth; allows a studio to convey separate programming to two sites; available for a variety of frequency ranges; features 2W output; HS1 and HS2 hot standby units enable the use of a second DSTL system as an automatic backup; an A12 analog interface unit enables the use of a conventional analog STL as the main backup, plus a further backup, such as a phone line.

Circle (153) on Reply Card

Production DAT
Fostex

• **D-10:** features auto cue to modulation and instant start, which make it well-suited for on-air play; RAM scrubbing and Jog/Shuttle offer analog-style reel rocking for pinpoint cuing; the model 8333 interface card adds time-code and RS-422 functionality.

Circle (159) on Reply Card

Spectral processor
Dolby Laboratories

• Spectral processor: raises low-level signals 20dB without affecting high-level signals; may be used as a dynamic EQ for production and post-production sweetening, and to improve program material transferred to carts; operates only on low-level signals; features user-adjustable threshold and crossover frequencies between low-, mid- and high-frequency bands; includes a sliding-band circuit to provide 12dB of noise reduction; has fixed high- and low-pass filters.

Circle (154) on Reply Card

Digital audio workstation
ITC

• **DigiCenter Plus:** provides expanded networking capability, simultaneous control of three workstations and extended server-to-server networking, allowing each workstation to be assigned to any server on the system; as many as 255 devices may be connected to the network at one time.

Circle (157) on Reply Card

Control surface
Studer

• **MultiDesk for Dyaxis II:** a control surface designed to improve speed, accuracy and ease of use; features the ability to edit splices or events and the control and automation of six Dyaxis II processors for up to 24 channels of audio recording and playback; offers dynamic automation of level, pan, mutes and DSP functions; includes 100mm moving faders, a jog wheel and precision edit and scrub controls.

Circle (161) on Reply Card

Digital cartridge machine
AIR corp Systems

• **AIR cart.mo:** a digital replacement for analog cart machines; features 10.5 minutes of non-compressed audio at a 48kHz sampling rate; uses individual, removable 3.5-inch magneto-optical discs; incorporates a cut selector, preview (listen to beginning) and outview (listen to end of cut).

Circle (164) on Reply Card

MiniDisc recorder, player
Denon
• **DN-980F and DN-990R MD Cart player and recorder:** feature instant start, cue-to-music (can cue to the start of music instead of the beginning of the track), end-monitor function, single-track or continuous-play functions, a stereo/mono selector, an end-of-message function with a time monitor, 8X oversampling digital filter driving 18-bit DACs, and active balanced audio outputs; a digital output employs the AES/EBU interface; offer a serial RS-232C port and switch-closure outputs for EOM, cue and end-cue signals; provide readout of track number, time code, track name and disc title; include a 24-segment peak-level meter with an overload indicator; the DN-990R adds magneto-optical (MO) recording.

Circle (165) on Reply Card

2.4GHz wireless modem
Cylink
• **AirLink:** provides voice and data services in remote or rugged areas where wired circuits are impractical; used for LAN extensions and LAN-to-LAN links, tetherless videoconferencing, "last mile" network connectivity and high-speed modem connections between computers; supports communications speeds from 64kbps to 512kbps; with a standard omnidirectional antenna, allows indoor or outdoor communication up to 1,000 feet; with a directional antenna, offers line-of-sight links up to 30 miles; offers user-selectable frequencies that allow multiple units to operate in the same building or share the same path; does not require a license.

Circle (162) on Reply Card

Professional CD player
Denon
• **DN-650F:** a rack-mount CD player featuring cue-to-music, instant start, balanced outputs and a dry-contact remote interface; offers 8X oversampling, dual 18-bit DACs and a transport design based on the DN-951FA CD cart player.

Circle (166) on Reply Card

Wireless IFB transmitter
Vega
• **RMT-14:** a 4-channel, private-line wireless IFB (interrupted foldback) transmitter for use with Vega PL-2 dual-channel miniature receives; can be field-expanded to four individual transmitters with the addition of internal modules (still requires only one rack unit); includes audio processing that reduces noise and interference and expands system range; has full-size XLR-type audio inputs that accept line-level input or can be programmed for compatibility with other wired intercom systems; features include a 50mW power output, crystal-controlled stability on one of 1,700 available frequencies, LED-bargraph audio displays, an internal dual-voltage AC power supply and input level control for each channel.

Circle (163) on Reply Card

Digital storage system
Radio Systems
• **DCS:** live-assist digital storage system, up to 144 cuts available from front-panel controls; interface resembles traditional cart machine for easy learning; simple serial interface allows access to system by all users simultaneously.

Circle (170) on Reply Card

Audio console
Wheatstone
• **A-300:** offers modular construction and four mainframe sizes; has two stereo AUD and PGM buses, a TEL bus, one internal mix-minus bus and mono sum output capabilities; Super Phone phone module has logic follow for A and B source selection, full machine control, mono mic and stereo line modules, clock, timer and built-in cue speaker, monitor modules and expansion slots; offers computer-grade ribbon bus technology and a non-VCA circuit architecture; has a dynamic range of more than 115dB, a +/-0.25dB frequency response (20Hz to 20kHz) and a 0.003% THD.

Circle (167) on Reply Card

Miniature microphones
Audio-Technica
• **Miniature and sub-miniature condenser microphones:** featuring interchangeable elements, integral power modules, $^5/_8$-inch, 27-thread adapter mount of XLR-type quick-mount and shock-mount flange, choice of cardioid, hypercardioid, omnidirectional or supercardioid; AT915 series of double-goosenecks with an adjustable-length gooseneck; the AT845R/RW (omnidirectional) and AT847R/RW (unidirectional) remote-powered boundary mics; and the AT933 series for overhead miking applications, featuring interchangeable elements and highly-directional, ceiling-plate or in-line power modules.

Circle (168) on Reply Card

Audio Workstation
Pacific Recorders & Engineering
• **ADX Basic:** a desktop system that includes a Macintosh Quadra 610 (with a 1.2GB internal hard drive for three track-hours of recording time), 16-inch monitor, keyboard and mouse, and an 8-channel digital signal processing unit; includes ADX software; can be outfitted with additional SCSI devices.

Circle (169) on Reply Card

Monitor for digital audio signals
Wohler Technologies
• **SMP-1A/DI:** monitors stereo digital audio signals carried in AES/EBU or SPDIF formats; includes a digital input section that automatically synchronizes to any sampling frequency between 31kHz and 48kHz; 18-bit low-jitter converters are used for internal D-to-A conversion; has a digital output for passive loop-through of the digital input signal; incorporates three power amps and five speakers; frequency response is 80Hz to 15kHz +/-7dB; output is 98dB SPL at a distance of 2 feet; digital input module options include a choice of SLR-F or BNC connectors, A-B input select and analog input (digital module bypass); optional XLR-M analog line outputs allow the unit to serve as a general-purpose D-to-A converter.

Circle (171) on Reply Card

Audio console
Fidelipac
• **Dynamax MX console:** cost-effective, high-quality and modularity design; ultra-reliable motherboard construction; six to eight channel configuration; VCA mixers and monitor control; available with linear or rotary faders.

Circle (173) on Reply Card

Noise gate and compressor
Aphex Systems
• **Model 105 4-channel noise gate/model 106 4-channel compressor:** noise gate incorporates Aphex 10001 VCA providing high-speed performance; stable and accurate turn-on regardless of attack time; external key input -10dbV/+4dBu switchable output levels; model 106 compressor uses Aphex 10001 VCA; layered time constraints; simple setup and operation; -10V/+4dBu switchable output levels.

Circle (172) on Reply Card

Commercial system
Computer Concepts Corporation
• **DCS Live!:** Windows-based graphical interface; excellent for live and live-assist formats; drag and drop carts into graphics on-screen representation of cart machines; touchscreen control; remote control and networkability; customized on-screen FlexKey.

Circle (177) on Reply Card

Harmonizer
Eventide
• **H3000 D/SE Studio Enhanced Dynamic ultra-harmonizer:** power dDFX-dynamic effects, 100 Mod Factory presets, 200 SE presets and 100 new presets; 3D speaker-based spatial imaging effects; 19-waveform function generator, true stereo pitch shifting and unique Diatonic Pitch Shifting.

Circle (174) on Reply Card

Digital audio recorder
360 Systems
DigiCart/II: provides up to eight hours of stereo audio on hard disk and up to 68 minutes on three sizes of removeable media employing Dolby AC-2 data compression; other new features include two new remote-control units, time-code synchronization for use with VTRs; BCD automation interface.

Circle (175) on Reply Carc

Compact disc autochanger
Pioneer
CAC-V3200: 300-unit CD autochanger; dual players for non-stop play, compact size; digital and analog audio outputs; +10% pitch control; easy maintenance features; capability of interconnecting up to 49 units on one controller port.

Circle (176) on Reply Card

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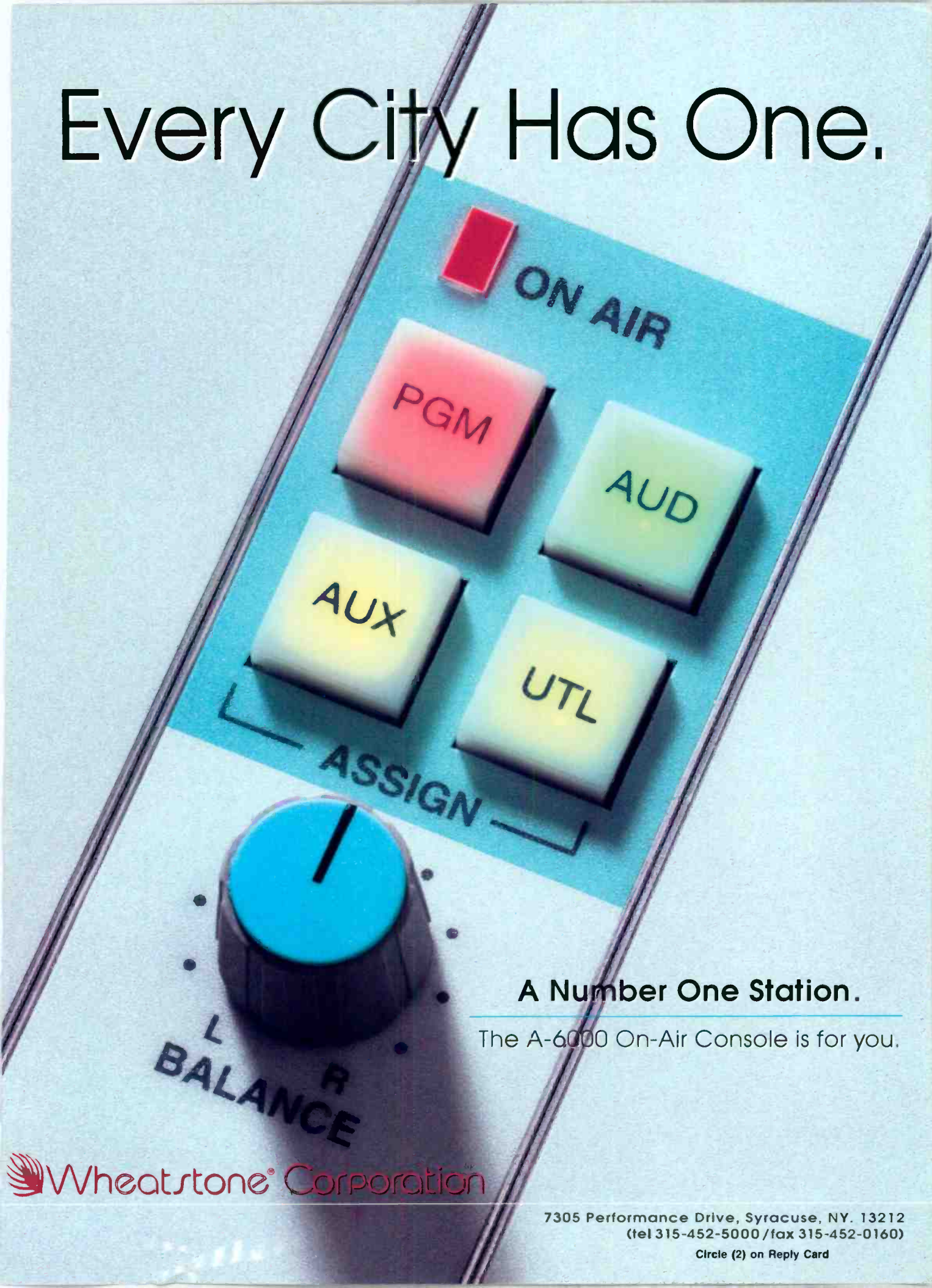

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DENON

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