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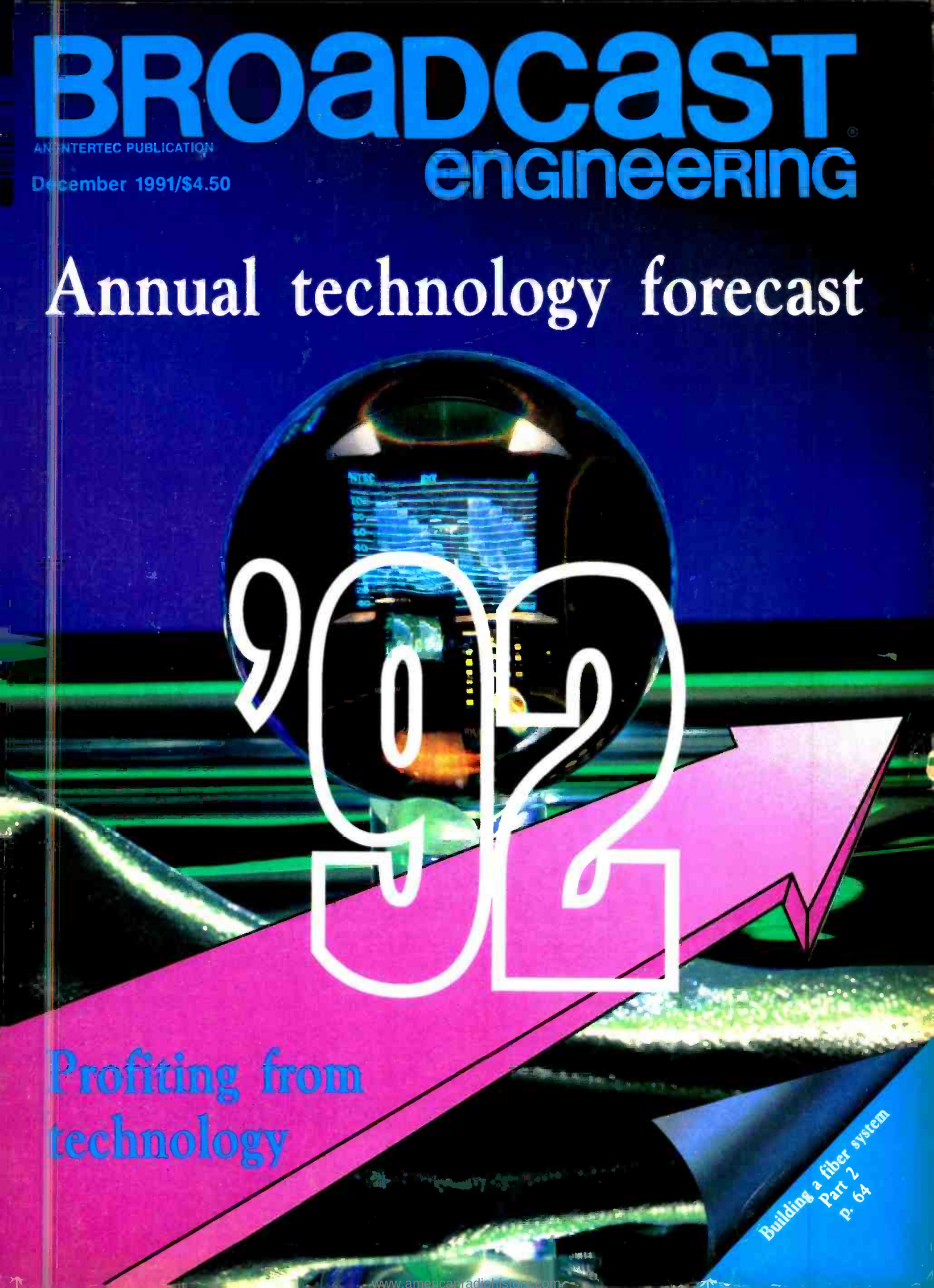
Annual technology forecast



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P. 64

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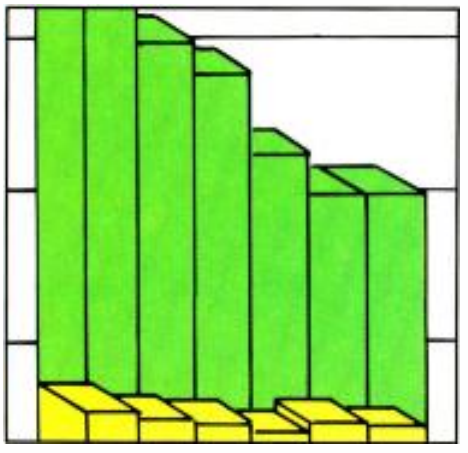
Contents

December 1991 • Volume 33 • Number 12

BROADCAST engineering



Page 26

Page 42

Page 58

ANNUAL TECHNOLOGY FORECAST:

Future technology is like tomorrow — it's always just around the corner, it never arrives. That doesn't reduce our desire to know what new technologies and events may lie just out of our view. Predicting these events and technological improvements is fascinating, but challenging. The rapid pace of technological developments further compounds the prediction problem. What do you think tomorrow holds?

DEPARTMENTS

FEATURES:

OTHER FEATURES:

ON THE COVER

Forecasting the future is risky business. It's the same kind of predicament facing weather forecasters — no one remembers when they're right, only when they're wrong. If you could accurately predict the changes in store for our industry, you would be rich. Because few of us have such "insightful powers," we have to rely on more conventional methods, such as surveys. This month's cover symbolizes viewing future technology in the reflected image of the old-fashioned crystal ball. (Cover credit: Photograph by Magni Systems; photographer, Tracy Brown; concept design by Diane Runyan.)

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News

By Dawn Hightower, senior associate editor

Task force announces DAB performance objectives

The NAB DAB task force has outlined the following performance objectives that a DAB system is expected to meet:

1. *CD-quality sound.* The system should provide CD-quality sound with 20Hz-20kHz frequency response. If implemented in the AM band, the system should provide a frequency response of 20Hz-15kHz. The system may use a data-compression algorithm that meets the requirements of MPEG Layer II.
2. *Coverage area.* The system should replicate or improve reception within existing coverage areas.
3. *Accommodation of existing AM and FM broadcasters.* The system should allow all existing AM and FM broadcasters to have access to a DAB channel.
4. *Immunity to multipath interference.* The system should provide for immunity to multipath interference.
5. *Immunity to stoplight fades.* The system should operate while stationary in the presence of a broadband multipath fade.
6. *No interference to existing AM and FM broadcasts.* The system must not generate interference to reception of existing AM and FM broadcasts. (Standard to be determined.)
7. *Immunity to interference.* The system must be robust enough to operate in the presence of any existing signals. The receiver should achieve its specified performance while operating within the specified coverage area of the DAB transmitter.
8. *Minimization of transmission costs.* The system should be designed to minimize all costs associated with transmission.
9. *Receiver complexity.* The receiver must be affordable and small enough for automotive and portable applications. Signal-processing functions and complexity should be transferred from the receiver to the transmitter as much as possible. The receiver should be capable of being implemented in a box no larger than existing radio technology.
10. *Additional data capacity.* The system should provide as much data capacity as possible in the transmission channel while still providing CD-quality stereo sound.
11. *Reception area threshold.* Sharp threshold degradation should be avoided by a DAB system. Receivers should be designed to default to the analog signal should the digital signal fall below the reception threshold.

Canada announces digital radio test results

Results of the Canadian propagation studies in the 1,500MHz (L-band) region have been released, showing that the band seems feasible for digital radio use via terrestrial and satellite delivery. Earlier fears of extremely high power requirements and poor building penetration at L-band have been dispelled by the study. (See "re: Radio," pg. 12.) The tests also gathered significant information regarding the effect of RF channel bandwidth on multipath immunity, of interest to L-band and "in-band" methods of digital radio transmission. The study was conducted by the Canadian Broadcasting Corporation, the Canadian Association of Broadcasters and the Canadian government's Department of Communication and Communication Research Centre late last summer. Final reports are expected in January.

Meanwhile, the same consortium has released a final report on its earlier tests of the Eureka 147/DAB system, conducted from May 1990 to May 1991 (see "News," September 1990). The report presents favorable conclusions for the MUSICAM coding algorithm and the COFDM transmission system (tested in the UHFTV band). It also cites the positive consumer response, preference and demand for a digital radio service observed during the tests.

FCC moves to S-band for digital radio allocation

The FCC has announced that it will seek an allocation for satellite and complementary terrestrial digital radio in the S-band (2,310MHz-2,360MHz) at the 1992 World Administrative Radio Conference (WARC '92), to be held in Torremelinos, Spain, next month. This appears to rule out an L-band (1,500MHz) allocation that the NAB and other North American broadcast organizations had supported.

The commission will also seek the addition of terrestrial digital radio allocation issues to the agenda of a later WARC conference, where further spectrum discussions for the service could be held.

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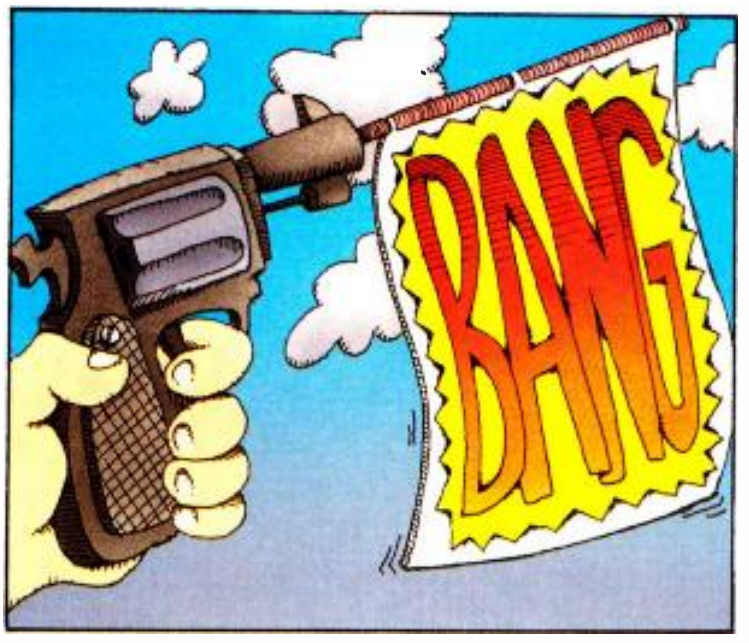
More bang for the buck

What this industry needs is a good fall trade show. "Wait a minute, I thought we had a fall trade show," you say.

Yes, Virginia, there are fall trade shows, but what I want (and so do many other people) is a *good* fall trade show.

During September and October, all we hear about is the next trade show. First comes the radio show, then RTNDA, then AES, followed by SBE and SMPTE. Give me a break! Why does this industry have to endure four or five separate and similar trade shows, when we are suffering through tough economic times? Couldn't one combined show do more with less?



The answer to that question is an emphatic *yes!*

The technology exhibited at these shows is not only similar and related, but also much, perhaps even most, of the hardware is the same. Why should exhibitors have to cart their equipment around the country for two months to see a few hundred potential clients? Why do attendees have to spend approximately 50% of those two months on the road seeing the same people with the same hardware? Finally, why should we have to choose from competing events?

Last month, I congratulated SBE and RTNDA for agreeing to combine the exhibition portion of their conventions. After attending the recent SMPTE convention, I'm convinced that it's time to go even further.

The industry is in a slump. Facilities are not buying hardware as fast as they used to. Manufacturers are more cautious about developing new products, and costs are on everyone's mind.

These facts are clear at the current fall shows. Fewer exhibitors are attending the individual shows and, in most cases, there are fewer attendees. It doesn't take a rocket scientist to realize that there is a problem.

The rumor at the SMPTE show was that it and AES were discussing a combined event. Great, but it's not enough.

It's time for AES, RTNDA, SBE and SMPTE to swallow their pride and do what's in the best interest of their members — and exhibitors. They should combine the exhibitions of their conventions into a single large fall trade show.

Who wins by such an approach? Everyone. Having been involved in the recent SBE/RTNDA agreement, I can tell you there are significant cost savings when groups combine show efforts.

One more thing. It's time for the associations to address the issue of location costs. Why do we go to New York every year? It may be a great place to visit, but there are certainly other lower-cost and just as entertaining locations available. Perhaps, if it didn't cost $200 per night for a minimum-quality hotel room, and $20 for breakfast, a few thousand other professionals might be able to attend. Besides, increased attendance translates to higher profits for the associations.

The SBE and RTNDA just made great strides toward the solution of our fall show problem by combining efforts. Now it's time for the other two players, SMPTE and AES, to put aside their territorial differences and combine with the other groups to form a single fall event.

Members and exhibitors are suffering through bad times with layoffs, cutbacks and smaller budgets. These groups need to recognize this fact and adjust accordingly. From lower cost-per-square-foot exhibition space to lower hotel rates, a larger convention provides the attendee and exhibitor more bang for the buck.

Brad Dick

Brad Dick, editor

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Circle (5) on Reply Card

AM rules amended

By Harry C. Martin

In September, the FCC adopted revisions and adjustments to its AM rules and policies aimed at improving the health and ensuring the survival of the AM service. The new rules implement three policy initiatives: 1) expanding the AM band; 2) implementing new technical standards designed to reduce interference; and 3) consolidating AM broadcast operations. Furthermore, the commission stated that in three years it will "revisit" the issue of whether to limit program duplication by AM/FM combinations.

AM band expansion

The commission selectively opened 10 newly available frequencies in the expanded band, 1,605-1,705MHz, to those AM stations that significantly contribute to congestion and interference in the existing band. The agency will adopt an allotment plan for the AM expanded band that is based on wide station separations and low interference levels. A "ranking system" based on interference reduction will be established to select from among the AM stations seeking to migrate to the expanded band. A preference will be awarded to AM stereo broadcasting in the expanded band. Finally, the commission will allow dual ownership and operation of existing and expanded band stations for a transitional period of five years, with a corresponding waiver of duopoly and national ownership rules during the permissible period of dual ownership.

Technical interference standards

A number of steps were taken to improve the quality of service in the existing AM band. Specifically, the commission increased first- and second-adjacent channel protection ratios to reduce adjacent channel interference and to promote the development of receivers with higher audio fidelity. In an attempt to improve nighttime reception, the commission refined the methodology for calculating nighttime coverage and interference to more accurately measure interference effects.

Finally, the commission will, in some cases, require a 10% interference reduction when voluntary modifications are made to AM station facilities.

Martin is a partner with the legal firm of Reddy, Begley & Martin, Washington, DC.

Station consolidation

To reduce interference, the FCC is encouraging the discontinuance of operation of marginal stations by issuing tax certificates to stations shutting down in exchange for payment by other licensees. The commission will also relax its multiple ownership rules for applicants proposing facility changes that would result in significant reduction of interference to co-channel or adjacent channel stations.

Other changes

In addition, the FCC will relax its rules pertaining to the Travelers Information Service to allow for the authorization, on a secondary basis, of such stations on any AM frequency.

The freeze on AM applications was scheduled to be lifted upon approval of the new rules by the Office of Management and Budget.

EBS signal length to be shortened

The commission is proposing to reduce the required minimum length of the Emergency Broadcast System (EBS) 2-tone attention signal to eight seconds. Current rules specify 20 seconds as the minimum length for EBS test signals.

The agency also plans to reduce the time delay incorporated in the demuting process to a minimum of three seconds and a maximum of four seconds. This would ensure that the EBS alert tone will be audible for four to 22 seconds. In addition, the commission has proposed adding a new rule section prohibiting broadcast stations from any transmission of the EBS attention signal tone, the broadcast of any recording of the attention signal, or the transmission of any other simulation of the attention signal tone other than in an authorized test of the system or an actual emergency situation.

The commission announced that it will initiate a Notice of Inquiry to solicit information and comments on two other EBS-related issues — possible revisions to the EBS test script, and whether to permit activation, monitoring and control of EBS systems by remote control.

Wireless cable rules changed

The FCC has made several changes to the rules it adopted for the service in 1990. (Wireless cable is a multichannel video service that uses microwave channels rather than wire or cable.)

- In certain circumstances, signal boosters of extremely low power (−9dBW E.I.R.P.) may be constructed and operated without prior FCC authorization. This change is designed to relieve operators of regulatory and economic burdens, while preventing harmful interference to authorized facilities.
- The ITFS excess capacity leasing rules were amended to give ITFS licensees greater flexibility in scheduling ITFS programming.
- Licensed ITFS stations that lease excess capacity will be protected from harmful interference from newcomer ITFS applicants during hours of non-ITFS programming.
- The three private operational-fixed service (OFS) "H" channels were reallocated to the MDS service.
- Response channels associated with the OFS H channels are to remain allocated to OFS, while half of the MDS response channels have been reallocated to OFS. All ITFS response channels remain with that service.
- The FCC has declined to permit facility modifications to facilitate co-location without prior agency authorization.
- A "rural" exemption to the prohibition of cable ownership of wireless cable was adopted. An additional exemption was adopted to permit cable systems to provide local programming over wireless cable under certain conditions.
- Existing cable TV ownership of wireless cable interests were grandfathered.
- Wireless cable entities will be permitted to access up to eight ITFS channels so long as at least another eight such channels remain available for educational use in the service area.
- Eligibility to use ITFS channels will be limited to MDS operators in the service area.

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Circle (6) on Reply Card

TV stereo intermodulation

By Rick Lehtinen,
technical editor

One of the most troublesome things about the Broadcast Television Standards Committee (BTSC) stereo standard concerns the stereo light on the viewers' TV sets. Early on, a lack of receiver standardization left many viewers puzzled. When the stereo light went on, the SAP switch did something. Unfortunately, that something varied from set to set. Some viewers became so confused that they blamed the TV stations. Many switched channels because second languages or non-related audio kept coming out of their sets. (See the Editorial, BE October 1989.)

Now, an advancement in high-power UHF technology may also haunt multichannel TV sound (MTS).

Many new UHF transmitters operate common mode. They use the same power amplifier for video and audio power amplification. Although this has significant technical and cost advantages, it may also cause a problem with the viewer's MTS decoder. If the transmitter manufacturer isn't careful, harmonics from the video sync pulse may mix into the transmitted audio, and masquerade as the stereo pilot. This can trigger stereo receivers, turn on the stereo decoder, and treat the viewers to non-stereo audio on their expensive receivers. Also, because the receiver is now working in wideband mode, it may be doing its best to stereo decode mono audio plus intermodulation.

Although this problem may seem trivial, it has two major consequences. First, it would appear to violate section 73.682(c)(3) of the FCC rules, which requires protection of the stereo pilot. According to the rules, the energy found at 15.734kHz must be at least 46dB below 25kHz equivalent deviation for stations not transmitting in BTSC stereo. Furthermore, section 73.1570(b)(3) of the FCC rules sets maximum peak deviation of the aural carrier for monophonic stations at 25kHz. Intermodulation in some common-mode amplifiers may exceed this. Second, this problem may attract undue attention to your facility. If the FCC determines this is a violation, it might want to investigate further to see what else it could find.

The issue of whether section 73.682(c)(3) applies only to intentionally generated subcarriers, such as from some alternative, non-BTSC stereo scheme, or whether the BTSC pilot must also be protected from unintentionally generated signals, is an issue now pending before the FCC. The commission has also been asked to clarify whether aural modulation caused by H-sync components contaminating the aural baseband count toward the ±25kHz frequency deviation limit for monophonic TV signals.

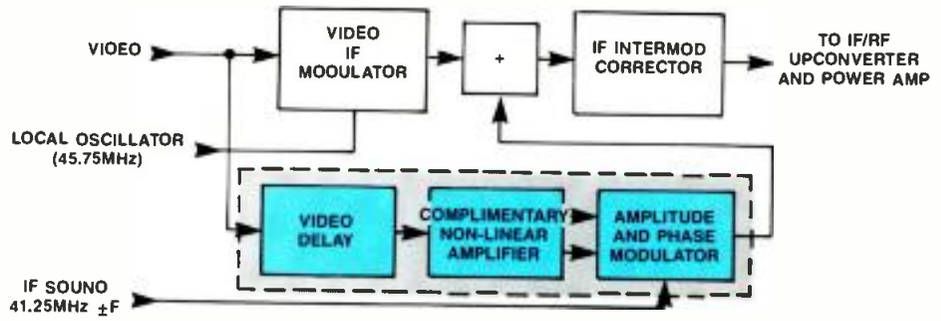

Figure 1. Block diagram of a patent-pending system that limits aural intermodulation. (Courtesy of Comark.)

Hard to find

Unfortunately, the problem is often hard to spot. Before BTSC, it was known that the visual signal could amplitude cross modulate the aural carrier, but few people cared. It wasn't thought to have any meaningful effect on the demodulated sound in a monaural system. One reason for this may be that the effect is so hard to measure. A conventional RF spectrum analyzer cannot always measure the amplitude of the first order 15.734kHz FM sidebands in the aural carrier of a common-mode TV transmitter. The reason is that there will also be *amplitude*-modulated H-sync components present. The AM sidebands of these signals may mask the FM sidebands. In fact, normal monaural proof-of-performance measurements may not be sufficient to demonstrate the problem. It will likely present itself, however, when examining the audio of the full BTSC bandwidth.

At first glance, any problem that is hidden and doesn't seem to hurt anything may seem to be something that can be safely ignored. However, with the number of stereo televisions sold growing at double-digit rates (up 32% last year), that may be an unwise approach. Intermodulation products can turn on a set's MTS decoder. The result of a wideband representation of narrowband audio may not be the quality of sound you want your viewers to have.

Aural carrier correction

One approach to cure this problem resembles a technique sometimes used to overcome common-mode transmitter video distortion products. The drive signal is predistorted in such a way as to create equal amplitude but opposite phase intermodulation products. These generated products cancel the unwanted ones.

A similar technique can be employed with audio. (See Figure 1.) In a transmitter equipped with this system, the video is IF modulated, then corrected, then upconverted and power amplified. The video also feeds an audio corrector. It is first delayed to accomplish a phase reversal, then amplified non-linearly to enrich it with out-of-phase aural intermodulation products. These signals then phase modulate the sound IF, which is summed into the signal stream. This tends to cancel the intermodulation. This, in turn, helps keep the stereo decoder off during monaural programming.

Acknowledgment: The author wishes to thank Dane Ericksen, senior engineer, Hammett & Edison, San Francisco.

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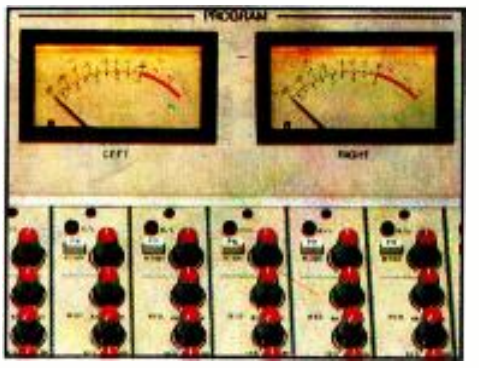
Part 1

re: Radio

The digital radio spectrum hunt

L-band gets a look, then the hook



By Skip Pizzi, technical editor

The hunt for spectrum in which to place new digital radio broadcast service has been a fundamental and nagging question since the earliest consideration of this technology.

In North America, the choices for digital radio spectrum have been narrowed to either *L-band* (around 1.5GHz), *S-band* (around 2.4GHz) or *in-band* (using existing broadcast radio spectrum in the AM and/or FM bands).

The L- and S-bands have been used only for low-power, point-to-point operation, and never for wide-area broadcast to the public. The industry has wrangled over their viability for digital radio use, citing apparently conflicting data. But preference for L-band over S-band did find general agreement.

New, targeted research

Late last summer, L-band propagation tests were conducted in Canada (see "News," pg. 4). The tests were designed to examine digital radio application in the band, although they were *not* specific to any particular digital format. An 8kW ERP signal was centered at 1,497MHz, for tests conducted in Ottawa (at 85m HAAT) and Montreal (at 260m HAAT). Both unmodulated carrier and 7MHz-wide noise signals were used for the tests.

To get a good look at multipath effects, samples were taken every 2.5cm along an 800m path at each outdoor test location. Indoor reception was also examined, using a variety of domestic and office building sites. Altogether, more than 50 million sample points were measured, and preliminary results were presented for the first time at the 1991 SBE Convention in Houston.

The tests showed that on a pure *propagation* basis, L-band is quite similar to UHF. Considering the whole picture of propagation and *reception*, however, and assuming a digital system is used, results indicated that L-band power requirements would be essentially *the same as FM power requirements for equal coverage* from the same antenna location and height. (The tests compared L-band measurements to predicted FM contours at the same ERP and HAAT.)

The key to this important finding involves the assumption that a digital radio receiver's threshold will be approximately 20dB lower than that of a typical FM receiver. This is a widely accepted notion in the field, cited in most proponents' papers and recent CCIR documents.

Foliage losses and other received-power variance ranges were in direct proportion to signal strength (i.e., the higher the received power, the wider the variances observed), and in no case was this near-field attenuation enough to drop received signal below threshold. At greater distances, the effects of *composite multipath* take over, whereby many reflections of relatively equal strength render any single obstruction less problematic.

Building penetration was also ruled out as a problem. Interior reception tests showed that L-band performed as well, if not better, than FM of equivalent transmission power in almost every case.

The FCC may be buying time for in-band systems to mature.

Significant problems remain

However encouraging, these tests show that L-band application wipes out one of the major advantages of digital broadcast, namely its astounding efficiency. The 20dB or 30dB greater propagation loss of L-band over VHF neatly cancels the 20dB to 30dB greater efficiency of a digital system obtained by its coding gain and lower C/N requirements. In a nutshell, it's a wash. And a 100kW ERP at 1,500MHz would most likely carry a hefty price tag, even with several stations splitting the cost.

But perhaps an L- or S-band system's greatest obstacle to acceptance involves the matter of *shared use* by direct satellite digital radio operators. This would allow receiver manufacturers to make one box that picks up terrestrial and satellite broadcasts. It would also put broadcasters in the ironic position of promoting consumer purchase of new hardware that would pick up a whole new set of competing (national or regional) signals.

FCC moves to S-band

Just as the Canadian L-band test results were being digested by the U.S. broadcasters, the FCC delivered its own bombshell, having the opposite effect on L-band possibilities. The commission effectively ruled out L-band's use for digital radio in the United States, at least for the moment, opting for a 50MHz allocation at S-band (2,310-2,360MHz) instead. Strangely, this allocation is approximately 100MHz lower than the S-band frequencies proposed by others for satellite digital radio.

This is the position that U.S. representatives will apparently take to the 1992 World Administrative Radio Conference (WARC '92) in February, but they will also ask for a later conference to deal specifically with *terrestrial* digital radio, at which "all bands" will be considered. Whether L-band is resubmitted there remains to be seen, but the FCC is more likely just buying time for in-band systems to mature with this request.

Speculation on reasoning behind the S-band choice centers on U.S. Department of Defense objections to broadcast allocations in L-band, which is currently used for aeronautical testing of high-tech weaponry.

Although little is known about S-band for terrestrial broadcast use, it's fairly certain that it will require more power than L-band for similar coverage, and therefore, more than current analog FM powers. How much more is the critical issue. Its penetration behavior will also require study. The Canadian tests showed that no conclusions should be drawn until direct and specific research has been conducted. Nevertheless, no terrestrial proponents seem thrilled by S-band's prospects, so whether such tests will ever occur remains in question.

With the current variety of proposals, the spectrum picture may not be much clearer after WARC '92 than it is now. And the WARC acts are not binding — a country can "footnote" itself out of any agreement. All of this makes an in-band approach even more appealing to broadcasters and prospective receiver manufacturers. We'll examine the promise and problems of in-band in next month's column.

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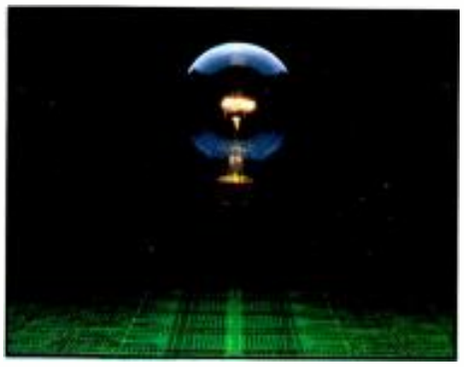

Storage for high-resolution digital video

By Carl Bentz,
special projects editor

Imagine trying to store two hours of high-resolution, full-motion digital images on one machine. Sound unrealistic? Not with some insight into current research on storage technologies.

How much memory?

A single frame of NTSC video represents more than 350kbytes of data (1 byte = 8 bits). Two hours of uncompressed video is nearly 80Gbytes, or 640Gbits (1,000 Gbits = 1 terabit).

For data transmission rates, an NTSC 30-frame/second signal equals a data rate for uncompressed video of 22Mbytes/s or 176Mbits/s.

Numbers for HDTV video are higher. We can expect that an ultimate video storage system will hold more than one terabyte (Tbyte) of data and support data transfer rates greater than 1Gbit/s.

A magneto-optical drum

One proposal to store extended-length, high-resolution video presentations is a video jukebox with a capacity approaching a terabit and data rates to several hundred Mbits/second. This system will probably use a magneto-optical recording device in a drum configuration for the best balance of size, cost and performance.

High data capacity recording requires a large recording surface. Data rates for motion need a combination of high surface velocity with simultaneous multitrack recording. Efforts to achieve these capabilities usually use several disks on a common shaft with a pickup head for each disk surface. However, a disk format with a constant angular velocity is volumetrically inefficient. The recording density is limited by the inner tracks of the disk, while the outer tracks operate far below the maximum density. On the whole, the disk may be 75% efficient.

An alternative to disks is a drum configuration. The surface of the magneto-optical drum is illuminated simultaneously by eight optical assemblies that are ganged on a common positioning device along the axis of the drum. (See Figure 1.) Each assembly covers a band of tracks and will handle one bit from each byte of data in the digital stream. One byte, a set of eight bits, are processed in parallel.

The key component for the optical-writing assemblies in a high-density data recording system is a blue laser. The wavelength (color) of the writing beam defines the size of the spot where data is being stored — the shorter the wavelength, the better. Blue light has a wavelength of 4,500 Ångstroms, while red is a much longer 6,700 Ångstroms (1 Ångstrom is 10^{-10}m in length).

The conceptual design for drum system suggests a 19-inch diameter and 30-inch length with a surface area of 1,800 square inches. The data storage capacity of the surface is proposed to be more than half a terabit. The parallel access data rate is 68Mbits/s per track or 547Mbits/s for the system. An estimated worst-case system access time of one second is based on a movement of 3.75 inches from edge-to-edge of a band for the write/read module.

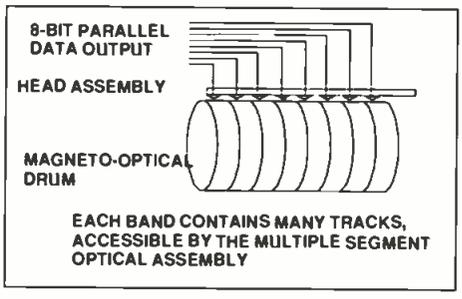

Figure 1. A proposed drum-type storage device consists of eight bands, each accessed by one of eight mechanically ganged optical modules.

If such an optical drum can store approximately two hours of digitally compressed video, its potential as a commercially viable device is excellent. Much of the development of such a drum is complete, and significant progress of critical components and the system design has been realized. However, questions remain about system cost, identity of the customer and expected delivery requirements.

A better disk

A newly proposed erasable optical disk technology promises to eclipse current magneto-optical systems in speed and capacity. Called electron trapping optical memory (ETOM), the technique also relies on the evasive blue laser to excite electrons in the storage medium. The ETOM process is completely photonic. The laser does not heat or physically alter the storage material. (In magneto-optical systems, a laser heats the disk material just enough to allow unilinearly polarized domains of an unrecorded disk to be reversed by the presence of a fixed magnetic field. The disk cools and retains the new domain polarity. To erase data, a laser reheats recorded spots in a magnetic field of the polarity of the original blank disk.)

ETOM accesses and stores more data than other optical methods. A 5.25-inch disk could hold 15Gbytes of data with a transfer rate of 120Mbits/s, compared to 300Mbytes of data on magneto-optical disks with 6Mbits/s rate.

The ETOM stores data on more than one level of the disk. Layers are written to and accessed by an amplitude-modulated laser. But instead of two amplitude levels (1-0 binary coding), ETOM will use four levels in quaternary coding. Presently, ETOM is more promise than reality.

When?

The requirements for high-definition video storage devices are moving targets. Parameters change with advances in digital compression of video. Optical storage seems the preferred technology now, but don't rule out solid-state devices.

A key ingredient for improvements in optical and magneto-optical storage is a blue laser. Once developed, it will offer a potential to triple or even quadruple the amount of data that can be stored on disks or drum systems. Current predictions suggest a target date two years away to resolve technical hurdles before the blue diode might become commercially viable.

Editor's note: Information in this article is based on "Video Storage in Digital Transmission Video Jukebox," from SPECS Technology (September 1991) by Dr. Aleksander T. Futro, CableLabs director of technology assessment.

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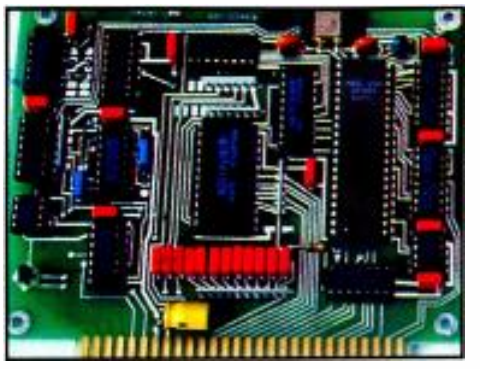
Part 4

Circuits

An in-depth look at analog ATR circuits

Tape path motor control



By Gerry Kaufhold II

Most analog tape machines use three motors: the supply reel motor, the take-up reel motor and the capstan drive motor. In older ATRs, intricate mechanisms regulated the motor speed. Modern equipment uses sophisticated microprocessor-based servo control circuits. To minimize wow and flutter, all three motors must operate properly together.

During play or record modes, the three motors operate as follows: The take-up reel motor rotates counterclockwise. It applies constant tension to take up the tape from the capstan.

The capstan motor rotates at a constant speed. The pinch roller presses the tape against the capstan motor. This maintains a constant linear velocity as the tape moves past the heads. Improper capstan motion can lead to flutter problems.

The supply reel rotates counterclockwise, but it has a preset back tension applied to it by its reel motor (clockwise motor rotation), to prevent the tape from spilling, and to help keep the tape properly tensioned as it moves past the heads. Intermittent or improper back tensioning can contribute to wow and flutter effects.

When an ATR starts, it must bring the tape up to speed as quickly as possible. This is not a simple task. Full reels of audiotape present a considerable mass. Audiotape is also fragile and easily deformed by stretching.

Phases of operation

Figure 1 illustrates the timing of the *start-up* phase of playback and recording. At Point A, the supply reel has dropped its brake, enabling the take-up reel to draw tape. The take-up reel is also released, and the take-up reel motor is being energized.

Between Points A and B the tape moves with zero back tension from the supply reel. This permits the take-up reel motor to achieve its normal operating speed as quickly as possible.

At Point B, the supply reel begins to apply back tension to prevent the tape from spilling. The control microprocessor monitors the tape break and/or dancer arm to be sure that tape is not spilling. If an error is detected, the microprocessor stops all tape movement.

Between Points B and C, the reel servos fine tune themselves to achieve constant forward tension on the take-up reel and correct back tension on the supply reel.

At Point C, the pinch roller is energized by a solenoid that presses the tape against the capstan rotor.

At Point D, the take-up reel is applying constant tension to tape coming from the pinch roller and capstan motor. Tape is moving smoothly across the heads. The supply reel is providing proper back tension by driving its motor gently backward, contrary to the tape motion. The playback or record circuits energize at this point.

The entire start-up process takes place in less than one second.

Kaufhold is an electronics industry analyst based in Tempe, AZ.

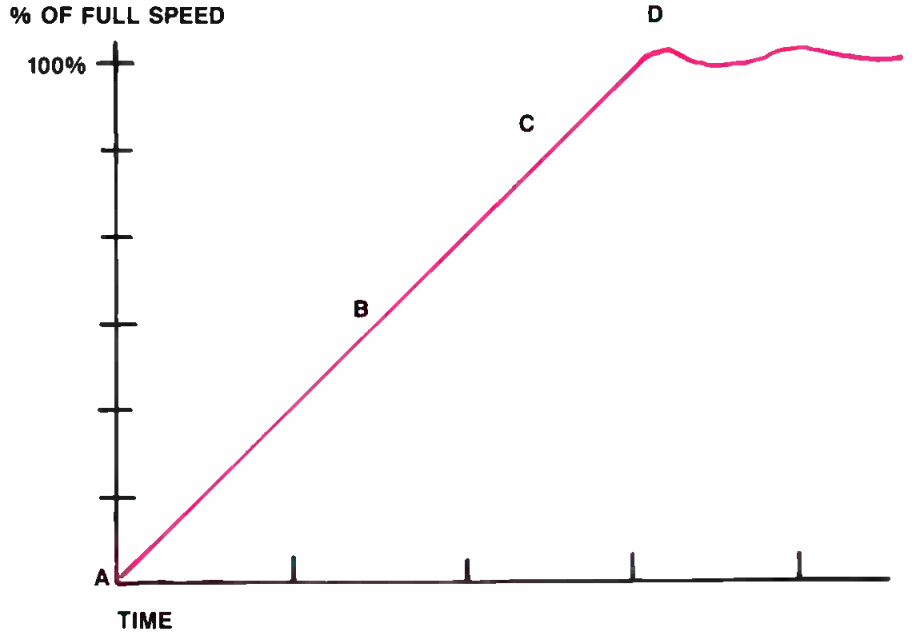


Figure 1. The phases of tape start up. Variations in tape movement are causes of wow and flutter.

Going steady

Most of today's ATRs use *constant-tension* operation (in contrast to earlier *constant-torque* designs). During the steady-state operation phase on constant-tension decks, the take-up and supply servo circuits constantly compensate for the flow of tape off of the supply reel and onto the take-up reel. Servo circuit accuracy directly affects the amount of wow and flutter.

In the *tape stop* phase, the pinch roller releases the tape from the capstan. The take-up and supply reels do a synchronized "reverse thrust" to reduce tape motion without stretching the tape. When the tape stops, the reel brakes hold it steady.

Drive motors are major contributors to ATR wow and flutter.

Fast forward and rewind

In fast forward and rewind operations, the servo controllers operate both motors in synchronization to provide high-speed fast forward and rewind without stressing the tape. A *head lifter* pulls the tape away from the head stack to avoid unnecessary head wear.

Next month's column will explore in detail modern servo motor control circuitry.

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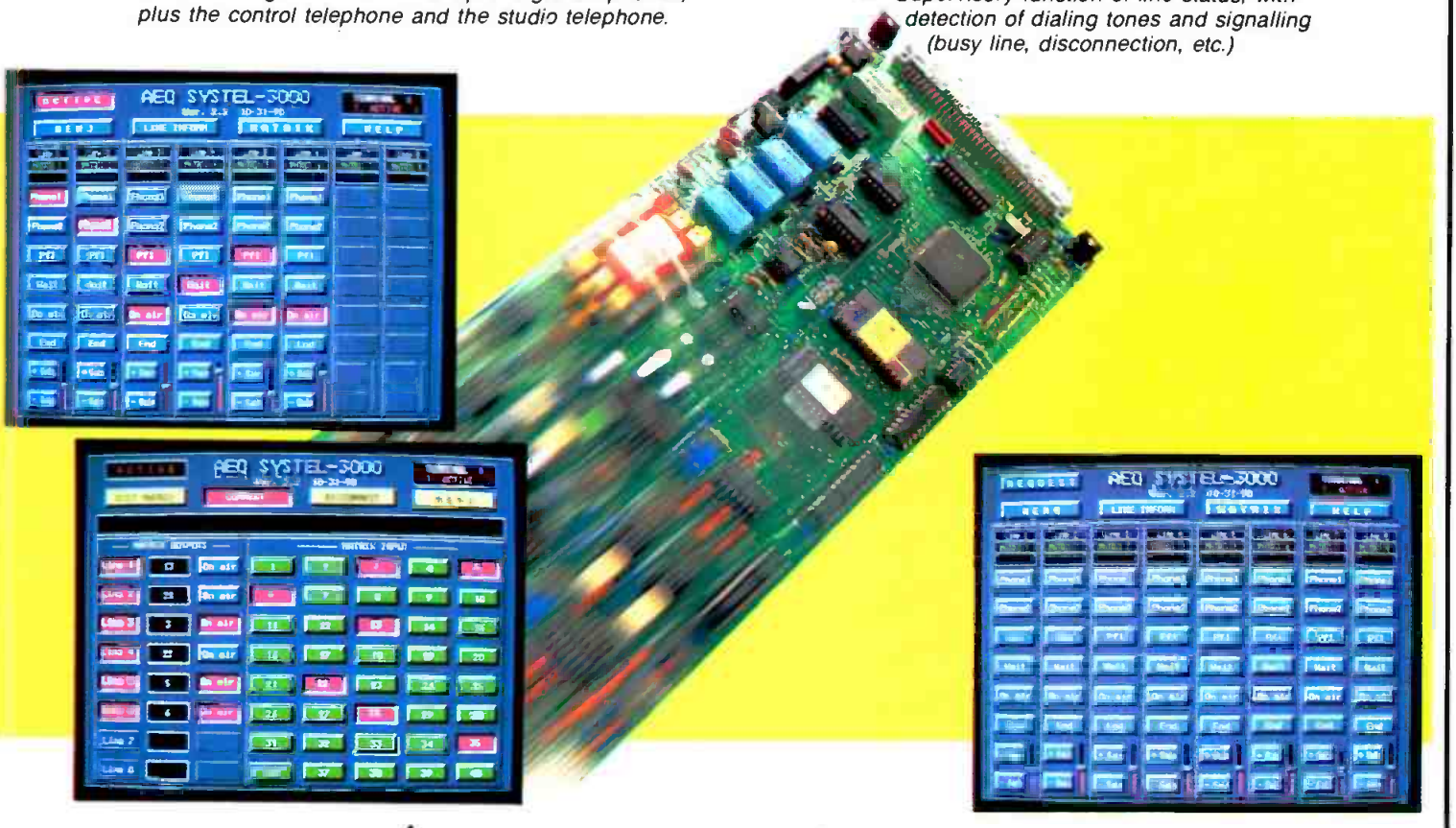

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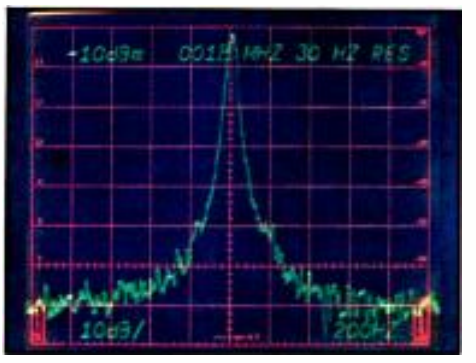
Part 4

Troubleshooting



Optimizing 2-track analog ATRs

Wow and flutter

By M. Raymond Jason

Digital recording has an unequivocal advantage over analog systems because of its immunity from time-dependent problems. Even the best analog recorders will forever be stuck with wow and flutter and (unless time code is used) timing errors.

Wow and flutter

Wow and flutter are the audible effects of disturbances in tape motion, manifested as periodic pitch variation. Wow refers specifically to low-frequency variation, from 0.5Hz to approximately 2Hz, while flutter encompasses all higher-frequency variations. At 15ips, any rotating component on the transport of two inches or more in outside diameter can contribute to wow or flutter, depending on how many geometrical or rotational imperfections are present over the span of the component's circumference. Smaller items, including the capstan, can contribute only to flutter.

Four wow and flutter measurement standards exist. They were published by the NAB, the IEC and DIN (Europe) and the JIS (Japan). Because the IEC and DIN specifications are identical, and little equipment in the United States uses JIS specs, the following discussion will only consider NAB and IEC/DIN measurements. The main differences between these methods are shown in Table 1.

Deriving a single number

Because indicated wow and flutter vary from moment to moment, there is ambiguity in associating a single-number measurement to a range of analyzer indications. In general, *peak* wow and flutter are more interesting than *average* or *minimum*, because your goal is elimination of all *audible* problems.

On the other hand, brief bursts of flutter that occur rarely (and which are often due to tape sticking within the supply pack) are unlikely to be noticed even during critical listening, and are often uncurable. A compromise technique, which allows for occasional bursts, selects the point at which the indicated value is exceeded only approximately 5% of the time.

Jason is an electronic engineer for National Public Radio, Washington, DC.

Scrape flutter

Flutter frequencies up to several thousand hertz can result from transport servosystem oscillations or intermittences, and from mechanical disturbance or oscillation of the tape sliding past the heads. This problem typically occurs at frequencies above 200Hz, and is called *scrape flutter*. It is measured using a wide-bandwidth flutter meter.

Scrape flutter can dramatically degrade sound quality, yet it is excluded from the standardized measurement techniques. (Note the 200Hz cutoffs listed in Table 1.) Few, if any, ATR manufacturers provide a scrape-flutter specification, probably because there is no standard. Furthermore, although wide-bandwidth flutter meters are available, they are expensive. So, this revealing measure of ATR performance has acquired an "exotic" status.

If you don't have a wide-bandwidth flutter meter, you can still obtain relative measurements of scrape flutter by recording a 12.5kHz tone, rewinding and playing it back through a harmonic distortion analyzer set to null the tone. Simply listening to the output of the analyzer permits fine adjustment of scrape-flutter rollers: Position the roller for minimum noise. Take care not to give the roller so much tape penetration that it lifts the tape from the heads. At optimum penetration, signal strength should not be diminished by more than 0.1dB.

Search and destroy

Finding the source of wow or flutter is the first troubleshooting challenge. Check the capstan and the pinch roller. Any grease pencil or 3-D oxide build-up problems can be solved by cleaning them off.

Pinch rollers age and incur damage over time. Swapping pinch rollers is a quick way to tell if you need a new one. Incorrect pinch roller pressure can also promote flutter, so check the pressure with a spring scale according to your service manual.

Although wow and flutter are rarely transferred from the *take-up* reel through the capstan/pinch roller system, the *supply* reel motor and its rotation-counting or velocity-sensing mechanism are common failure sites. Any problem of this sort appears as periodic tension variation on the supply side of the capstan. Large-magnitude tension variations may be visible as dancer-arm oscillations. Use an in-line tape-tension gauge to catch smaller amplitude oscillations.

If you don't have an in-line tension gauge, you may have success using a 3-to 4-inch length of 1/8-inch heat-shrinkable tubing (or even a plastic drinking straw — use its whole length because it's stiff) held vertically between your thumb and forefinger and pressed against the tape at the left of the head stack. Even small tension perturbations will be revealed in the jitterings of the tubing. If your ATR's transport logic allows it, holding the dancer arm fixed may help, because the dancer arm may reduce the amplitude of a problem, thereby making diagnosis elusive.

Curing wow and flutter problems is usually time consuming and mentally taxing. Ease the process by taking careful wow and flutter measurements when you first start your repair, and at each step along the way as you make adjustments or replace parts. This written record will organize your work, and may help the next time the same model ATR comes down with a case of wow and flutter.

PARAMETER	NAB	IEC/DIN
Test Frequency	3kHz	3.15kHz
Bandwidth	0.5 — 200Hz	0.2 — 200Hz
Detection method	Avg. response (rms cal.)	Quasi-peak

Table 1. *Differences between NAB and IEC/DIN standard wow and flutter measurement specifications.*

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Part 3

Management for engineers

Working smarter

Conducting meetings of value

By Judith E.A. Perkinson

Most business meetings either represent management at its best or management at its worst. One of the most valuable tools a manager can have is the ability to conduct meetings of value. Successful meeting management is a combination of understanding and practice. You can gain understanding by reading articles, and by paying attention to people who run beneficial meetings. The practice is up to you.

The need for leadership

Meetings of value are not accidental. They are run by an effective leader who provides direction and protects the process. Often, when we think of leading a meeting, we think of control.

Control can be good or bad, depending upon how it is used. If control is used to limit participation and force decision making, then it becomes dictatorship, not leadership. If control is used to protect the process of the group, keep the work focused and limit the counterproductive behavior of potential troublemakers, then it is a leadership tool.

What is a meeting of value?

Foremost, meetings of value do not waste the attendees' time. They accomplish goals, which means each one should have a clear and meaningful purpose. Meetings of value are well-organized, have a clear direction and remain focused.

Don't waste time

Meetings should begin and end on schedule. If you call a meeting for 10:00 a.m., don't wait until everyone is present — start at 10:00 sharp. Waiting for people who are late penalizes the people who are punctual. It also sends the message that latecomers will not miss out on anything. Furthermore, don't update the latecomers. Eventually, people will learn that they must be prompt for your meetings.

Inform everyone how long the meeting will last, and then end at that time. If you have not covered all of the material, schedule an additional meeting. When people learn that your meetings are not endless, the work will get done in the time allowed. Meetings often expand to fill the time that is allotted. You can turn this to your favor. By limiting the length of the meeting and planning your agenda carefully, the time spent can accomplish more than you thought possible.

Perkinson is a senior member, the Calumet Group, Inc., Hammond, IN.

Clear direction and focus

The following tips will help your meeting stay focused:

- *Have a purpose.* Every meeting should have a purpose. This should be understood by the leader and communicated to the participants.
- *Be prepared.* Have all of your data available and organized. Know how you are going to start the meeting. Be sure your agenda is clear and understandable.
- *Manage the meeting.* Focus on one topic at a time. Don't switch to another subject until you have finished discussing the current one. Use internal summaries to move from one issue to another. Make sure each topic reaches some type of conclusion, such as a decision, course of action, agreement or understanding.
- *Manage the participants.* Involve all of your participants. Don't let anyone bully, dominate, disrupt or pull the meeting off track.
- *Manage yourself.* If you are the only one who is going to have a chance to talk, don't hold the meeting; send a memo instead. Be sure your actions encourage, not inhibit, participation. Listen to what people are saying.

Participation makes the process work

A meeting is more than a gathering of people in the same room. If you have planned your meeting well, the attendees should be able to help you achieve the purpose of the meeting. As the leader, you are responsible for providing people the opportunity to participate.

Include the uninvolved

We often think that people who do not actively participate in a meeting have nothing to say. This is not always true. People who don't participate are usually uncomfortable speaking in a group, do not feel comfortable asserting themselves, or are afraid to volunteer their thoughts and feelings. However, they are thinking *something.* These people tend to be your best listeners and they probably do have something to contribute. It is your responsibility bring them into the discussion. Some of the ways that you can do this include:

- *Pay attention to your group.* Be aware of who is quiet and who is not.
- *Make it safe to speak.* Create a safe speaking environment by encouraging everyone to participate. Make sure you and/or the group do not become judgmental of ideas that are presented and by treating every attendee with respect.
- *Solicit ideas and opinions from your uninvolved group members.* When asked, most people will be happy to tell you what they are thinking and how they feel about an issue. Quiet members often have valuable contributions to make.

Handling the troublemakers

The most effective tool you have in handling troublemakers is to develop solid meeting organization. If you have communicated a strong and clear sense of purpose, if the flow of activity is logical and meaningful, and if you stick to your organizational design, you will eliminate much of the opportunity and motivation for troublemaking. Most disruptive meeting participants are bored, feel their time is being wasted or resent the leader's inability to manage the group.

The second most effective tool you have for handling troublemakers is the active participation of the other group members.

You can also control troublemakers by sticking to the subject, seeking other members' comments and, if necessary, letting the troublemakers know that although they have a right to an opinion, it shouldn't disrupt the purpose of the meeting.

Making the meeting work

There is no magic. Working smarter includes making good use of time spent in meetings. This is possible when meetings are well-planned and well-run.

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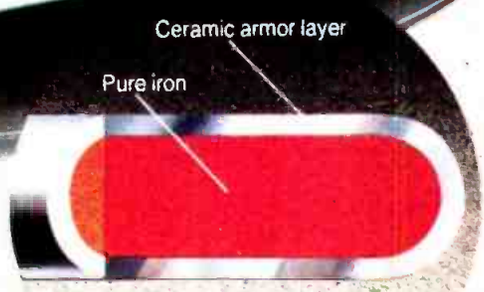

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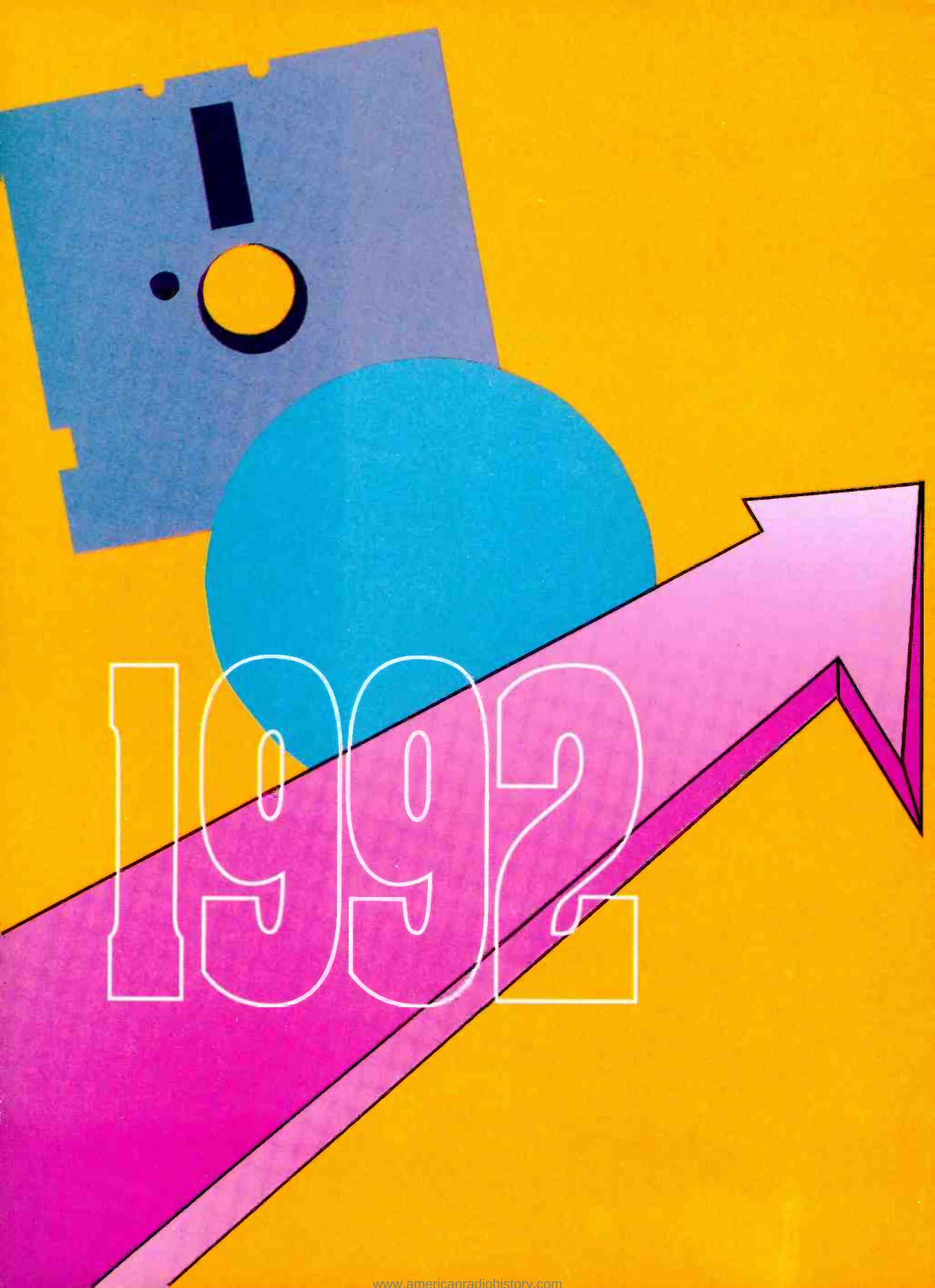

Annual technology forecast

Increased purchasing plans are a good sign of a healthy industry. Unfortunately, there are signs that the industry is suffering from a cold.

Broadcast Engineering's annual state-of-the-industry issue is looked upon as one barometer of the industry's health. Every year, we examine how stations view the future in terms of the equipment they plan to purchase. Increased purchasing plans are a good sign of a healthy industry. Unfortunately, there are signs that the industry is suffering from a cold.

Another indicator of the industry's mood is how broadcast professionals feel about the business. Our survey looked closely at that less quantifiable, but just as valid, information. It's one thing to crunch the numbers, showing the percent changes in purchasing plans. It's an entirely different matter to read the hundreds of comments from respondents. The numbers tend to show how stations view the short term, perhaps one year out. The open-ended comments reveal how those who work in the business see the future, well beyond next year.

This month's issue is designed to help you glean a clearer picture of where the industry is going and what other stations are planning. Knowing what the competition is up to is always good business.

In the "State-of-the-Industry Forecast," you'll learn what types of equipment your competitors view as important. The article also reviews how equipment decisions have changed from last year.

This year's "View From the Top" features a new approach to the topic. Previously, we've interviewed industry leaders, group-level engineering directors and chief engineers. This year, we look at the role standardization plays in the development of new equipment and, therefore, the direction taken in new production and broadcast products.

Profits will always be the focus of station managers. Engineers, at least the smart ones, have figured out that the way to a manager's heart is through money. "Profiting from Technology" highlights ways the engineering department can contribute to the income side of the ledger. Engineers need to take it upon themselves to suggest ways to make money in the area they know best — technology. This article may give you some ideas that can help your station compete more effectively or become more profitable.

In many areas of the country, the FM band is crowded with stations. This high density of stations harbors the potential for producing interference between stations. In the article, "FM Intermodulation Effects: A Case Study," learn how an interference problem affected several stations. The case study leads you through the legal quagmire these stations found themselves in once the problem developed. The bottom line here was that a technical problem was quickly changed into an expensive, long-running legal battle for several broadcasters. Learn how you might help protect your station from such a disaster.

Brad Dick

Brad Dick, editor

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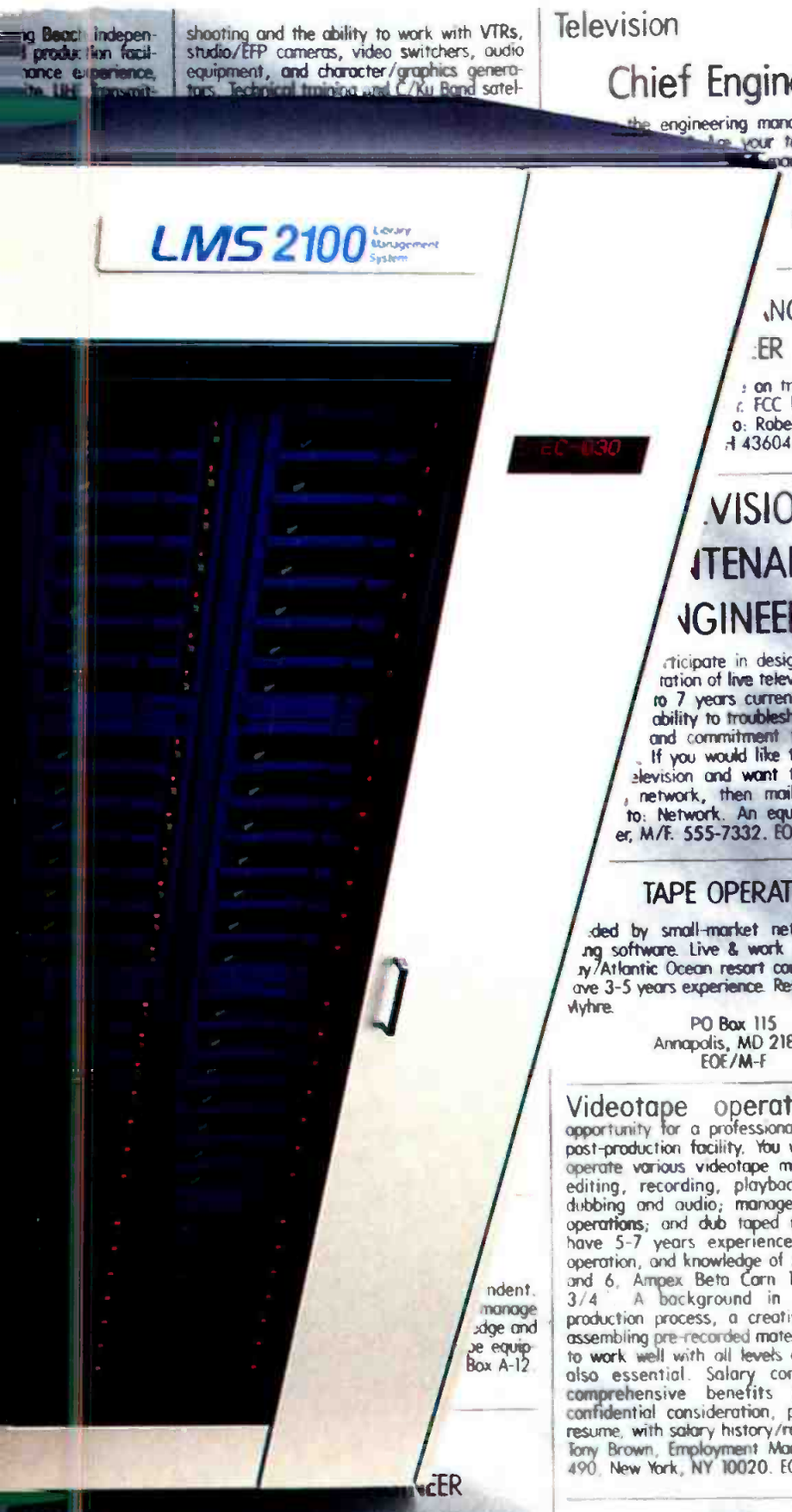

shooting and the ability to work with VTRs, studio/EFP cameras, video switchers, audio equipment, and character/graphics generators. Technical training and C/Ku Band satel-

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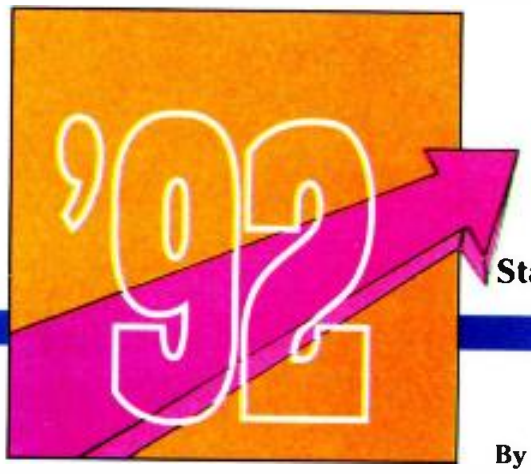
State-of-the-industry forecast



Stations continue to watch their spending.

By Brad Dick, editor

The Bottom Line

At the recent trade shows, there was much talk about pent-up demand for equipment. Manufacturers said they were selling hardware, and many thought a turnaround might be in the offing. Unfortunately, based on this survey, the industry checkbooks remain closed. Stations seem to be in a holding pattern, afraid to invest in their future.

Now is the time, however, when stations can grab hold of their destiny by buying the technology that will place them at the forefront when the industry finally turns around.

Money hasn't been this cheap for two decades. Clever engineering managers and GMs are investing now in their future with the new technology that makes them sound and look better and operate more efficiently. These forward-thinking stations will be miles ahead of the competition when the economy takes an upward swing.

S

A recent newspaper headline read, "Recession not over for the middle class." Replace *middle class* with *broadcasters* and the sentence remains true. The industry has suffered and continues to suffer through dire economic times. Occasional glimmers of hope are shining through, however, if you look hard enough.

Broadcasters are a competitive breed, but we don't want others to fail because of economic conditions. The same goes for equipment manufacturers. The trade publication pages are littered with news of company downturns, layoffs and even failures. With a background like that, where else is there to go but up?

The survey

The *Broadcast Engineering* state-of-the-industry survey forms the second half of our look at the industry. The first half was carried in the October issue. It reviewed salaries and benefits for broadcast professionals. The state-of-the industry report completes the examination by providing an overview of purchasing and budgeting plans.

The survey was scientifically conducted by the Intertec corporate research department. On July 16, 2,000 questionnaires were mailed to *BE* subscribers with technical and engineering titles on an "nth name" basis. A total of 715 usable questionnaires were received as of Sept. 9, representing a response rate of 36%. The data in this report is based on those responses. All results represent median values.

When measured over all markets and combining radio and TV responses, the results are not bad. Only 1% fewer stations plan upgrades next year as opposed to this year. However, this small drop hides some significant decreases when the data is examined by market sizes. A detailed review will begin with a look at what TV stations are planning.

TV plans

Looking at TV alone and measuring over all markets, 2.4% fewer stations plan to upgrade their facilities next year. This is a drop in the percent of stations planning upgrades from 74.3% last year to 71.9% this year. As previously noted, this factor is highly market-size dependent. In the top 50 markets, this value fell from 78.8% to 70.7%, an 8.1% decrease. The top 100 markets equipment-upgrading plans are only 5.2% off from last year to 66.2%.

Some good news can be reported for the below top 100 markets. The percentage of stations planning upgrades increased from 64.2% in the last survey to 72.2%. This 8% increase helps to offset the decreases seen in the other markets.

Almost 78% of the non-commercial TV stations are planning upgrades for 1992. That's less than a 1% drop from last year.

TV budgets

When examined across all markets, the median TV equipment budget for next year is $103,500. Budgets for equipment by market size are as follows: top 50, $281,800; top 100, $148,000; below top 100, $84,400; and non-commercial, $75,000.

The below top 100 market is the only

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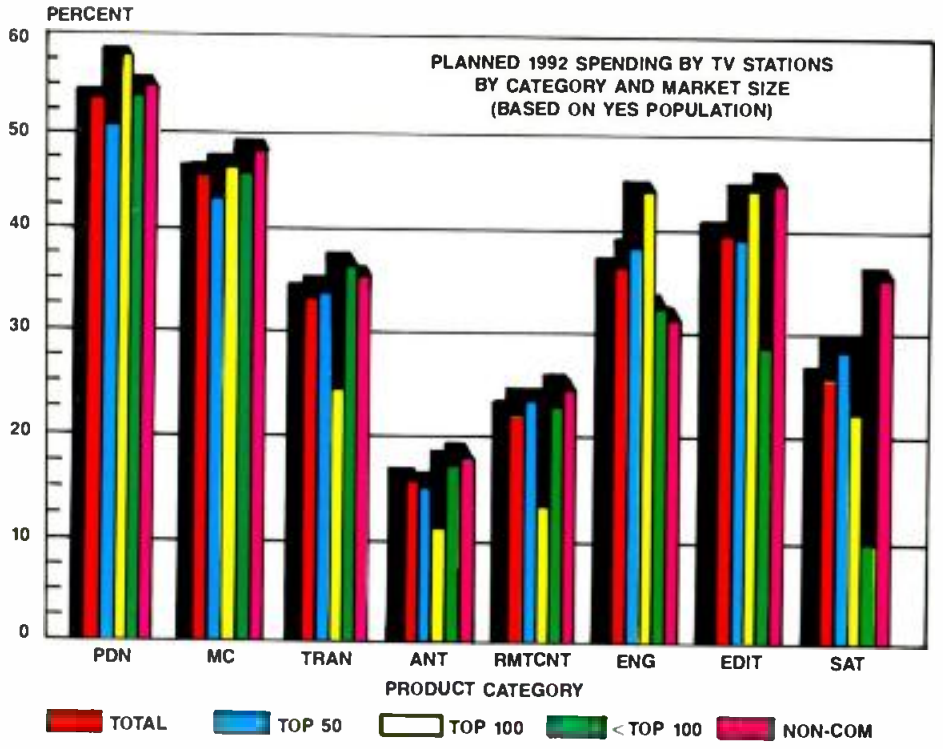

Figure 1. Planned spending by TV stations, broken down by market size and equipment category. Production and master control equipment remain the top picks for most stations.

market that has seen an increase in equipment budgets. The budgets increased by 12% from $75,000 to $84,400.

A check against the numbers is possible by asking if stations plan to spend more, less or the same. In the total TV category, fewer stations said they would spend more or the same. More stations said they would spend less on new equipment in 1992 than they did in 1991. Respondents that indicated they would spend less increased from 17.2% last year to 25.3% this year. Money for equipment is of great concern to TV stations.

TV equipment wants

It's always interesting to see how stations will spend their money. Figure 1 illustrates eight categories of equipment and the percentage of respondents saying they plan to buy that equipment. The relative importance stations place on equipment by category is approximately the same as last year. For instance, production gear is the most common equipment purchase. This category has been the number one selection in every survey.

In decreasing priority, the second, third and fourth most popular types of equipment are master control, editing suites and ENG. The fifth and sixth equipment categories swapped positions from last year. This time, the fifth most popular equipment for TV stations is transmitter gear. Completing the list in descending order are satellite, remote control and antenna systems. The relative priority of equipment category is consistent across all markets.

Radio plans

For the most part, the survey shows that stations continue to delay many equipment purchases. Planned spending for most areas is somewhat below last year's, but there are some areas of hope.

Measured over all markets, 67.1% of the radio stations plan on upgrading their facilities in 1992, which is down only 1.5% from last year. The real drop came in the top 50 markets, where the number of stations planning upgrades fell from 73.4% to 65.5%.

In the top 100 markets, a higher percentage of radio stations plan to upgrade their facilities. From 58.4% last year to 65.2%, the 6.8% increase is a welcome sight.

The below top 100 market category fell slightly. Last year's survey showed 67.1% of the stations planning upgrades. This year, that number fell to 65.3%.

The percentage of non-commercial stations planning upgrades fell by 1.3% to 73.2%. Historically, the percentage change in upgrade plans is smaller for radio and TV non-commercial stations than it is for commercial stations.

Radio budgets

All radio budgets show a decrease from last year. The amount of decrease varies widely. The median radio station equipment budget for 1992 (measured over all markets) is $12,500. This value may be extra low because of the tiny budgets available in the below top 100 markets. The median budget for these stations is $7,100.

Top 50 station equipment budgets fell to $25,000. The top 100 market radio equipment budget for 1992 is $15,000, which is down from last year. The median non-commercial radio station budget is $10,500.

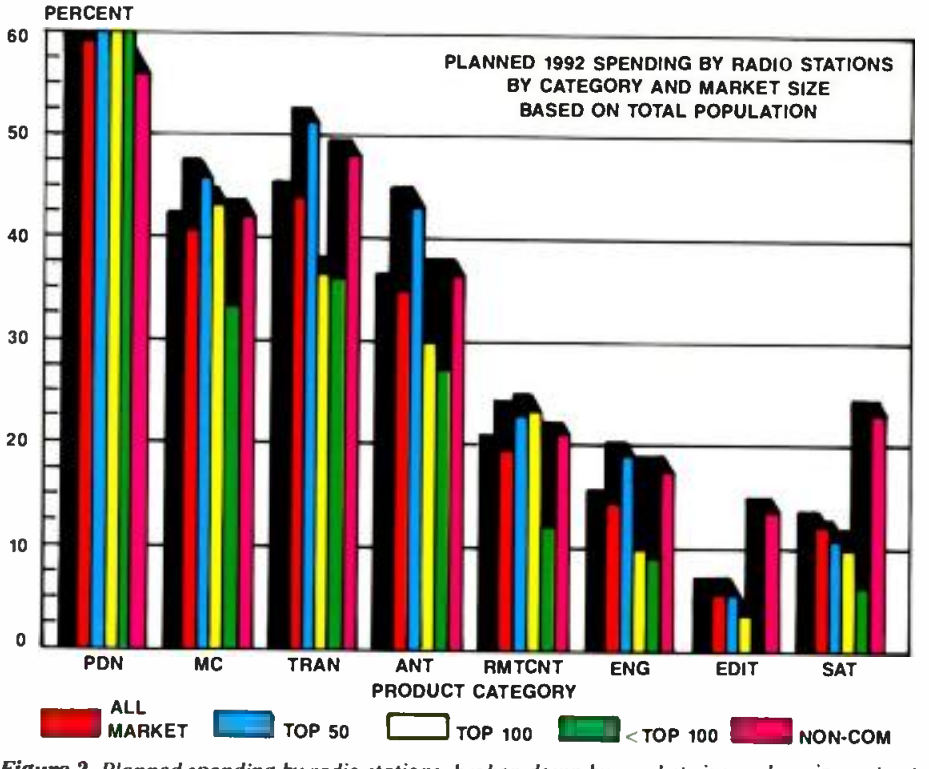

Figure 2. Planned spending by radio stations, broken down by market size and equipment category. The number one and two priorities for most stations are production gear and transmitters.

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It's sad to see, but in all but the top 50 markets, the 1992 planned equipment budget is not greatly different than what was seen in 1989. In fact, the 1989 budgets were actually higher than those reported this year.

Radio wants

Radio stations have different priorities than do TV stations. The most popular equipment for radio stations is production gear. The second most likely purchase for most radio markets is transmitter equipment, followed by master control equipment. Antenna systems take the number four slot. The data is shown in Figure 2.

The uniformity of equipment priorities across markets is similar to that found in television. For instance, except for the top 100 market category, the priority list for equipment category by market size is identical. The one difference is small—the number two priority (transmitter equipment) is swapped for the number three position (master control hardware). This shows that hardware needs are not market dependent.

In the past, radio stations have placed a high priority on transmitter equipment. Transmitters have been the number two priority for many years. Production equipment has always been number one.

Staff size

Engineering staff size is the final area to be examined. The relative importance of this should not be underestimated. Technical staff size is an indication of the effects technology and economic conditions have on our stations. Figure 3 shows the median engineering staff size for radio and TV stations over the past six years.

The most obvious trend is smaller TV engineering staffs. However, a close examination will show that radio stations suffered through similar reductions over the same period.

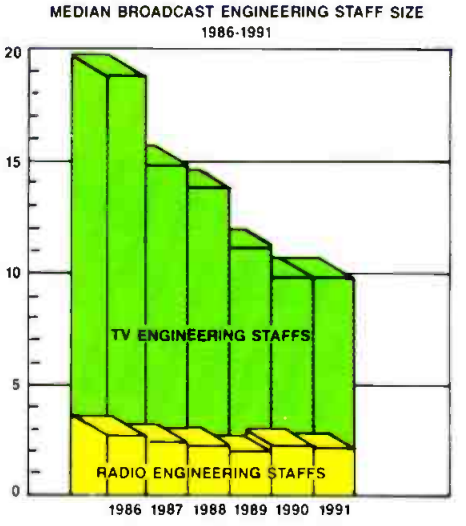


Figure 3. Median staff size for radio and TV stations. Technical staff size at TV stations remained constant at 9.7. Radio staff size fell from 2.3 last year to 2.2 per station.

This year, the median number of engineers on a TV staff is 9.7, which is the same as last year. The median number of radio engineers per station dropped by 0.1% to 2.2. That is still 0.2 higher than the low of 2 reached in 1989.

Written comments

Although the survey numbers are an important facet of the industry's plans, a different look is provided by the written comments. The mood of the industry's engineers isn't positive. (The accompanying article contains a sampling of this year's comments.)

A common theme in this year's results might be described as a fear of future technologies. Previous surveys have never had so many negative comments from engineers about new technology. In years past, the respondents showed enthusiasm for developing ideas and equipment. The enthusiasm is tempered greatly at this time.

The FCC, station owners, brokers and, of course, the bean counters typically receive the brunt of criticism. Not so this time. Engineers expressed doubt about the future of their stations. For the first time, there was a high percentage of comments about two upcoming technologies, HDTV and DAB.

The number one concern for TV engineers was competition from cable. They perceive cable delivery as a threat to their audiences with the result in lost revenue. Those that mentioned cable as a problem often saw new regulation as the cure.

TV engineers also expressed great concern about HDTV. Engineers appear to see HDTV as a technology being forced upon them. Few of those mentioning HDTV saw it as a positive influence for the industry. They viewed it as an expensive technology their stations can't afford. Sometimes, they said that someone else (cable, telco or satellite) will begin delivering the programming, effectively relegating them to a second-class service.

Radio engineers' comments also addressed the problem of increased competition. They quickly centered on a new villain — DAB. Just like HDTV for TV engineers, many of the radio respondents don't want DAB. They perceive it as a threat to their stations.

The issue of DAB was expressed somewhat differently for some of the AM engineers. These respondents often addressed it from the point of wanting access

Continued on page 73

The readers' comments

TV respondents:

"Good engineering has given way to bottom-line management."

"If we don't start banning together now, cable will definitely take over and commercial television will be a thing of the past."

"Free TV is far and away second fiddle to cable TV."

"Local stations must be assured of 'basic tier' access to cable systems."

"I think HDTV for broadcasting will not be successful."

"HDTV — have to have it to be competitive."

"Too many choices for the viewer, pulls them away from commercial (TV) stations."

"Cable and other types of delivery (DBS, fiber) making it hard to justify over-the-air transmission costs."

"HDTV is the most important issue facing the broadcast industry. Some standard should be selected quickly."

"We need an HDTV and digital format."

"Changing technologies makes it hard to decide which way to go."

"The depression."

"I am concerned with the continuing myth that on-staff engineering support isn't necessary."

"The most important issue is survival. If we don't band together now, cable will definitely take over and commercial TV will be a thing of the past."

"Certainly not HDTV as the industry would like us to believe."

"Survival!"

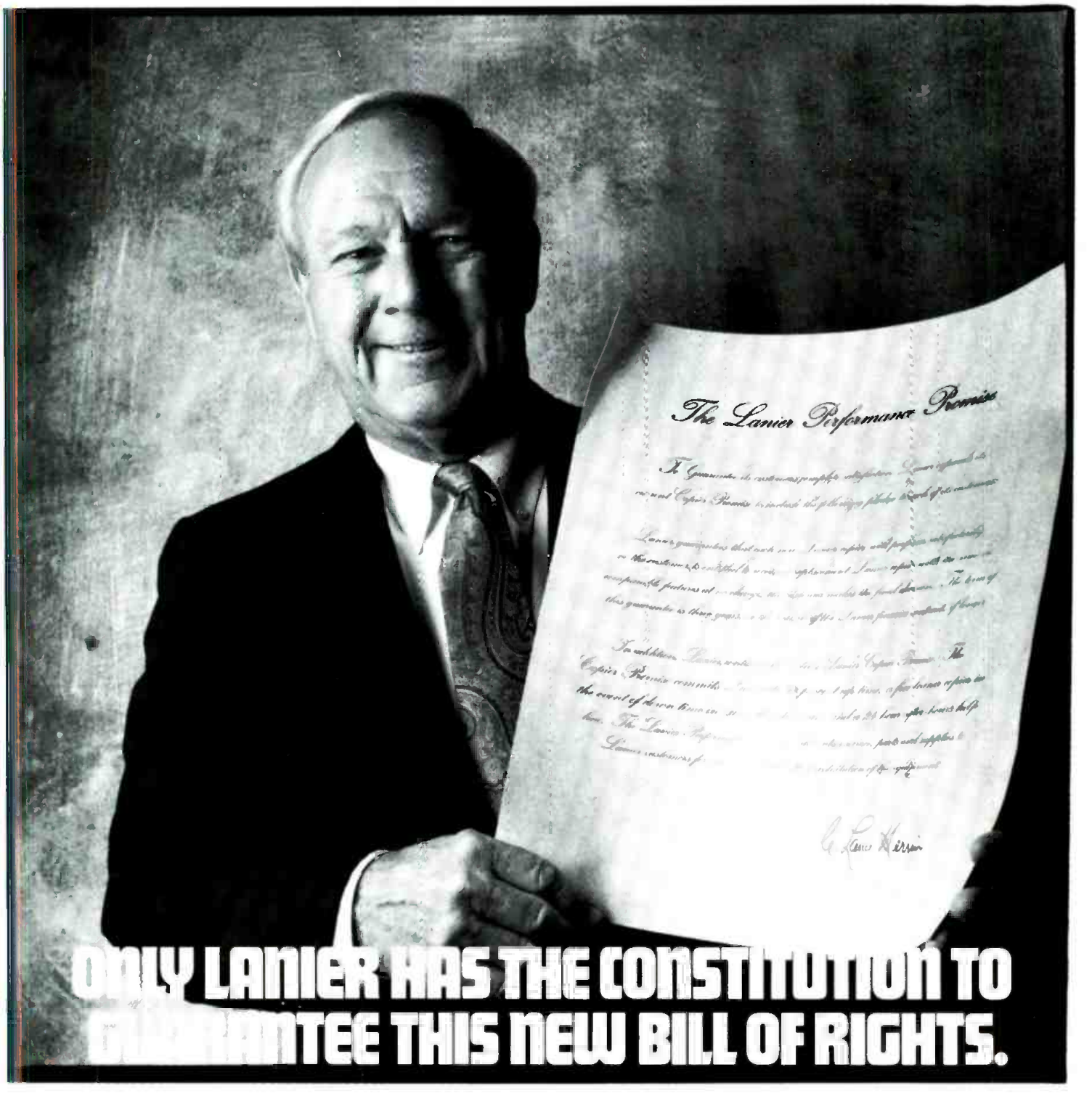
"I think HDTV for broadcasting will not be successful."

"We must win back lost viewers with better programming and local shows of interest. Give the viewers what they want."

"Does over-the-air broadcasting have much of a future?"

"Where did the viewers go and how do we get them back?"

Continued on page 73



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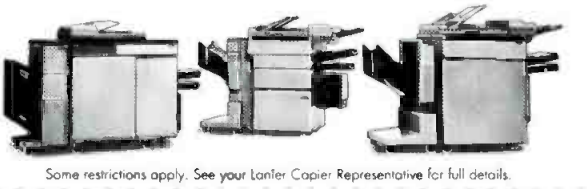

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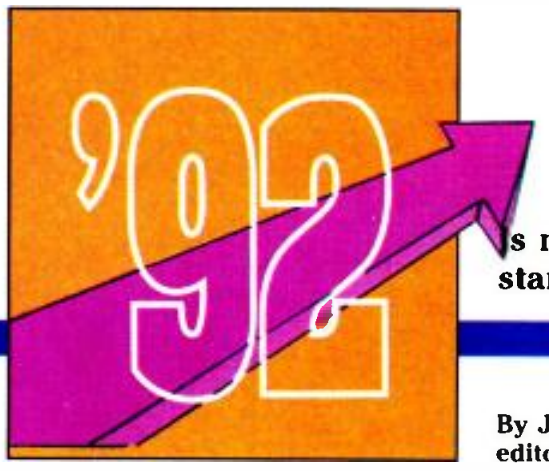

Is new technology moving too fast for the standardization process?

By Jerry Whitaker, editorial consultant

The world's first digital electronic computer was built with 18,000 vacuum tubes. It occupied an entire room, required 140kW of AC power, weighed 50 tons and cost approximately $1 million. Today, an entire computer can be built within a single piece of silicon about the size of a child's fingernail. And you can buy one at the local Radio Shack store for less than $10.

The progress of technology within our lifetime has produced dramatic changes in our lives and in our industry. Impressive as the current generation of microprocessor-controlled broadcast equipment is, we have seen only the beginning.

So if you liked the last decade, you'll love this one

Changing hardware trends

In raw numbers, the broadcast industry is small potatoes compared to other high-tech businesses. Research and development is extremely expensive, and is now born almost exclusively by manufacturers. The days of network-supported developmental labs are long gone.

Products today must be designed for more than a single market. Audio-video hardware intended for use at radio and TV stations must also be applicable to the post-production, recording studio and corporate/industrial markets. This wider customer base provides the promise of greater return on investment for equipment manufacturers, and lower prices to individual users. The downside is that the days of specialty and custom products for broadcasters are disappearing fast.

Love it or hate it?

Most technical managers at broadcast and production facilities have a love-hate relationship with new technology. They are thrilled by the numerous features of a new product, but terrified at the prospect of seeing the system they purchased at the last trade show rendered obsolete by some new development.

Love it or hate it, technology marches on at an ever-increasing rate. A typical development cycle today — from specifications to a deliverable product — runs two to three years, depending on the complexity of the system. Manufacturers are working to further reduce this cycle to permit faster response to industry needs.

Stan Baron, SMPTE engineering vice president.

This increasing pace of development represents a significant challenge to standardizing organizations around the world. SMPTE, the lead standardizing body for professional video, faces the particularly difficult chore of sorting out the many divergent views on digital recording, transfer and imaging.

To get a perspective on standardization work today, and how the process can be adapted to conform with changing technology, *Broadcast Engineering* conducted an in-depth interview with Stanley Baron, SMPTE engineering vice president. What follows are excerpts from that conversation.

Q: *How important is standardization work to the overall goals of SMPTE?*

A: Very simplistically, it is extremely important; it's one of the reasons the society was founded. The original goals were to provide for industry standardization and education. Those are two very important contributions.

Our charter is to make order out of chaos, and when we bring that order, there is benefit to both users and manufacturers. The manufacturer establishes the basis for a marketplace in which the user can have confidence. Standards provide manufacturers with access to the marketplace — customer confidence already exists. It is a benefit to the users because they know what they're buying. There are fewer mysteries with standardization.

Continued on page 36

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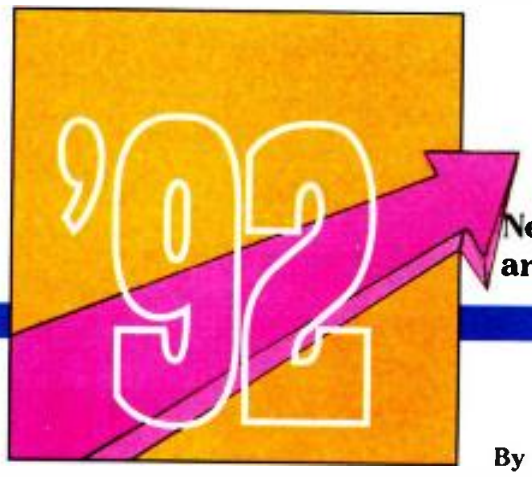

New technology means business — if its applications are understood.

By Skip Pizzi, technical editor

The Bottom Line

New technologies allow broadcasters to cut the cost of current operations and create new revenue streams in related services. Expenses can be reduced through the use of new telco offerings, automation, PC software and on-line services (instead of consultants), inclined-orbit satellite transmission and less power-hungry hardware.

Revenue-producing services include new opportunities for rental of tower and RF assets, rental of satellite, studio and remote facilities, new telemarketing options (including audiotext and 900 services) and upcoming wireless interactivity. The future holds even greater possibilities with multiple program streams via alternate delivery methods, including pay-per-view/listen and other interactive services.

In today's high-tech, fiercely competitive and recession-struck marketplace, traditional work roles are being reassigned within organizations, and not always willingly.

Broadcasting is just one among the many well-established industries exploring unconventional methods toward new growth. It is an industry in transition, and as such, many of its personnel are likely to find that their mandates from management have changed, engineering included.

Engineering is defined as the *application* of science. Today's broadcast technologists must reappraise their environments with renewed emphasis on such applications, using sound business sense. A business can be significantly strengthened through proper application of technology.

This evaluative process has two branches. The first branch involves a thorough assessment of available technology to better perform established operations. The second looks at what technology can do to fill unserved needs in the marketplace with new and profitable ancillary offerings.

Through both of these methods, new technologies can widen the gap between revenues and expenses at broadcast facilities. The place to begin is on the expense side of the ledger. Consider the following methods of reducing the cost of operations with "replacement technologies."

Cost-cutters

New telco services. After massive rate increases in the mid-1980s, it's a welcome trend to see reductions in cost for some audio and video program services being offered by most telephone companies. Although actual service and installation charges are decreasing, most of the savings are due to new data compression technologies that allow more program information to be transmitted through a given data circuit than was previously possible. Applications can include full-time (STLs, backups, news bureau lines, return paths, permanent remote sites) or part-time (remotes, ad-hoc networks) applications.

In most cases, data compression will need to be purchased by the station. Other terminal equipment may either be leased from telco or bought. The equipment cost (and any lease/purchase decisions) must be weighed against the savings in telco service charges that the hardware will provide. This is a classic capital budget vs. operating budget comparison, which some accounting processes may have difficulty reconciling in a straightforward manner. The important figure is how soon the cost of any new hardware will be amortized by the savings in telco charges.

Qualitative improvements are icing on the cake, although their competitive value should be stressed. Flexibility and the speed of installation and setup that these new services provide may also have competitive importance, along with their lower operating expenses, which may allow more frequent remotes at some stations.

The rapid and locally variable changes in this technology bear continued close

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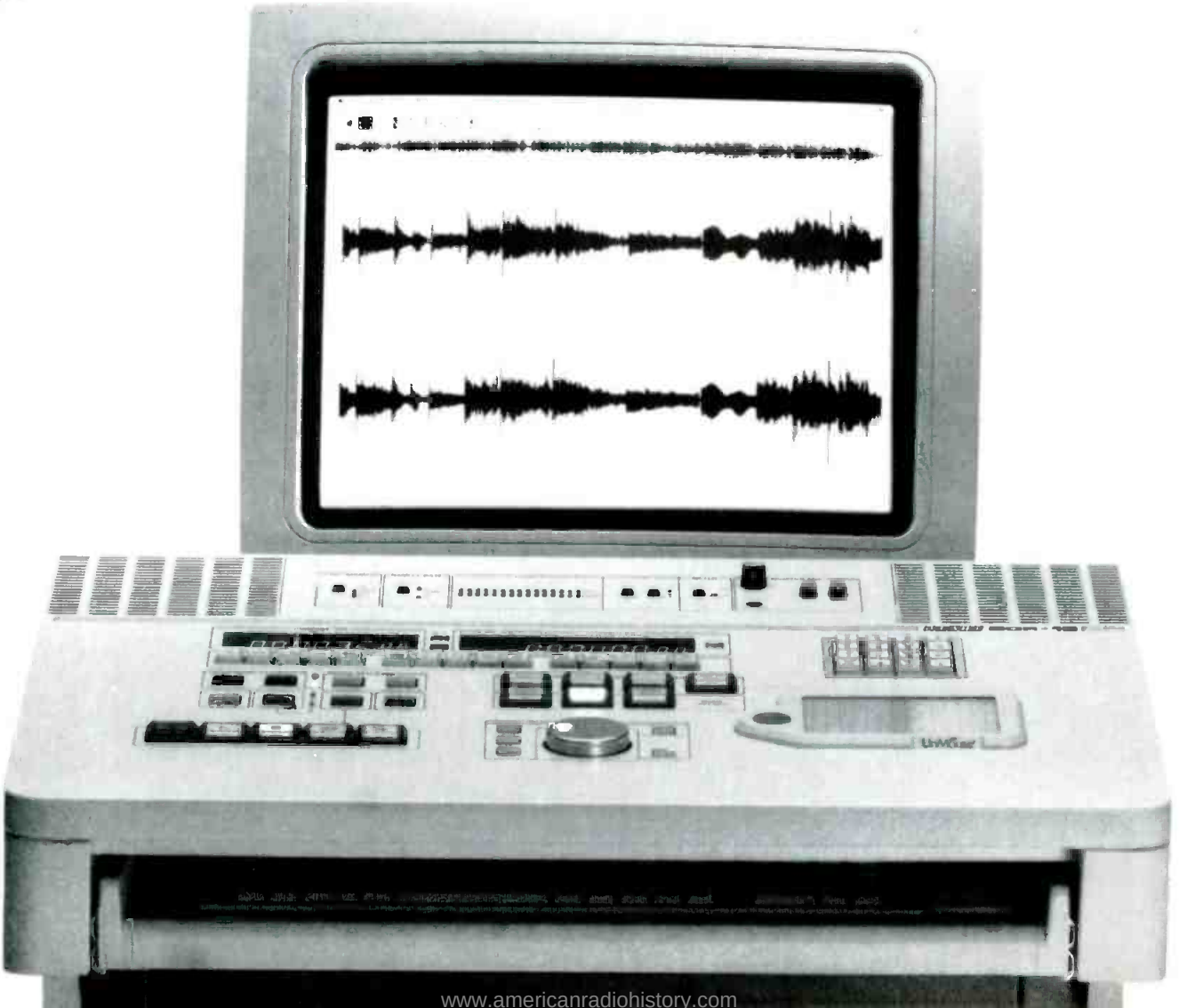

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Then there's our multi-tracks, from 32 tracks on down, at almost every price level – 8 machines, 12 different versions! And, of course, the CTM-10, a high performance cart machine we built for perfectionists, and an automated radio station reproducer.

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Continued from page 42

scrutiny by broadcasters. Telco sales forces are often surprisingly unaggressive in presenting these services to the broadcast market, so the burden falls upon the buyers to discern what savings may be had. Telcos will also avoid promotion of any compression hardware that they do not market themselves, and those devices are the key to much of the savings involved here.

However, data line brokerage services that can keep a station aware of conditions and rates in various markets do exist. These services operate on commission from the telcos, so their services are free to users. Typically, they are the best (i.e., easiest and often cheapest) way to book local and long-haul data lines. Engineers have a serious opportunity to score points with a little research and experimentation in this area. (See "Remotes Revisited," January 1991.)

Finally, digital compression can allow several stations to share an STL channel that used to be occupied only by a single station's feed. In markets where many stations share a common transmitter site, a station can profit from this technology by renting part of its STL channel to other stations. If the cost of getting signals across town to the STL studio head-end is not prohibitive, this will be advantageous to all stations involved.

Automation. Engineers should continually assess station operations. If simple, repetitive processes are being performed by the staff, they could be automated. Often, the station already owns sufficient computer hardware to do the job, and some new software or peripheral hardware may be all that is needed.

Consider a voice mail system to handle the office and/or studio/contest phones. Several such systems are designed to run in background mode on a desktop computer. After a short period of transition, most staffers will wonder how they got along without it (especially the receptionist). Plenty of options are available for these systems, so shop carefully, and invite the staff to offer system design suggestions. Current slowdowns in the projected growth of this marketplace mean that pricing will be favorable, but beware of an expected market shakeout among low-end operations. Future viability is important for support and upgrading of these systems.

Automation can certainly help in much of the administrative and traffic/logging operations, and there are plenty of systems from which to choose. Again, many operate on standard PCs. Investing in program automation systems is a more important decision, but remember that daypart-automation or live-assist options are possible as smaller increments to full-time, full-blown automation. (See the April 1991 issue, which deals with automation.)

A station's satellite equipment can be a significant profit center if properly marketed. (Courtesy of Teleport Minnesota.)

The most ambitious new designs attempt to completely integrate station operations — from production to master control to traffic and logging — into a single computer system.

PCs replacing consultants. Several software and/or on-line services are available that allow a broadcast station to serve itself in areas that traditionally required outside consulting. Among these are RF path and coverage prediction, frequency searches, population counts and other demographics, equipment maintenance data, air chain proofing, inventory control and facility design. (See "Engineering Software for PCs," October 1991.)

Inclined-orbit satellite use. An increasing number of satellites are in service with inclined orbits. These are satellites that have exhausted their station-keeping fuel, but maintain functional RF operations. Their orbits are no longer geostationary, but they are predictable, and easily tracked with appropriate receive dishes. Channel time on these birds is available at approximately half the price of regular service. Converting an uplink or downlink dish to the "step-tracking" operation required for inclined-orbit satellite tracking can pay off with sufficient usage over time.

Consumables assessment. Beyond community recycling programs, a broadcast facility goes through other items that may generate needless waste. What *really* needs to be archived on tape? How many of those tapes sitting on the office shelves are still timely and critical to keep?

Newer audio cartridge designs feature reduced friction, therefore requiring less frequent reloading or replacement. New digital storage systems incorporating DAT, computer hard disk or magneto-optical drives may offer efficiencies in cost and storage space for archiving or logging.

Recent transmitter designs also exhibit improved efficiencies over older models, providing monetary and environmental benefits from their reduced power consumption. Even something as simple as establishing rules and routines for turning off lights in unused rooms (including restrooms) and replacing HVAC-system filters can help. Be alert to any technical and physical plant functions that might lend themselves to such economies. They all add up.

Through proper application of technology, a business can be significantly strengthened.

New revenue opportunities

When it comes to considering new services, a business plan should be designed for each operation. Most new services will be related to the traditional functions of broadcasting, but some opportunities may stretch that connection. In any case, the first question should always be, "Will any new capital investment be required?"

Sometimes the answer is no. New revenue can be generated by simply taking a new marketing direction and using assets that a station already owns. In other cases, the facility will need to "spend money to make money," and that implies a risk venture. For those situations, a specific business plan — one backed by credible market research and conservative projection of return on investment — is absolutely essential. Consider the following possibilities at your facility:

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Tower rental. Business radio use of broadcast tower space continues to grow slowly, along with other 2-way services, cellular telephone, LPTV and paging. On the horizon are HDTV, digital radio and personal communication systems (PCS). The latter will require many antenna sites and associated feeder links. Even heavily loaded towers may be able to take advantage of PCS, because they will typically use small, lightweight antennas.

Baseband resources. Many FM and TV stations have already taken advantage of this valuable commodity by selling *subcarriers* or the *vertical blanking interval (VBI)* to other companies for distribution of programming or data to customers equipped with the necessary receivers. Coverage is generally equivalent to the station's main channel. Because VBI data is part of the NTSC video signal (on lines 10-20), it passes through cable systems and any other video distribution method.

FM subcarrier capacity has recently been increased up to four times by new encoding technology. Usage for audio programming is declining, while datacasting applications are increasing. (See "FM Subcarriers in the 1990s," October 1990.) VBI continues to be used for data only, typically as videotext. Data rates generally range up to 9.6kbit/s for an FM subcarrier and up to 19.2kbit/s for VBI. Both are cost-effective ways to distribute data from point-to-multipoint. Addressability is also possible.

More recently, *paging* systems have begun to use FM subcarriers. This can provide a lucrative return for no investment and little or no trouble. (Encoding hardware is provided by the paging company.)

The proposed *Radio Broadcast Data System* (RBDS), the latest U.S. incarnation of the European RDS format, will also incorporate paging of some sort on its 57kHz FM subcarrier. RBDS also provides a function called Radiotext (RT), which would provide appropriately equipped receivers with text data. This text might be program related (name of cut now playing, request line number). However, it could also be sold as advertising, either adjunct to a spot on the air at the time (showing the advertiser's phone number or "today's specials") or as a completely independent advertising stream.

The system includes comprehensive emergency alerting features that an RBDS-equipped station could market to government or private industry for their disaster-response needs.

RDS is already in use in Europe, and RBDS could be up and running in the United States as early as 1992. Receivers are ready for domestic deployment, but have not yet been distributed. Some final RBDS format details are still under discussion. These involve the important matters of how paging will work (especially how current MBS paging systems that also use the 57kHz subcarrier will be accommodated), and by what names an RBDS receiver will identify radio stations' formats. Also contentious is RBDS' FM-only nature, with no equivalent AM system in the works.

Finally, the *second audio program* (SAP) channel found in all MTS stereo TV signals is another marketable piece of RF real estate. Any MTS-equipped VCR or television can receive it, and those VCRs can also record it. At present, it is used primarily for public service functions, such as PBS' *Descriptive Video Service* (DVS), which provides narration for visually impaired members of the TV audience. In some bilingual markets,the SAP channel is used for second language soundtracks or announcements.

Again, SAP audio need not be program-related, and a few have experimented with around-the-clock weather and other services. (SAP provides a quiet, 15kHz mono audio signal.) C-SPAN uses it to provide an audio program guide, running continuously and updated six times a day. The SAP channel could eventually provide another revenue-producing vehicle for advertising or other sponsored services appropriate to a mass audience (as opposed to the more closed-circuit nature of subcarriers or VBI).

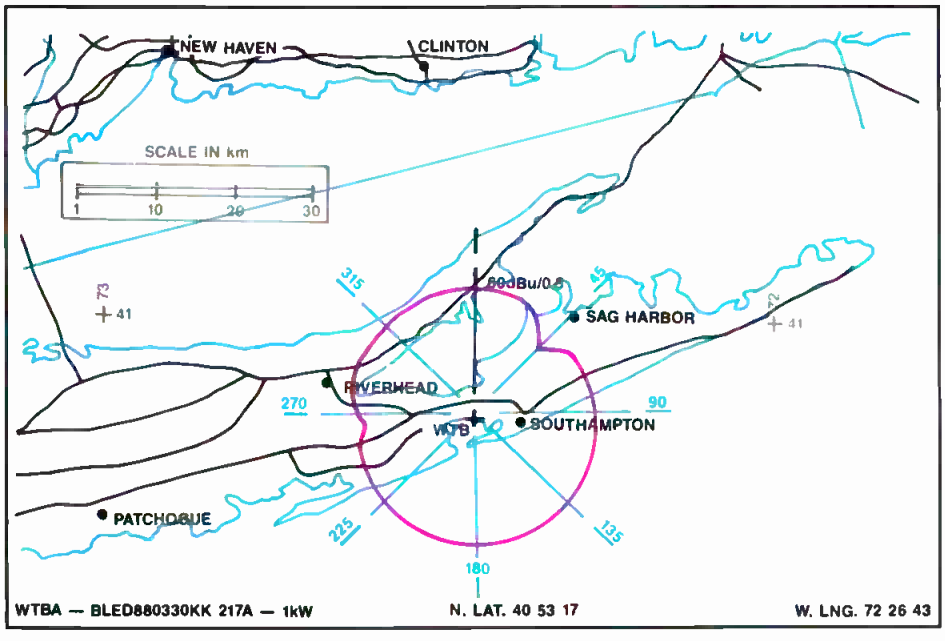
Satellite transmission. If a station owns audio or video satellite equipment, there may be money to be made from its use by outside clients. Fixed uplinks or downlinks can transmit or receive programs for customers that are played back or recorded on station equipment, or passed through in real time via phone lines or other terrestrial paths (the so-called "first mile" or "last mile" connections). Data transmissions are also a possibility. Mobile uplinks can be even more valuable for rental to other users. (See "Engineering Can Be a Profit Center," October 1991.)

Audio or teleproduction facilities in your town may even use this service to distribute advertising or demo material to their clients quickly, or to import distant voice talent into a local session. Sports backhaul and other events of national or regional interest are other opportunities for outside clients to use this equipment.

Facility rental. Often, a station will have more technical equipment and staff on hand than it needs. This facility can be put to work for outside clients and provide a significant revenue stream. A popular application for a TV station's studio or remote equipment is its use for business TV feeds or corporate videoconferencing. Studios can also be used for promotional or training audio and video recordings or their post-production. Offering a turnkey package to a company that doesn't have its own teleconferencing or production facility can be an attractive and cost-effective proposition to the client. It also puts idle station resources to good use. (See "Engineering Profit Centers," April 1991.)

A couple of caveats here: Teleconferencing relies heavily on a few techniques that broadcast television rarely uses, and may require some specialized hardware and techniques foreign to standard ENG work. Furthermore, be careful not to overbook these facilities, or to book them in conflict with primary station needs.

Other facility rental possibilities include test and measurement services for stations less well-endowed with test gear, the provision of real time weather radar data to public safety agencies (the station's system may outclass the local weather service's



A number of PC software and on-line services can help a station provide its own research data, rather than relying on expensive consultants. Here, station coverage is displayed by a color plotter. (Courtesy of Doug Vernier, Broadcast Consultant.)

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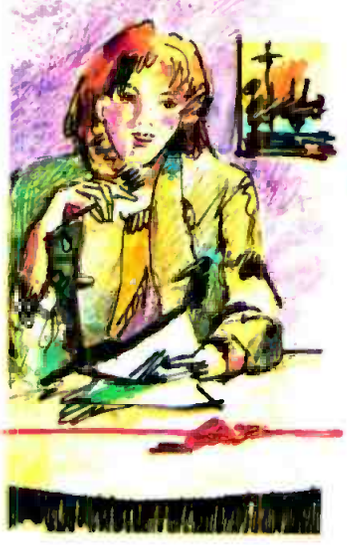

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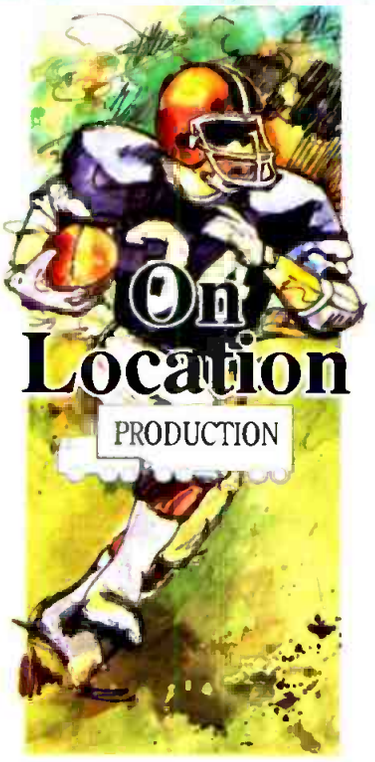

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That's why we designed an entirely new scanner for our D2 machines. And we managed to do it with an effective wrap angle of less than 180 degrees, so only one pair of heads is on the tape at any time. And we need only four head pairs for record/play versus sixteen heads for D1.

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Continued from page 48
or the airport's) or, for stations with closed-caption origination hardware, the captioning of industrial or other preproduced videos.

Telemarketing. Another lucrative new direction that broadcasters are exploring involves two elements with which the industry is quite familiar: audio and the telephone. As a spinoff of a station's voice mail system, an *audiotext* function can be established. Listeners call a number that connects them with an automated operator, who presents them with a menu of choices. The listener chooses a message from the menu by pressing a touch-tone digit.

The messages can contain a wide variety of information, typically related to the station's regular programming. Recordings are made by station air talent using existing station facilities. Examples range from weather forecasts read by a TV station's meteorologist to entertainment calendars read by a popular DJ. These services could also be read by off-premise announcers who call in their updates by phone. For example, a local ski shop could handle ski reports, a travel agency could do weather reports for major cities around the country, a movie theater could present show times and synopses of current feature films and so on.

Other ideas include sports scores read by a station sportscaster, mortgage rate updates presented by a local bank or real estate agency, business news from a brokerage house and road construction reports by an automotive concern or the daily traffic reporter/company. Station talent could also read winning lottery numbers or present restaurant listings and reviews.

These all present sales opportunities for the station, either as stand-alone placements or in conjunction with an on-air flight. Production is fast, simple and cheap. Services and the phone number(s) to call are promoted on the air and in print ads that the station or sponsors may run.

From a competitive perspective, consider that newspapers and other print media have started to invest heavily in audiotext, primarily to counteract the immediacy that their electronic competition (broadcasting) enjoys. It's a much easier move for broadcasters to incorporate this same service, and minimize any competitive advantage that print media may attempt to gain with audiotext.

Beyond sponsored messages, a related revenue-producing telephone option is the use of a 900 service. In this case, the listener is prompted by on-air announcements to call a 900 number and respond to a poll or hear a special message of interest. A charge for the call appears on the caller's next phone bill, and the station receives a portion of that fee. Polling data that may result from these calls can also be of use in on-air reporting or for market research.

Setting up a 900 service is simple and quick. Many companies offer such services for a small percentage of the proceeds. A station need only call and place an order, setting the cost of each call, the start and stop times, and the parameters of the response (touch-tone digit[s] or verbal reply). The station is given its 900 number by the service, and operation can begin almost immediately. Alternatively, computer hardware is available to operate a 900 service in-house, using lines ordered directly from the local telco.

Typically, a 900-line message will not include advertising, because the caller is paying for the call (unlike audiotext, in which the call is free). In this case, the 900 line should offer some information or opportunity of value to the caller, such as a request line, a political survey or comment line, entertainment reviews, business news or sports scores, or short features or interviews with celebrities.

A prototype car radio equipped with an RDS display shows information about the station currently tuned in. Home receivers will incorporate larger alphanumeric displays for the RDS "radiotext" (RT) feature.

An additional revenue-producing function of a 900 service involves its use of real time *automatic number identification* (ANI). Using this technology, the telephone or 900 service company can provide a list of the callers' names and addresses to the station. (These listings are reverse-matched from the callers' numbers, which are recorded by the telephone company for billing purposes immediately after each call.) The station can in turn market and rent/sell these lists to clients who may value the information. This makes the 900 service a doubly lucrative proposition.

Because some 900 lines have, in the past, been operated by members of the "ethically impaired," the service has gotten a bad reputation. The majority of 900-line operations are strictly legitimate business ventures, however, and it is important to keep your station's 900 offerings in this class. Make sure the per-minute rates are clearly stated whenever the 900 number is mentioned or shown on the air.

Wireless interactive television. An interactive over-the-air TV service may be in broadcast TV's future. The FCC is currently considering allocation of 500kHz of highband VHF spectrum (218MHz-218.5MHz) for "interactive video and data systems," which would allow TV viewers to respond to survey questions or order merchandise via a transmitter adjacent to their set.

This service would afford a measure of interactivity to broadcast TV stations that is currently only available in some cable TV systems, and may provide an opportunity for additional station revenue, plus another value-added offering to advertisers. Technology currently proposed for this service would require a 250kHz-wide channel, allowing only two such operations in any market, however. Final FCC action authorizing this service is expected soon, with service beginning as soon as mid-1992.

Satellite trucks, such as this one, can sometimes be used effectively to produce addtional income. The truck and crew can be rented to other stations or networks for temporary use. (Photo courtesy of Wolf Coach.)

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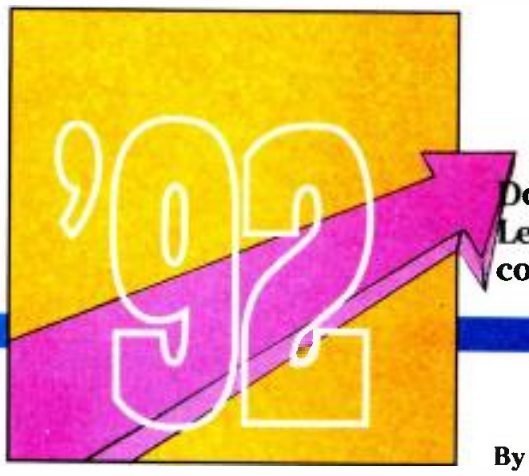
FM intermodulation effects: A case study



Don't let RITOIE interfere with your station's frequency. Learn the legal and technical issues behind this complicated electrical interference.

By Robert D. Greenberg

The Bottom Line

You can lose part of your audience because of a mysterious electrical interference called RITOIE. This complicated phenomena occurs when stations' signals interact inside listeners' radios. RITOIE is typically an engineering matter. But when it occurs, it may quickly escalate into a legal battle. This makes it important to determine who is responsible for clearing it up. Knowing the legal issues and technical issues surrounding RITOIE can help you save market share and money.

$

Imagine you are driving down the highway, and the signal from your FM station disappears as if you were entering a tunnel — only there is no tunnel. You may be experiencing a phenomena called RITOIE[1], which occurs when signals from two stations interact inside a receiver. This may generate a new signal on a third frequency. If this signal falls on your station's operating frequency, it can disrupt reception.

RITOIE interference may significantly alter the number of listeners who can receive your station. Therefore, it is important to know who is responsible for causing and resolving this objectionable interference.

RITOIE was the subject of a Federal Communications Commission (FCC) memorandum opinion and order (MO&O — FCC 91-3) adopted Jan. 2, 1991. The MO&O created new case law on the subject. The following case history describes RITOIE, and some of the circumstances and decisions behind the adoption of this MO&O.

A major minor change

In March 1988, WKLX-FM, Rochester, NY, filed a minor change application. The station requested permission to move 6.6 miles, and co-locate with WRMM-FM. The request was granted. The station began automatic program test authority (PTA) in late April, filing its license application May 6, 1988 (BLH-880506KB).

Greenberg is a supervisory engineer with the Federal Communications Commission, Washington, DC.

Soon, WCMF-FM, Rochester, NY, began receiving RITOIE interference. The commission ordered WKLX to return briefly to its licensed site while the Buffalo field office investigated the interference. After the investigation, WKLX was allowed to return to the new site, and was granted limited program test authority.

The distance between the WKLX and WCMF sites is 5.1 miles. The blanketing contour for WKLX is 1.5 miles. (See Figure 1.) RITOIE arose in this case because the carriers of WKLX (98.9MHz) and WRMM (101.3MHz) form a 2-frequency third-order intermodulation product at 96.5MHz ($98.9 \times 2 - 101.3 = 96.5$), which is co-channel with WCMF. (See Table 1.)

The arguments

WCMF claimed it received objectionable RITOIE interference when WKLX began PTA operations at its new site, in spite of WKLX's claims to have fixed the problem. Therefore, WCMF filed an informal objection to WKLX's pending license application. WCMF complained that many of WKLX's fixes were likely to be undone by listeners wanting to receive stations other than WCMF. Furthermore, nothing had been done about complaints involving mobile receivers. (Many of the mobile receiver complaints originated near the I-490/I-390 interchange.)

WKLX responded that it had resolved every verified complaint concerning reception of WCMF's signal on non-mobile radios. There were 836 complaints, 164 of which involved non-mobile receivers.

In November 1988, the chief of the Au-

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dio Services Division found that although WKLX's move to its new site had initially resulted in RITOIE-based service disruption, its efforts to resolve the problem were sufficient to fully discharge its responsibility in the matter. The Mass Media Bureau upheld WKLX's exclusion of mobile and battery-powered receivers from its RITOIE resolution efforts. Accordingly, the bureau granted WKLX's license application and denied WCMF's informal objection.

WCMF requested reconsideration, arguing that WKLX made a material misrepresentation in its application by claiming no RITOIE interference would result from its proposed move. The station also claimed that to grant WKLX's license, with the attendant RITOIE, was, in effect, a modification of WCMF's license without notice and opportunity to be heard. Furthermore, WCMF claimed that the bureau had erred in finding that WKLX's anti-RITOIE efforts were sufficient. The bureau's decision to exclude mobile and battery-powered receivers from the scope of WKLX's RITOIE resolution program violated commission precedent. It also argued that the finding lacked the reasoned decision making required by the Administrative Procedures Act (APA). This act requires the bureau to proceed with reasoned decisions, supported by substantial evidence, and to explain fully all

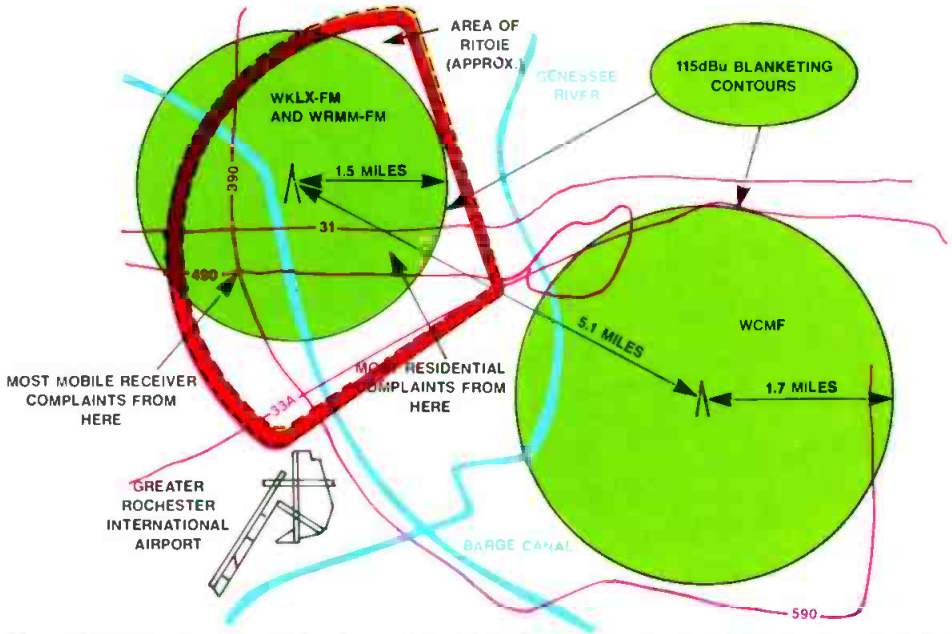

Figure 1. The approximate locations of WKLX-FM, WRMM-FM and WCMF-FM. Most of the RITOIE occurred on a bearing between the two sites, but closer to the WKLX antenna.

departures from earlier rules.

WCMF requested that the commission designate the WKLX license for hearing, and determine whether allowing such RITOIE would be in the public interest. The station also requested that the commission suspend WKLX's PTA and force WKLX to return to its former transmitter site.

The issues

License modification. WCMF claimed that RITOIE caused an indirect license modification in violation of Section 316 of the Communications Act. The interaction of the WKLX and WRMM operating frequencies within certain receivers generates a signal on the same frequency as WCMF. This means WCMF can't be received on many receivers within its protected contour.

WKLX argued that Section 316 covers situations in which one licensed broadcast facility directly causes a permanent loss of a radio service that listeners are accustomed to receiving. RITOIE interference, as an indirect license modification, doesn't count.

The commission found that WCMF was not entitled to a hearing under Section 316. Disruption by undesired signals, not dependent upon receiver characteristics, may create a Section 316 right if uncorrected. In this case, the transmitted signals complied with all emission standards and requirements. The commission does not believe service disruption to particular receivers, because of their particular design, establishes a prima facie case of license modification.

WKLX = 98.9MHz
WRMM = 101.3MHz
WCMF = 96.5MHz
WKLX × 2 – WRMM = WCMF
(98.9) × 2 – 101.3 = 96.5MHz

Table 1. *The channel relationship that lead to RITOIE in 164 non-mobile receivers in the Rochester, NY, area.*

The commission does not believe that service disruption to particular receivers, because of their particular design, establishes a prima facie case of license modification.

However, where such reception problems occur after a station begins operation, the commission may find it in the public interest to require resolution of individual complaints. WKLX had taken appropriate measures, which typically include re-orientation of receivers and antennas, replacing of receivers with different models not affected by RITOIE, or installation of filters or shielding. WCMF submitted no supporting documentation with its informal objection to show that there were any new, unresolved non-mobile service disruption complaints.

Service disruption: non-mobile receivers. WCMF argued that the bureau erred in ruling that WKLX had fully discharged its responsibilities in this matter. WCMF claimed that WKLX should eliminate the interference, not just address some reported cases of it. The station contended that in order to eliminate the RITOIE disruption, the commission should deny WKLX's license application and require WKLX to return to its former site. Alternatively, WCMF should be permitted to move to the same tower as WKLX at WKLX's expense.

Two previous actions involving objec-

tionable interference, *Midnight Sun* (Midnight Sun Broadcasting vs. FCC, 11 FCC 1119, 1947) and *Sudbrink* (Sudbrink Broadcasting of Georgia vs. FCC, 65 FCC 2d 691, 1977), may have supported such a claim. WKLX countered that although these cases require elimination of objectionable interference, they do not require WKLX to resolve the interference beyond addressing the reported cases. Furthermore, they impose no moral or financial responsibility to provide a solution that permanently eliminates the interference.

RITOIE occurs when signals from two stations generate a third signal within a receiver that disrupts the reception of any station on the same frequency. Therefore, RITOIE effects are similar to blanketing, but different in origin.

WKLX asserted that *Midnight Sun* only obligates the newcomer to satisfy any complaints of interaction. *Sudbrink*, although recognizing a station's financial responsibility to resolve interaction between transmitting facilities, emphasizes that the paying licensee need not incur excessive and needless costs. WKLX claims it had satisfied the interference complaints in compliance with *Midnight Sun*. Relocating WCMF's transmitter would, therefore, result in the excessive and needless costs that *Sudbrink* holds as voluntary.

The commission has consistently found it in the public interest that newcomers make reasonable efforts to alleviate RITOIE-based service disruptions. Resolving disruptions on a complaint-by-complaint basis has been established as consistent with *Sudbrink*. Accordingly, WKLX was ordered to resolve the RITOIE complaints.

In a letter dated Sept. 29, 1988, WKLX stated that it had resolved every verified complaint it had received concerning reception of WCMF's signal on non-mobile radios. In a letter dated Nov. 7, 1988, the bureau accepted this showing, finding WKLX's efforts to be sufficient. Accordingly, the commission affirmed that WKLX had satisfactorily cured the service disruption to WCMF's signal regarding non-mobile receivers.

Service disruption: mobile and battery-powered receivers. WCMF argued that the bureau erred by allowing WKLX to exclude mobile and battery-powered

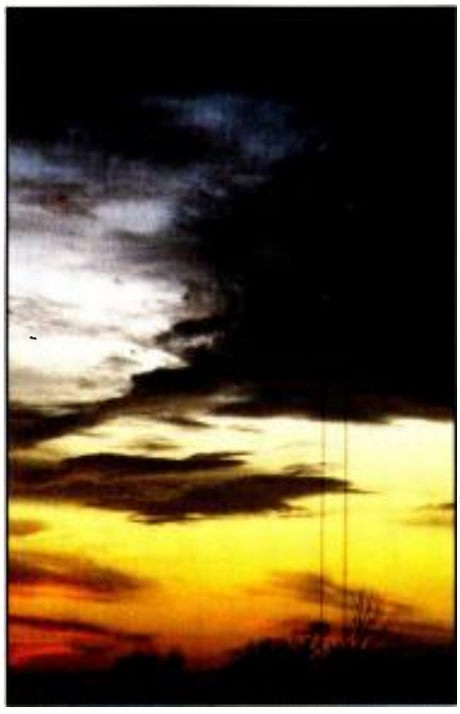

Photo courtesy of Utility Tower

receivers from its RITOIE resolution program. The exclusion relied on a commission ruling excluding mobile receivers from consideration when dealing with FM blanketing interference. WCMF claimed that because RITOIE and blanketing are significantly different, the ruling violated the Administrative Procedures Act.

WCMF also claimed that mobile receivers are contained in vehicles. To include battery-powered receivers in the same category is without precedent.

WCMF requested that the commission designate the WKLX license for hearing, and determine whether allowing such RITOIE would be in the public interest. The station also requested that the commission suspend WKLX's PTA and force WKLX to return to its former transmitter site.

WKLX argued that the bureau's ruling met all the requirements of the APA and was therefore correct. WKLX noted it had voluntarily rectified interference problems of home portable radios where their locations were reasonably constant.

The commission reviewed the matter and found that excluding mobile and battery-powered receivers was not a departure from precedent. Therefore, it was not a violation of the APA.

In the past, the commission has excluded mobile receivers from consideration in problems, such as blanketing interference. The commission did not include RITOIE under the blanketing interference rulemaking because it was not within that rulemaking's scope.

The commission defines blanketing as interference that occurs when an FM station's signal is of such magnitude that it partially or completely blocks receivers near the transmitting antenna from receiving other broadcast stations. In contrast, RITOIE occurs when signals from two stations generate a third signal within a receiver that disrupts the reception of any station on the same frequency. Thus, RITOIE effects are similar to blanketing, but different in origin. The commission's decision not to include RITOIE under the scope of the blanketing rulemaking was an acknowledgment that notice had not been given regarding RITOIE. It did not preclude similar treatment of RITOIE where similar treatment was warranted. Nothing in the APA stops the commission from using the principles set forth in a rulemaking decision to decide a similar issue.

Mobile receivers were excluded from the blanketing rulemaking because such receivers are transient. Moving through the potential interference area, a mobile receiver will encounter constantly varying propagation paths and signal strengths.

Mobile receivers were excluded from the blanketing rulemaking because such receivers are transient. Moving through the potential interference area, a mobile receiver will encounter constantly varying propagation paths and signal strengths. This also applies with RITOIE. Battery-powered receivers are also inherently transient. Excluding them from the scope of blanketing and RITOIE resolution efforts is equally justified.

License granted

The commission found that the bureau's positions were sound. Therefore, it denied WCMF's petition for reconsideration, and it affirmed WKLX's license grant.

When RITOIE arises, it quickly becomes a legal issue — not just a technical issue. It is important for engineers and managers to understand the legal foundations upon which such decisions are based.

Editor's note The opinions expressed by the author are not necessarily those of the Federal Communications Commission.

Footnote:

1. **RITOIE** (ri-tü-ē) stands for receiver-induced third-order intermodulation effects.

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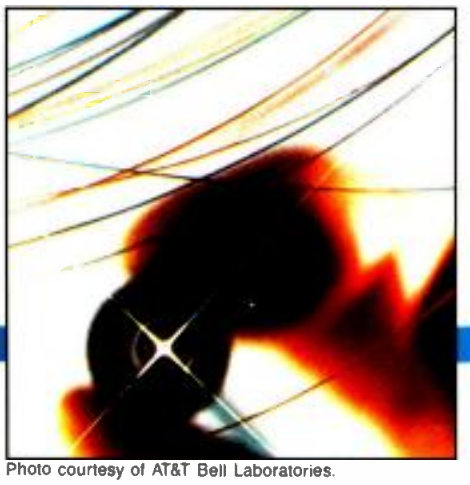

Photo courtesy of AT&T Bell Laboratories.

The advantages of fiber outweigh the complex design process. This is Part 2 of a 3-part series.

By Brad Dick, editor

The Bottom Line

Fiber-optic (FO) cable is no longer a mystery technology. Today, FO cable is used in many broadcast and production applications. Why? Because it provides cost-effective transmission of audio and video signals, often with no loss in quality.

A single fiber cable can carry many, perhaps hundreds, of signals in a wire smaller than standard coax. The result can be lower installation costs — and plenty of bandwidth for future growth.

If your facility isn't using fiber, look for potential applications. Designing your own system might solve many of today's — and tomorrow's — problems.

The use of fiber in video applications is growing by record amounts. Even if you don't use fiber-optic cable in your station or production facility, get ready, because it's coming.

S

Last month, in Part 1, the important basic terms used in fiber-optic cable were reviewed and the construction of fiber cable was detailed. Part 2 will lead you through the design process and show you how to set basic mechanical and environmental specifications.

Completing the specifications

In order to specify completely a fiber-optic cable, you need to define at least 38 specifications. (Don't worry, it's not as difficult as it might seem.) To organize these 38 specifications, they will be divided into two main groups, each of which is further subdivided into subgroups. These two main groups are *cable* specifications and *fiber* or *optical* specifications. Cable specifications will be examined in this section. Fiber or optical specifications will be addressed later.

The cable specifications are divided into two subgroups: *installation* and *environmental* specifications. The various specifications are grouped by category, as shown in Table 1.

Note that not all specifications apply to all situations. You will need to review your application to determine which of the specifications are applicable to your system's requirements. For example, cable installed in conduit or in protected locations will not need to meet a crush load specification.

Installation specifications

The installation specifications are those that must be met to ensure successful installation of the cable. There are six such specifications, which include:

- maximum installation load in kg-force or pounds-force
- minimum installation bend radius in inches or millimeters
- diameter of the cable
- diameter of subcables or elements
- recommended temperature range for installation (°C)
- recommended temperature range for storage (°C)

Maximum installation load. This is the maximum tensile load that can be applied to a cable without causing a permanent change in attenuation or fiber breakage. This characteristic must always be specified. Load values for some typical types of installations are shown in Table 2.

If your application will require a strength higher than those listed, just specify a higher strength cable. The increased cost of specifying a higher strength cable is small, typically 5%-10% of the cable cost.

Minimum installation bend radius. This is the minimum bend radius to which the cable can be bent while loaded at the maximum installation load. This bending can be done without causing a permanent change in attenuation, fiber breakage or breakage of any portion of the cable structure. This bend radius is usually specified as being no less than 20 times the cable diameter.

To determine this value, examine the locations where the cable will be installed, and identify the smallest bend the cable will encounter. Conversely, you can choose the cable and then specify that the

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INSTALLATION SPECIFICATIONS

- Maximum recommended installation load
- Minimum installation bend radius
- Cable diameter
- Diameter of subcables
- Maximum installation temperature range
- Maximum storage temperature range

ENVIRONMENTAL SPECIFICATIONS

- Temperature range of operation
- Minimum recommended unloaded bend radius
- Minimum long-term bend radius
- Maximum long-term use load
- Vertical rise
- National Electric Code or local electrical code requirements
- Flame resistance
- UV stability or UV resistance
- Resistance to rodent damage
- Resistance to water damage
- TEMPEST-rating
- Crushing characteristics
- Resistance to conduction under high-voltage fields
- Toxicity
- High flexibility/static vs. dynamic applications
- Abrasion resistance
- Resistance to solvents, petrochemicals and other chemicals
- Hermetically sealed fiber
- Radiation resistance
- Impact resistance
- Gas permeability
- Stability of filling compounds

FIBER SPECIFICATIONS

Dimensional specifications:
- Core diameter
- Clad diameter
- Buffer coating diameter
- Mode field diameter

OPTICAL SPECIFICATIONS

Power specifications:
- Core diameter
- Numerical aperture
- Attenuate rate
- Cut-off wavelength

Capacity specifications:
- Bandwidth-distance product (dispersion)
- Zero-dispersion wavelength

Table 1. *Fiber cable specifications are broken into two general areas: cable and fiber. Each of the areas are further broken into design specifications. When building a system, each of these factors must be carefully considered.*

conduits or ducts do not violate this radius. This radius is actually limited more by the cabling materials than by the bend radius of the fiber itself.

Cable diameter. Despite the space-effective nature of FO cable, it still must reside in the available space. This is especially true if the cable is to be installed in a partially filled conduit. If the cable diameter is limited by the space available, then the diameter limits may be the only factor that determines which of the five designs from which you must choose. When faced with limited space, look first at an MFPT design. It requires the least amount of space.

Diameter of subcables or elements. The diameter of the subcable or of the cable elements can become a limiting factor. In the case of a *breakout*-style cable, the diameter of the subcable must be smaller than the maximum diameter of the connector boot so that the boot will fit on the subcable. In addition, the diameter of the element must be less than the maximum diameter acceptable to the backshell of the connector. Most breakout cables have tight-tube elements, usually with a diameter of 1mm or less.

Maximum installation temperature range. All cables have a temperature range within which they can be installed without damage to either the cable materials or the fibers. In general, the cable materials restrict the temperature range more than the fibers do.

Not all cable manufacturers include this parameter in their data sheets. In these cases, select a more conservative temperature range of operation.

Maximum storage temperature range. In severe climates, such as deserts and the arctic, you need to specify a recommended temperature range for storage in °C. This range will strongly influence the materials used in the cable.

Environmental specifications

The environmental specifications are those which must be met to ensure successful long-term operation of the cable. There are 22 factors that should be considered when designing an FO system. Refer to Table 1 for the complete list.

Because of space limitations, detailed discussions of all 22 environmental specifications will not be covered. A thorough review of these parameters is contained in the publication, "How to Specify and Choose Fiber-Optic Cables," on which this article is based. For more information about this publication, see the Editor's note at the end of this article.

However, some environmental specifications need special attention. The follow-

TYPICAL MAXIMUM RECOMMENDED INSTALLATION LOADS

Application	Pounds force
1 fiber in raceway or tray	67lb.
1 fiber in duct or conduit	125lb.
2 fibers in duct or conduit	250-500lb.
Multifiber (6-12) cables	500lb.
Direct burial cables	600-800lb.
Lashed aerial cables	>300lb.
Self-support aerial cables	>600

Table 2. *Although fiber cable is durable, care must be given to the loads placed on it during installation. The table lists typical loads the cable might encounter in certain application environments.*

ing factors are especially applicable to broadcast applications:

Temperature range of operation. This is the temperature range within which the attenuation remains less than the specified value. There are few applications where FO cable cannot be used because of temperature considerations. In fact, some cables have coatings that will survive continuous operation at 400°C.

There are two reasons why you must consider the temperature range of operation. The first is physical survival of the cable. The second is the increase of attenuation within the fiber when it is exposed to extreme temperatures. Let's see why that is the case.

All FO cables are composed of plastic materials, which have temperatures above and below which they will not retain their mechanical properties. After long exposures to high temperatures, plastics deteriorate and become soft. Some materials will begin to crack. After exposures to low temperatures, plastics may become brittle and crack when flexed or moved. Under such conditions, the cable coverings would cease to protect the fiber.

Another reason for considering the temperature range of operation is the increase in attenuation that occurs when fibers are exposed to temperature extremes. This sensitivity is seen when the fibers are bent.

When a cable is subject to extremes of temperature, the plastic materials will expand and contract. The rates at which the expansion and contraction take place are much greater (perhaps a 100 times) than the rates of the glass fibers. This movement results in the fiber being bent at a microscopic level. The fiber is either forced against the inside of the plastic tube as the plastic contracts, or the fiber is stretched against the inside of the tube as the plastic expands.

In either case, the fiber is forced to conform to the microscopically uneven surface of the plastic. On a microscopic level, this is similar to placing the fiber against sandpaper. The bending results in light escaping from the core of the fiber. The outcome is an increase in attenuation, referred to as a *microbend-induced increase in attenuation.*

TYPICAL MAXIMUM RECOMMENDED USE LOADS

Application	Pounds force
1 fiber in raceway or tray	23-35lb.
1 fiber in duct or conduit	67lb.
2 fiber in duct or conduit	67lb.
Multifiber (6-12) cables	33-330lb.
Direct burial cables	132-180lb.

Table 3. *The amount of load placed on the fiber cable over the long term is important and must be considered in the design phase. The table lists typical loads a cable might encounter in some applications.*

Minimum long-term bend radius. This represents the minimum bend radius to which the cable can be bent for its entire lifetime. It is usually specified as being no less than 10 times the diameter of the cable.

Maximum long-term use load. Most FO cables are designed for unloaded use. However, substantial loading occurs when cables are strung outdoors between poles or hangers or mounted on broadcast towers. In these cases, the cables are subject to self-loads and to additional loads from the environment, such as wind, snow and ice. The actual load experienced by the

cable is primarily dependent upon the spacing between hangers.

It's important to specify the correct long-term use load characteristic so that the strain applied to the cable does not exceed a critical value. If this critical value is exceeded, it is likely that the fiber(s) will spontaneously, and for no apparent reason, break. The long-term use load depends upon the design and construction of the cable, but typically runs 10%-30% of the maximum recommended installation load.

If the cable will experience a significant long-term use load, this specification will be more important than the maximum installation load. *Self-support* cables are available from several manufacturers and are used by power utilities for suspensions as long as 3,000 feet. In these cases, the maximum span length is specified instead of the long-term use load. Typical long-term use loads are shown in Table 3.

Vertical rise distance. The vertical rise distance is related to the maximum use load. When cables are installed in a riser (within a building) or along a long vertical length, such as up a tower, the self-weight of the cable imposes a load on the cable. This load must be less than the maximum use load. Typical vertical rise distances for some cables are shown in Table 4.

UV resistance. Outdoor installations require that the cables be UV resistant or *UV stable*. Otherwise, the cable jacket will crack and lose flexibility when exposed to sunlight. Most cables for outdoor use rely on a black polyethylene jacketing material, which has a built-in UV-absorbing capability and no plasticizers that can evaporate over time.

Crush loads. The crush load is the maximum pressure that can be applied perpendicular to the cable's axis without causing a permanent increase in attenuation or fiber breakage. Two types of crush loads include short term and long term. Short term can mean during installation or during use. The long-term crush load is a load that might be applied continuously during the life of the cable.

In many applications, the crush load consideration is not important. Experience has shown that most of the cable products available today have crush performance sufficient to meet the needs of the typical user.

However, ENG and remote production applications require additional thought. These environments may place the cable in situations where it is run over by cars and trucks or even a 250-pound spiked-shoe football player.

If there's a chance that the cable may be crushed, you have to decide if the crush load is likely to be a short-term or a long-term condition. If it's a short-term condition, you will have two basic concerns: first, that the fiber not break; and second, that the *residual* or *hysteresis-type* increase in attenuation (which remains after the crush load is removed) is acceptable. Typical crush strengths for some commercial cables are given in Table 5.

TYPICAL MAXIMUM VERTICAL RISE DISTANCES

Application	Distance
1 fiber in raceway or tray	90ft.
2 fiber in duct or conduit	50-90ft.
Multifiber (6-12) cables	50-375ft.
Heavy-duty cables	1,000-1,640ft.

Table 4. *When cables are installed vertically, the self-weight of the cable imposes a load on the cable. This load must be less than the cable's maximum use load rating. Typical maximum vertical lengths for some cables are shown.*

TYPICAL CRUSH STRENGTHS

Characteristic	Type of Cable	Force lb/in
Long-term crush load	>6 fibers/cable	57-400lb/in
	1-2 fiber cables	314-400lb/in
	Armored cables	450lb/in
Short-term crush load	>6 fibers/cable	343-900lb/in
	1-2 fiber cables	300-800lb/in
	Armored cables	600lb/in

Table 5. *Broadcast and production applications may subject the cables to special crushing loads. The loads encountered must be less than the rating for the selected cable.*

Experience has shown there is one known exception and one likely exception to the specified crush resistance of FO cables. The one known exception is fibers that have a plastic cladding, such as plastic clad silica and hard clad silica. The one likely exception is all-plastic fibers. Some of these fibers do exhibit a residual, or net, increase in attenuation after removal of the load. Although this type of hysteresis has been observed, it is not significant enough to prevent use of these fibers in situations where crushing is unlikely.

High-voltage resistance. In some applications, FO cables need to be nonconducting because of their proximity to high voltages. In other applications, FO cables also must be unattractive to lightning (such as on a tower). In these situations, specify an all-dielectric cable. Such cables are readily available.

Three basic approaches are used to determine the optical specifications...Each method has its advantages and shortcomings.

Flexibility — static vs. dynamic applications. In some applications, cables are subject to repeated bending or flexing. This would be the case for ENG and remote production use. The cables used in this type of application need to meet a minimum flexibility requirement for cable materials and fibers.

A polyurethane jacketing is commonly used to create a cable that can withstand these stresses. Although the jacketing increases the cost of the cable, it also increases the flexibility to 10,000 cycles from the 1,000-cycle level common with the lower-cost PVC and polyethylene jacketing materials.

Optical specifications

Determining the required optical specifications for a fiber system is the most complex step of the design process. Because the system's performance relies primarily on these parameters, you need to consider carefully all of the optical requirements. A detailed discussion of each of the three possible design procedures is included in the publication upon which this article is based. Because of the relatively complex and lengthy nature of the optical design process, just an overview will be presented.

Three basic approaches are used to determine the optical specifications. The three techniques include *ask the vendor, lowest cost* and *direct calculation*. Each method has its advantages and shortcomings.

In the "ask the vendor" method, you rely on the optoelectronic vendor to recommend the specifications for connectors and cables that will function properly with the electronics equipment. The vendor will then provide the following information: cable core diameter, the nominal or

minimum attenuation rate and the bandwidth-distance product at the operating wavelength and loss per connector pair.

This approach is useful when dealing with simple systems. The obvious advantage is ease of use. Someone else does the specification work for you. This procedure is the most conservative of the three, but has the potential disadvantage of excessive system costs.

The higher costs result from the vendor's lack of vested interest in recommending the lowest-possible cost combination. Or, the vendor may simply be conservative and recommend products with higher performance (and higher costs) than those actually needed.

Determining the required optical specifications for a fiber system is the most complex step of the design process.

The second method for determining the optical specifications, lowest-cost, requires more work on your part. It does, however, force you to consider lower-cost components before deciding to use higher-cost devices. Another advantage is that it helps the designer to quickly determine the project's overall scope. You will be able to immediately determine the important basic details of the system.

The third design option is the direct calculation technique. This procedure will often result in the lowest-cost combination of hardware and cable.

This procedure requires that you follow an iterative approach in determining the basic optical power or loss requirements of each of the system's components. When determining the power budget, the designer considers separately the optical power losses from fiber, connectors and any other passive components.

The third design option is the direct calculation technique. This procedure will often result in the lowest-cost combination of hardware and cable. Using this technique requires the designer to determine five parameters for the system: fiber core size, fiber NA, central wavelength, spectral width and bandwidth-distance product. Often, this technique is used to either meet a particular design specification or because the new hardware must connect to an existing cable system.

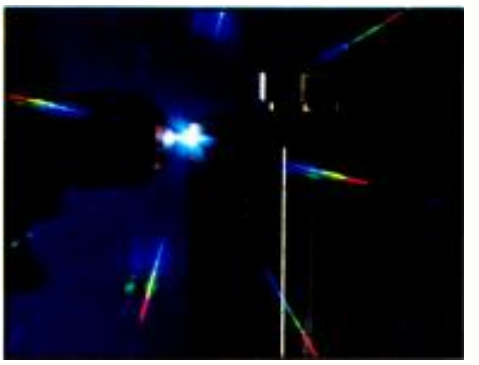
Each of the aforementioned three design techniques requires calculations beyond the space available here. See the Editor's note for information about obtaining the complete reference source.

The final step

This completes the second part of the 3-part series. The final installment will appear in the January issue.

The conclusion of this series will cover three important system design considerations: cost-performance tradeoffs, evaluating competitive products and common misconceptions of fiber.

Editor's note: This article is based on the publication, "How to Specify and Choose Fiber-Optic Cables," by Eric Pearson, president, Pearson Technologies, Acworth, GA. Because of the limited space available, not all of the factors related to FO system design can be covered here. Readers may wish to consult the above publication for additional detailed information on the design process.



A logical approach to transmitter design

By Timothy P. Hulick, Ph.D.

Power efficiency is the last frontier in UHF TV transmitter design. With today's technology, non-linear klystrons are made to look linear, intermod products are canceled, and video and IF processing can clean up most signal imperfections. However, electric bills are still high, and they'll probably go higher. Therefore, it becomes worthwhile to investigate new technologies that will increase the efficiency of UHF transmitters.

Few changes have been made in the basic building blocks of TV transmitters since the introduction of IF modulation almost a quarter of a century ago. However, several recent developments promise to make UHF broadcasting more cost-effective. This article will explore one such new technology — the UHF digital TV transmitter.

Many paths to higher power

Several techniques are used in high-power UHF applications. *Klystron pulsing*, for instance, has significantly increased transmitter efficiency, and has been employed for several years. In fact, it is universally used in areas where electrical power is expensive because, in many cases, it can double transmitter efficiency.

The *Klystrode* gains increased efficiency by operating in Class B, compared to the klystron, which runs in Class A. In this mode, the Klystrode is a hybrid between the klystron and the tetrode. This also provides an efficiency improvement.

Another approach toward higher efficiency is the *multiple-stage depressed collector* (MSDC) klystron. This is still a klystron, but its efficiency is enhanced by a new way of collecting electrons.

Another emerging technology for UHF television is the *inductive output tube* (IOT). This device has efficiency and performance similar to that of the Klystrode.

Of course, there is the venerable high-power *tetrode*. New versions of this tube have overcome electron transit time problems, enabling its use in high-power UHF TV transmitters.

Hulick is vice president, engineering, Acrodyne Industries, Blue Bell, PA

All of these devices have several things in common:

- They are all improvements over existing devices and approaches.
- They are all amplifying devices that must maintain correctable linearity to be useful.
- They all approach the theoretical power efficiencies dictated by their class of operation.

These devices are similar in many aspects. There is, however, a new digital approach to UHF TV transmission. It promises high power, simplicity and higher efficiency.

It's only logical

The most basic, yet efficient, active electronic modulation device is a simple switch. It neither consumes nor creates energy, yet it has the ability to modulate a carrier. It is certainly not linear — but within its 2-state realm, it is marvelously efficient at either passing energy or blocking it.

What if there were two switches, one gating a signal source with half as much current as the other, as shown in Figure 1? Such a modulator can present to the load resistor four possible load currents. Of course, it is not much of a stretch to imagine such a modulator with four switches for 16 possible load currents, or eight switches for 256 possible outputs, 10 switches for 1,026, or n switches for 2^n possible output load currents. This concept, including a mathematical derivation, was explored in a previous issue of *Broadcast Engineering*.[1]

Transmitter in the works

Figure 2 is a block diagram of a prototype 1kW transmitter that embodies this principle. An RF oscillator operating on arbitrarily chosen UHF Channel 43 feeds into a power splitter. The splitter distributes the RF over n identical paths. In this case, n equals 10, because 10-bit integrated circuit analog-to-digital converters are readily available.

Each splitter output feeds a solid-state amplifier stage. Note that the output powers of these amplifiers are binarily related one to another. The most significant amplifier, corresponding to the most significant bit (MSB), delivers half the transmitter's total output. The second MSB has output equal to half the first, and so on.

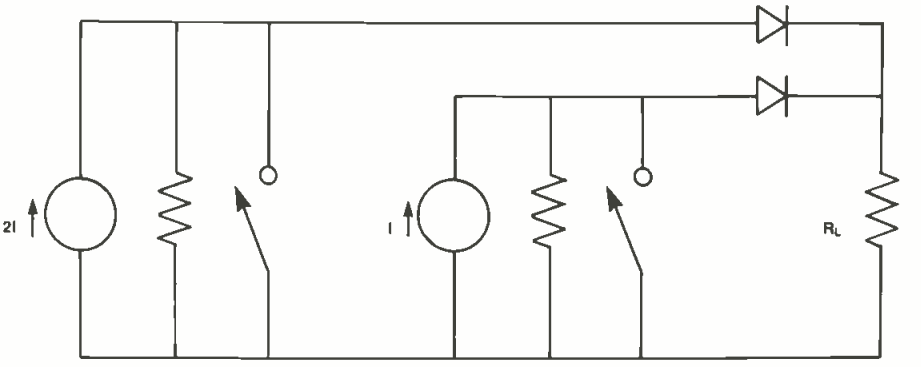


Figure 1. A 2-switch modulator illustrates the concept of digital modulation. The current sources are binarily related, and between them provide four output states.

The A/D is of the flash converter type. It samples the instantaneous video voltage applied to its input and converts it to a corresponding digital bit pattern. The RF carrier drive to each amplifier is gated on or off by the output of the A/D that has the same bit value.

The amplifier outputs are all summed in a combiner. The combined power output is matched to the antenna for transmission, or to a dummy load for test.

Bit-based modulation

This digital drive gating method linearly amplitude modulates the carrier wave

by continuously adding and subtracting the number of amplifiers in use. Note that the individual amplifier modules need do nothing more than turn on or off. Because the amplifiers do not pass a video-modulated carrier, they can be operating in a non-linear mode. This offers two advantages. First, it means the amplifier can operate Class C or even D (switch mode). This is highly efficient and reduces power consumption. Second, this class of amplifier is threshold driven. The PIN diode driver switches provide approximately 25dB isolation when off. Ordinarily, this would not prevent feedthrough energy from entering the amplifier, and from there into the combiner, where it might affect the output resolution. However, the amplifier, operated Class C, can provide an additional 30dB of isolation when off.

An early prototype of this transmitter used a rather lossy combiner. Each stage added approximately 0.6dB loss. This means that the lowest order bits had to endure significant cumulative losses before they reached the output (up to 6dB for the LSB).

This had the effect of rolling off the output resolution as viewed on a demodulator. Although 10-bit video went in, only about 5-bit video came out. An improved, low-loss combiner has solved this problem.

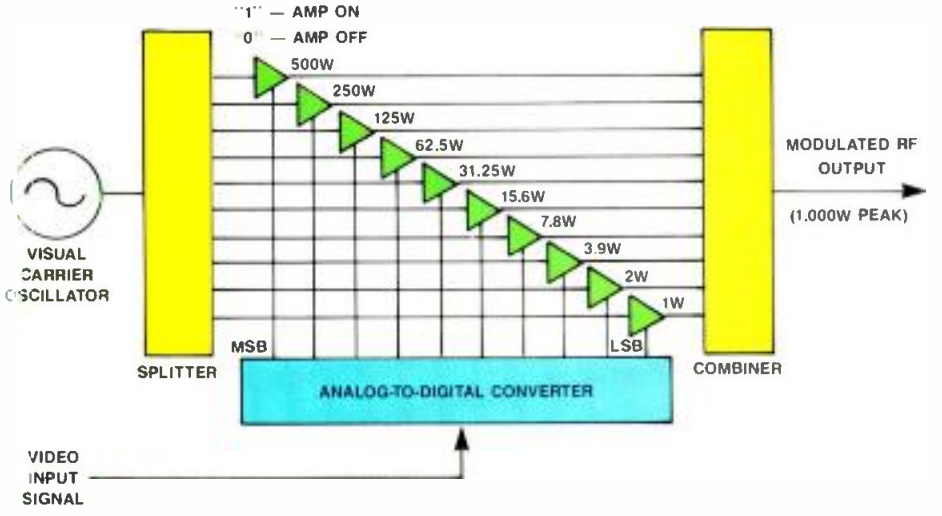


Figure 2. A block diagram of a prototype 1kW digital UHF transmitter. On peak signals, such as sync tips, all amplifiers are active, and the system provides full power. At other times, carrier modulation occurs by adding and subtracting amplifiers as required to track the input video.

Transmitter operation

This transmitter is essentially an RF digital-to-analog converter (DAC). It reconstructs the modulated waveform from ones and zeros. The summing action of the RF combiner results in a synthesized analog waveform on channel.

The digital nature of this transmitter allows it to have simple alignment and operation. The digital control electronics are fairly straightforward. The oscillator frequency can be set with any stable frequency meter of sufficient accuracy to assure transmitter compliance. The amplifier section itself is a bit more complicated because of the way individual modules interact within the combiner. Nevertheless, alignment is still fairly simple. This is because the amplifiers needn't operate in a linear fashion.

The transmitter is tuned by first select-

ing one amplifier as a reference. A second is then electrically tuned to provide peak output to the combiner. The power level of the second amplifier is then adjusted so that both amps together provide the correct output level. One at a time, following sections are similarly adjusted. Measuring the power in this manner assures proper compensation against combiner losses.

One parameter that is critical to the transmitter's performance is the timing of the diode switch that feeds each amplifier. This is exaggerated by the high sampling frequency that clocks the A/D. Although the *Nyquist* theory states that the lowest sampling frequency must be at least twice the highest signal frequency, in practice, the sampling frequency must be much higher. This is because the digital transmitter generates spurious copies of the modulated signal at integral multiples of the sampling frequency. Raising the sample frequency to some point near the limits of the A/D, typically 50MHz-60MHz, gives good video performance and also simplifies output filtering.

Building blocks

It is difficult to find Class C solid-state devices for UHF television. Transistors come with internal matching components trimmed for use in certain bands. It would be ideal to employ devices that are optimized for UHF television, but until now, there has apparently been little application for them. For this reason, a prototype 1kW digital transmitter uses devices designed for the cellular telephone industry. The amplifiers include the needed compensation circuitry.

Digital future

A logical future step for this kind of transmitter is to include a digital input. This could be a direct digital output from a digital VTR, digital routing switcher or digital fiber optic or telephone circuit. This could greatly enhance the signal quality delivered to the home, because it reduces the possibilities for analog signal degradation.

The digital nature of the transmitter also lends itself to all manners of digital processing. This may include preemphasis, automatic gain control, peak limiting and other conditioning circuits, such as receiver envelope delay-correction circuitry. Vestigial sideband filtering, for the near term, is likely to take place at a high level, after the transmitter output.

Power savings

The real advantage to TV station operators will come in the form of reduced power consumption. This transmitter can achieve 30% power savings over traditional means. Interestingly, the power savings has little to do with the use of semiconductors. Research has shown that it is more the class of operation, not so much the nature of the device, that determines efficiency.[2] Because the amplifiers in this transmitter operate Class C, their higher efficiency is inherent.

The digital UHF transmitter, with its simplified circuitry and high efficiency, should be able to provide some economic relief to broadcasters in these difficult times. Adopting such new techniques may require new thinking. However, digital UHF transmission may eventually end up being the logical choice.

References

1. Hulick, T.P. "A Digital Amplitude Modulator/Transmitter." *Broadcast Engineering*. Dec. 1987, pp 66-81.
2. Hulick, T. P. "Using Tetrodes for High-Power UHF." *Proceedings* of the 1989 SBE and *Broadcast Engineering* Conference, pp. 52-57.

Continued from page 30

Radio respondents:

"Digital is the problem. DAB and RDS, where will they lead?"

"The overpopulation of AM and FM stations."

"Debt service on stations that were purchased at highly inflated prices because of the station trafficking of the 1980s."

"There is less concern on producing a quality product, and more concern with the bottom line."

"Whether it (radio) will continue to grow in the face of new technologies trying to be the big juke box in the sky."

"Digital broadcasting is the future, but we shouldn't jump on any bandwagons (Eureka 147) until more research is completed."

"DAB will only bring more competition to an already overcrowded industry."

"AM makes up more than 50% of the U.S. radio market. Are we going to obsolete an entire medium? Broadcasters and the FCC and the receiver manufacturers need to pull their heads out of their *&%/$%! and do something, now."

"Please give us an in-band DAB system."

"DAB, let's get it together and move with it!"

"To the FCC: Please solve the AM stereo issue and allocate spectrum for DAB."

"It's sad that broadcasting is a business. Bottom lines take the fun out of it."

"To go digital or not to go digital."

"DAB — how soon? How much? How do we get ready?"

"The FCC has no business trying to invent ways to increase the number of stations available."

"AM, FM, DAB and HDTV. We are at the crossroads of our future."

"The outcome of WARC '92 will determine the future of DAB and thus the future of radio as we know it."

"We are coming to the day when everything will be digital, which is great."

"The FCC has no business trying to come up with ways to increase the number of stations available. Making spectrum space available for more stations is ludicrous!"

Continued from page 30

to the technology. Many wanted some guarantees from the FCC that they would be given first choice for any new DAB channels. The FM engineers occasionally mentioned wanting an in-band digital transmission system. Even so, the opinion on DAB was that it's a threat to current AM and FM stations.

In other areas, there continues to be those who view broadcasting as a non-business. These people complain that their stations are being run as businesses, rather than as a service to the community. It's often expressed as a complaint about the bean counters or profit-motive-based decisions. They say, "Broadcasting isn't fun anymore."

It's time for these people to realize that broadcasting has to be a business if the station is to survive and they're to keep their jobs.

Looking at the overall survey results, a more tight-fisted approach seems in store for equipment purchases. For the engineer, that involves difficult choices. What do you replace? What technologies do you implement? Fortunately, the rough times we've encountered have toughened us up. Engineers are now better trained to deal with the interlocking issues of economics and technology than ever before.

SBE Update

6th annual national convention a success

By Bob Van Buhler

The society's sixth national convention, in a year of significant economic retreat, proved to be a success for exhibitors and attendees. Total daily attendance at the show was 3,367, with 151 exhibitors. This year's attendance was comprised of many international guests from Ireland, Italy, the Philippines, the Netherlands, Canada, Mexico and South Korea.

Although attendance was down 9% from last year's convention in St. Louis, it was still deemed good, considering the weak broadcast economy. Next year's annual convention will be held in October in San Jose, CA.

SBE awards announced

The 1991 Chapter Awards were announced at the chapter chairmen's meeting, which was held at the convention. The Bryan, TX, chapter topped the list for active chapters with the best attendance ratio and the most SBE-certified members. The Huntsville, AL, chapter had the largest growth in 1991.

The Best Chapter Newsletter award went to the Indianapolis chapter. The Manchester, NH, chapter won the Best Newsletter Editor award. The Madison, WI, chapter again won Best Technical Paper by a Local Chapter and Best Local Frequency Coordination effort.

Martin (Sandy) Sandberg, a member of the Dallas chapter, was honored for his many years of service to SBE certification in his own chapter.

Joint SBE/RTNDA exhibition

SBE president Richard Farquhar and RTNDA president David Bartlett announced a collaborative effort in the 1991 SBE and RTNDA conventions.

The SBE and RTNDA will combine exhibition portions of their shows in Miami in 1993. The joint event will involve only the exhibit hall portion of the shows. Each group's meetings will remain separate.

Newsrooms and engineering are the technical hubs of many radio and TV operations. Being able to bring together the news and engineering personnel on one show floor will be advantageous to attendees and exhibitors.

The combined exhibition creates opportunities for news directors to travel with engineering managers and view new equipment firsthand. In addition, the shift to a September convention date is more advantageous for many stations' capital budget planning.

An engineer on the FCC

The idea of an engineer occupying a mandated seat on the Federal Communications Commission (FCC) came one step closer to reality, with the creation of H.R. 3501 by Don Ritter, R-PA. He announced his legislative initiative at the convention's closing banquet.

Ritter is one of the few engineers in Congress, which is populated largely by attorneys. He holds an Sc.D. from the Massachusetts Institute of Technology. He is also a member of the House of Representatives Telecommunications Subcommittee of the Energy and Commerce Committee, which keeps a legislative eye on the FCC.

Ritter's bill would require "at least one commissioner to be "skilled in the engineering sciences at the time of his or her appointment." This skill is to be measured by possession of "at least a bachelor of science degree in any engineering discipline from an accreditation board for engineering and technology approved institution, or by virtue of holding senior or fellow status in a nationally recognized engineering society, or by virtue of registration as a "professional engineer."

The House Telecommunications Subcommittee has recently been the target of an SBE lobbying effort, based on a project spearheaded by SBE director Dane Ericksen, of Hammett & Edison Consultants, San Francisco. Ericksen is a registered professional engineer and a former FCC regional inspector. He is chairman of the SBE's FCC liaison committee. Ericksen praised Ritter's efforts, and promised grassroots support to ensure Ritter's bill receives serious attention in Congress.

NPR certification course

National Public Radio (NPR) announced the use of its extensive satellite network to provide training opportunities to current and potential broadcast engineers everywhere NPR's satellite signal can be heard. The course, developed in cooperation with the SBE's Ennes Foundation, will cover Broadcast Technologist certification, and provide a review for the Broadcast and Senior Broadcast Engineer certification levels.

The course includes sections on electronic theory, audio theory and practices, AM/FM radio frequency theory, satellites and microwave, and FCC rules and regulations. Instructors include SBE vice president and broadcast author Jerry Whitaker, John Reiser, chief of the international section of the FCC, and Andy Laird of Heritage Broadcasting.

It was partially funded by a grant from the Corporation for Public Broadcasting (CPB). The NPR/SBE course will be transmitted to NPR member stations on a closed-circuit basis during the winter of 1992.

The course is available to each SBE Chapter for $150. This charge is to help cover the costs of tapes, books and other expenses. If your chapter is interested in participating, call Donna Fox at NPR's training department, 800-235-1212 ext. 2737.

Bylaws revision approved

The recent bylaws revisions were approved by a margin of 7:1 by the voting members. The changes, authored by past president Jack McKain and SBE Washington counsel Christopher Imlay were proposed and approved by the executive committee before they were submitted to the membership.

Some concern has been expressed by a small, but vocal, minority of members on the procedures followed in the ballot approval process. A review of the facts shows that the bylaws committee followed the correct procedures, but that the changes were submitted to the national office too late to include extensive explanatory materials with the ballot mailing.

President Richard Farquhar has appointed a committee to continue to review the SBE bylaws and provide an update on the approved changes in the next SBE newsletter.

Van Buhler is manager of engineering at KNIX-FM/KCWW-AM Phoenix.

Industry briefs

BUSINESS SCENE

Digital Vision, Stockholm, Sweden, has been awarded the contract to design and manufacture a digital HDTV codec to be used for HDTV transmission signals. The contract was awarded by a group involving the Norwegian and Swedish Telecom, the Swedish radio and TV corporations.

Thomson Broadcast, Englewood, NJ, has sold 20 Synonym top-end digital component vision mixers around the world since its launch at Montreux.

BTS, Salt Lake City, has sold a TVS/TAS 2000 switching system to Postique, Southfield, MI.

GTE Spacenet, McLean, VA, has agreed to provide satellite news gathering (SNG) services to the NBC News Channel.

Snell & Wilcox, Hampshire, England, has sold a DEFT conversion system to Du-Art Video, New York.

Canon, Englewood Cliffs, NJ, has sold three J55X super lenses and three J18X8.5 hand-held lenses to KWGN Remote Services, a remote operation in the Rocky Mountain region.

Scientific-Atlanta, Atlanta, has announced that IDB Communications Group, Culver City, CA, will convert its satellite transmissions to Scientific-Atlanta's spectrum efficient digital audio technology (SEDAT).

Conus Communications, Tallahassee, FL, has expanded in Florida by opening a state capitol bureau, complete with a satellite news gathering (SNG) vehicle.

Vinten Broadcast, Towaco, NJ, has delivered a multistudio Microswift camera robotics system to CBS, New York.

TFT, Santa Clara, CA, has sold its first Reciter booster system to K101-FM, San Francisco.

Solid State Logic, New York, has sold an SL 4000 G series console to Cinar Studio Centre, Montreal, Canada.

Microdyne's Telemetry Division, Alexandria, VA, has sold a Telemetry processing antenna system (TPAS) to the Department of the Air Force to be used at Holloman Air Force Base in New Mexico.

Digital Audio Research, Surrey, England, has appointed Audio Intervisual Design, Hollywood, CA, as U.S. West Coast distributor of the company's DASS 100 multifunction digital audio interface and sampling frequency converter.

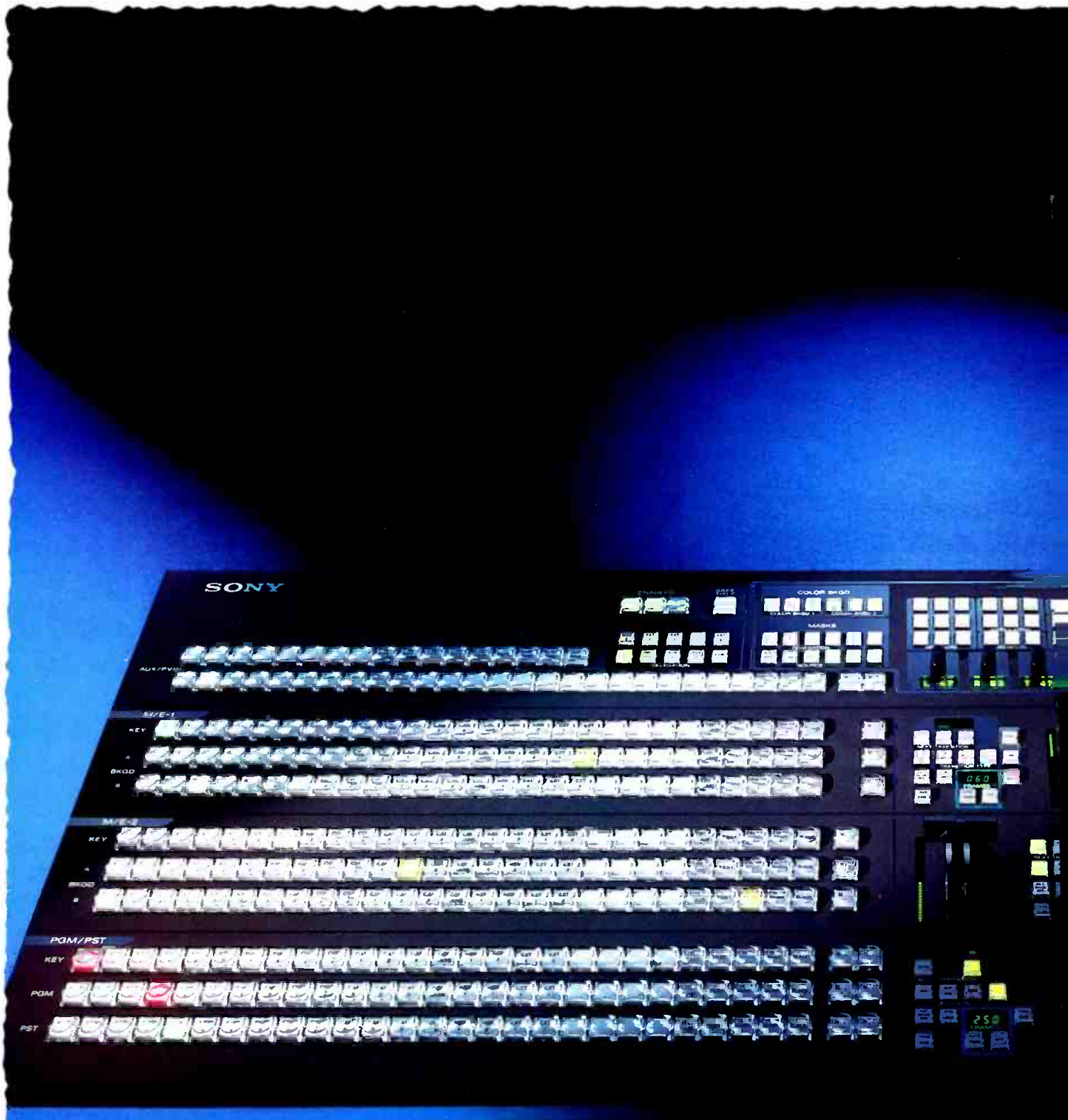
Canon U.S.A., Lake Success, NY, has opened its Eastern regional headquarters in Jamesburg, NJ.

Schmid Telecommunication, Zurich, Switzerland, has relocated its headquarters within the city. The address is Binzstrasse 35, Zurich, Switzerland CH-8045; phone 01-456-11-11; fax 01-461-48-88.

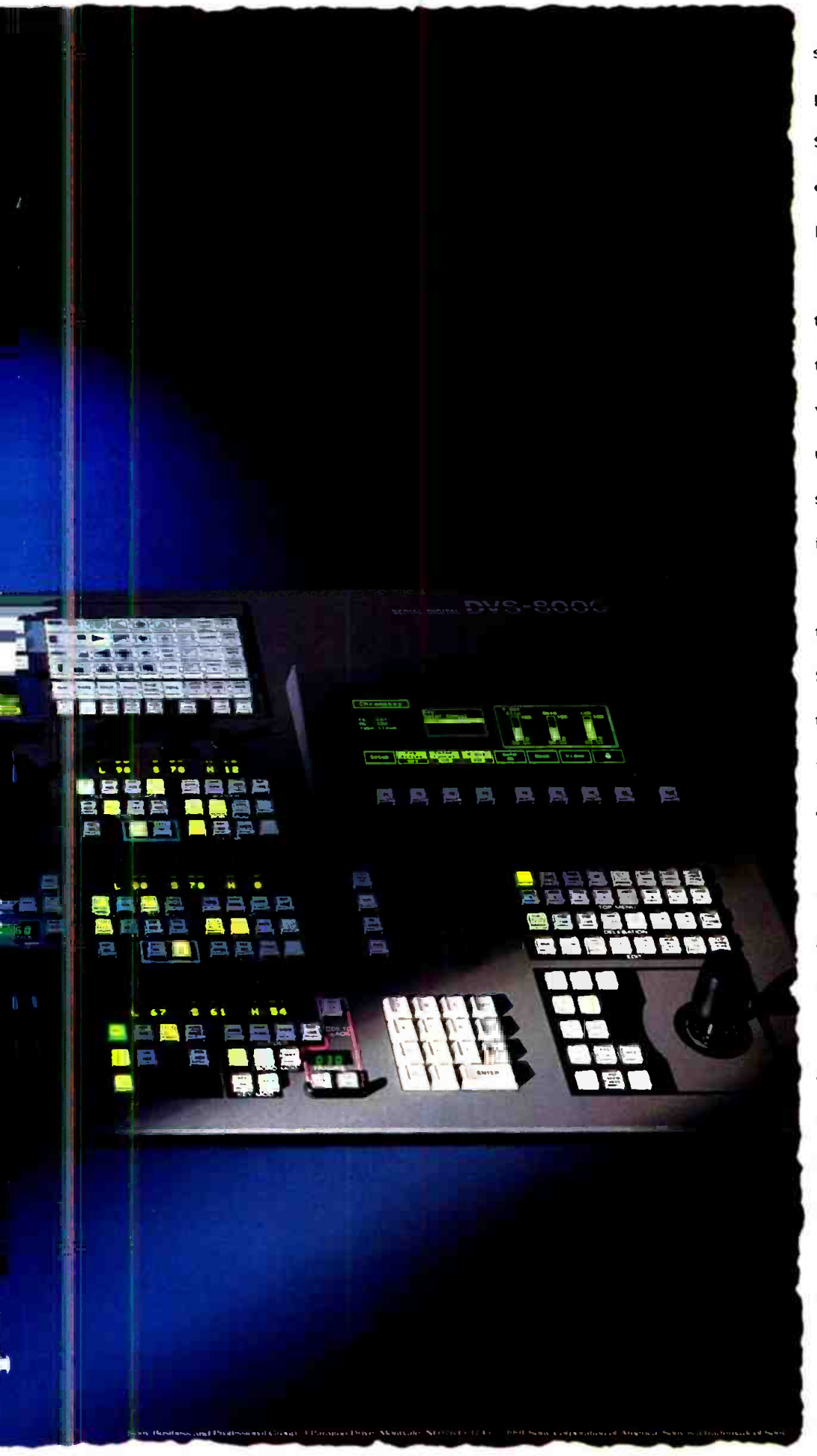
SkyPix, Kent, WA, has signed an agreement with four partners for its direct digital broadcast satellite (DBS) home entertainment system under the name SkyPix Joint Venture L.P.

The partners include Sky King Investment Corporation; OI, Inc.; the Calafia Corporation; and Richard Owens Investment Corporation.

With Sony's digital switcher and effects, it's never been easier to switch.



SONY



If you're still hesitant about switching to digital, then you probably haven't experienced Sony's DVS-8000 Digital Switcher and the DME-5000 Digital Effects System.

They're remarkably easy to learn. Both are set-up like the switchers and effects devices you're accustomed to using today. And they're instantly familiar, so you'll be instantly productive.

They're designed to work together as the heart of an all Sony, all-digital system. A system designed to let you work with more power, more speed and greater flexibility.

And they're made by Sony. With all the reliability, service and support that Sony has always been famous for.

Best of all, the DVS-8000 and DME-5000 are incredibly cost-effective. What's more, they're available for immediate delivery.

Just call 1-800-635-SONY, ext. 712, to learn more.

Once you do, you'll realize it really has never been easier to switch.

Business and Professional Group.

Rank Cintel has relocated its offices from North Hollywood, CA, to Valencia, CA. The address is 25358 Avenue Stanford, Valencia, CA 91355; phone 805-294-2310; fax 805-294-1019.

Comark, Colmar, PA, and **EEV**, Elmsford, NY, have placed the world's first IOT-equipped UHF station on the air in Springfield, MA. WGBY-TV, Channel 57, is now operating its full broadcast schedule using a pair of EEV IOT tubes installed in a Comark 70kW transmitter.

Lexicon, New York, has named Westlake Audio and Audio Techniques as exclusive advanced product dealers for the Southern California and metropolitan New York areas, respectively.

Broadcast Microwave Services (BMS) has relocated its facility. The address is 5795 Kearny Villa Road, San Diego, CA 92123-1190; phone 619-560-8601; fax 619-560-1637.

Yamaha Corporation of America (YCA), Buena Park, CA, has formed the Pro Digital Products Department, a separate department for the marketing, sales and end-user support of the company's professional digital audio products.

PEOPLE

Paul J. Sweeney has been appointed sales executive for A.F. Associates, Northvale, NJ, for the New York metropolitan area.

Shoichi Takada has been named executive vice president for Fujinon, Wayne, NJ.

Robert Luka has been named broadcast sales manager for Cablewave Systems, North Haven, CT.

Mark Terry has been appointed executive vice president, marketing and sales, for JBL, New York.

John DeBrocke has been appointed Midwest regional sales manager for HM Electronics (HME), San Diego.

Jeffrey Maul has been named vice president of systems engineering and service for Advanced TechCom, Inc. (ATI), Lawrence, MA.

Tom Dolan has been appointed international marketing/sales director for MCL, Bolingbrook, IL.

Carl Holder has been named product management director for Dynair, San Diego.

Steve Krampf and **Ray Maxwell** have been appointed to positions with Lexicon, New York. Krampf is vice president of sales and marketing. Maxwell is regional sales manager.

David P. Aucoin has been promoted to vice president of customer services for Avid Technology, Burlington, MA.

Kathy Demerit has been named regional sales manager, production, Northeast region, for Sony Business and Professional Group, Teaneck, NJ.

Harris Rogers has been appointed director of sales for Dynatech Broadcast Group, Madison, WI.

Cal Vandegrift has been appointed director of export sales for Symetrix, New York.

Preview

January...

REMOTE PRODUCTION SPECIAL REPORT

• Fiber's Digital Solutions

Remote broadcasts can be a lucrative — or a losing — proposition. The difference usually depends on the technology needed to distribute and backhaul broadcast audio. The article shows the reader that the dial phone is no longer the only way to relay the signal back to the studio. Digital telephone techniques (ISDN, Switched 56) and analog and digital fiber systems are available to improve the transmission process.

• Remote Production Equipment

Remotes can be difficult if the right equipment isn't available. Selecting from the wide variety of equipment on the market can be just as challenging. The article will walk the reader through the decision-making process to select the best equipment for any remote production or recording application.

• Intercom System Design

As stations try to originate programming from remote and studio locations, communication becomes the difference between delight and disaster. The article reviews the different types of intercom system designs, and offers suggestions on how to select the options your facility may need.

February...

CUTTING-EDGE TECHNOLOGY

• Digital Compression for Audio and Video

Digital compression is the "hot" topic for audio and video applications. Compressed signals require less storage space than do non-compressed signals. Even more important, it's possible to transmit more channels of video than would otherwise be possible. This feature is composed of two parts. Part 1 addresses compression for audio. Part 2 addresses compression for video. The future of audio and video storage is at the height of rapid growth. Broadcast Engineering magazine will lead the industry in providing the reader with the latest in compression information.

• Optical Disc Recording Systems

Optical disc recording techniques have finally begun to mature. With the arrival of "affordable" recorders and read-write-erase laserdiscs, users are provided with exciting new production tools. The article will look at the technology behind optical recording, emphasizing the new erasable techniques.

• Distributing Serial Digital Signals

As production equipment begins to rely on serial digital signals, the task of routing those signals around facilities becomes a problem. Until now, serial digital signals primarily resided within one or two pieces of equipment or within a single suite. Now, facilities need to send those signals to other locations. Only a few companies have discovered how to handle these signals. The article will lead readers through the process, showing them what considerations to make when designing and building interconnection equipment for serial digital signals.

• Camera Lens Technology

Probably no piece of production hardware is less understood than the camera lens. People who buy lenses seldom understand the technology, and often end up purchasing a lens that may not be best suited to their needs. Just as bad, the people who sell cameras are in the same boat because they sell cameras — not lenses. The article will address two sections: camera lenses and how they work, and how to maintain ENG lenses. The article will be the first definitive piece on the physics of lenses in many years.

New products

CD cart systems
By Denon America
• **DN-970RA enhancements:** auto-track select kit for designation of specific track on CD for auto-cue or permanent lockout; looping feature permits repetitive sound from material on CD without apparent seam from 2-frame or greater segment with pre-set crossfade times.
• **DN-7700R CD cart recorder:** record and playback unit; AES/EBU or Sony digital interface; BU-0170A interface provides A/D and D/A functions for direct analog input and output; 63-minute capacity of 16-bit sound at 44.1kHz sampling; does not require TOC information.

Circle (398) on Reply Card

Woofer transducers
By Klipsch & Associates
• **K-1200, K-1500, K-1800:** 12-, 15-, 18-inch woofer components; high-efficiency units require significantly less power than conventional units for a given sound pressure level; heavy magnets and Kapton voice coil forms permit continuous extended 300W operation over 40Hz-2kHz spectrum with peaks to 3kW.

Circle (405) on Reply Card

Digital audio control
By New England Digital
• **DSP mixer:** 16-channel system for use with NED digital audio workstations includes 24-bit mixing and processing; 5-band parametric EQ, gain control, digital crossfading and panning are performed without leaving the digital domain; AudiMation Mac-based mixing software; MultiArc multitasking, multiuser technology; SDIF-2, SDIF-M digital I/O; 32kHz, 44.1kHz, 48kHz sample rates with 60Hz or 59.94Hz time bases.

Circle (409) on Reply Card

Console enhancement
By TASCAM/TEAC Professional
• **M7/MFA package:** moving fader automation system designed for M700 production console; may be used to upgrade other console brands of appropriate design; LED display on fader panel shows all necessary information, but PC terminal display may also be used; Solo Link and Channel Link features designate any channel for solor or group functions; capable of controlling 128-channel M700 console.

Circle (414) on Reply Card

Expanded DAT control
By JVC Professional Products
• **DS-DT900N enhancement:** serial control of digital audiotape transport expanded for interfacing to various controllers and serial devices; ID protocol number available to permit development of interfaces for video editing systems.

Circle (404) on Reply Card

Console, acoustics enhancements
By Lexicon
• **OPUS V 3.0:** updated software for digital audio production system; extended functions for machine control, time compression/expansion, sample rate conversions and integrated audio and automation files; 4.8Gbyte storage on four hard disks; 12-channel mixing with digital EQ; random-access editing; full control of audio, video transports.
• **LFI-10:** intelligent digital audio format interface links professional, consumer digital audio formats such as digital multitrack, DAT and DASH equipment.
• **LARES:** Lexicon Acoustic Reverberance Enhancement System; electro-acoustical augmentation of natural direct and reflected energy improves listening conditions and intelligibility of halls, studios.

Circle (408) on Reply Card

Power analysis
By Eastern Time Designs
• **The Detective PC Edition:** power-line monitor senses power anomalies; stores up to 1,500 events in memory; Power Audit diagnostic software transfers data to a hard drive and compiles a power quality audit; results available on screen or printout.

Circle (400) on Reply Card

Audio system measurements
By Gold Line
• **DSP-30 spectrum analyzer:** multifunction, portable instrument uses 85dB window to display dynamic characteristics of a studio or hall as well as to monitor distortion levels; capture mode stores data; display can be recalled with 0.25dB to 5dB steps; useful for testing audio recording systems, filters, etc.

Circle (403) on Reply Card

Audio workstation, effects
By KORG USA
• **SoundLink:** random access, 8-track hard-disk recorder and editing with digital mixer; 48kHz sampling permits 110-minute capacity with expansion capability to 11 hours; includes 16-track MIDI recorder, sequencer and synchronization to LTC, VITC time codes and digital audio signals; full software control from hardware console.
• **Wavestation EX:** audio synthesis unit; Vector Synthesis, Wavesequencing and Dynamic Digital Multi-Effects features with PCM memory expansion; 484 ROM-based sound-control waveforms.
• **A1 effects processor:** DSP chip, 59 internal effects and 50 programmable effect chains; effect order sequencing control; use for stereo or independent dual channel work; compatible with digital workstations and DAT recorders.

Circle (406) on Reply Card

Distribution system
By Lester Audio Laboratories
• **DAS 2000:** audio signal distribution uses optical transmission with 1,300nm LED and 48kHz digital sampling; maximum matrix size of 64×64 uses 18-bit Delta-Sigma A/D conversion with PCM D/A converter; FDDI/B-key optical connectors.

Circle (407) on Reply Card

Camera support equipment
By Matthews Studio Equipment Group
• **T 650, H 600:** Horizon series tripod and fluid head from ITE features lightweight construction; spreader, clawball bowl and non-slip locks on telescoping legs; ENG/EFP head has recessed controls with tilt and telescopic control handles, quick release camera plate, ball base, complete lock and drag control.
• **SPAGS bags:** miniature sandbags that can be used on a camera operator's shoulder to reduce unwanted movement of the camera.
• **TPD box:** temporary power distribution unit for stage or location; two 100A, four 50A circuits have Bates connectors; each has power indicator light.

Circle (365) on Reply Card

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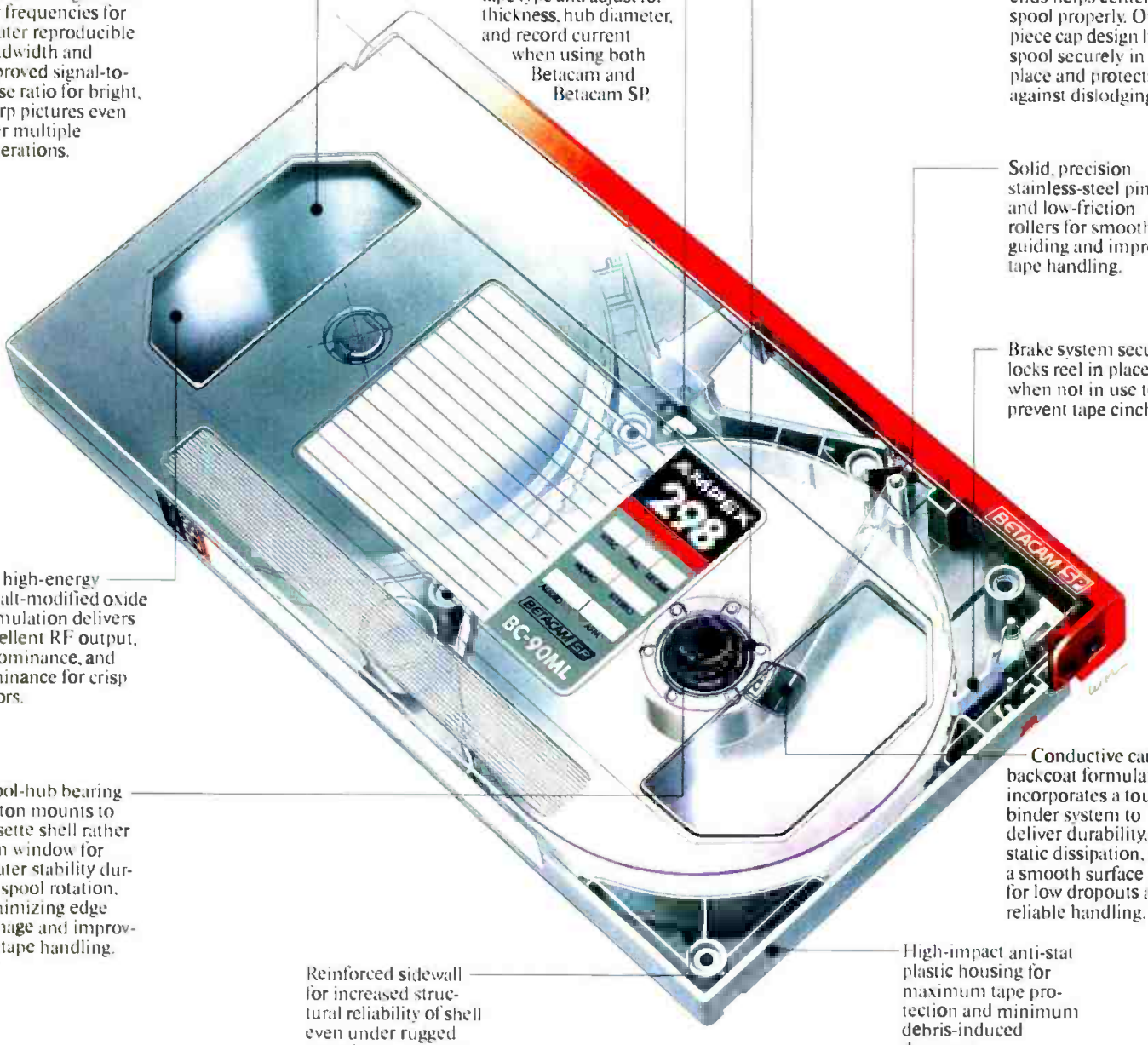

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Circle (43) on Reply Card

Satellite receiver

By ComStream Corporation

• **ABR200:** digital audio receiver with MUSICAM audio compression: 20kHz bandwidth signals at 128-, 192-, 256kbit/s rates; for Ku- or C-band operation; receiver software upgrades sent through the satellite link; CD-quality stereo; Quick Access Channelization via SCPC/FDM permits channel changes locally or from uplink.

Circle (397) on Reply Card

Audio recording systems

By Otari Corporation

• **MX-50 II enhancement:** integral cue speaker, headphone amp, level and channel selection control; standard features include Voice Editing Mode with 2× play speed operation and single-octave downward pitch shifting for quicker editing of news and voice-over segments.

• **DTR-90 R-DAT recorder:** removable front panel serves as remote control; Edit Memory PC board option stores edit points for subsequent automatic execution; AES/EBU-SPDIF, standard SDIF-II digital interfaces.

• **PD-464 system:** disk-based recorder, editing unit for 4- to 64-track applications; Series III software with DSP option controls I/O levels, pan, mix functions.

• **DE-24 editor:** controls network of BVU video deck, slaved MTR-90 24-track ATR with start-stop triggering for seven individual sources using SMPTE addressable triggers; 4-in/24-out router for use with 4-bus console.

Circle (411) on Reply Card

Expanded tool kit

By Panasonic Audio

• **SV-3900:** software developer's kit; available for MS-DOS or Macintosh systems; simplifies control of SV-3900 Pro-DAT systems from a PC using bidirectional, RS-422, ESBus serial network; graphic "remote-control panel" allows point-and-click operation of multiple DAT recorders.

Circle (412) on Reply Card

Satellite communications

By SpaceCom

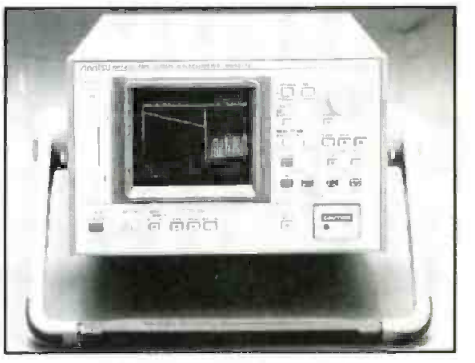
• **fm³:** FM Cubed data and audio transmission system; downlink package contains antenna, receiver, LBN and cabling; service through Hughes Communications' Ku-band SBS-6 satellite from Chicago International Teleport uplink; full range of bit rates for data and digital audio services.

Circle (413) on Reply Card

Fiber-optic instrumentation

By Anritsu America

• **MW9043A optical TDR:** time domain reflectometer for 1.31μm or 1.55μm single-mode fibers; senses fault location and transmission loss from Fresnel reflections and back-scattered light; integral 3.5-inch DOS disk stores 100 screens of data; 30dB dynamic range; 5-point masking function.



Circle (352) on Reply Card

RF loads

By Altronics Research

• **Product catalog:** displays numerous 50Ω air- and water-cooled coaxial load resistors, self-contained heat exchangers and high-power non-reactive cermet resistors; the OMEGALINE products cover VHF through FM to UHF frequencies with power ratings to 300kW.

Circle (351) on Reply Card

Broadband analysis

By Calan

• **COMET remote monitor:** for LAN or multicarrier systems, such as CATV; monitors all carrier levels and compares data with pre-established operating parameters; produces aural and visual alarms for out-of-limit conditions; covers 40-550MHz; RF, telco communications; color spectrum analyzer; data storage facilities.

Circle (353) on Reply Card

Digital audio workstation

By Digital Audio Research

• **SoundStation Sigma:** multichannel simultaneous analog or digital recording or playback; variable speed operation; rewritable optical disk; full-function editing with touch-screen console; segment-based processing.

• **DASS 100:** multifunction interface for digital audio; enhanced with phase reversal, stereo fader features; includes sampling frequency converter and processor.

Circle (356) on Reply Card

Archiving software

By Nesbit Systems

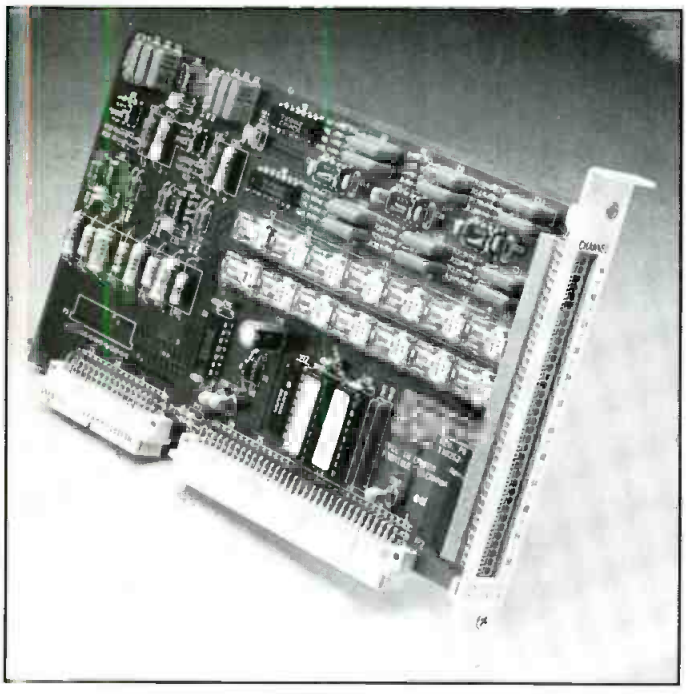
• **NSI tape library:** available for single PC and multi-user network systems; tracks location of 15,000 videotapes, permits selected information to be retrieved within seconds; for production, broadcast and other types of facilities.

Circle (367) on Reply Card

Audio circuit tests

By Consultronics

• **MUX card:** enhancement for PC3000 audio test system; scans six stereo program channels; when an audio quality check sequence (5s or longer) is sensed, the PC3000 performs a set of measurements and stores the results for later review.



Circle (355) on Reply Card

TBC/synchronizer

By Hotronic

• **Model AP41:** combination TBC, synchronizer for composite and Y/C inputs; full proc-amp control with gen-lock; strobe, optional pixel-by-pixel dropout compensation; serves VHS, S-VHS, U-matic (SP) and satellite feed synchronizer requirements.

Circle (359) on Reply Card

Cable assemblies

By ITT Pomona

• **Series 2249:** prepared BNC cables; four variations include RG58C/U, RG174/U, RG59B/U and RG62A/U cable types; PVC boot molded onto cable jacket and connector body provides stress protection and weatherproof seal.

Circle (360) on Reply Card

Workstation controller

By JL Cooper Electronics

• **CS-10 control station:** interface for DigiDesign Pro Tools digital audio workstation; includes faders to control automation functions; programmable potentiometers access processing functions; transport controls similar to typical audiotape transport.

Circle (361) on Reply Card

Antenna products

By Electronics Research

• **Medium-power master antenna:** multistation design, reduced weight and windloading characteristics; economically suited to single-station use.

• **Lambda section:** antenna-mounting support provides antenna radiation pattern of a similar-sized antenna pole, but reduces weight and windload; increased rigidity over similar poles.

Circle (358) on Reply Card

Editing enhancement

By Editing Machines

• **LSI logic chips:** second-generation JPEG compression available for EMC editing systems; full video bandwidth support with resolutions to 720×484 pixels; frame buffer uses YUV storage format allowing higher compression ratios.

Circle (357) on Reply Card

Fiber test unit

By Tektronix

• **FiberScout:** optical fiber fault finder tests 1,550nm single-mode link; available with ports for short range (3km) to extended long range links to 64km (40 miles); identifies bends, faults, relative location and related decibel losses.

Circle (374) on Reply Card

CRT setup assistance

By Minolta

• **CC-100 convergence meter:** used with dot or cross-hatch pattern to determine degree of misconvergence of dot or stripe phosphor CRTs; measures vertical and horizontal error separately.

Circle (366) on Reply Card

Computer video

By STB Systems

• **ERGO-VGA/MC:** SuperVGA video adapter for IBM micro channel bus PCs; supports refresh rates to 75Hz for flicker-free display on PS/2 systems; includes drivers for several popular software packages; 256 color with 1,024×768-pixel maximum resolution; available with 512kbyte or 1Mbyte on-board memory.

Circle (373) on Reply Card

Audio frequency measurement

By Stanford Research Systems

• **SR760 FFT:** spectrum analyzer with 90dB dynamic range; 50kHz bandwidth; performs THD, PSD, octave, band and sideband analyses from menu and help screens; DOS 3.5-inch disk storage; RS-232, GPIB interfaces.

Circle (372) on Reply Card

Telecine utility

By The Adelaide Works

• **SCAN/R:** data acquisition unit for Rank and Bosch telecines creates database relating film key numbers and video time code during film-to-tape transfer; the video EDL can be translated into a negative cut list for editing.

Circle (375) on Reply Card

Audio monitoring

By The Falin Company

• **KRK-9000 near field monitors:** 9-inch 2-way speaker systems; 91.5dB efficiency in generating SPL greater than 108dB; time-aligned crossovers; 35-pound units in 16.5×13.74×14-inch cabinets.

Circle (376) on Reply Card

ID product brochure

By United Ad Label

• **1991 catalog:** displays more than 1,000 different label products for audio, videotape ID and status applications, as well as inventory and warning labels; custom colors and printing available for most labels.

Circle (377) on Reply Card

Lens testing

By OpTex

• **Mark V test system:** acts as a substitute for a TV camera to perform tests on all electronic functions of camera lenses; individual modules required for Sony, Ikegami or Hitachi/JVC cameras.

Circle (370) on Reply Card

Instrument protection

By Simpson Electric Company

• **Grab-N-Go:** carrying case for 260 series meters and other similar test instruments; 3/4-inch padding; water-repellent nylon material; adjustable carrying strap and rings to attach case to tool belt.

Circle (371) on Reply Card

Instrumentation products

By John Fluke Manufacturing

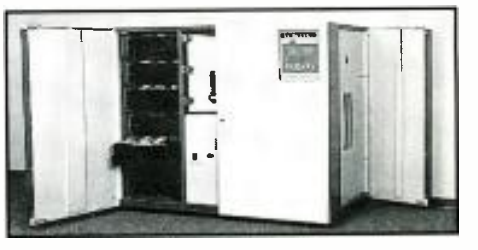
• **1991 distributor catalog:** 20-page publication includes improved 70 series digital multimeters and specifications for Philips frequency counters and timer products.

Circle (362) on Reply Card

Power assurance unit

By LORTEC Power Systems

• **Series LE 3000:** 3-phase UPS units rated from 10kVA to 30kVA in single-cabinet packages; battery run times from five to 60 minutes; digital control circuitry provides "smart" battery charging; software-controlled inverter output waveform; on-line diagnostics; batteries slide out for maintenance; cabinet mounted on casters.



Circle (363) on Reply Card

Audio connectors

By Neutrik USA

• **Series G, GC:** XLR-type connectors of plastic construction for low RF environments; metal plate gives support with threaded screw holes; gold contacts in female versions; latch release available; series G for PC mount, series GC for chassis mount.

Circle (368) on Reply Card

Station automation system

By Louth Systems

• **ADC-100:** PC-based software for control of VTRs, cart machines, switchers, still-stores; serial connections tie eight devices to server; workstations network to server through Ethernet LAN; permits multiple lists for playback and record functions.

Circle (364) on Reply Card

ENG data publication

By Nucomm

• **PT3 series brochure:** outlines various models of PT3 series ENG microwave products including frequency and channel data, audio and video performance and power requirements.

• **PA series:** data sheets on mast-mount power amplifiers.

• **PS series:** ENG truck control units.

Circle (369) on Reply Card

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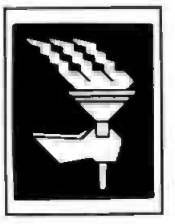

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	Page Number	Reader Service Number	Advertiser Hotline
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EDAK	72	41	
EEV, Inc.	33	16	800-DIAL-EEV
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