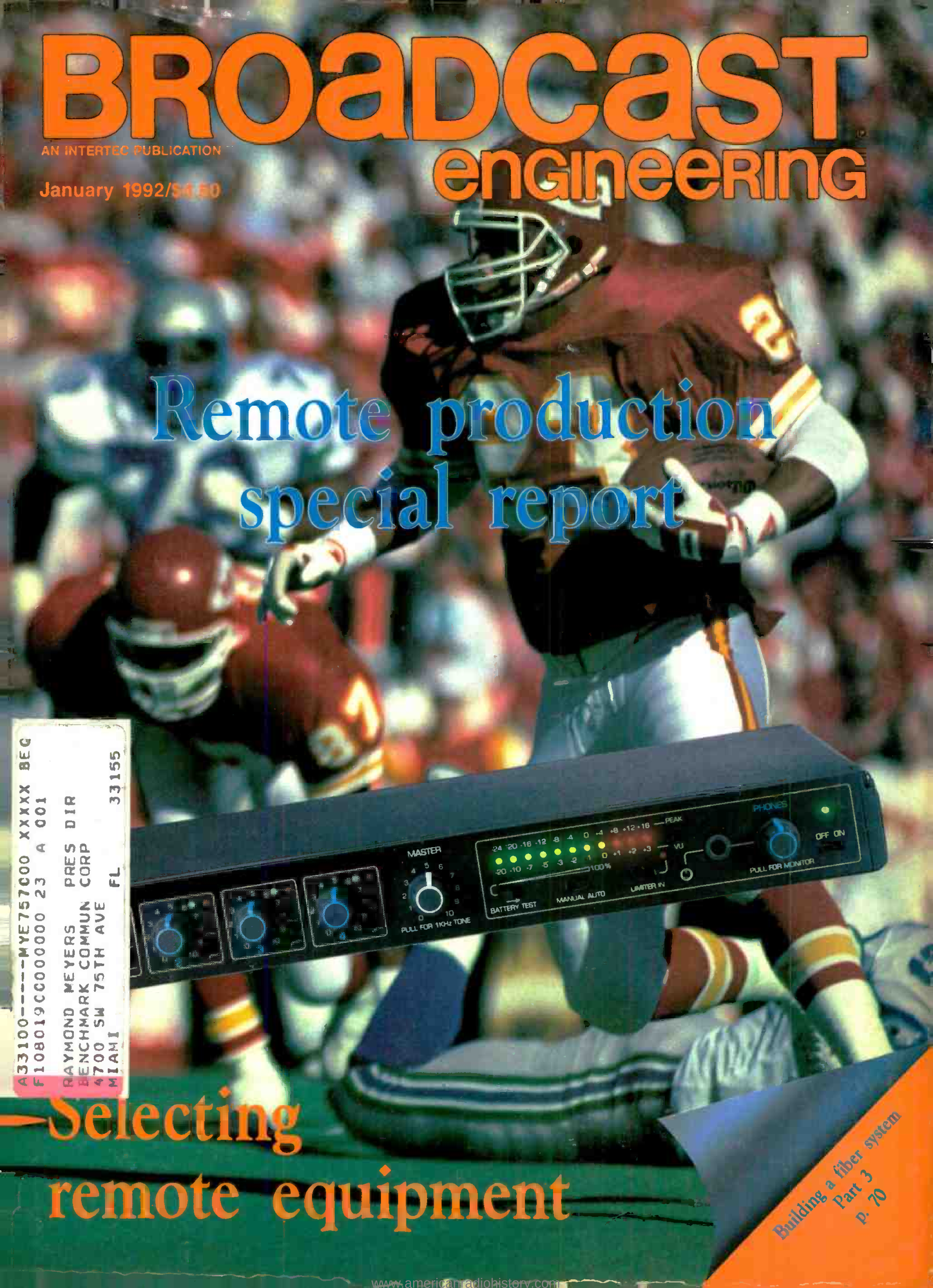
BROADCAST engineering

AN INTERTEC PUBLICATION

January 1992/$4.50



Remote production special report

Selecting remote equipment

Building a fiber system Part 3 p. 70

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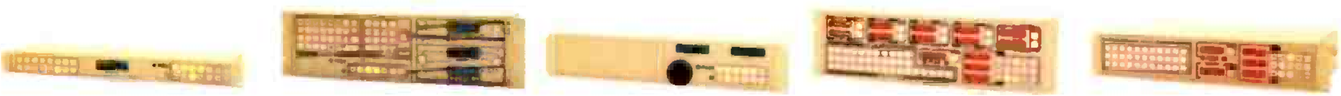

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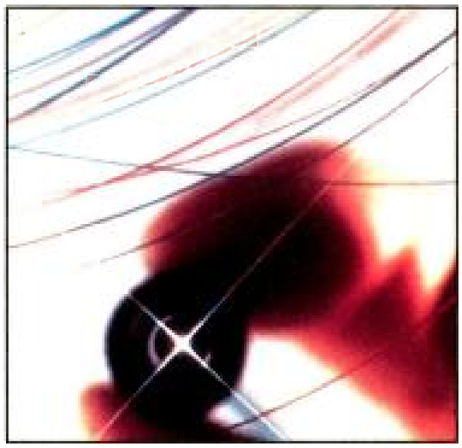

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REMOTE PRODUCTION SPECIAL REPORT:

Broadcasters have learned that the way to the listener's ear or the viewer's eye is through local production. One effective way to accomplish this feat is through remote broadcasting. Typically, there are two key elements to a successful remote broadcast or recording: the right on-site equipment and a way to deliver the programming back to the studio. This month's issue provides solutions to both issues.

FEATURES:

OTHER FEATURES:

DEPARTMENTS

ON THE COVER

Remote broadcasting continues to be a challenge, no matter how modern the technology. As stations try to cover more events, broadcasters are finding ways to do so cost-effectively and with higher quality. Today, nothing symbolizes a fall remote broadcast better than a football game, such as the one shown on the cover. (Cover credit: Shure Brothers; Sports photo courtesy of Young Company.)

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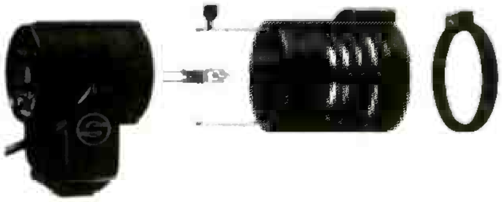

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News

By Dawn Hightower, senior associate editor

Date set for NAB '92

The official date of the National Association of Broadcasters Convention has been expanded to accommodate the Broadcast Engineering Conference and additional radio sessions. The convention is set for April 12-16. Radio sessions begin at 1:30 p.m. on April 12.

Exhibits will remain open Monday through Thursday as originally scheduled.

Legislation introduced to require engineer on the FCC

Don Ritter (R-PA) has introduced legislation that would require at least one commissioner on the Federal Communications Commission (FCC) to be an engineer. He made the announcement at the Society of Broadcast Engineers national convention in Houston, Oct. 2-5.

Ritter commented, "The FCC is charged with regulating one of the fastest growing and technologically dynamic industries in this country. Yet, since its creation in 1934, only eight of 64 commissioners have had any kind of engineering background." Ritter noted that the commissioners have professional staff assistants, but pointed out that "of the 15 professional staff assistants to current FCC commissioners...only one has a background in engineering."

Ritter is a member of the Telecommunications Subcommittee of the Energy and Commerce Committee, and a member of the Science, Space and Technology Committee. He is also an engineer, and holds an Sc.D degree from MIT.

Ritter told SBE members that requiring an experienced engineer on the commission would "give a new level of technical sophistication to the (FCC)...and give the FCC greater ability to handle the complex technical engineering questions that will be coming before the commission in the years to come."

Ritter's bill, H.R. 3501, would amend the Communications Act of 1934 to require "At least one commissioner shall, by virtue of possessing at least a bachelor of science degree in any engineering discipline from an Accreditation Board for Engineering and Technology, approved educational 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, be skilled in the engineering sciences at the time of his or her appointment."

SMPTE calendar updates

The 26th annual SMPTE Advanced TV and Electronic Imaging Conference will be held Feb. 7-8 at the Westin St. Francis Hotel in San Francisco. The theme is "Collision or Convergence: Digital Video/Audio, Computers and Telecommunications."

This all-digital conference will examine areas of compatibility and discord between television and computers, covering topics, such as data compression, mass storage, video-audio workstations, and fiber-optic and satellite transmission of digital bitstreams.

The SMPTE all-day tutorial, "Computers for Video, Video for Computers" will be held Feb. 6 at the Westin St. Francis Hotel. It will be a hands-on look at current applications of computers in video and audio production. Topics will include resolution, storage and retrieval, image quality, compression, distribution, interchange and control. In addition, video and computer manufacturers will provide product information and presentations.

SBE/NPR offer technical certification course

The Society of Broadcast Engineers (SBE) and National Public Radio (NPR) have combined forces to offer an instructional certification course in broadcast technology. The NPR/SBE course will be carried by NPR via closed-circuit satellite to its member stations in the winter of 1992. It will cover the SBE Broadcast Technologist certification level, as well as a review of the Broadcast and Senior Broadcast Engineer certification levels.

This project is designed to provide a library of fundamental engineering concepts and information for a variety of students. Each course will include a workbook, audiotapes, review exams and live satellite interconnects with expert instructors.

The project is partially funded through a grant from the Corporation for Public Broadcasting's System Development Fund.

The course will cover five elements of radio station operation: electronic theory, audio theory and practices, AM/FM radio frequency theory, satellites and microwave, and FCC rules and regulations.

For more information, contact Donna Fox at National Public Radio, 1-800-235-

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BROADCAST ENGINEERING is edited for corporate management, engineers/technicians and other station management personnel at commercial and educational radio and TV stations, teleproduction studios, recording studios, CATV and CCTV facilities and government agencies. Qualified persons include consulting engineers and dealer/distributors of broadcast equipment.

BROADCAST ENGINEERING (ISSN 0007-1794) is published monthly (plus three special issues) and mailed free to qualified persons within the United States and Canada in occupations described above. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to **Broadcast Engineering**, P.O. Box 12960, Overland Park, KS 66282-2960.

SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada; one year, $50.00. Qualified and non-qualified persons in all other countries; one year, $60.00 (surface mail); $115.00 (air mail). Subscription information: P. O. Box 12937, Overland Park, KS 66282-2937.

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INTERTEC PUBLISHING CORPORATION

Editorial

More for you

FCC Update

FCC proposes rules for HDTV

By Harry C. Martin

On Oct. 24, the FCC proposed policies and rules to govern high-definition television (HDTV). The proposed rules reflect the previous commission decision that HDTV should operate in a standard 6MHz channel that would be independent of the existing channels currently used by TV stations for their NTSC transmissions. Comments are being sought on the following issues:

• *Eligibility.* The FCC is proposing to restrict initial eligibility for HDTV frequencies to existing broadcasters. However, this restriction would be eliminated after HDTV assignments are made to existing stations. Stations would have three years from the time that an HDTV allotment is made to apply for its use, and two years from the grant of a construction permit to build the HDTV facility.

• *Frequency assignments.* The commission is seeking comment on whether it should allot HDTV channels to each community and randomly assign particular channels to existing licensees in the community. Alternatively, the agency would first assign a number of channels to a community, and then permit licensees to apply for them on a first-come, first-serve basis during an initial filing window. Competing broadcasters would be randomly ranked so that the top-ranked would be granted its first choice. The commission is also seeking comment on whether parties should be permitted to negotiate channel changes among themselves after HDTV frequencies are assigned, and whether a financial qualification showing should be made before an HDTV frequency is assigned. In the event that there is insufficient spectrum to accommodate all HDTV applicants in a community, the commission would use comparative criteria or a lottery to determine which applicant would prevail.

• *Spectrum use.* HDTV proponents are proposing various digital transmission techniques that would permit spacing of HDTV stations as close as 100 miles to a co-channel NTSC station. It would also eliminate consideration of most of the UHF spacing "taboos" in making the new allotments. By using these standards, the FCC expects to accommodate all existing TV stations, except perhaps in the New York City area.

The commission currently does not see a need to use vacant non-commercial channels for HDTV except in a few cases. LPTV and TV translator stations, which have secondary status vis-a-vis full-service TV stations, may well be displaced, particularly in major markets.

• *Conversion to HDTV.* The commission is considering several alternatives to convert from the existing NTSC standard to HDTV. Such conversion could be accomplished in three ways:

1. Conversion could be scheduled on a nationwide basis for a certain date after a specified rate of penetration for HDTV receivers is achieved; or

2. The agency could require conversion on a market-by-market basis when penetration rates reach a certain level in the market; or

3. A specific date for conversion would be established, and consumers would be given a number of years to purchase new receivers and adjust to the new transmission form.

Other issues being considered by the commission are whether it should cease issuing new NTSC construction permits once initial HDTV assignments have been made, and whether requiring simulcasting is the appropriate means of protecting existing consumer investment in TV receivers.

FCC orders tower destruction

Recently, the commission ordered the owner of a radio tower located in Tennessee to dismantle the tower because it constituted a hazard to air navigation. The tower was not lighted according to the station's FCC license.

The licensee had ceased using the 755-foot tower after moving its transmission facilities to another location. No other licensees were using the tower, and the local electric utility company had stopped power to the site.

The commission's authority to order the dismantling of the tower is contained in Section 303(q) of the Communications Act, which states as follows:

"In the event that the tower ceases to be licensed by the commission for the transmission of radio energy, the owner of the tower shall maintain the prescribed painting and/or illumination of such tower until it is dismantled, and the commission may require the owner to dismantle and remove the tower when the administrator of the Federal Aviation Agency determines that there is a reasonable possibility that it may constitute a menace to air navigation."

FCC proposes "hoax" rule

Responding to recent incidents of harmful hoaxes by broadcast licensees, the commission has proposed to adopt a hoax rule that would enable the agency to apply fines in such situations. The new rules also would codify the responsibility of broadcasters in this area.

Under the proposed standards, a licensee would have to know that the material broadcast is false, that the information directly causes public harm and that the harm was foreseeable. Noting that most dramatizations would be implicated under the new rule, because they are false by definition, the commission is seeking comments on whether its rule should be limited to false reports of crimes or catastrophes. The agency has considerable concern that its proposed rule would be so overly broad or restrictive as to infringe upon First Amendment rights.

The commission's rule also would require that, to be punishable, the hoax must have directly caused immediate, substantial and actual public harm. The commission is seeking comment on how to determine when such harm has occurred.

Finally, the commission is suggesting the rule require that the foreseeability of the harm must be established before a forfeiture can be assessed. In this connection, the agency said factors such as the timing of the hoax broadcast and the content of the broadcast should be considered. ■

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

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Strictly TV


Courtesy of A.F. Associates

Camera video control

The basics

By Talmage Ball

A bewildering array of knobs and switches adorn most camera control units (CCUs). What do all of these knobs do? How are they used? Questions such as these run through the minds of most newcomers to TV production.

No matter how sophisticated or computerized TV stations become, cameras, the heart of image acquisition, will be around for a long time. This means that time spent teaching employees the basics of video control is time well spent.

This column is designed to help you introduce new employees to the proper operation of the CCU for tube cameras. Subsequent columns will address the special case of multiple camera shoots and the control of CCD cameras.

Knobs, knobs, knobs...

Camera controls come in two broad categories. *Registration controls* set the scanning of the electron beams within the pickup tubes. *Shading controls* affect the way a pickup tube's output is translated into colors.

The goal is to have all the camera's tubes scan the image as identically as possible. In multiple camera shoots, all the cameras must render the subjects as the same color.

Most modern cameras include an automatic setup feature. Some systems use a special alignment slide in the lens, sometimes called a *diascope*. Other systems work using reference voltages or memories. Regardless of how well the automatics work, most video operators insist on touching up the cameras manually, particularly in multiple camera shoots.

Focus on focus

After the camera is powered and checked out as functional, allow it to stabilize for approximately 20 minutes. Then run an auto setup routine. This puts the camera at a close to optimum setting before proceeding.

One of the first things to check is *back focus*. This alignment sets the distance from the lens's rearmost element to the camera's prism. Check it by first turning off any detail or enhancement circuits. Then zoom in tight, focusing on some high-contrast object at a distance of at least 20 feet, such as a clock face. Zoom out, watching for the image to drift out of focus. If it does, restore it by adjusting the back focus knob on a studio lens, or the back focus ring on an EFP lens. Zoom in again, and refocus if needed. Then zoom out and reset back focus. Repeat until the camera is tightly focused at both ends of its zoom travel. Restore the enhancement circuitry.

Ball is chief engineer, KSL-TV, Salt Lake City.

Registration

Most cameras are adjusted by aligning the registration of the red and blue channels to match the green. (Green channel adjustments are usually performed in a maintenance shop.) To simplify registration, most cameras have a specialized output that can display green inverted — that is, swapped white for black. Feed negative green onto a monochrome monitor. Mix in the red or blue channel under test. When the two are perfectly aligned, the screen will become a flat gray. However, don't look for perfection. The registration in the center of the picture takes priority over the sides and corners. Find a good compromise.

Color my world

When viewing a high-contrast scene, the best color pictures happen when the camera displays an excellent black-and-white picture. Check the camera's color performance by focusing on a chip chart. This is a card with monochromatic chips of various luminance levels pasted over a gray background. Figure 1 shows how the waveform monitor will reproduce the chip chart as a pair of crossing stairsteps. (See "Strictly TV," January and February, 1991, for information on reading the waveform monitor and vectorscope.)

The goal is to balance the red and blue channels with respect to the green. With the scope set for flat response, note the fuzziness of each stairstep compared to the same step viewed when the scope is set in the IEEE response position. The more fuzz, the poorer the color balance. (See Figure 2.) Tweaking the red and blue gains (whites) will balance color at the top of the stairstep waveform. Tweaking the red and blue pedestal (blacks) will balance the color at the bottom of the stairstep waveform.

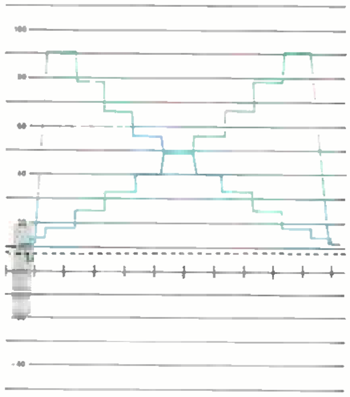

Figure 1. *The waveform display produced by focusing a camera on a typical chip chart.*

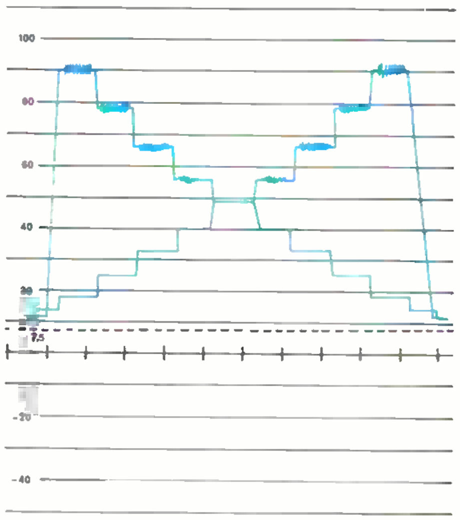

Figure 2. *A camera displaying poor white balance. Note increased RF in the white areas.*

If the camera has an automatic white balance feature, frame up on a white image in the proper light and press the white balance button. Cap the lens and do an auto black balance. If the automatics are working correctly, the chip chart will appear black-and-white with no color tint on a color monitor. ■

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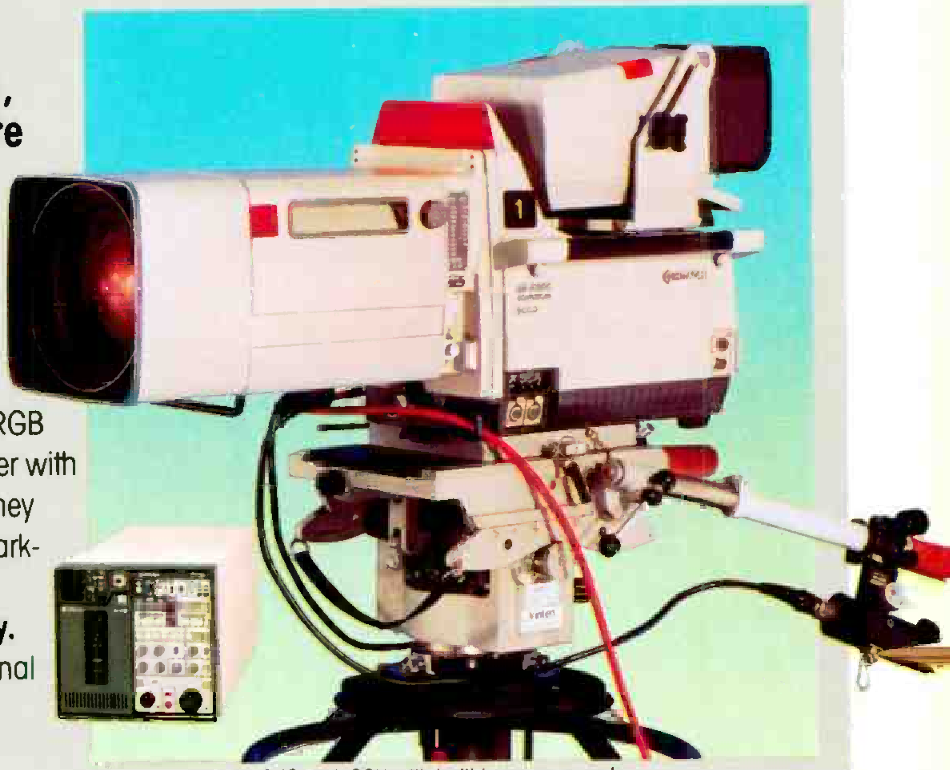

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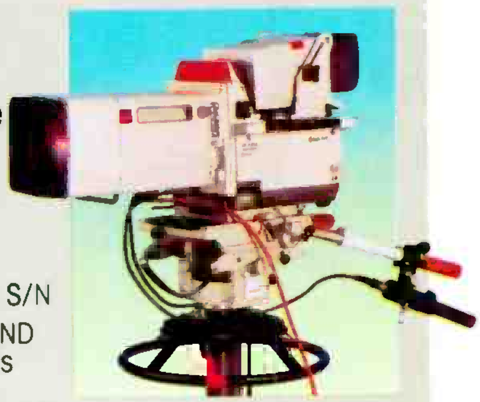

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Part 2

re: Radio


Courtesy of Wheatstone

The digital radio spectrum hunt

In band — so near and yet so far

By Skip Pizzi, technical editor

Last month's consideration of L-band and S-band (out-of-band) applications for terrestrial digital radio in the United States noted the economic and political difficulties involved there. Those same non-technical matters seem to be highly supportive of in-band digital radio systems (which would use existing broadcast spectrum for the new service). The FCC's decision last fall to use S-band for U.S. digital radio has only added to in-band's allure.

In-band proponents cite its advantages over out-of-band: lower implementation costs, easier regulatory processes and continued protection from direct satellite competition. From such a business-oriented perspective, it seems like in-band wins, hands down.

The "perfect" system

Taking these pure-policy arguments to their logical extremes, the ultimate incarnation of a digital radio format would probably involve an in-band on-channel (IBOC) system with exactly matching digital coverage to the analog broadcast contours, and no interference problems between the analog and digital signals. It would include AM and FM stations, making them sound *proportionally* better (implying that the digital signal on the FMs would be superior to the digital signal on the AMs).

This kind of approach would solve most of the nagging policy issues and economic concerns. No new spectrum is required, no new allocation process is needed, no new competition is engendered. AM and FM stations retain their relative quality and coverage positions, and little new hardware (and no new antenna site) is necessary. Yet, compatible digital transmission is achieved now, and later, a separate service might be established on it (such as the AM/FM transition of the '60s and '70s). For management, this pushes all the right buttons.

Reality sets in

If this sounds too good to be true, that's because at the moment, it is. Six in-band formats are now under development (see "Digital Radio — The First Five Years," July 1991), and none has fully achieved such a system. In fact, only one even envisions this approach on paper (USA Digital). Although this proponent has made demonstrated progress into prototype hardware for its FM IBOC scheme, its AM system is still some distance from realization.

Two other IBOC techniques have been offered to date. The first (from Kintel Technologies) implements a technique known as power multiplexing, but has yet to be publicly demonstrated, even though it was the first in-band system to be announced. It serves only FM stations and does not appear to provide any solution to the multipath problem.

The second (a joint proposal from Synetcom and Radix) uses standard FM subcarriers for the digital signal (requiring twice the data compression that all the other systems call for), and an active diversity receive antenna array (of the high-tech "beam-former" style) to combat multipath. Again, only FM stations could benefit, and to maintain compatibility with current SCA regulations, the FM signal would have to go to mono (and probably forego its existing SCAs) under this plan.

IB, but not OC

Because the ideal IBOC scenario has proven so technically elusive, several in-band alternatives have been proposed. These still use current broadcast spectrum, but forsake the on-channel approach for an *interstitial* or *adjacent*-channel format.

Within this method are "narrowband" and "wideband" proposals. The first (espoused by Mercury Digital and LinCom) places each station's digital signal on its own separate low-power transmitter operating in a first-adjacent channel, or another channel not currently allocated to the market. (Mercury addresses the FM band only, while LinCom proposes such channels in the FM and AM bands; it recently demonstrated a prototype of its FM system, developed in cooperation with Strother Communications.) On the other hand, the wideband approach (American Digital Radio's concept) multiplexes several stations' digital audio signals together, then distributes the datastream in a spread-spectrum-like manner across many carriers placed in non-allocated FM channels.

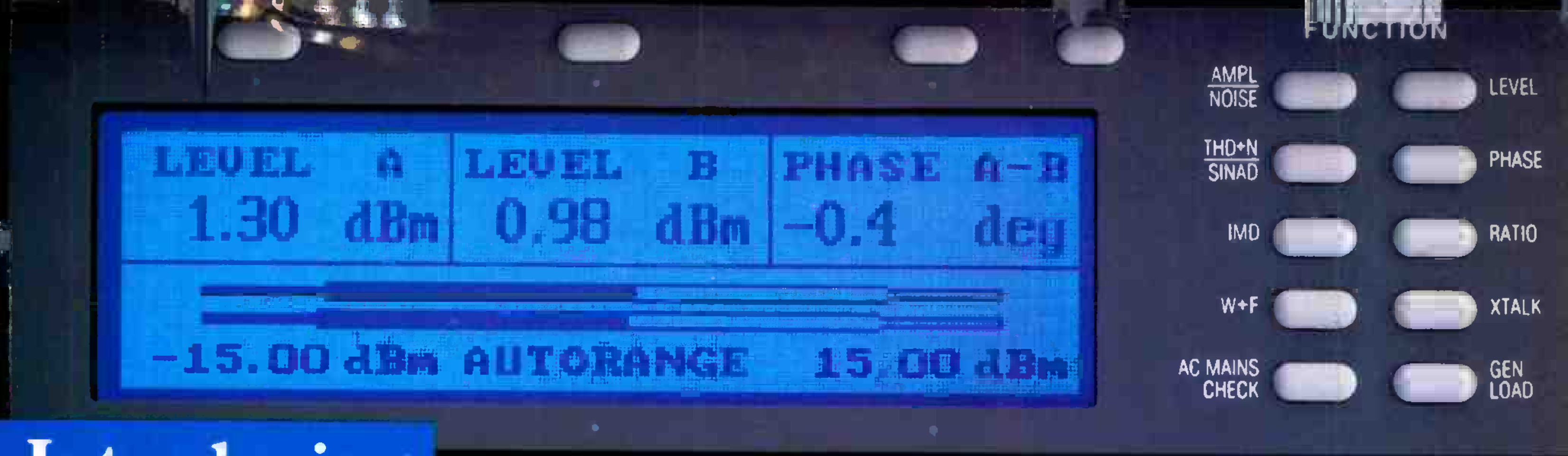
Of greatest concern with these formats is the issue of interference to existing service. Although each proponent addresses this in some detail, on-air testing will be required to see whether their methods will adequately protect channels in neighboring markets, especially short-spaced ones. Since Docket 80-90, FM broadcasters are particularly loathe to invite any more carriers onto their turf. In the case of AM, interference is already at such levels that many broadcasters consider AM in-band with great skepticism.

The latest wrinkles

The Eureka 147 partners recently floated a concept for an in-band, adjacent-channel variant of its system for use in the United States. Although apparently not yet an official proposal, the system under consideration would use first-adjacent channels on *both* sides of an existing FM (for greater frequency diversity), each with an RF level 40dB below the FM carrier. However, the proponents themselves are still concerned about neighboring market interference in this plan.

But the double-adjacent idea may have some merit. The paramount technical challenge to any IBOC or narrowband-adjacent approach is its multipath performance. Because these systems are constrained to use existing channel bandwidths, multipath resistance of the same caliber as a wideband system may be difficult to realize. New Canadian studies indicate that channel bandwidths below 1.5MHz or 2MHz exhibit significant losses in this regard. A 200kHz channel would require 5dB to 7dB or more RF margin (about four times the transmitter power) to approximate the multipath performance of a 2MHz or wider channel, according to these tests (which assume optimized channel-coding algorithms in each case).

Meanwhile, the Electronic Industries Association (EIA) has established a digital audio radio (DAR) subcommittee to study and propose a standard for digital radio, and its work has begun. Look for other independent tests and demonstrations in the upcoming year, as digital radio development continues in its various camps (despite the reported scarcity of R&D dollars). 1992 may prove again that where there's a will, there's a way. ■



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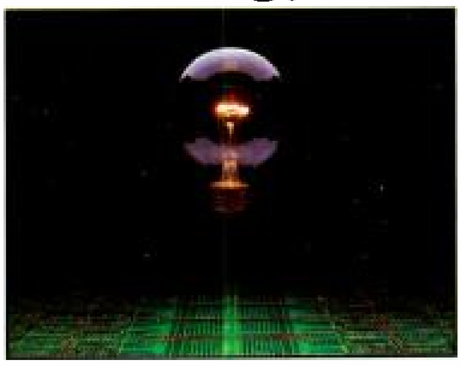


Reaching out for resolution

By Carl Bentz, special projects editor

Parallels can be drawn between TV camera tubes and video recording formats. The goal for both is the highest possible image resolution, and in order to reach

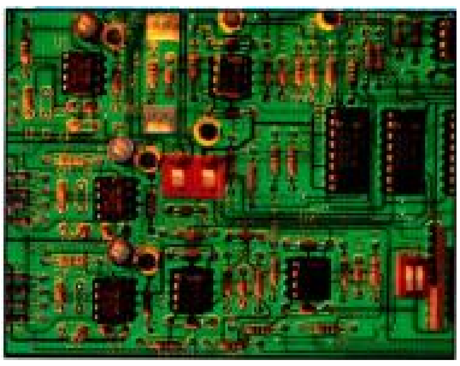
Saticon (selenium, arsenic, tellurium) devices. One implementation of a $^2/_3$-inch diameter tube shows that practical sensitivities of 20 lux or less (F/4) are possible.

no crystalline structure is present to deflect and defract the light and resulting electrons.

Interesting features have been designed

Part 5

Circuits



Courtesy of Auditronics

An in-depth look at analog ATR circuits

Servo motor control for ATRs

By Gerry Kaufhold II

Designing servo control systems for variable speed and torque motors is a complex task. First, the motors themselves must provide suitable torque throughout the entire span of expected loads. This can range from the zero-speed startup of the take-up reel with no tape on it, to full speed fast forward with a full reel.

Second, the motor power supply must be able to provide sufficient drive current at the system's highest operating frequency.

Finally, the electronic control section must be designed to provide stability, accuracy, and enough speed to handle the full range of motor speeds under varying load conditions.

Servo sections

Figure 1 shows a typical ATR motor control system. A motor control circuit provides voltage oscillations at the proper frequency and phase to achieve the desired motor speed.

The power section amplifies the oscillating voltages. It converts voltage into current to energize the drive coils (stator) and rotors of the motor. The rotor inside the motor rotates in the direction of the magnetic fields of the drive coils.

Motor torque is dependent on the phase relationships between the rotating magnetic field of the drive coils and the electromotive force (EMF) induced into the rotor.

The motor sensors measure the direction of rotation and speed of the motor. The sensors may use Hall Effect devices, or a visual detection mark on the motor shaft coupled to an LED and a photosensitive transistor.

An amplifier increases the voltage level of the motor sensors to a level high enough to be detected by low-cost A/D converters.

Any differences between the incoming signal from the motor sensors and those being generated by the motor control circuit represent error. The motor control system uses the error voltage to make adjustments to the frequency, phase relationship or voltage levels output by the motor control circuit.

In modern tape machines, a microprocessor creates the motor control signals and performs the error comparison. Servo system look-up tables stored in memory allow the microprocessor to provide accurate control and excellent stability.

from the motor sensors, in conjunction with the adjustments made by the microprocessor, provide a stable, accurate and fast-responding servo loop.

To maintain correct forward tension, the take-up reel error signal is monitored continually. As tape builds up on the reel, the error signal indicates a slower speed of rotation combined with a loss of take-up tension. The microprocessor responds by decreasing the motor drive frequencies and by adjusting the phase relationships and current supplied to the motor. The generated error signal from the motor sensors continually feed back data to the microprocessor, thereby keeping the loop closed.

The same basic process is used for the fast wind modes. Note that videotape decks use similar servo mechanisms to control the shuttling of videotape.

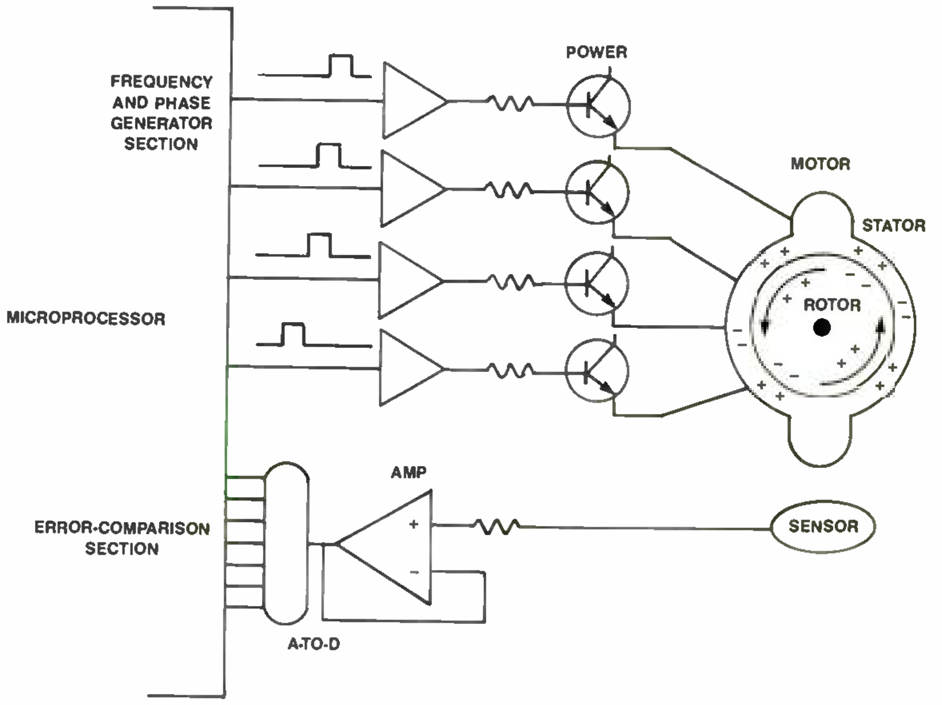


Figure 1. Block diagram of a microprocessor-controlled audiotape recorder servo-mechanism system.

How it works

Last month, we discussed the startup phase of putting the tape deck into play mode. From a full stop, the ATR sequentially executes steps that quickly bring the tape up to full operational speed.

During the beginning of take-up reel rotation, the motor sensors supply almost no signal, so the system operates *open loop*. As the take-up reel gains momentum, the motor sensors begin to deliver useful information. This is amplified and read into the error comparison section. As soon as the first error correction is calculated by the microprocessor, the system begins to operate in a controlled mode. Feedback

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

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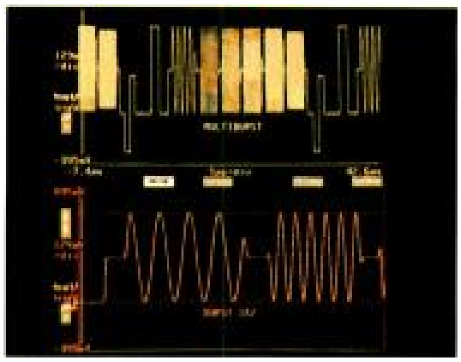
Part 5

Troubleshooting

Optimizing 2-track analog ATRs

Timing problems

By M. Raymond Jason



Courtesy of Tektronix

The elapsed playing time, tape speed and physical length of a segment of tape are related by the equation:

Equation 1.

Elapsed time = length/speed

This would appear to indicate that timing and speed are inversely proportional, meaning that a speed or a timing problem are just different names for the same problem.

But such reasoning assumes that *tape length is constant*, and because of tape's unavoidable and significant linear elasticity, this is *not* the case. So tape timing is a function of not one but two variables: speed and length.

Length effects

Three factors influence a tape's effective length. In order of importance they are: temperature, humidity and tension. One tape manufacturer provides a rough rule of thumb: one second of error in a 30-minute program results from a temperature change of 30°F, a humidity change of 50% and a tension change of three ounces.

Of these factors, only tension is under your control during maintenance and alignment. An in-line tension gauge is the best and quickest way to check tension and should be part of your tool kit. Also include a thermometer and a hygrometer. If the air conditioning breaks down and the timing complaints increase, the problem is more likely to be from expanded tape than shortened tempers.

Capstan and pinch-roller problems

The second variable in the timing equation is speed, which on most ATRs is controlled by the capstan/pinch-roller system. Any deviation from perfect rotational velocity or perfect capstan diameter will show up as a timing error.

For 1/4-inch-diameter capstans, a diameter error of just 0.0001 inches (0.1 mil or 100 micro inches) will result in a timing differential of 1.5 seconds per hour (independent of tape speed). Manufacturing tolerances can be several tenths of mils, and tape wear can reduce capstan diameter by mils. Half-inch capstans, although more expensive and prone to greater flutter given their slower rotation, exhibit half the timing error of 1/4-inch capstans for the same diameter error.

Use a micrometer accurate to 0.0001 inches to measure all your ATR capstans, then calculate the expected timing differentials using Equation 2. You may be surprised at the variability you find.

Equation 2.

$$\text{Error (sec./hr.)} = 3{,}600\,\frac{d_{capstan} - d_{ref}}{d_{ref}}$$

Tape slippage from a dirty, damaged or poorly adjusted pinch roller will introduce yet another speed factor: the tension differential between supply and take-up reels. Avoid this out-of-control situation by keeping capstans and pinch rollers clean, and by checking pinch-roller pressure and supply/take-up tensions as part of routine maintenance.

Most ATRs today use a crystal reference for capstan velocity. Check it with a good frequency counter, at a point in the capstan drive circuit that will not load the oscillator. Accuracy should be at least 0.01%. Your ATR's service manual should provide proper voltages, waveforms and frequencies to look for in the capstan drive circuit.

If your ATR uses an AC-referenced (hysteresis-synchronous) capstan motor, then the accuracy of your capstan speed is in the hands of the local power utility.

Two kinds of symptoms

A tape timing error can be detected in two ways: as an error in elapsed playback time or as a pitch error. The latter is much more likely to be noticed on musical material than on voice or other audio. The pitch error is typically a pitch change across a splice when editing between takes made on different recorders or under differing ambient conditions.

As previously noted, the most probable causes of these problems are tape-length variation or differing capstan diameter between machines. But finding the actual culprit can be a tedious process.

Tracking down timing problems

Tape timing difficulties almost always show up as relative problems between two ATRs. First, determine which two ATRs are involved, and then figure out which one has the problem, if not both. For ATRs that use *constant-torque* drive to the reel motors (an older, lower-tech predecessor to today's *constant-tension* drive), timing problems are also common from the head to the tail of a reel on the same machine. (This is another frequent cause of pitch shifts between musical takes.) Multiple factors may also be involved.

Equation 2 provides a quick check of whether differences in capstan diameter alone account for the observed timing problem. Keep in mind, however, that pitch and timing are forever interlocked in an analog ATR (unlike digital or rotary head recording systems). So for an overall check, sensitive to all sources of timing error, simply compare the playback frequency of a 10kHz recorded tone on each of your machines. Include measurements at the head and tail of a full reel to uncover differential tension problems. Equation 3 translates the frequency differential into a timing error.

Equation 3.

$$\text{Error (sec./hr.)} = 3{,}600\,\frac{\text{frequency 1} - \text{frequency 2}}{\text{frequency 2}}$$

You'll need a stable oscillator — frequency drift should be less than 1Hz per minute. For this, most oscillators need to be warmed up approximately an hour. You'll also need an accurate and stable 5-digit frequency counter with 1Hz resolution. To create a reference tape, use a constant-tension ATR with a well-aligned transport, and a pinch roller and capstan in excellent condition. Thoroughly clean the tape path. After allowing 10 or 20 seconds of recording time at the head of a full reel of tape (for tensions to stabilize), record one minute of 10kHz tone at nominal level. When using the tape for measurement, also allow time for the transport-under-test to stabilize before reading the frequency. ■

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

Part 1

Management for Engineers

Conflict resolution

Understanding conflict

By Judith E.A. Perkinson

It's 9:00 in the morning as you trudge back to your office. You're tired and can't seem to get motivated about the day ahead. You've been waiting three months for a raise, a problem employee hasn't been towing the line, the computers went down yesterday afternoon erasing some maintenance files, and your boss wants to get together to discuss a problem you're not prepared for. You can't figure out why you feel so worn down.

This is an example of *burnout.* Some familiar signs of burnout include fatigue, loss of motivation, sleeplessness, loneliness, social isolation, irritability, decreased work efficiency, cynicism and depression.

You often know when you are burned out, but you may see it as a result of overwork, not as a by-product of unresolved conflict. If you can get a grip on the conflict in your life, you can manage burnout.

Understanding conflict

Conflict doesn't just happen, it is generated. To handle conflict, you must examine the role you play in generating it. Only then can you take charge of the conflict and limit its negative effects.

Learning to deal with conflict begins with understanding how it is generated. Conflict can be broken down into two basic categories: 1) conflict you generate, and 2) conflict you don't generate.

Conflict you generate

You probably like to think that conflict is the result of someone else's actions. Everyone is responsible for generating conflict. Five ways that you can generate or contribute to conflict include:

1. *Overreaction.* Almost everyone has encountered people who have overreacted to something that was said to them that they didn't like. And you have probably all been in positions where you have overreacted. Because everyone is capable of overreacting, we are all responsible for introducing unnecessary conflict into our lives.

2. *Personalization.* "Why did this have to happen to me?" Although you may feel like the world revolves around you, it did not rain to ruin your day, the equipment did not break down to spite you, your employee didn't get sick to put you behind schedule, and your co-worker's bad mood was not directed toward you. These situations may have occurred, but they did not happen *to* you, they happened to *affect* you.

Many of you have taken a normal situation and allowed your frustration to make you believe that the problems or circumstances were aimed at you. At times, everyone takes things personally. It is an expression of frustration generated out of a need to gain control over the situation.

3. *Confrontation.* A problem exists and you confront the person you feel is responsible. This is a deliberate act on your part, and you realize that it may become a potential source of conflict. That does not make it bad, it is simply one of the ways in which you generate conflict.

4. *Avoidance of issues.* Just as effective in generating conflict is avoiding issues that should be resolved. People often avoid conflict, hoping it will disappear. At times it may work, but more often than not, it makes the problem worse.

Avoidance is not a malicious act, it is a means of evading a problem you unrealistically hope will go away. Examples include avoiding a report you don't want to write, putting off dealing with a difficult employee, not finding time to prepare for a meeting that you're dreading, or catching up on those not-so-critical maintenance jobs around the facility. Before you know it, you have a serious conflict that could have been avoided.

5. *Perpetuating the problem.* When this occurs, you are usually acting more out of anger than reason. Many people find it difficult to let go of an issue. This is often fostered by a much-repeated saying, "Don't get mad, get even." Whether you are dealing with revenge or holding a grudge, any behavior that perpetuates the problem adds to the conflict.

Conflict you don't generate

Conflict can be generated from sources or circumstances that you don't initiate. Some of the ways in which conflict is generated include:

- *Lack of understanding.* Communication is a valuable tool. Yet, there are times when you don't understand someone or something, and there are times when something you say or do isn't understood. It is critical that you take responsibility for understanding and communicating. Lack of understanding most often flows from lack of effective communication. This can produce unnecessary conflict.
- *Decisions you cannot live with.* There are times when a superior, a peer or a subordinate makes a decision that you simply can't live with. When this happens, conflict follows.
- *Problem dumping.* There are people who dump problems. When you are ultimately responsible for a project and someone on the team doesn't do the fair share of work, the problem is dumped on you.

Some standard dumping phrases start with, "I forgot...," "I don't know how this happened...," "You just have to...," and "What are you going to do...?" Therefore, conflict results.

- *Someone picking on you.* There may be a time in your career when someone is "out to get you." They don't like you, they don't like your discipline, they don't like your boss or they are trying to get your job. Check to make sure that none of the other reasons for conflict exist before you assume someone is picking on you. However, it can happen. And when it does, conflict results.
- *Needs and purposes at odds.* At times, your needs and purposes will be at odds with those of someone else. This causes conflict.

Avoiding conflict

Conflict can be avoided. It is your reaction, your anger and your communications that result in conflict. However, sometimes conflict is unavoidable, such as when you are at odds with someone's needs or purposes, when someone else is trying to foster a problem or when someone makes a decision with which you disagree. When faced with unavoidable conflict, you must learn how to deal with it.

This month, you have taken the first steps in examining the sources of conflict and the role you play in it. Next month, we will examine what to do about conflict. ■

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

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Remote production special report



station apart from the competition by learning ssful remote production techniques.

As stations look for ways to differentiate themselves from their competition, remote broadcasts are often seen as one more tool in the competitive battle. Because audiences can often receive the same programming from several sources, it is sometimes difficult to stand out on the dial. So what's a station to do? Many successful stations have found that the key to setting themselves apart is by getting involved with the local community. Today, localism may mean the difference between a profitable or an unprofitable station.

Broadcasters have learned that the way to the listener's ear or the viewer's eye is often through a local production. One part of that production involves the origination of programming from sites within the community. Although such productions can be complex and taxing, they often result in more visibility for the station and better community relations.

The engineering staff is usually charged with making such productions work. The challenge sometimes is to stage a remote with little advance notice at a location that may pose many obstacles. Fortunately, there are tools to make the local remote easier.

This month's emphasis is on remote production techniques. There are two key elements to a successful remote broadcast or recording: the right on-site equipment, and a way to deliver the programming back to the studio. This month's issue provides solutions to both topics.

Brad Dick

Brad Dick, editor

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Telco and fiber: broadcast solutions

Telco options simplify and reduce the expense of remote broadcasts.

By Rick Lehtinen, technical editor

The Bottom Line

The 80/20 rule applies in remote work. Most of the events in a given city take place in relatively few venues — city hall, the mayor's office, a few hotels. Production and news organizations can capitalize on this fact by using new telephone technology and services. With digital techniques and fiber optics, broadcasters can expand their coverage without increasing their overhead, or do their traditional tasks with reduced costs. However, broadcasters should be wary of becoming too dependent on the telephone industry.

The essence of remote broadcasting is going somewhere to get a signal, and then returning that signal to the studio for transmission. Over the years, fulfilling this mission has led facilities to build up arsenals of remote broadcast equipment. On the audio side, there are remote pickup transmitters, conditioned telephone lines, telephone line frequency expanders, cellular phones and wideband 2-way systems. On the video side, there are camcorders, microwaves, ENG trucks and satellite newsgathering vehicles.

Unfortunately, each facility's drive toward self-sufficiency in remote work has sometimes lead to wasteful expenditures. Worse, multitudes of users have crowded the RF spectrum, making remote broadcasts harder for everyone.

Fortunately, new telephone company technologies can help. This article explores some of the ways facilities can use advanced telephone company services to increase the productivity of remote broadcasting.

Pool feeds are forever

To conserve resources and simplify their operations, news organizations have long relied on *pool feeds*. A pool feed is generic coverage. It brings home only what happened or what was said, without commentary or interpretations. In a pool feed, nothing is heard or appears on camera that might link the coverage to a particular news organization.

Pools are also useful in situations when facing representatives of many news organizations at once might intimidate a subject. Additionally, many venues, such as the Oval Office in the White House, are too small to accommodate large press contingents.

The opposite of the pool feed is the *unilateral* feed. A unilateral feed is required by news organizations that either are not participating in the pool feed, or that choose to augment the pool feed with their own reporters or commentators. (See Figure 1.)

Power pooling

Many facilities have discovered that they can save considerable operating expense by relying on a *switched pool feed* to get the signal home. For example, in the Washington, DC area, ABC operates two audio services — the Washington Audio News Distribution (WAND) system and the Presidential Audio News Distribution (spelled PAND, but pronounced POND) system.

Subscribers to WAND or PAND get one or more drops from the system's switch, which is housed in a downtown Chesapeake & Potomac (C&P) telephone switching center. The switch itself is a broadcast-quality audio routing switcher. Users control which signals connect to their drops with a touch-tone telephone, using DTMF commands. The WAND assignment manager daily sends an assignment sheet by fax and wire service. It lists the times and channels of the various offerings.

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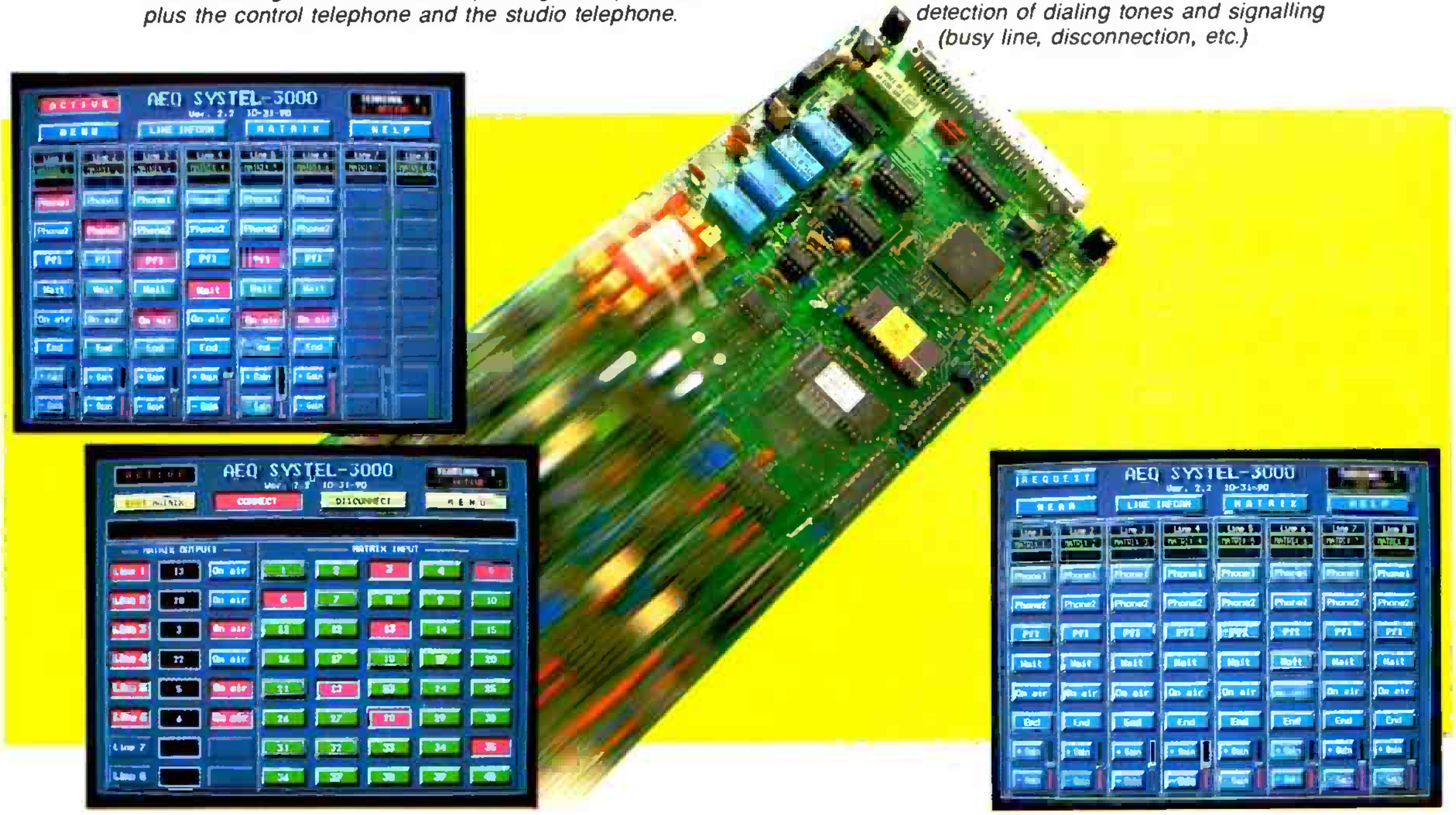

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The WAND carries events from several Washington venues. The system also will do remote origination to cover events at non-wired venues. If needed, the network may be fed audio from ABC television. The *dry* or *generic audio* feeds are controlled by ABC-supplied technicians at the venues.

Using these audio pools ensures that subscribers have access to most news events. Users may augment or replace the pool feed with their own unilateral feed, but they must provide their own circuit.

TV-switched pool feeds

TV broadcasters also make use of switched pool feeds. For instance, in the Washington area, four networks (ABC, NBC, CBS and CNN) maintain a cooperative switched pool. The participants rotate responsibility for the pool among themselves. The daily state department briefing and the twice-a-week Pentagon briefings are normally handled in this way. The NASA select feed service will also soon be available on this system.

In addition to lines from the popular venues, the pool switch has inputs from each of its members. This enables any member network to feed the pool using its existing resources. For instance, not all networks go to the Justice Department, but those that do can easily provide the pool feed by bringing the feed into their own facility. They can then send it to the switch, where it is routed onto the pool output. The pool output feeds a distribution amplifier, with an output for each member. This way, the responsible member can verify it has switched correctly simply by monitoring its own incoming pool line. (See Figure 2.)

The switching center of a national video fiber-optic distribution system. (Courtesy of Vyvx.)

Growing circles

Switches similar to the Washington system are found in many cities. Service can extend between cities as well. One national long-haul fiber-optic provider is establishing a nationwide video production network. The network connects more than 50 production facilities across the country.

A key to the system's success is the use of digital telephony techniques. Inside the network, all the signals travel in the DS-3 format. At network switching centers, the signals are broken out of the network and converted to analog. An analog routing switcher then distributes the signals to customer premises. Customer premises connect to the switching centers by analog fiber, coax and microwave. (See Figure 3.)

Standard NTSC video requires slight compression to fit in the 45Mbit/s DS-3 bandwidth. This is accomplished by the digital encoder and decoder (CODEC). However, the science of compression has advanced considerably in recent months. NASA recently announced it had performed experiments involving the TDRS satellite system at the Johnson Space Center in Houston. In the NASA trials, researchers passed SMPTE 240M (1125/60) HDTV, with a data rate of 1.188Gb/s, through a DS-3 link.

Fiber's capacity is enormous. Each fiber carries approximately 90 of the bidirectional DS-3 channels. Each channel can carry one video and four audio signals. Between eight and 144 fibers lie in each glass pathway. The carrier with the video network, one of four carriers in the nation, has more than 11,000 miles of cable pathway.

Continued on page 32

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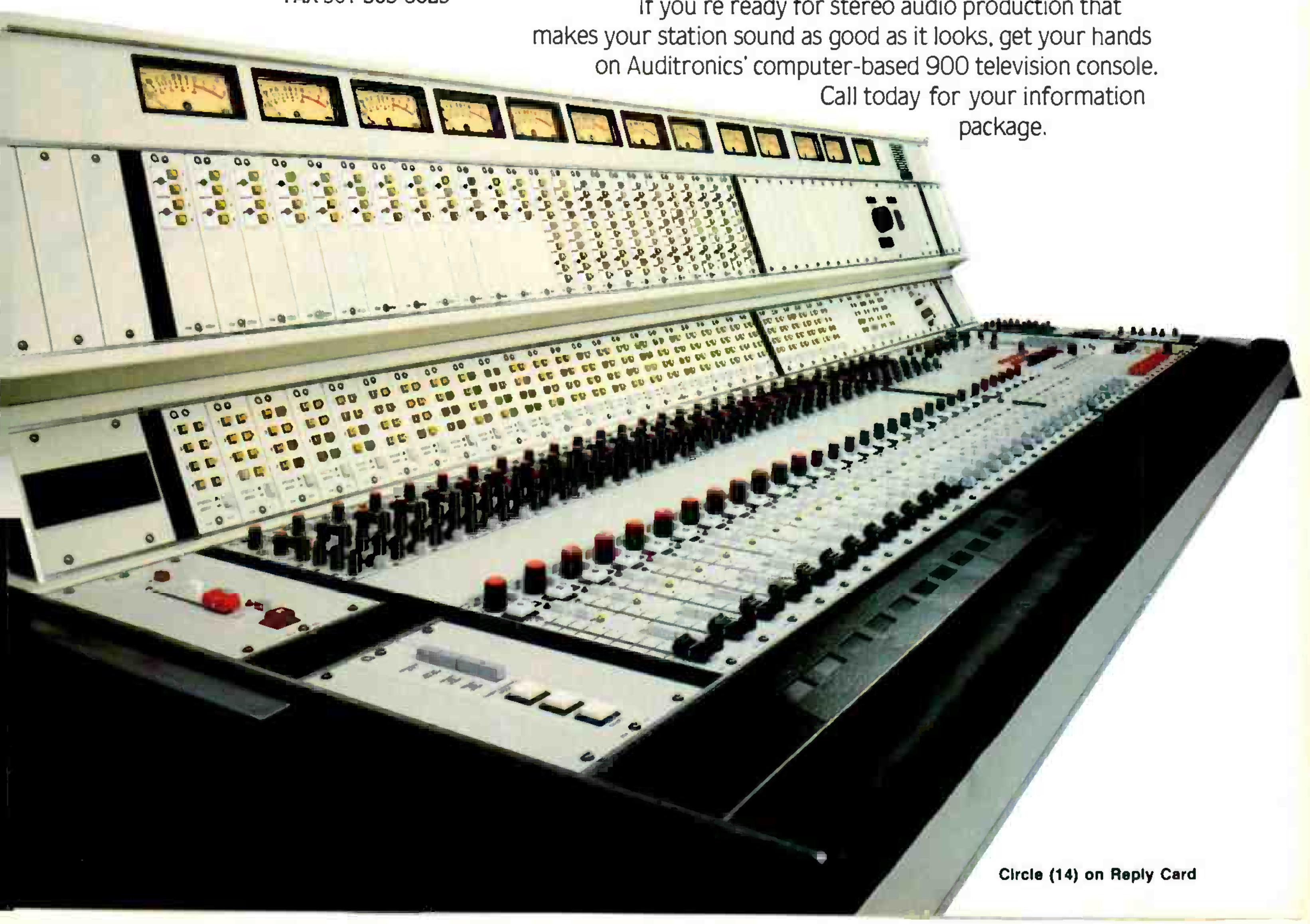

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transportation, have a high front-end cost. Nevertheless, the per-use and monthly charges amount to little more than labor to set them up and the maintenance to keep them operating. However, spectrum congestion has increased the potential for interference. Furthermore, the TV auxiliary spectrum is often envied by other services. This creates a regulatory pressure for those frequencies. (See the related article, "PBXs in the Sky?" pg. 32.) Finally, the signal quality of telco fiber and digital products is often better than traditional broadcast solutions.

Pool patches

The Washington example will prove instructive. Two years ago, the networks used a major telephone company's facility as the point of interconnecting and splitting the pool feed. That company then drastically increased its tariffs for video interconnects. The price for connection was so high the networks had to change their practices.

At that time, C&P was just beginning to offer its customers switched services. This service saved money several ways. It eliminated most manual patching, which reduced switching charges. The phone company needed to process fewer orders, and the user bore the responsibility of making sure all the switching was done correctly.

It also saved money by reducing the lines into stations. Each fiber has an access charge and a mileage charge, based on its distance and whether it crosses through different service areas. Say a network wishes to connect regularly with five or six venues. It buys the use of cables from the many venues to the switching center, and then buys a few cables from the switching center to its master control room. This saves the line expense of bringing all the venues back to master.

Say that a pool switch and a network's own unilateral switch are located near

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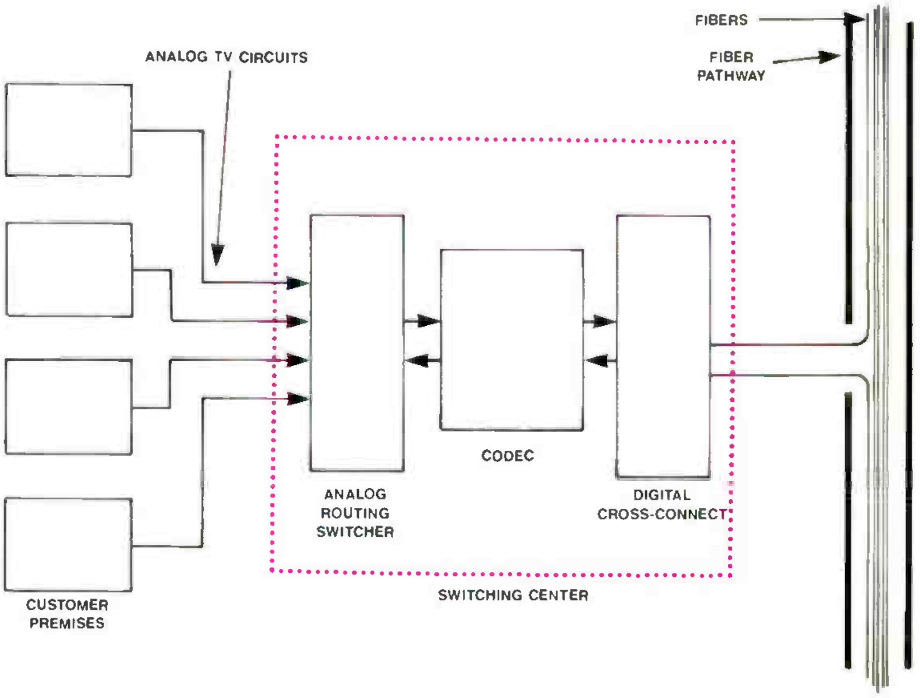

Figure 3. *One national fiber optic uses DS-3 channels to transport TV audio and video around the country. At various cities, fibers are pulled from the pathway, run into a cross-connect and fed to an analog switch for distribution.*

vide users with telephone communications. (See "Communicating With the Field," January 1991.) Using advanced *demand-assigned* access techniques, multiple users can share a transponder on an as-needed basis.

Most of the satellite telephone systems used for news gathering today are analog, frequency-modulation based, single-channel-per-carrier (SCPC) systems. These techniques have the advantage of being well-proven. However, improvements in digital voice-coding techniques will shortly allow the development of systems that will not only offer superior quality to analog methods, but also greater efficiency. Where pulse code of delta modulation requires 64kb/s of toll-quality circuits, new digital signal-processing schemes require 7kBbs to 14kBbs, depending on the needed quality.

Other advantages of digital

- Simplified multiplexing and switching is easier to do in the digital domain. Digital audio and data can be multiplexed together.
- Digital components are subject to less drift and need less adjustment.
- Digital systems allow for easier encryption.
- Forward error correction allows improved communications reliability in marginal areas.
- The required hardware is smaller and consumes less power for transmission, resulting in cost and weight savings.

Most of the digital systems under investigation use quadrature phase shift keying (QPSK) and provide multiple channels per carrier (MCPC).

New satellites ease portable operation

A new generation of satellites is gradually coming on-line to replace the current aging series. Launches have been hampered somewhat by the decreased use of the space shuttle, coupled by occasional failure of launch vehicles from this country and others.

Figure 1. *A flyaway satellite receiver being used in coverage of the Yugoslavian civil war. (Courtesy of Conus Communications.)*

One major news cooperative is moving to the Hughes SBS-6 satellite. The increased power of the SBS-6 bird will allow TV stations to reduce the cost and increase the reliability of their ground segments.

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INTELSAT-K will be situated at 338.5° east longitude. From this position, its spot beams can cover large portions of North America, South America and Europe. Because the satellite is high-powered, receivers can employ dishes as small as one meter.

The beam patterns of international satellites, as well as statutory constraints, restrict the use of international satellites for domestic news operations. They are popular, however, for certain fly-away operations, such as the coverage of recent European uprisings.

Acknowledgments: Thanks to Harry Mahon, director of broadcast services, GTE Spacenet, McLean, VA; and Steve Blum, Conus Communications Minneapolis/St. Paul, for help in preparation of this article.

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Continued from page 28

The network is laid out roughly in rings. If a problem, such as a *backhoe fade*, interrupts one link in the ring, the network's controlling computers can quickly reroute the signal around the ring's other side to restore service.

Curbside service

Another new fiber application is the *video spigot*. In this system, a telco wires a section of town, such as the Washington mall area, with fiber-optic drops. An organization that wishes to send a feed merely pulls up at a video hydrant, calls in a reservation, connects its camera or deck, and transmits. The routing is all accomplished by computer.

An interesting potential application for this service is in TV sports. Conceivably, a network could position a mix of manned and robotic cameras and microphones at a stadium, and feed everything back to the station on switched fiber. Camera video control, camera robotics commands, return video, IFB and intercom could flow from the station back to the stadium on fiber as well. The facility's own switcher and mixer would produce the program, doing away with the remote truck. Remote crews could therefore be reduced to *grips* to set up and tear down the equipment, *talent* to call the play-by-play, and a few *camera/utility* personnel.

How does all this save money?

At first glance, pools, switched feeds and fiber networks seem to do little more than put the broadcaster at the mercy of the phone companies. Indeed, broadcasters have alternately depended upon and sought independence from telcos since the earliest days of the radio networks. The low front-end cost and convenience of having "Ma Bell" take care of (and be responsible for) the signal is offset by having to pay per use or monthly fees.

Broadcasters' non-telco tools for remote production face some problems. Microwave links, a popular medium for signal

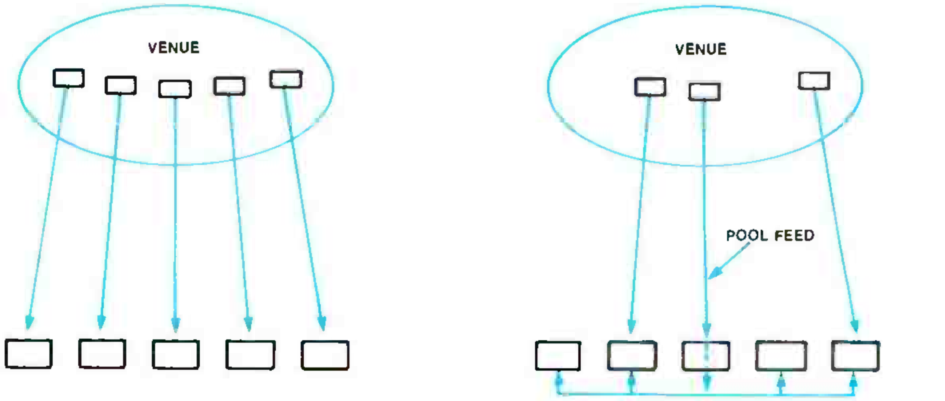

Figure 1. *Remote operations by more than one facility require either multiple unilateral feeds (a), or a pool feed, augmented by unilateral feeds in which the facility uses its own equipment and talent.*

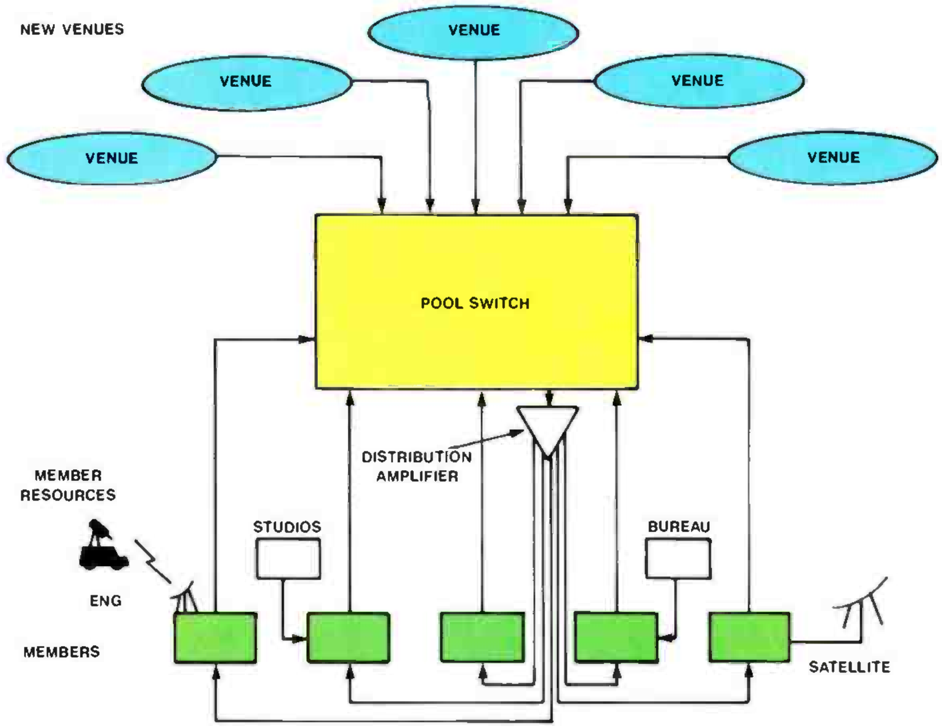

Figure 2. *A pool-switched video system allows feeds from prewired venues or from its members' own production resources. A distribution amplifier on the pool feed ensures that pool switching is accurate and self-policing.*

PBXs in the sky?

Portable satellite operations have been part of news gathering for almost a decade. Portable satellite hardware comes in two configurations: truck-mounted and fly-away.

The truck-mounted units are employed by many stations, particularly in cities surrounded by sparsely populated areas. A satellite truck provides the capability to bring in live coverage from regions beyond the reach of station microwaves.

Fly-aways are often used for action in overseas venues. They are shipped as air cargo or baggage, and are assembled on-site.

Most satellite news operations operate in the Ku-band. This is because the antennas can be proportionately larger with respect to the wavelength, and hence have higher gain than a C-band assembly of the same size and weight.

Cooperatives

As a way of sharing satellite resources among several stations, satellite news cooperatives, ad hoc networks and most broadcast networks cooperate in news coverage. Stations will either fly their talent to a major story and use locally available satellite equipment, or else rely on their partners in the remote location to provide their coverage. When the news hits close to home, member stations are expected to reciprocate.

E.T. call home

Communications in the field is always a challenge. News doesn't always happen in venues convenient to telephones. Although cellular telephones are convenient, many areas in the country still do not have adequate cellular service. Additionally, international telephone service varies widely in quality and availability.

Fortunately, the same satellite trucks that get the news home can also pro-

transportation, have a high front-end cost. Nevertheless, the per-use and monthly charges amount to little more than labor to set them up and the maintenance to keep them operating. However, spectrum congestion has increased the potential for interference. Furthermore, the TV auxiliary spectrum is often envied by other services. This creates a regulatory pressure for those frequencies. (See the related article, "PBXs in the Sky?" pg. 32.) Finally, the signal quality of telco fiber and digital products is often better than traditional broadcast solutions.

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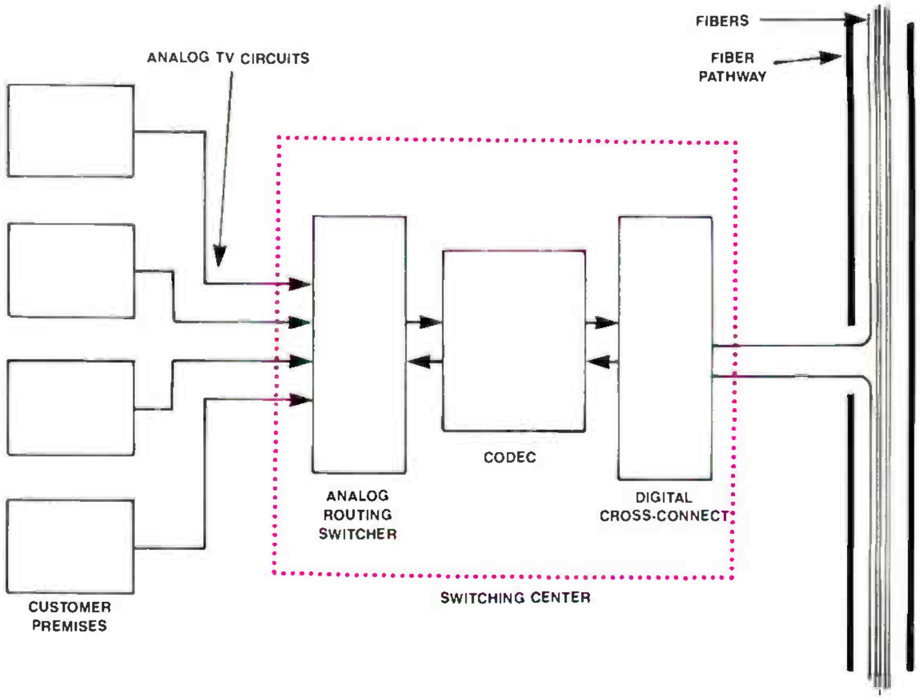

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Selecting remote audio equipment

What's needed in the field varies with the programming involved.

By Skip Pizzi, technical editor

The Bottom Line

Having the proper tools on hand is critical to the success of a remote broadcast. You have one chance to get it right, and if you don't, the results are instantly obvious to your audience. But beyond the simple quality of the remote, having the "right stuff" in the field can also translate into more efficient operation on location. This keeps costs down and gives the staff more time to concentrate on production elements. Even more savings may be possible with new equipment that gets the signal back to the station using less-expensive transmission paths.

One of broadcasting's fundamental attributes is its power to deliver the world to its audience with convenience and immediacy. But a broadcast station's facility, no matter how elegant, only achieves half of that goal — namely, the delivery of a signal to many places. Therefore, the station is just the *midpoint* of this chain. To actually bring the far-flung events of the day to its patrons, a broadcast station must also provide the other half of the path, the "front-end" that carries signals from ever-changing places back to home base — *the remote.*

This simple word involves plenty of technology and effort, in terms of preparing the program on location and in delivering the signal back to the station. As always, the proper tools make the job simpler and the product better. Recent hardware refinements and new delivery methods have made excellent audio from the field easier and cheaper to achieve.

A programming-driven operation

The process of selecting audio equipment for a remote begins with a thorough understanding of what the program will include. Naturally, a big difference exists between the complement required for a news spot and that needed for the Grammy Awards show. However, there are also many important distinctions between these two extremes. Exact requirements for each remote may not be completely clear at the outset. Broadcast technical personnel should be involved from the beginning of planning for these events to ensure successful results.

Table 1 breaks down the variety of typical live remotes into four main categories, listing the general type of equipment likely to be required by each. Also noted are appropriate transmission paths for wireless and wired audio (if it is to travel separately, i.e., not be bundled with a video transmission). (For more on wired paths, see "Telco and Fiber: Broadcast Solutions," page 26.)

The program type greatly affects the equipment required. The number of technical staff required on site will also vary along these lines.

A few other issues of remote audio production will also be noted in this discussion.

Back to mono

The increasing number of remotes done in stereo today has created a peculiar problem — the absence of a mono mix on location. This often occurs when the remote audio is being handled by a radio operation, and a TV ENG or documentary crew shows up to capture a few minutes of the action, expecting a mono audio feed. Most remote audio mixing consoles do not provide a separate mono program output, so the radio crew may not have a straightforward solution to this unexpected request.

However, there are two simple ways of solving this problem. First, if either the radio or the TV crew has a small, simple ENG-type (3- or 4-input mono) mixer, a

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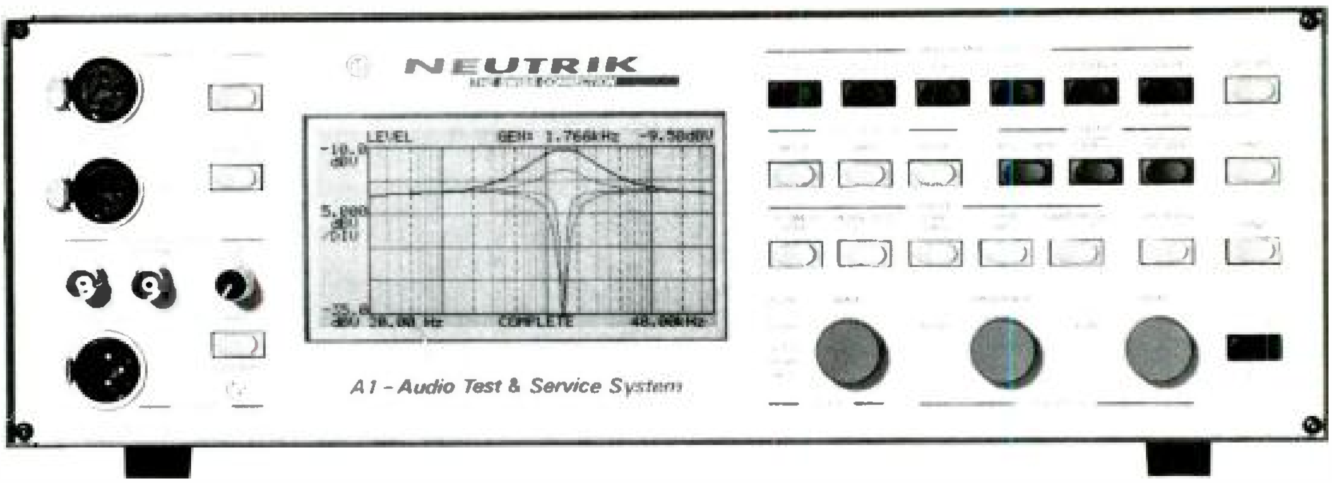

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PROGRAM CONTENT	REQUIRED (& OPTIONAL) REMOTE EQUIPMENT	MINIMUM-QUALITY TRANSMISSION MEDIA
Reporter/DJ drop-ins/spots	Microphone, headset, telco interface box, (mic mixer)	•Standard dial-up line •Cellular phone
Long-form DJ remote or news event coverage	Microphones, headsets, mic mixer, playback equipment, (snake, mult box, communications system)	•Dial-up w/ multiline bandwidth extension •Sw. 56/ISDN w/ G.422 data compression •Mono RF link •8kHz telco circuit
Sports broadcast or complex news event	Microphones, headsets, mixer(s), playback equipment, audio processing, communications system, snake, (mult box, wireless mics)	•Dial-up w/ single-line bandwidth extension •Mono RF link •5kHz telco circuit
Concert or other complex, hi-fi remote (variety, awards, drama)	Many microphones, stereo mixer(s), audio monitoring system, recording & playback equipment, audio processing, communications system, snake, (mic splitter, wireless mics, mult box)	•Fractional T-1 w/ 256kbit/s (stereo) data compression •Basic-rate ISDN w/ "joint-mode" stereo 128kbit/s data compression •Wideband stereo RF link (analog or digital) •15kHz stereo telco circuit

Table 1. *Comparison of general equipment categories and transmission media requirements for different types of remote broadcast programming.*

stereo feed can be sent to two of its line inputs, and its output will provide a mono mix. To ensure proper summing, send reference level (0VU) tone on one channel only of the stereo mix, and turn up that channel's pot on the mono mixer until its meter reads −6VU. Then send tone on *both* stereo channels, and bring up the other channel's pot on the mono mixer until its meter reads 0VU.

If such a mixer is not available, the second solution uses an unassigned, post-fader, mono auxiliary bus (reverb, foldback, effects or utility send) on the stereo mixer. In this case, the send level control for that bus on every input of the console is opened to its "design center" (usually around two o'clock on a rotary pot), and the overall send level to the mono crew is adjusted using the auxiliary bus' master level control.

A related and more prevalent problem involves the lack of monaural *monitoring* ability on location for the stereo audio mix engineer. Don't overlook this important feature when selecting a remote audio mixing console. Comprehensive monitoring of all on-board buses (plus a couple of external inputs) with stereo/mono switching is a necessity on a remote board. The biggest differences between a small "recording" or sound reinforcement-type console and a true remote broadcast mixer will be found in the monitoring section, so take a hard look there. Preferably, this monitor output will appear not only at a stereo headphone jack, but also on balanced XLR outputs for feeding a monitor amplifier and speakers, under the control of a monitor level pot on the console.

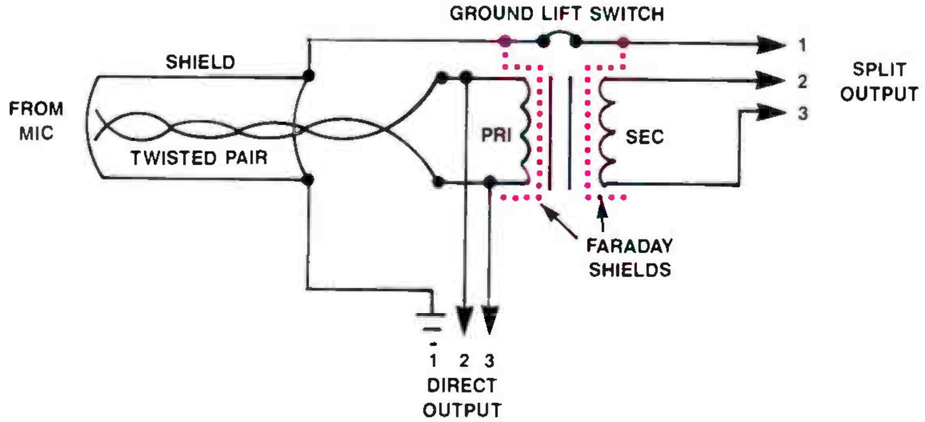

Figure 1. *Basic block diagram of a 2-way microphone-splitting transformer circuit. Note that the Faraday (electrostatic) shields for primary and secondary retain ground reference to their respective consoles, even when microphone ground is lifted to the split output. Three-way (or 4-way) splitter employs transformers with double (or triple) secondaries. Phantom power, if required, must be supplied by the direct console.*

Multiple users on location

Many location events involve several separate but interconnected services, such as a recording system for the event, the sound reinforcement for the event, and one or more broadcasters covering the event. In addition to the physical complexities and "rats' nests" that these situations can create, technical problems generated by the interconnections are likely to occur. Primary among these for audio are ground loops (creating hum and buzz) and loading problems (creating level drops or frequency response anomalies). A wide variety of hardware has become available off-the-shelf to solve these difficulties.

One class of helpful device is the mic splitter, which allows multiple mixers to share multiple microphones at an event. (See Figure 1.) Typically, these devices route each microphone's output directly to one mixing console (via the so-called "direct out"), and to other console(s) via transformer isolation (the "split out[s]"). These transformers have bridging primaries, so that they present no additional load to the microphone, and they use one or more *separate* secondaries for feeding split outs independently. Mic splitters usually allow the ground connnection (shield) of balanced mic lines to be broken between the mic and the split output(s), so that the microphone is grounded only at one place (the direct console). This feature is essential to curing the buzz and hum of mic-level ground loops often encountered in these situations.

Although such a microphone-splitting technique is useful at entertainment events, a different kind of distribution is necessary at news remotes. This is the area of what is commonly known as the *mult box*, a device that distributes the signal from a single microphone to all the members of the media who wish to record an event. (A variant of this is the *pool feed*, which implies that instead of a shared single microphone, the signal being distributed is a mix of multiple microphones at the event, provided by one broadcast entity, and distributed to any other electronic media organization on hand.)

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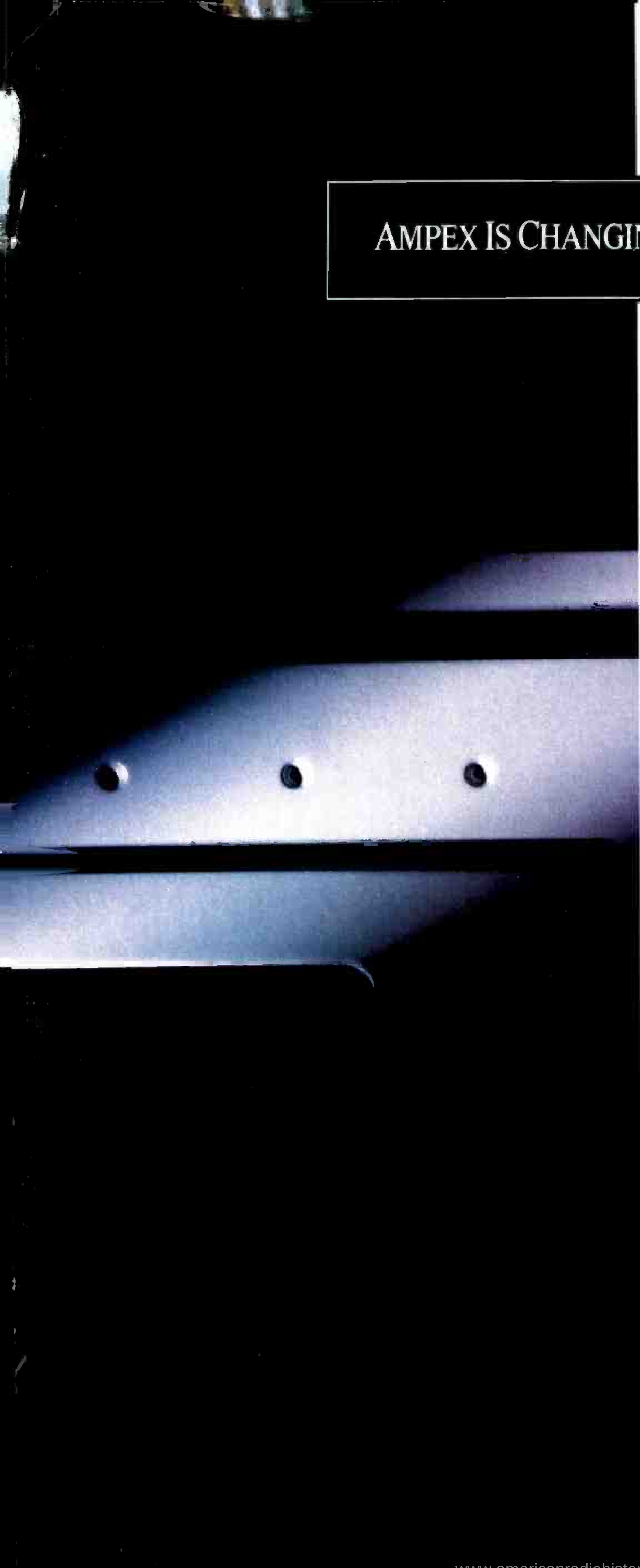
DCT



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Continued from page 38

As shown in Figure 2, the mult box takes a single mic level input and amplifies it to line level (or in the case of a pool feed, simply takes in a line level feed from the mixer output), then feeds the signal to a distribution amplifier (DA), pads each DA output back down to mic level, and feeds each one through an isolating transformer to an output jack (typically an XLR male connector).

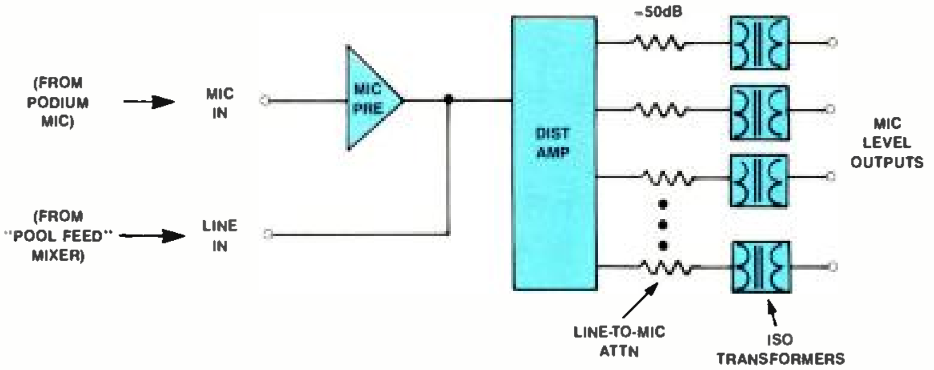


***Figure 2.** Basic block diagram of a "mult box." Its application at a news event eliminates the need for a multitude of microphones at the podium, with a single mic (or "pool" mix) feeding all media and sound reinforcement.*

New methods of transmission

The cost of dedicated analog telco program circuits (and in some cases, their lack of availability) has made these former mainstays of remote origination less attractive to today's broadcasters, forcing them to seek alternative transmission media. The following are among the current options:

• *Single and multiline bandwidth-extension systems.* Using one, two or three standard dial-up phone lines, these encode/decode systems can provide audio bandwidth up to 10kHz. Some systems also implement complementary noise reduction to enhance dynamic range. For occasional use, they are often available on a rental basis.

• *Dial-up digital systems.* Check with local telcos to see whether Switched 56 or ISDN service is available in your area. If so, consider it for frequent remotes from fixed locations, using a compression algorithm, such as CCITT G.422, which provides 8kHz mono audio bandwidth on a Switched 56 line, or "joint-mode" stereo 128kbit/s compression, allowing 15kHz stereo on basic rate ISDN (two 64kbit/s channels). These circuits are bidirectional, so a return path to the remote site is always included. (See "Remotes Revisited," January 1991.)

• *Dedicated digital lines.* Digital compression systems can also be used with non-dial-up digital telco circuits, such as T-1, fractional T-1 or DS0 services. CD-quality stereo audio plus communication line(s) can be provided on the widely available T-1 service (1.544Mbit/s), which many telcos now offer for a lower rate than equivalent analog circuits. Installation costs for dial-up and dedicated digital lines are also lower than analog circuits in most locations. These services are typically provided as bidirectional circuits as well.

• *Cellular transmission.* Where wide bandwidth is not required, programs can be sent from the field using an audio interface to a cellular telephone. Single-line bandwidth-extension hardware can also be used with these. Furthermore, if live-to-air or real time transmission is not required, half-speed transmission with such extension equipment can provide 5kHz bandwidth. (Because of *multiline* bandwidth extension systems' critical requirement for constant transmission level on each line, their use is not recommended with cellular phones. When switching between cells — which can happen even when transmitting from a stationary location — audio level changes will often occur, causing mistracking of the bandwidth extenders' noise-reduction systems, and possible frequency response errors in their decoding. Single-line systems exhibit no such problems.)

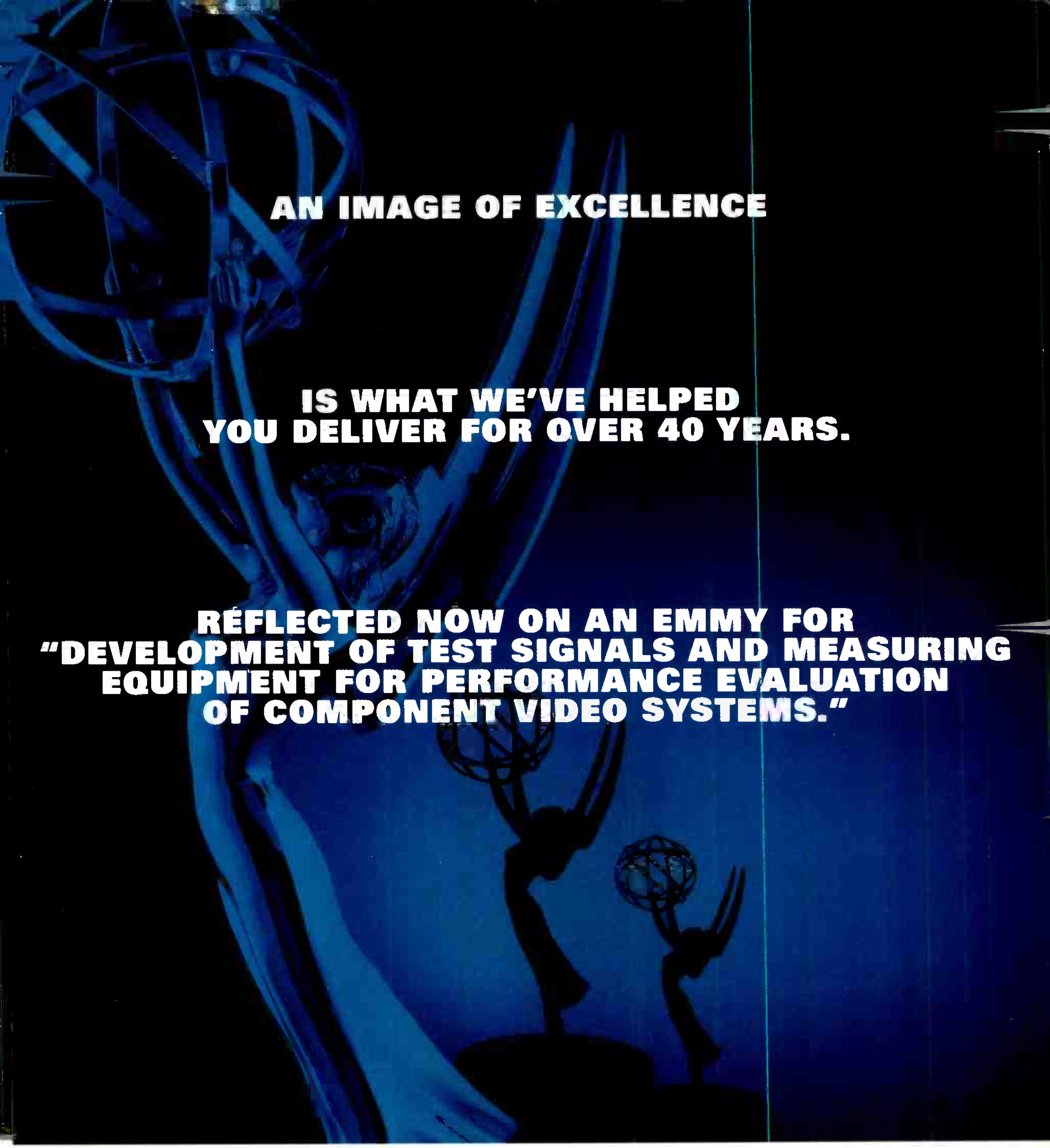
Sam Atkins, former Seattle Seahawk, checks statistics during his color commentary for KOMO-AM's broadcast of the 1991 Rose Bowl. Program audio was fed from the stadium in Pasadena, CA, to KOMO studios in Seattle via multiline frequency extension on three dial-up lines. (Courtesy of Comrex Corporation.)

Work savers

Anything that saves effort on location means less time and labor, and less expense to the broadcaster. In most cases, these also provide a better quality product. Consider the following new product areas for possible application at your remotes:

• *Digital snakes.* Application of some of the same techniques used in digital telco lines has made possible the introduction of digital replacements to traditional multipair microphone cables (commonly referred to as "snakes"). Whereas the older snakes are bulky and heavy, with diameters of one to two inches, these digital replacements can carry 16 microphone channels on a *single* twisted-pair cable, with runs extending up to 1,000 feet. Longer runs (up to 15,000 feet) and/or higher capacities (up to 64 channels) can be accommodated on a single fiber-optic cable. Systems using fiber are also available in audio-video (analog FM) configurations, capable of carrying two video and two audio signals (plus communications) for more than 10,000 feet. The robust fiber-optic cable used by these devices resembles a standard heavy-duty microphone cable, carrying single or twin fibers

Continued on page 46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Continued from page 42

in an insulated jacket of approximately a ¼-inch total diameter.

The significant ease of setup workload and reduction in cable costs may quickly amortize the investment in these systems. They typically use 16-bit or 18-bit, 48kHz uncompressed digital audio transmission, with high-quality A-to-D converters on stage and D-to-A converters at the console. Therefore, they are immune to most audio interference. Return lines from house

A small amount of specialized equipment is all that is needed for a simple remote. Here, a Kansas City radio station originates talent segments of its morning show live from the MGM Studios theme park at Walt Disney World in Orlando, FL. (Courtesy WDAF-AM/KYYS-FM.)

Site survey and selection for RF links

By Peter Lowten

The design of microwave broadcast transmission links must consider a range of diverse functions. Planning, designing, licensing, installation and testing are all critical factors in setting up service. It is particularly important that the initial microwave path survey and site preparation be conducted thoroughly.

Although the process described here applies most specifically to permanently constructed RF links, its basic practices should also be considered for temporary remote-site links.

Path survey

A microwave path survey should include data on transmit and receive site locations and their conditions, nearby airport location data, site access data and proposed antenna location and elevation data. This information must support a number of different activities. The location data will be used for frequency coordination and FCC license application. The site description will also facilitate the acquisition of the appropriate topographical maps, which are used in the initial path study and RF design steps. The site access and contact information allows for coordination of any necessary future activities.

A microwave path survey should have at least five objectives:

1. Ascertain that a clear line-of-sight exists.
2. Determine whether adequate Fresnel zone clearance is available.
3. Evaluate the effects of varying atmospheric conditions on the path.
4. Analyze path reflection points.
5. Determine the received signal level, thus assessing path feasibility and setting the antenna size requirement.

Site preparation survey

A site preparation survey provides information about the structure and condition of the proposed terminal sites. This information serves as a basis for installation cost estimates, third-party contractor agreements, installation material and special tool requirements, and statement of work generation.

In preparing a site, it is important to keep the following considerations and objectives in mind:

- data required for FCC license
- determination of whether FAA notification is necessary

Lowten is vice president for video products, Microwave Networks Inc., Houston.

to stage are also provided. But a significant change from traditional snakes is a digital system's need for microphone pre-amplification *on-stage*, ahead of A-to-D conversion. Remote mic pre-amplifier gain control is therefore provided at the console end of the system, with control data traveling back down the digital path to the pre-amps on stage.

An additional advantage of these systems is their ability to easily provide a large number of splits in the digital domain, typically with programmable point-to-point or point-to-multipoint configurations that can be retained in non-volatile memory.

• *Specialized mic mixers.* Several recent refinements have allowed microphone mixers to be further optimized for remote use. Among these are improvements in automatic mixing systems (see "Solving Multiple Open-Microphone Problems," page 50), enhanced monitoring and communication capabilities, internal compressor/limiter on each input, and integral bi-directional telephone audio interfacing.

• *Cellular applications.* Audio interface to cellular telephone transmission has widened the range of the radio reporter even further. Several companies offer simple and flexible audio interfacing for 2-way audio interconnection to a cellular phone system. The actual hardware used here does not require much sophistication, because cellular phones are 4-wire throughout. Therefore, no hybrid is needed.

Recent hardware refinements have made excellent audio from the field easier and cheaper to achieve.

One manufacturer integrates a small mixer, single-line frequency extension and a cellular phone into one battery-powered box, providing a handy and quick way to get on the air from practically anywhere.

• *Data-compression hardware.* Off-the-shelf incarnations of multirate data-compression systems are now becoming available in packages that lend themselves to remote work. With the variety of ap-

- local jurisdiction requirements (permits, licenses and so forth)
- physical site preparation requirements
- structural requirements
- research on local contractors
- path analysis and profile information
- scope and statement of work
- options for future expansion
- testing requirements

Broader considerations

Unanticipated obstacles often deter the broadcaster from quickly establishing a link. Finding clear microwave frequencies and an open path for transmission are the first steps necessary for setting up an effective RF link. Locating an uncrowded frequency may be more difficult than an operator anticipates. With the advent of higher power capabilities, non-traditional frequencies — such as the 23GHz band — can be explored.

Private users of RF spectrum are regulated by the FCC, although governmental users come under the jurisdiction of the Interdepartmental Radio Advisory Committee (IRAC) and the National Telecommunications and Information Administration (NTIA).

However, if a broadcast entity needs a point-to-point RF link channel, it first files its request with a *coordinating agency* (such as the Society of Broadcast Engineers, not the FCC), which helps identify a frequency that won't interfere with those already in use. This type of agency often has a large database of information at its disposal that covers local use of frequencies within particular plications outlined previously and the increasing number of data transmission capabilities, it makes sense to choose a multirate converter, thereby maximizing your versatility today and in the future.

Optimize and standardize

Smaller, lighter and better equipment will continue to proliferate, and much of it will be useful to the remote broadcaster. With increased miniaturization often comes higher cost, but consider the easier transport and faster setups that smaller size allows. The higher price of smaller hardware may pay off handsomely. On the other hand, repair and maintenance of a smaller device may cost more than its larger predecessor, so high reliability is a must.

> ***The exact requirements of each remote may not be completely clear at the outset.***

Finally, don't suffer from "paralysis by analysis." Design an affordable package that works in *today's* environment, implement a successful method of its use, and stick with them both until there's a problem. Once it's solved, return to that stable approach, avoiding "change for the sake of change" or on-air experiments. Remotes are high-pressure, so creating additional stresses with unfamiliar techniques or equipment is asking for trouble. A solid, reliable technical system can indeed soothe the savage gig.

Stereosurround production on location

By John Owens

As the "home theater sound" movement has progressed over the past few years, the Stereosurround production format has come into significant use among broadcast producers and engineers throughout the United States. Many remote productions can benefit greatly from the enhancement this kind of system can provide — especially sporting events and live concerts. An increasing number of radio and TV broadcasts (of remote and studio origination) are now delivered with such a sound format, and most movies are also produced and aired with this kind of soundtrack.

Owens is director of sales and marketing for Shure HTS, Evanston, IL.

To fully appreciate the merits of a surround sound format, a review of some basics is in order, beginning with the perception of stereo sound.

The term *stereo* is often misunderstood by consumers. It actually comes from the Greek word *stereos*, meaning solid, firm or 3-dimensional. When applied to audio systems, it means realistic or lifelike. Yet, from the perspective of the typical consumer, stereo has come to imply an audio program or system designed for two loudspeaker channels — left and right. In theory, stereo merely defines a *line* (while mono defines only a point source) of sound reproduction, and is therefore not truly 3-dimensional. The fact that only two channels are used is also a practical matter of the storage formats and transmission systems available today.

Early psychoacoustical analysis of audio recording and reproduction systems showed that more than two loudspeaker channels could greatly improve audio realism. Three front channels and at least one rear channel provided a more robust and convincing sense of spatial reality. By adding these "hard center" and "surround" channels, stable center images could be created for a larger listening space, in addition to creating "interior" (all-around) ambience images. The use of a true center-channel loudspeaker eliminates the traditional 2-channel stereo system's reliance on a "phantom center," meaning that a listener must no longer be seated in the "sweet spot" directly between the left and right speakers to perceive a proper central image. Sounds can also be made to move across the front of the soundstage and between front and back.

Editor's note: The term *Stereosurround* is a registered trademark of Shure HTS for its matrixed surround sound encoders and decoders. Although the hardware design is proprietary, programs encoded in the format are compatible with all other manufacturers' surround sound decoders.

bands, therefore allowing a thorough search for an available frequency. A frequency search team can aid an operator in formulating a frequency plan when information is difficult to obtain.

Applying for the required FCC license for an RF link is the second step in the process. It can only take place after local coordination has been accomplished by the prospective licensee. On its application form, the commission asks whether such coordination has been done. It will typically not grant a license unless this response is affirmative.

In larger markets, temporary or non-full-time permanent links (such as those used by remote pickup units [RPUs] and other ENG operations) will often operate on *shared* frequencies. Coordinating agencies usually provide contact information to all users of a shared channel. It is then the responsibility of each user to coordinate the time of a channel's use. In some cases, each user will be licensed and equipped to operate on two or more RPU frequencies, each shared with different entities, so that sufficient options exist for non-interfering use at all times. For this reason, and for pure operational redundancy, the survey and selection of *multiple* sites and paths for a particular link may be warranted.

The search

Deciding which frequencies are available first requires that the potential sites be accurately identified and located. A site-to-site detailed path survey provides the primary building block upon which available frequencies can be routed.

Lower frequencies are the most popular for studio-to-transmitter links (STLs), and hence the most crowded. In such cases, a higher-frequency channel in the 23GHz range may offer a cost-efficient solution. These are best used for short hops (one to five miles), and are subject to fading during heavy rain or fog. For longer and more robust links, the 18GHz band can also be used.

Often, the topography within a region is not thoroughly or accurately documented. For example, a map may not reveal a new structure between two sites on which a broadcaster wants to mount microwave equipment. An accurate path survey will identify these obstructions and allow them to be circumvented.

An accurate path survey not only provides the road map for a broadcaster's frequency plan, but it is also the blueprint for designing and building efficient, effective RF links.

The road most traveled

Many towers, geographical high points and other potential antenna sites may already exist, so a designer need not always re-invent the wheel. A path can often be linked by using existing structures.

Taking advantage of the existing path-routing devices is a wise choice when setting up a link. In addition to saving time and money, the path routes are also already proven.

On the other hand, with rapidly expanding RF operations in many areas, existing towers and structures may be at risk for overloading. A broadcaster must be assured that the existing structure can support the necessary antennas and other equipment. Determining the current load and the maximum load of an existing structure is important not only to the initial stability and safety of your equipment, but also as a guide for future expansion.

Today, the findings of these studies are implemented in a practical way by sophisticated *4-2-4 matrix* encoding and decoding systems. These devices take four production channels and encode them onto two storage or transmission channels, then decode them back to four loudspeaker channels for the listener. The resulting programs can offer greater realism when reproduced over systems with three front channels (L, C, R), and a single rear or "surround" channel (S). The latter is typically reproduced through two or more distributed speakers. (See Figure 1.) Some decoders add a pseudostereo enhancement to the mono surround channel, providing "left" and "right" surround outputs. The use of dipole speakers for surround channel reproduction is another recent home theater innovation, helping to further diffuse S-channel sound in the typically small-room domestic listening environment.

However, the more critical work is performed by the *encoder*. A block diagram of its processing is shown in Figure 2.

Compatibility and enhanced fault detection

Essential to the success of any such enhancement system for broadcast use is its ability to provide acceptable results for the large majority of listeners still using stereo or mono reproduction systems, as do today's surround formats.

Figure 1. *Surround sound monitoring configuration in the remote truck or control room.*

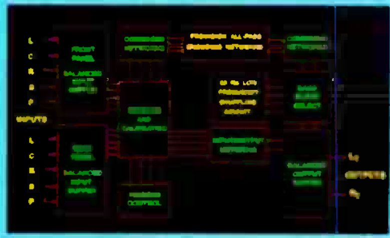

Figure 2. *Block diagram of a Stereosurround encoder. ("P" channel refers to a pannable input, assignable to any location in the sound field through pan controls on the encoder.)*

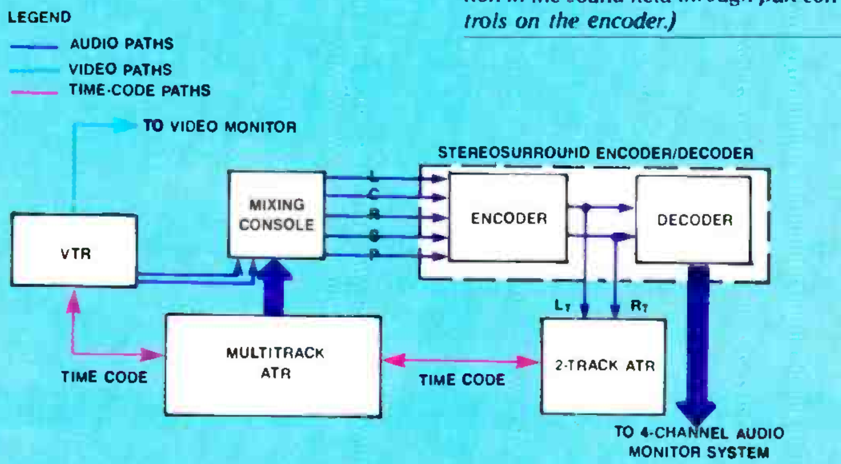

Figure 3. *Block diagram of a surround post-production setup. L_T and R_T refer to the two encoded channels used for transmission or storage (the "2" in a 4-2-4 system), which can be listened to directly as a stereo mix, summed for a mono mix or decoded for a surround mix.*

Azimuth error is more easily detected, appearing as high-frequency information in the surround channel.

A fringe benefit of monitoring audio through a surround decoder in the production control room or remote truck involves its treatment of out-of-phase material. Significant out-of-phase material in a stereo mix might be desirable in some cases, but it can severely compromise the level and/or quality of the mono mix. Monitoring in stereo only makes it difficult to sort out the offending out-of-phase elements (if they are even noticed at all). But a surround decoder of the type described previously will tend to place all the out-of-phase material in the surround channel, making it easily discernible because of its localization to the sides and the rear. Azimuth error is also more easily detected, appearing as high-frequency information in the surround channel. (Detection of this problem — nearly impossible in stereo monitoring — and its subsequent solution will prevent loss of high frequencies in the mono mix.) Furthermore, unintentional L/R channel imbalances show up as clearly off-center reproduction of center-channel audio.

In addition, through the use of a surround encoder, problematic sound elements can be effectively *repositioned* in the mix, allowing an acceptable result in stereo and mono, while an exciting surround effect is available to the rapidly growing user base of surround-equipped homes. Figure 3 shows a typical post-production configuration of a surround system in block diagram form.

Surround sound monitoring provides a better way to analyze 2-channel audio production.

Surround sound systems present all in-phase information across the front soundstage, with relative phase material appearing between the front and back positions. Fully out-of-phase audio will appear only in the surround channel, and will not appear in the mono mix. (It will appear in the stereo mix as diffuse, unlocalized or "outside the speakers" sound.) For the in-phase signals, relative *amplitudes* distinguish placement among the front three channels, with equal level (mono) audio directed to the center channel, and left-heavy or right-heavy signals sent to the left or right speakers, respectively.

Overall, the Stereosurround format reveals more information about the elements of a mix to the production team. Help in this regard is especially useful on a remote. Beyond providing an additional creative palette to producers and an enhancement to those listeners with decoders, surround sound monitoring also provides a better way to analyze 2-channel audio production. This serves as a fundamental starting point for improved audio performance and production on location.

References

Several excellent, application-oriented papers on the use of surround sound techniques for broadcast appear in the *Proceedings* of the AES 9th International Conference, "Television Sound Today and Tomorrow." (Detroit, Feb. 1991.) The following are particularly recommended:

1. Schulein, R.B. "Television and A-V Production Techniques Using the Stereosurround Audio Production Format."
2. Goodson, Larry. "Microphone Selection and Balance Techniques for Television, Stereo and Surround Sound."
3. Woszczyk, Wieslaw. "A Review of Microphone Techniques Optimized for Spatial Control of Sound in Television."
4. Allen, Ioan. "Matching the Sound to the Picture."

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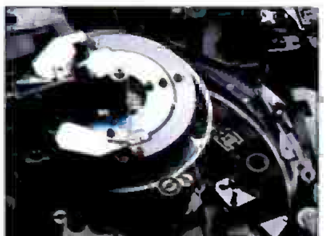
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Continued from page 54

phones are the best solutions to these problems. *All* standard microphones, whatever their quoted polar pattern, are omnidirectional below approximately 200Hz, so directional mics cannot be relied upon to help reduce low-frequency noise and reverb pickup.

Reduced gain before feedback when using a PA system

If your talk show remote will have a live audience of approximately 100 people, you will probably require some type of PA system. Most broadcast audio engineers do not deal with a PA system on a daily basis, and having to provide a feedback-free PA in an unknown acoustical environment (such as a remote at the mall) can be a problem for even the most experienced engineer.

Acoustic feedback (or "howling") can be a problem any time a PA system is used. To avoid feedback, PA systems must operate 5dB-10dB below the point where the system becomes unstable and starts to feed back. This safety margin below the PA's feedback point is reduced each time another microphone is opened. (Again, multiple open mics are working against you.) If a PA is being operated at 5dB below the feedback point with one mic open, the system would feed back if four mics were opened (same mics, same level), because the audio mix level would rise by 6dB. In other words, a PA system with one open mic can deliver approximately 9dB louder sound reinforcement than the same system with eight open mics.

PA systems are complex because they involve the interaction of speakers, listeners, mics, loudspeakers, amplifiers, signal-processing electronics and the acoustical environment in which the PA operates. It's beyond the scope of this article to completely discuss how these factors interact. But we can look at the factors that can be easily controlled on a talk show remote.

It may come as a surprise that the following three factors most affecting the amount of gain you can get from a PA have nothing to do with what type of mic or loudspeaker is used:

1. Distance from speaker's mouth to a mic (decrease it).
2. Distance from a mic to the closest loudspeaker (increase it).
3. Number of open mics (reduce it).

Keeping in mind the general rule that a 10dB increase sounds approximately twice as loud, how can you get more gain from your PA? (The following gain calculations are theoretical predictions, and may actually be less because of acoustical conditions.) First, reduce the distance from the speaker to the mic. Moving the mic from 12 inches to six inches away provides approximately 6dB more gain (based on the Inverse Square law). However, moving the mic from 12 inches to one inch away provides about 20dB more gain. Once again, a headworn mic delivers a distinct advantage.

Next, consider the mic-to-loudspeaker distance. Moving the loudspeaker from six feet to 18 feet away from the closest mic can provide as much as 10dB more gain.

Finally, reduce the number of open mics. When using an automatic mixer for this, NOM attenuation helps by slightly lowering the mix level whenever a new mic is activated. In this respect, you are assured that if the PA is set up so that it doesn't feed back when any *single* microphone is activated, the PA will remain feedback-free if *all* the microphones are activated (assuming level, mic type and mic-to-loudspeaker distance are relatively equivalent for all mics).

There is a popular belief that unidirectional mics prevent feedback. Although they may help, they are not a complete safeguard. To get the most gain from your PA, use the three factors illustrated in Figure 4. And if you have a choice, an omnidirectional mic at three inches from the speaker will always beat a unidirectional mic at 12 inches. The omni's lower sensitivity to plosives ("p-pops"), wind noise, handling noise and proximity effect (bass boost at close range) and its typically lower cost make it preferable in almost any case where close miking can be used. Directional mics only become helpful when mic-to-source distances are necessarily large or where proximity effect is desirable.

As with using multiple open mics, proper PA operation is loaded with technical challenges that must be handled in order to provide broadcast-quality audio. Each could easily fill a chapter in a remote audio textbook. This article has focused on the first link in the remote signal chain, the use of multiple microphones, because it is typically the least understood and the most overlooked factor.

It's a wrap

Table 1 presents a review of the three main problems faced by a remote crew on location with a multi-mic event. In the solutions column, notice how often the issues of NOM and source-to-mic distance occur.

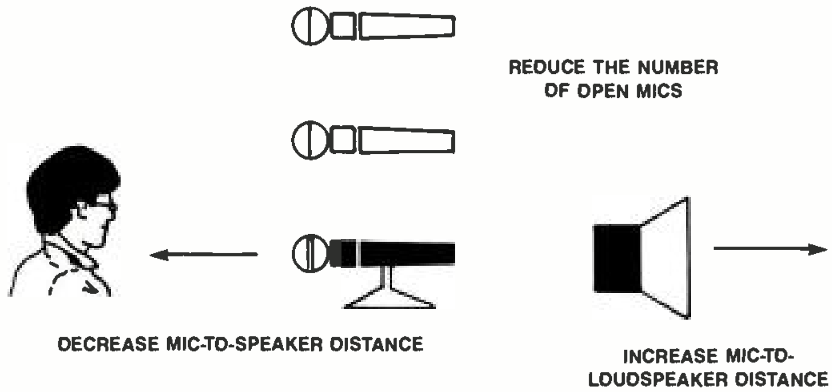

Figure 4. *A PA system's gain before feedback can be increased by following these three rules.*

PROBLEM	SYMPTOMS	SOLUTIONS
Comb filtering	Hollow, thin audio	• Minimize NOM • Observe 3-to-1 rule
Excessive ambient noise and reverb	Loss of clarity and intelligibility	• Minimize NOM • Minimize source-to-mic distances
Reduced gain before feedback	Feedback before system is loud enough for audience to hear	• Minimize NOM • Minimize source-to-mic distances • Maximize mic-to-loudspeaker distances

Table 1. *A summary of multiple open-microphone problems and their solutions. (NOM = number of open microphones.)*

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Intercom systems

Comparing 2- and 4-wire type intercoms highlights their similarities and their differences.

By Dave Richardson

The Bottom Line

The coordination needed for a successful production project requires communications. Two types of intercommunications are available — the party line and the matrix. Although the party line provides sufficient communications capabilities for some facilities, the matrix, operating under digital control, offers the functions of the party line in addition to other advantageous modes. For installations with party line systems, interface products are available that allow the older equipment to be tied into a digital matrix. **S**

When digitally controlled matrix intercoms were first introduced, reliability was not high. Some operated satisfactorily, until an electronic fault in the central matrix or disk drive disabled the entire system. These failures prompted 2-wire party line systems with multiwire, subsystem architectures as an interphone standard.

Electronic redundancy and microprocessor control have been integrated into today's digital 4-wire systems. As a result, facility planners now view digital matrix systems more favorably, a trend found in large facilities as well as smaller studios, which once relied on extended multiconductor cabled 2-wire intercom systems.

2-wire vs. 4-wire

A 2-wire intercom circuit transmits and receives audio on two wires. This format is *party line* (PL) by nature, with each station attached to one multiple conductor cable. Communication may be half or full duplex. Other features may be introduced by adding subsystem modules to achieve functions, such as point-to-point, interrupted fold back (IFB), isolate (ISO), group presets and relays.

A 4-wire intercom circuit transmits audio on one pair of wires and receives on a second pair. This format is point-to-point and can be pictured as a star configuration — each station connects to the center through its own multiconductor link. Instead of subsystems to achieve different functions, the central microprocessor and software permit the system to be dynamically configured for different types of communication.

Audio signals carried by either system structure individually should be of sufficient quality for on-air work, if the necessity arises. Some applications do use the intercom for program audio. However, when the two structures are brought together, problems can arise. In particular, the quality of 2-wire equipment can exhibit degradation from 4- to 2-wire conversion hybrids used in the 2-wire station. Also, audio operating levels may be different from one brand and system to another. Some means to compensate for differing house reference levels is necessary. Despite these points, facilities with installed 2-wire beltpack circuits can enjoy the best features of 2-wire and 4-wire formats by integrating a digitally controlled matrix 4-wire system.

Multifunction 2-wire intercom systems require distributed subsystems for each task. This means that several multiconductor cables (one for each subsystem) must be pulled throughout the facility and connected to the subsystem modules at each system control panel to achieve the desired communications features. (See Figure 1.) Today, the cost of such cable can be significant.

A digital 4-wire system uses one centrally located control matrix. The matrix switches a number of audio inputs to a varying number of outputs and uses one multiple conductor cable to tie the cen-

Richardson is a systems engineer with the Telex Intercom Systems Group, RTS Division, Burbank, CA.

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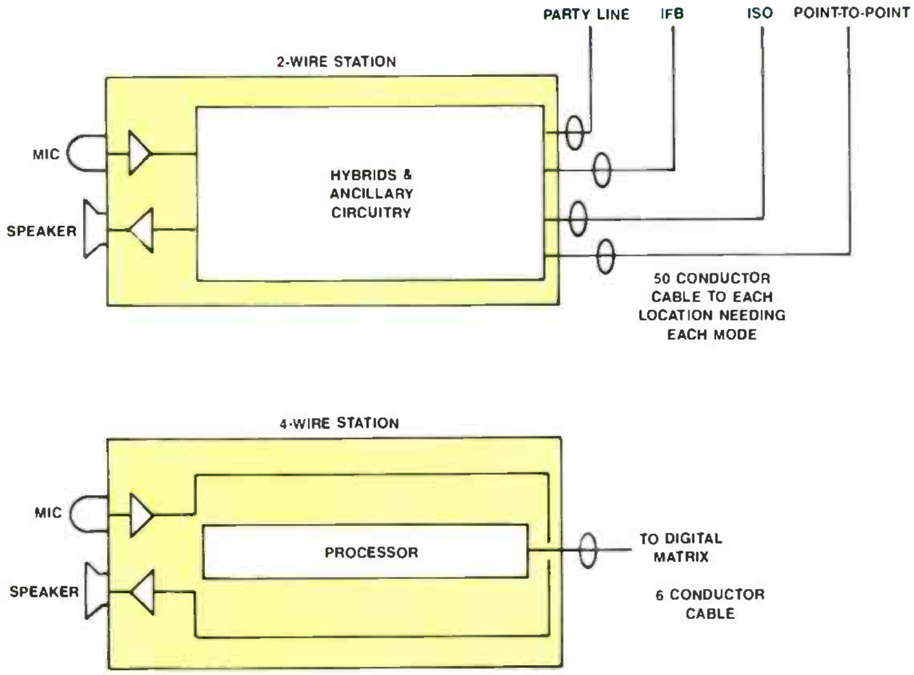

Figure 1. *A 2-wire master station features six PL, four IFB, six ISO and 10 point-to-point circuits; overall, 200 wires per station interconnect the four separate subsystems. The digital 4-wire station with 16 PL, 24 IFB, 16 ISO and 50 point-to-point circuits uses 6-wire cable that connects from the station to the central matrix.*

tral unit to each control panel. Setup and system programming for the matrix is accomplished through a PC/terminal unit. The inputs are sources, while outputs are destinations. An input/output pair serving one physical location in the facility connects to a port. Inside, the microprocessor digitally directs communications through the matrix according to the stored setup data. Each control panel can be assigned all or certain functions. The traffic management can be compared to an audio routing switcher. Although routers use only 1-way paths, the intercom matrix must accommodate 2-way paths and develop the various forms of communications — PLs, IFBs, group presets, ISOs and relays.

A feature of many digital 4-wire systems is that every control station may access any form of communication during initial setup of the system from the terminal or from a control station panel, if the panel contains a keypad. Any position has the potential to access IFB, ISO, point-to-point, PLs, group calls and relays without subsystem modules.

The case for 2-wire

One reason studio control operators prefer an extended 2-wire intercom is a subconscious panel differentiation. With a separate module used for every form of communication, a director's station may have separate panels for PL, ISO, point-to-point and IFB control. A minimal link exists between the control stations and subsystems as an unswitched or hot microphone and a speaker that appears on one of the added panels. In the heat of a production, the director knows what panel does what, and may quickly access IFB to a specified talent.

In contrast, a digital 4-wire control station emulates each form of communica-

DESTINATIONS

SOURCES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Master Control	1		X	XL		X	P																		
Switcher 1	2	X		X	X	DL																		SL	IL
Audio 1	3	DA	X						X																IL
Video 1	4		X																					SL	
Switcher 2	5	X	DL	X			X																	SL	
Video 2	6					X																			
Audio 2	7								X																
Post-Switcher 1	8										X														
Post Audio 2	9										X														
Post VTR	10								X	X															
Telecine	11	X	X		X	X	X																		
Video Art	12		X			X																			
Graphics	13	X	X			X																			
StillStore	14	X	X			X																			
Titler/CharGen	15	X	X			X																			
VTR 1&2	16	X	X	X		X	X																		
VTR 3&4	17	X	X	X		X	X																		
Maintenance	18		X	X		X																			
PL1	19		SL	SL																					
PL2	20					SL																			
PL3	21																								
Video Control	22		X			X	X																		
Cameras	23		SL		SL	SL	SL																		
Program 1	24	A	A	A		A	A																		
Program 2	25		A	A		A	A																		

X - DIRECT ACCESS
P - PAGE
D - DYNAMIC PARTY LINE
S - STATIC PARTY LINE
I - IFB
R - RELAY
L - LISTEN KEY
A - PERMANENT ASSIGNMENT (ON OR OFF)

DESTINATION NUMBERS AT TOP CORRESPOND TO SOURCE NUMBERS AT LEFT

Figure 2. *This partially completed source/destination diagram will show all attributes of the intercom system, including matrix size and types of stations required and how many of them will be assigned in the matrix controller for most applications.*

dard size is achieved with more matrix frames and controllers. Expanded versions of matrix intercoms also may require additional ancillary equipment.

Point-to-point

A digitally operated matrix, in its simplest form, provides instant point-to-point communications between all control stations attached to the matrix. Direct access occurs when a caller depresses a talk key. At the destination panel, a tally indicator displays the origin of the call, and the caller is heard in the destination speaker or headset. The destination hears the call *hands free*. No one else on the matrix hears the conversation. The destination may establish a return point-to-point call in reply. Point-to-point operation usually does not involve listen keys.

One common use of point-to-point communication is for *roll tape* commands from the technical director to the tape room.

Party line

The PL connection is the hallmark of 2-wire systems. Four-wire systems can create multiple PLs dynamically through the central matrix. A dynamic PL uses various 4-wire ports and may be restructured rapidly. Any 4-wire port of the matrix may be part of a dynamic PL, including any control station (master station) attached to the matrix and other devices, such as a telephone interface or a group of beltpacks.

Unlike a 2-wire master station PL (each master station accepts the same PLs on each talk and listen key), a digital matrix permits any PL to be assigned to any key on any station.

A static PL uses an external 2-wire loop and may contain a number of 2-wire beltpacks or user stations. They are static because they cannot be modified by the matrix microprocessor. A static PL enters the matrix through a 4-to-2-wire converter or interface. Larger 2-wire systems have a number of 2-wire circuits, which are assigned to users from an outboard source delegation panel.

If only a few beltpacks are required in the system, the 4-wire variety may be used. Such beltpacks connect directly to the matrix, eliminating delegation panels and conversion interfaces. If directly connected, the 4-wire beltpacks can be used on dynamic PLs under digital control.

By definition, a PL involves a talk key and a corresponding listen key (or volume control on beltpack). It is a conference line with many users talking and listening on the same channel. This is a setup for day-to-day operation in the control room and studio. A visual tally indicator is seldom used on PLs unless a special call signal option provides a signal tally to all members of the PL circuit simultaneously.

Sometimes, listen keys can be used to create a *selective PL*. A selective PL is created at each station. When the system is configured, the listen keys on the control panels are assigned to those destinations to be eligible as members of the selective PL. Each operator then selects the points of the PL by choosing appropriate listen keys. The operator may address all members of that PL by using the group call preset feature, or may program a listen button to monitor a predefined group. The selective PL allows the operator to remove non-critical points quickly.

Because listen keys are part of the PL function on control stations, it is possible to miss a call if a listen key was not depressed at the time of the call. Conversely, a point-to-point call always gets through to the destination.

IFB

The IFB circuit, used in virtually all TV facilities, is usually a 1-direction audio cue to on-air talent. The signal interrupts a predefined audio source, such as program audio, to inject a directive from the director, producer or audio. In its simplest form, IFB uses an earpiece, an external headphone box (to permit the talent to control the audio foldback level), a program

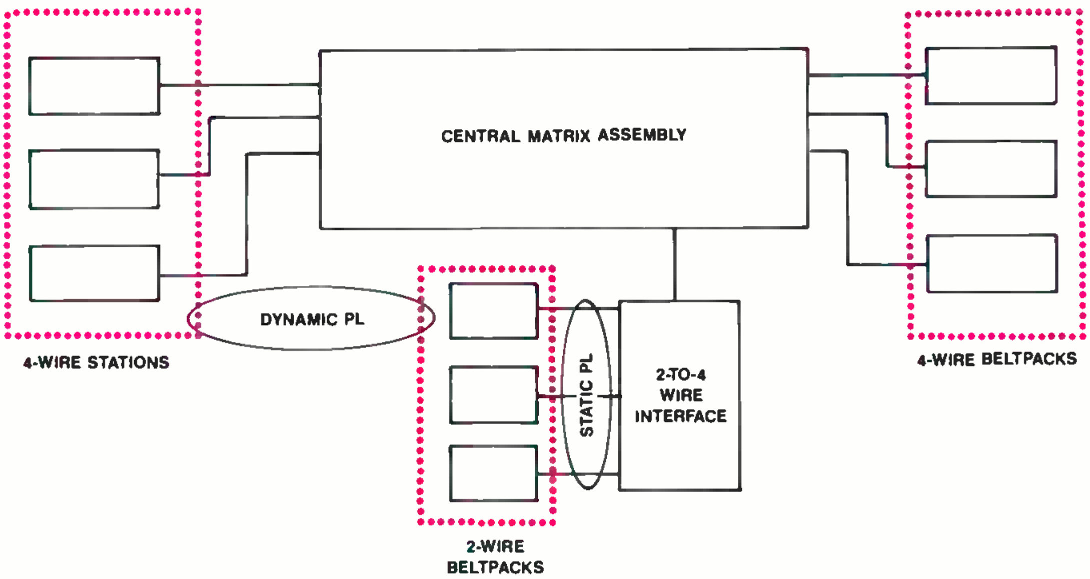

Figure 3. *A dynamic PL may include static PLs. Although connections among the 2-wire units themselves cannot be changed, the relationship between the 2-wire group and other entities of the system can be changed dynamically.*

source and a control station. A common IFB application is the live TV newscast where a director wishes to advise the talent that a cut-in is starting.

Another form of IFB uses a stereo headset (interrupt and non-interrupt foldback with on-air mic), two programs (one to each ear), an external amplifier box with two volume controls and a control station. This type of IFB is common in live sports events where many on-air talent personalities may be physically located on a playing field or near a race track. In a setting, such as the Olympics, as many as 80 IFB circuits may be required for the TV production.

IFB works best when it is not used. Talent can be distracted from overuse of IFB, so it is wise to confine IFB usage to necessary communications only. Consequently, a means to restrict the number of people who can simultaneously access the talent's IFB circuit is advisable. If two controllers (for example, director and audio) attempt to cue the talent at the same instant, the system can be tailored to allow only the director to be heard in the talent's earpiece.

Another feature of a digital matrix system is the ability to inhibit any control station from acquiring IFB circuits. This function prevents the accidental engagement of IFB by a user not related to the production or authorized to use this function.

Many self-contained IFB systems are available today, but a digital 4-wire matrix permits flexible and interesting variations. One type involves a programmed listen key on the control panel to facilitate preshoot setup on remote productions. The director may elect to hear the talent's comments just prior to the shoot on a dedicated telco or microwave channel by using a control panel listen key. When the production begins, the director deactivates the listen key, reverting to the normal IFB talk key to cue the talent.

ISO

The ISO circuit is an interrupt that reconfigures one type of 2-way communication to another. A destination station is removed from a PL to establish a point-to-point channel between two locations.

ISO is common between video and camera operators. By depressing the select key, the video operator automatically switches a camera circuit from its assigned PL, to permit the video and camera operators to communicate without interference. At the end of the conversation, the camera is returned to the PL. The same function is often requested by producers who want ISO capability at their intercom station to talk privately and creatively with an ISO'd camera.

In some ISO systems, a *listen inhibit* mode removes the caller and the destination from the communications net. Subsequent calls to either location on the ISO channel are disabled. More often, however, the calling station continues to receive and monitor audio from the entire grid at that station, thereby not completely isolating the operator from the rest of the TV studio.

Relays

Relays are not really a form of communication, but they have become essential in intercoms. They may key the PTT of 2-way radios, activate telephone lines, mute speakers, light indicators and activate ring-down circuits. Relays are assigned to talk and/or listen keys and may be globally set for all or some inputs, or just one (station). The number of relays in a system usually depends on the size of the system.

Paging

The page feature can be a simple function that provides all-call general paging to control stations from any other control station. The digital matrix expands that premise by creating zones or group calls. Stations in each group are predefined at the terminal. Although one group call may page all stations, another one may page only those stations in the tape room. The ability to page may be assigned on a key-per-key basis.

A variation on paging uses a visual tally to predefined stations, while the caller's audio defaults to an overhead speaker. The listener, hearing the page, returns to the station, sees the identity of the caller, selects the caller's audio and continues the conversation privately. Subsequent pages continue through the overhead speaker.

Making a choice

In order for the intercom to keep your crew and talent in touch, you must determine your needs, wishes and budget limitations. Today's intercom systems offer various architectures and features. In analyzing the forms of communications for a system, it is important to note that there are numerous quantities of fixed assets, and under normal circumstances a system's standard configuration will prove sufficient. Custom systems and special software may be provided by the manufacturer on a case-by-case basis, if an increased number of fixed assets is necessary.

Although analog 2-wire intercoms will continue to carry basic communications for many production facilities, digitally controlled matrix systems offer a range of flexible alternatives. By integrating various forms of communications features, the matrix system can make the difference between confusion and a successful production session.

■

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Building fiber-optic transmission systems

Photo courtesy of AT&T Bell Laboratories.

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

By Brad Dick, editor

The Bottom Line

Although fiber-optic cable offers superior performance and installation factors, it still carries the stigma of being expensive and difficult to handle. This 3-part series was designed to remove much of that confusion.

The concluding part of this 3-part series completes the discussion of using fiber in video and broadcast applications. Combined, the series debunks the old, mistaken adage that fiber is only for telephone companies.

To the manager, an important advantage of fiber is the ease with which expansion can take place. If your facility is planning to upgrade, consider carefully the advantages afforded by this proven technology.

To the engineer, you'd better understand how to use fiber. You need to know how to design fiber systems, install the cable and repair it when it's broken. Tomorrow's HDTV and high-speed data applications will rely on this technology. Don't be left in the dark — learn about fiber optics now.

As fiber-optic cable growth accelerates into video and broadcast areas, technical managers must increasingly understand the technology. Today, fiber's excellent performance, reasonable cost and extremely high signal-carrying capacity make it the cable of choice for many applications.

In the concluding part of this series, we'll look at three areas important to the overall facility design: cost-performance tradeoffs, evaluating competitive products and common misconceptions of fiber.

Cost-performance trade-offs

Let's look at three of the most common cost comparisons that can be made with regard to fiber. First, we'll compare the costs of two major cable designs — the breakout and MFPT designs. This aspect of system design is often misunderstood by end-users. In fact, it can have a major affect on the overall cost of the installed system.

Second, we'll compare the costs of different fiber types. Many new users don't realize that there are different types of fiber. The selection of fiber affects performance as well as cost.

The third area that will be examined centers on cost-based optical performance. Although this aspect may be obvious on the surface, there are several important design considerations that should affect your overall design and cable-purchasing decisions.

Comparing cable styles

The two major competing designs for data and video applications are the *breakout* and the *loose tube*, multiple fiber per tube designs (MFPT). The basic differences are visible in terms of cable cost and installation cost. The MFPT design has a lower cost-per-fiber per meter than does the breakout design. This is a direct result of the differences in the designs and the manufacturing processes. However, the MFPT cable has a higher installation cost. It's important to keep in mind that installation cost means more than the cost of installing the cable in the duct or conduit. It also includes the cost of preparing the cable ends so connectors can be installed.

When using the breakout design, the user needs to remove the outer jacket(s) and, if present, the armor. The subcables provide protection for each fiber. Because of the protection, no special equipment is required at the ends of the breakout cable.

However, when using the MFPT cable, the user must remove the outer jackets, remove the blocking materials and expose the bare fibers. This preparation is a labor-intensive process. In addition, special equipment is needed to protect the fragile fibers from breakage. The labor costs and extra equipment required at the end of the MFPT cable can result in a higher total installed cost than that required for the breakout design.

Let's work through two different analyses: one for low fiber counts (12 or fewer fibers per cable) and one for a high fiber count (24 fibers per cable). The first analysis is fairly old, because it is based on 1986 data when most data applications used low fiber counts. The second analysis was developed on today's designs, which often rely on higher fiber count cables.

To review the two cable designs, see the November 1991 issue, page 82, Figures 5 and 6. Comparing the costs of the breakout design to those of the MFPT produces the ratios shown in Table 1.

The important fact gathered from Table 1 is that an MFPT cable is the least-expensive design. Note also that the second lowest-cost design, the SFPT cable, is 25% to 80% more expensive than the least-expensive design. Table 2 shows the total installed cost savings and break-even distance for the MFPT design.

A more realistic case is that of a 24-fiber MFPT gell-filled cable. The data and results are summarized in Table 3. This comparison shows that breakout cables will have lower installed costs for distances between 989 feet and 1,889 feet. Above these distances, the MFPT has a lower total installed cost.

A basic guideline to follow is if you are using plenum-rated FO cables, evaluate the cost advantages of the MFPT designs. The savings from the use of the MFPT designs over other designs are larger for plenum-rated cables than for the general usage cables, which were used to develop the data in Tables 1-3.

Evaluating competitive products

Once you've completed the basic design steps, you'll realize that similar products are available from different manufacturers. You may want to perform some basic tests on samples to see how well the cable will work within your environment.

• *Uniformity of attenuation.* One of the attributes that can be used to evaluate cables is uniformity of attenuation. Although this is not universally included in cable specifications, there are some situations in which this attribute can become important. If jumper cables are to be cut from a longer length of cable and used in a system with a total optical power budget close to the limit of the optoelectronics, non-uniformity in the longer length can result in high-loss jumpers. In such cases, uniformity of attenuation can be specified. A typical uniformity specification is: attenuation shall be uniform with no local losses greater than 0.1dB.

• *Microbend sensitivity.* Microbend sensitivity can be easily tested. Connect a section of cable to a power meter and stabilized light source. Now bend the cable. If properly designed and manufactured, the cable will show no change in power trans-

Continued on page 74

No. of fibers	MFPT	Break-out	Single Fiber Loose Tube
2	1	1.25	—
6	1	1.8	1.75
12	1	1.58	1.43

Table 1. *Ratio of costs in three cable designs. Note that MFPT is set to one. The breakout and SFPT designs appear then as ratios of increasing cost over the MFPT design.*

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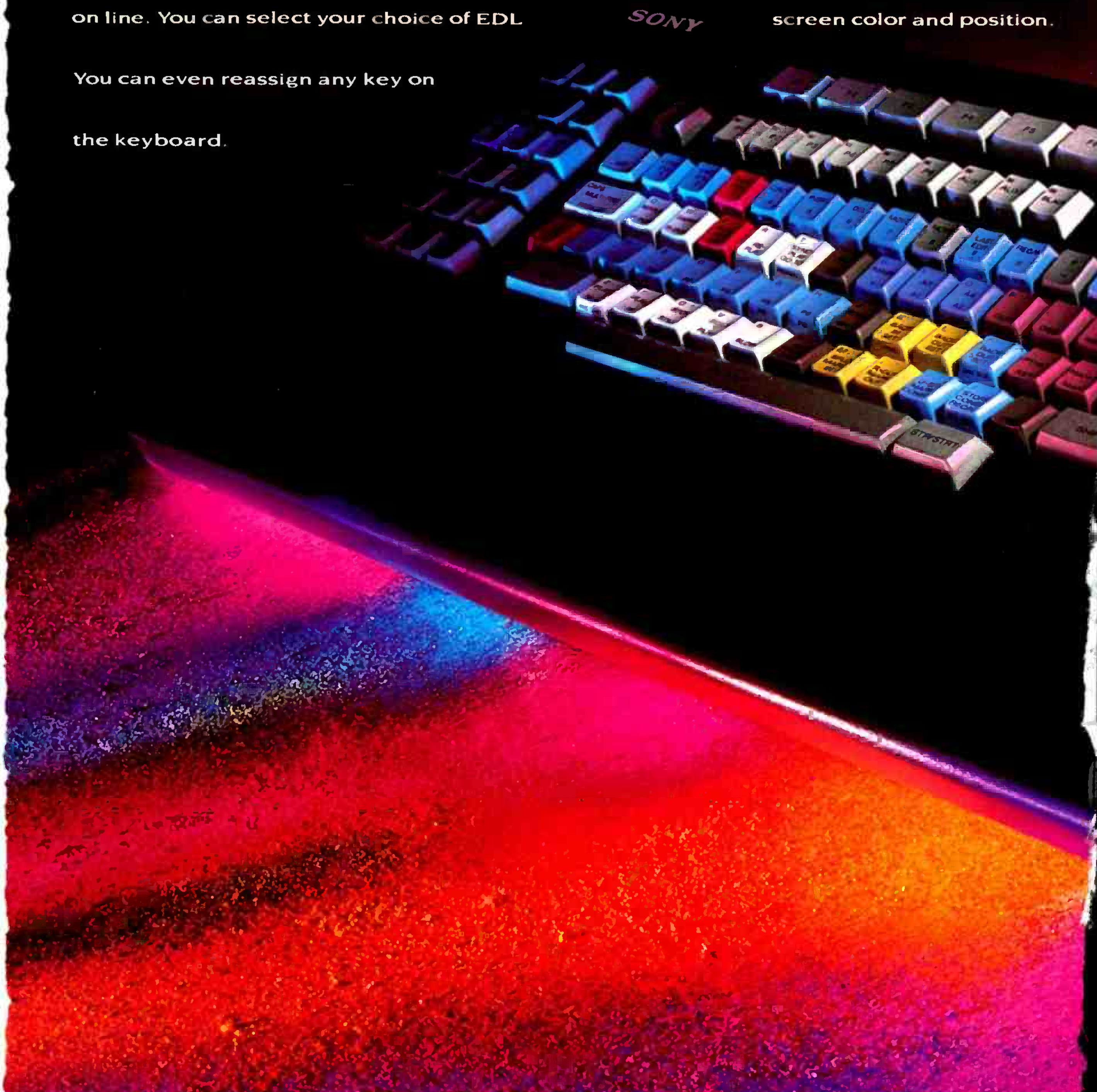

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SONY

Continued from page 71
mitted until the cable is bent to below its minimum recommend bend radius.

• *Consistency of stripability.* This is an important characteristic for tight tube designs, and one that can be easily checked. Using the proper buffer tube stripper, repeatedly remove the buffer tube from the fiber. The best-made cables (in terms of stripability) will be those that consistently allow stripping without fiber damage on the first attempt. Poorly made cables will be those that frequently break during the stripping process.

• *Ease of jacket removal.* The ease with which the jacket can be removed from the cable varies among manufacturers. Experience shows that cables with rip cords take much less time to prepare for connector installation than those without rip cords.

Cables with the same design from different manufacturers usually have subtle differences. These differences can impact the overall price and the ease and total cost of installation.

Some cables use fiber glass rods as a partial replacement for Kevlar as strength members. Using fiber glass lowers the manufacturing cost without a reduction in strength. However, fiber glass cable should not be used for jumper cables because the fiber glass does not always survive when crimped in a connector.

Using fiber glass lowers the manufacturing cost without a reduction in strength.

Many cable products use fiber glass epoxy rods as strength members instead of steel. These products will have slightly higher costs (approximately 5%), but do result in an all-dielectric design. These types of cables allow for more flexibility in replacement because the NEC requirements are less restrictive for all-dielectric cables than for those using conductive components. For this reason, the fiber-optic cable industry has evolved to almost complete use of dielectric strength members.

Another advantage of fiber glass epoxy rods is the lack of memory. Cables with steel strength members can retain a permanent set after being bent. Although this is not a major problem during installation, a memory can allow inadequately experienced installers to damage cable during installation.

A drawback to the use of fiber glass epoxy rods as strength members is the increased rigidity of the cable. This increased stiffness can make installation more difficult, especially in long pulls or in conduit systems with many bends.

A few cables use wire rope instead of steel as strength members. Wire rope provides the same temperature range of operation with improved flexibility and a lack of memory.

Cables can be jacketed with a variety of materials. The material choice impacts cost, installation ease, abrasion resistance and other factors. Polyvinylchloride (PVC), polyethylene (PE) and polyurethane (PU) materials are the most common jacketing materials. PE has the highest abrasion resistance of the three. PE and PU have good cut-through resistance. PU is more flexible than PVC, although PVC has adequate flexibility for most indoor installations. PE jacketing tends to produce a stiff cable and is normally not used for indoor applications. A PU cable, however, has a high coefficient of friction, making installation difficult when used in long pulls.

Fluorocarbons and plenum-rated PVCs are the two types of plenum-rated cables. The fluorocarbons are stiff and more expensive than the plenum-rated PVCs. The increased flexibility results in better appearance of the latter after installation, because tight bends can result in permanent deformation of fluorocarbon jackets.

The MFPT cables with stranded loose tubes are manufactured using two different processes. One process results in the buffer tubes being stranded in one direction around a center strength member of fiber.

The second method uses a counter-rotating process for both fibers in the buffer tube and for the buffer tubes. This counter-rotating process twists the fibers first in one direction and then in the other. The advantage of this process is a reduction in preparation time, because the fibers and buffer tubes are easier to untwist during preparation of the cable ends.

Recent developments

One recent development is the use of cables containing fiber and copper conductors. Many data communication users are installing such hybrid or composite cables. This practice can reduce the total installation cost, even if the user has no specific need for the copper. The most common version of such hybrid cables contains two tight tube subcables. Although the fibers can be either multimode or single mode, the multimode designs are specified more frequently.

Toxicity is becoming a major concern for standard organizations and users. Expect to see continued development of standards and halogen-free cables. At this time, however, no plenum-rated halogen-free cables are available.

How many spares?

Most users of fiber optics discover that their needs increase with time. Therefore, it is necessary to install more fibers than initially needed. Three techniques are used to determine the number of spare fibers to install. The first technique is to accurately estimate the growth needs of your facility. This is a difficult process to perform accurately.

The material choice impacts cost, installation ease, abrasion resistance and other factors.

Anyone who has built a broadcast or production facility has faced the arduous task of predicting the future with respect to interconnect needs. Many of us have failed in this regard, because it's almost impossible to know what's going to be needed in two, let alone five or more, years away.

The second technique is to use an industry rule of thumb, which was developed by telephone companies. It requires the installation of two to three times the number of fibers required. The current industry ratio is approximately three.

The third technique is to use the cost of cable installation to calculate the minimum number of spare fibers. A mathematical technique for determining the minimum number of additional fibers in the cable will be equal to the cost of installing an additional cable in the future.

This estimating technique can be used as a guideline. However, don't use it as a strict decision-making rule, because it doesn't take into account a number of business factors, such as the future value

No. of fibers	Break Even Distance, m	$ Saved per 1,000 m
2	131-114	$ 190 - $ 219
6	58-69	$ 680 - $ 803
12	31-37	$2,048 - $2,417

Table 2. *Payback distance for MFPT designs. The distance at which an MFPT design results in an equal or lower cost varies, depending on the number of fibers in the cable. The more fibers, the shorter the distance at which the MFPT cable becomes more cost-effective.*

Difference in cost/fiber-meter .... $		0.21	0.16	0.11	0.11	0.13
No. of fibers = ...		24	24	24	24	24
EXTRA COSTS OF MFPT .... $						
Labor cost to install		380.16	380.16	380.16	380.16	190.08
[illegible] at cable ends		960	960	960	720	720
Supplies		28	28	28	28	
4 splice trays		80	80	80	80	80
Loose tube cable to slide over fibers .		72	72	72	72	72
TOTAL PREPARATION COST OF MFPT		$1,520.16	$1,520.16	$1,520.16	$1,280.16	$1,062.08
Break even distance =	m	302	396	576	485	340
	ft	989	1,298	1,889	1,591	1,117
Specifics of comparison						
MFPT		gel-filled	gel-filled	gel-filled	gel-filled	no gel
Standard cost case?		yes	yes	yes	yes	low-cost case

Table 3. *Comparison of MFPT and breakout cable costs. Using 24 fibers as the design criteria, the total costs for both cable types are summarized. The costs are those required to prepare the cable for connector installation. Actual connector installation will be the same for both cables, and is therefore not shown.*

of dollars spent now.

Minimum number of additional fibers=

$$\frac{\textit{(Installation Costs/ft)}}{\text{(additional cable cost/fiber/foot)}}$$

One strategy currently being used is to install cables containing single mode and multimode fibers. By multiplexing multimode signals onto single mode fibers, you will be able to increase the bandwidth capacity and free the multimode fibers for new uses.

Common misconceptions

Because fiber-optic cables contain glass fibers that are approximately the size of a human hair, many assume that the cables can be easily broken. This is not the case.

Evidence of the ruggedness of these cables comes from several sources. In one company's training laboratory, students were required to practice installing cables. The students were instructed on how to abuse several fiber products in an effort to see how rugged the cables were. The abuse involved subjecting the cables to installation loads, bend radii and to crush loads in excess of the limits stated by the manufacturer.

In more than 20 courses involving more than 193 students, no student was able to break the fiber in one loose tube-designed cable under the above conditions. Some cables were broken, but only when the cables were subjected to conditions that violated the bend radius or maximum installation loads.

Do you need a premium cable?

Some new fiber-optic cable users are tempted to buy or accept a sales argument to buy more performance by paying a premium price. In some cases, this is a smart decision. In other cases, it's a waste of your resources. Let's examine two characteristics — bandwidth-distance product and attenuation rate — to see when premium performance at a premium price does and does not make sense.

Buying a premium bandwidth-distance product makes sense only if the design's effective bandwidth actually obtained is not in the flat region of the effective bandwidth-bandwidth distant product curves. Once the effective bandwidth is in the flat region, it is possible to pay 100% more for a modest 10% improvement in effective bandwidth. Because this ratio is unfavorable, it does not make sense to pay premium price, unless the additional bandwidth is absolutely needed.

Buying a premium attenuation rate product makes sense as long as the proper design steps have been taken. There are two common arguments in favor of buying a premium attenuation rate at a premium price.

Forward-thinking engineering managers will increasingly look to fiber-optics for solutions to their problems.

The first argument is that it provides additional margin for splices and additional connectors, which may become necessary in the future. This argument is not valid in situations in which excess or unused margin already exists. For instance, if the optical power budget from the optoelectronics is greater than 16dB, and if the optical power actually consumed by the cables, connectors and aging margin is only 8dB, there is already 8dB of optical margin. Paying for more expensive ([low] rate of attenuation) cable does not make sense in this particular situation.

The second argument is that such an approach provides for expansion beyond the initial system design limits. This argument is valid only if a design study shows that the purchase of the low-loss cable allows the network to reach the new limits (for example, a new building). If the low-loss version allows the cable to reach only one-half or two-thirds of the distance between the two buildings, a signal regenerator will be needed. If so, it should be placed inside the first building anyway, which negates the need for premium attenuate rate cable. The key point in both of these examples is that a design study needs to be done in order to justify the use of premium fiber.

What's next?

The use of fiber will continue to increase as video and data signals require additional bandwidth. As data transfer speeds increase and the resolution of video signals increase (HDTV), fiber will become the cable of choice.

As you examine the next phase of growth for your facility, consider carefully the possible use of fiber. It has many advantages: high signal-carrying capacity, small size, ease of installation and cost-effectiveness.

Forward-thinking engineering managers will increasingly look to fiber-optics for solutions to their problems. Don't limit your facility's future options by using old-style technology.

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.

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1991 Annual Editorial Index

For your convenience, the following pages contain a listing of all editorial columns and features appearing in the 1991 issues of *Broadcast Engineering*.

January

Theme: Broadcasting from the Field

Editorial (page 6)
- A show in transition

('90 SMPTE conference suffered from economy, New York and Javits Center; indications for Toronto in '92 look good.)

FCC Update (page 8)
- FM translator standards tightened.
- Community of license rule clarifications.
- FCC proposes children's TV rules.

Strictly TV (page 10)
- What does my video really look like? (Part 1)

(Tutorial on video signals, components and their interrelationships and levels.)

re: Radio (page 12)
- We're legal...(Aren't we?)

(FCC rules on EBS, tower lighting and remote-control points should be read and understood. Responsibility and compliance are needed.)

SBE Update (page 14)
- Suggestions for expansion of Ennes Foundation board, education and job placement services.
- Session for women in broadcast engineering offered.
- Certification expanded with arrangement between Defense Department and SBE.
- SBE Fellowships to Gerry Dalton, Robert Goza, Joseph Manning.
- SBE awards for chapters announced at convention.

Circuits (page 16)
- Building with microcontrollers (Part 5)

(Linking external memory, configuring I/O ports as memory and system timing at microcontroller ports.)

Troubleshooting (page 18)
- Servicing your klystrons (Part 4)

(Power up and shut down procedures for klystrons affect correct system operation and possible early failure.)

Management for Engineers (page 20)
- Project management for engineers (Part 4)

(Project management minimizes effects of problems; most effective solution is to be prepared to work around trouble.)

Remotes revisited (page 26)
by Skip Pizzi, technical editor
Several choices exists for backhaul from a remote site. Data compression and bit-rate reduction trim transmission circuit costs when used through telco services. A multiple video channel per satellite transponder is assessed for reduced costs. A glossary of terms is included.

Communicating with the field (page 48)
by Rick Lehtinen, technical editor
For coordination between a remote site and the studio, cuing of talent at the remote location and a program signal path to the studio, options range from a station's Pro subcarrier channel to satellite links. Standard and cellular telephone and 2-way radio offer other links.

Sharing the crowded spectrum (page 62)
by Richard Rudman, KFWB-AM
Successful coexistence of radio services requires cooperation. Microwave service is the most vulnerable to interference. A narrower bandwidth for transmissions is needed; transmitter licensing is necessary; shielding on receivers may be needed.

Show replay (page 68)
- SBE convention shines in St. Louis

(The '90 SBE national convention combined equipment exhibition and technical sessions on enhanced and HDTV, digital audio broadcasting, radio data systems, Ennes workshop specialized training programs.)

DBS in the United Kingdom (page 72)
by Brad Dick, editor
England learns from a year of direct satellite broadcasts with D-MAC 27MHz bandwidth signals from Marcopolo satellite to terrestrial user links. Encryption will stifle free use of services.

February

Theme: Winning with Digital Technology

Editorial (page 6)
- Selecting a digital radio standard

(The public interest standard guides American communications. That principle should apply to digital radio broadcasting.)

FCC Update (page 8)
- Hearing procedures streamlined; guidelines, standard forms, procedures, time limitations resolve comparative hearings.
- Settlement payments limited in comparative hearing cases involving applications for new stations.
- FCC studies criteria of 3-signal standard to determine if a cable system is subject to effective competition.

Strictly TV (page 10)
- Teaching "non-techies" about color (Part 2)

(Non-technical view of video basics, burst levels to better understand test signals and a vectorscope.)

re: Radio (page 12)
- Radio recollections

(Battison reminisces from a crystal wireless set in 1923 to his acceptance of a position with KMBC in Kansas City in 1945.)

SBE Update (page 14)
- SBE seeks support to change FCC composition – one commissioner should be an engineer.
- FCC proposed adoption of SBE definition of "congested area" and minimum standards of antenna performance.
- Help for chapter programs as former treasurer launches SBE speakers bureau.

Circuits (page 16)
- Building with microcontrollers (Part 6)

(Tying memory to a microcontroller, address tracking, data and control lines.)

Troubleshooting (page 18)
- Servicing your klystrons (Part 5)

(Vacuum integrity of stored klystrons measures standby device serviceability, with electron gun as a triode ionization gauge.)

Management for Engineers (page 20)
- Project management for engineers (Part 5)

(Progress reports and a final summary is useful for the future and additional work.)

Using computer-based effects systems (page 26)
by Rick Lehtinen, technical editor
Graphics and effects provide extensive capabilities to manipulate images, if attention is paid to scan rates. Massive memory, VGA video cards and scan conversion or timing place limits on PCs.

Radio frequency radiation, Part 1 (page 48)
by Don L. Markley, P.E.
ANSI C95.1-1982 limits exposure to non-ionizing radiation. A study of Sears Tower (Chicago) installation (five TV and six FM and microwave from 950MHz to 23GHz) found no location accessible to personnel during normal operation with a level greater than 20% of the ANSI limitation.

Radio frequency radiation, Part 2 (page 66)
by Tim McCartney
OST 65 (1985 FCC document accepting ANSI non-ionizing radiation standard) and subsequent FCC rules require transmitting facilities to comply with radiation limitations. Stations, including multiple transmitter installations, must maintain compliance or risk the loss of their license.

A look at high-performance recording formats (page 54)
by Rick Lehtinen, technical editor
An overview of recording technologies considers D-1, D-2, D-X, S-VHS and Hi-band 8mm; advantages and disadvantages of each.

March

Theme: Facility Design & NAB Pre-show Information

Editorial (page 6)
- Vegas: home, sweet home

(Returning to Las Vegas creates a superficial gloss on NAB attendees, but the industry's future concerns everyone.

FCC Update (page 8)
- FCC liberalizes time leasing policies; leased stations required to maintain control over programming and an independent operating staff. Antitrust rules must be observed.
- Field Operations Bureau fines daytime AM for operating beyond authorized sign-off time and other rule infringements.

Strictly TV (page 10)
- Good video from start to finish (Part 3)

(Waveform, vector monitors show technical aspects of video, allow video operators to keep the output at unity gain.)

re: Radio (page 12)
- An adventure in tower detuning (Part 1)

(Expanded a 2-tower antenna LPTV, AM site with FM antenna on a taller tower used a third tower for the FM, LPTV antennas, but poses pattern problems for the AM.)

SBE Update (page 14)
- SBE increases certification fees.
- Call for papers for 1991 convention.
- Johnson Space Center tours offered during convention.
- SBE board to meet in Houston.
- Board vacancies filled: Terry Baun (Criterion Broadcast Services, Milwaukee) to finish 1-year term, Marvin Born (WBNS) fills unexpired 2-year term.
- New SBE chapters: Knoxville, TN; southern Idaho; and Manila, Philippines.
- Broadcast Engineering conference note: suggested topics for papers.

Circuits (page 16)
- Building with microcontrollers (Part 7)

(Using EPROM with a Z-8 microcontroller.)

Troubleshooting (page 18)
- DAT maintenance (Part 1)

(Problems with DAT units suggest test equipment needs similar to those for VCRs.)

Management for Engineers (page 20)
- How do you rate?

(The manager-employee relationship needs feedback in both directions, to keep both aware of their performance. General manager-chief engineer situation applies to chief engineer-technician case.)

News Special Report (page 22)
- DRB (digital radio broadcasting) initiated in Japan (1990) from a geostationary satellite; service offers "ambient" channels for background uses.
- FTC tells FCC to auction DRB frequencies. NAB and others suggest DRB should be

treated as replacement service and handled as AM and FM grants.

- NAB moves to license Eureka 147; exclusive North American license agreement with European consortium for Eureka 147/DAB digital radio broadcasting.
- Copyright Office hears DRB comments; issues involve home taping, artist royalties.
- Skip Pizzi to assume chair post of CDRB (Committee for Digital Radio Broadcasting); joins with SBE for forum for DRB issues. Invitations for CDRB representation issued by EIA and NRSC.
- Gannett Radio introduces "in-band" DRB system called "coded polyvector digital modulation" (CPVDM); CBS participates in "Project Acorn." MUSICAM coding algorithm employed in the project.

NAB engineering conference preview (page 26)
by Skip Pizzi, technical editor
The industry meets in Las Vegas for '91 NAB Convention and 45th annual Broadcast Engineering Conference and special HDTV World exhibit, including NHK Technology Open House; digital radio demonstration of Eureka 147/DAB; conference papers.

Applying ergonomics to studio design (page 40)
by Dr. Walter Black, Video Design Pro
Productivity measures the facility design, the interface between man and machine, and comforts provided to workers. Designs for function may impact physiological and psychological concerns of employees. Designing can be simplified with CAD software.

High-end control rooms (page 56)
by John Storyk, Walters-Storyk Design Group
An audio control room environment involves time, energy and frequency (TEF) domains. TEF standards define aspects of the room, architecture, but equipment and people alter the design. The monitor system and placement of its components must coordinate with the other aspects.

Taking advantage of digital video (page 74)
by Alan J. Wechsler, Vidcom Post
D-2 replacement for type C has surprises because of the comparatively forgiving nature of analog contrasted with strictness of digital signals. Integrating digital video equipment into existing systems requires careful thought and some costs.

Building a sports cable network (page 84)
by Bob Billeci, Prime Ticket
Cable network facilities have concerns similar to production and broadcast plants, including video/audio functionality and acoustical characteristics. Reliable service demands backup power for technical equipment and computers coordinating functions of the plant.

New competition for your audience (page 96)
by Michael Leader, Leader Sound Technologies
Attention once given to television and radio is fragmented by other alternatives. Cable, videotape, laser disc and satellite services compete with CDs and R-DAT. Technologies, posed as improvements for broadcasting, now exist in home entertainment systems. Broadcasters must use these technologies to remain in competition.

Cable considerations for broadcast wiring (page 110)
by Benjamin L. Nemser, Nemal Electronics
Interconnecting equipment requires different types of cable, per the National Electric Code. Non-compliance with NEC codes can result in fines, based upon safety considerations of electrical and fire codes. Underwriter's Laboratories (UL) and Canadian Standards Association (CSA) are test facilities to establish standards for product compliance.

Revising the FM band rules (page 118)
by Robert D. Greenberg, FCC
February '90 policy changes to speed licensing approvals affect processing of commercial FM CP applications. One change relaxes "hard-look" processing rules the commission has used.

NAB '91 Equipment Exhibitors (page 149)
New at NAB (page 191)
by Carl Bentz, special projects editor
Manufacturers attending and new product introductions at the '91 NAB exhibition.

Field report (page 232)
- Bryston BP-1 pre-amplifier

Field report (page 236)
- Rohde & Schwarz model EMFT precision TV demodulator

Field report (page 239)
- Ampex AVC Century production switcher

April

Theme: Automation Special Report

Editorial (page 6)
- Buggy whip technology

(The complexity of FM modulation level measurements has been resolved by leaving methods pretty much as they were, even if they prove inadequate.)

FCC Update (page 8)
- FCC opens OFS spectra to wireless cable.
- Effective date deferred for reform in comparative hearings, fees announced in December '90; outcome dependent on appeals filed with the commission.
- Strict adherence to FCC tower painting and lighting regulations avoids fine assessments.
- FM translator rules revised; freeze on translators, commercial FM modifications effective until May 1; amendments updating pending applications up to the new rules to be made by July 1.

Strictly TV (page 10)
- Keeping hard disks up and running.

(Time, temperature, general wear of hard disks can cause system failure. Non-destructive low-level formatting may alleviate problems.)

re: Radio (page 12)
- An adventure in tower detuning (Part 2)

(A new tower near an AM array may result in changes to the AM pattern; the reverse-folded monopole concept can detune the new structure and reduce the effects.)

SBE Update (page 14)
- Definition of frequency congestion uses 4-level exemption scheme with existing standard metropolitan statistical areas.
- Membership renewal forms mailed.

Circuits (page 16)
- Building with microcontrollers (Part 8)

(Serial links talk to the microcontroller.)

Troubleshooting (page 18)
- DAT maintenance (Part 2)

(Maintenance for DAT machines means an array of equipment besides that used with analog decks; greater precision needed in measurement.)

Management for Engineers (page 20)
- Learning to say no

(A 'yes' response often should have been 'no.' The result increases stress and other characteristics more harmful than having said 'no'.)

Purchasing automation: a manager's guide (page 26)
by Steve Walker, Broadcast Automation
Do not contract for an automation system unless automation makes economic sense. The role of automation varies in every situation. The decision to automate must answer more than financial analyses. Guidelines to analyze needs are suggested.

Implementing PC-based automation (page 32)
by Michael Rich, Media Computing
PCs using -286, -386SX microprocessors are effective automation control units. Most use RS-232, RS-422 (SMPTE) or TTL communications. Interface cards in the PC, associated with appropriate software packages, include LAN systems.

Trends in newsroom automation (page 48)
by Skip Pizzi, technical editor
The tasks of newsroom automation have not changed, but methods to achieve them have. New applications using PCs to direct machine controllers results in a broader range of users to pursue station automation.

RoboCam 2 (page 54)
by Skip Pizzi, technical editor
Robotic camera control moves into the production studio. Many applications benefit from repeatability of the electromechanical system when fixed shots are repeated. Portable field units exist with reduced costs.

Automation station libraries: a systems approach (page 60)
by Rick Lehtinen, technical editor
An automation library system must balance cost, technical and operational issues. Consider media, robotics, types of transports, control hardware and electronics, communications for report generation and diagnostics, user interface and off-line archive storage.

Weather radar update (page 74)
by Rick Lehtinen, technical editor

National Weather Service updates radar and data services with Doppler radar, environmental condition sampling at more frequency intervals, atmospheric soundings and high-frequency satellite-sensed imaging processed by a super computer and distributed to subscribers over private networks.

Engineering profit centers (page 84)
by Skip Pizzi, technical editor
Increasing income, reducing expense increases productivity. Before implementing cost cutting, look at possible damage caused by cut backs. Replacement technologies and automation of repetitive processes with assets provided by the existing staff and new ventures into peripheral areas can increase revenue.

May

RF transmission systems update

Editorial (page 6)
- Vegas: still our place in the sun

(Not everyone considers Las Vegas the ideal site for the NAB convention, but logistics make Vegas venue better than others tried in recent years.)

FCC Update (page 8)
- Rules on "time leasing" includes leasing contracts; consider different time duration leases, authority vested in leased station employees and management.
- Potential problems of time leasing: responsiveness to community of license; adherence to political broadcast regulations; failure by the licensee to exhibit control over the facility.
- "Pioneer preference" applies to preferential treatment in requests for spectrum allocation changes for development of new services and technologies.

Strictly TV (page 10)
- SuperNTSC unveiled in San Francisco

(4-day demo of improved TV technology by KPIX-TV, KGO-TV, Bay Area Viacom Cablevision using Faroudja SuperNTSC received positive marks from observers.)

re: Radio (page 12)
- Applying vectors (Part 1)

(The concept of vectors explains many AC and RF circuit basics and effects.)

SBE Update (page 14)
- Emergency antennas get new FCC regulations; public health, non-ionizing radiation are key concerns; emergency and temporary facilities to perform according to environmental protective rules; RFR analyses needed before rigging emergency antennas.
- SBE to meet with AMITRA, Mexican broadcast engineering organization, Puerto Vallarta, Mexico, August 7-9.

Circuits (page 16)
- Building with microcontrollers (Part 9)

(Operation and applications for UART universal asynchronous receiver-transmitters with microcontrollers.)

Troubleshooting (page 18)
- DAT maintenance (Part 3)

(The movement of media through the tape path is a critical factor in DAT performance; mechanical complexities, rotary head drum replacement are examined.

Management for Engineers (page 20)
• Time management (Part 1)
(Doing more, faster, with less are attributes of the art of time management, how to make effective use of your time.)

Directional antenna system evaluation (page 26)
by Thomas Gary Osenkowsky, consultant
The effectiveness of a directional array can be determined by analyzing its performance and making adjustments in areas where improvements are needed. Knowledge of basic formulas and current system operation is needed before trying to restore a wayward AM DA to its original condition and pattern. PC software can predict signal coverage.

Decibels vs. meters: pricing antenna performance (page 46)
by Jack Herbert, Andrew
An earth station antenna, selected on size alone, may not perform as expected. Assessment should include figure of merit, antenna pattern analyses. Investigation of different antennas and related equipment could lead to a smaller size system, with reduced cost, upkeep, increased performance.

Solid-state vs. tubes in TV transmitters (page 66)
by Skip Pizzi, technical editor; Martha Rapp, Harris Allied Broadcast; Guy Clerc and William House, Thomson Tubes Electroniques
Which is the better technology for modern TV transmitters – tubes or transistors? Solid-state devices are used in nearly every aspect of electronics, but places exist where tubes find waiting sockets. Side-by-side comments on high-power amplification for TV examine both sides of the question.

Using Loran-C for field measurements (page 84)
by Roald Steen, instructor
LOng RAnge Navigation (LORAN) enables an exact determination of location. Chains of master and secondary transmitting locations allow triangulation, based on propagation delays of 100kHz signals from several transmitting sites. A "global positioning system" will use satellites and provide 3-D data in location finding.

CCDs vs. camera tubes: a comparison (page 90)
by Roald Steen, instructor
CCD cameras quickly supplanted many of the established design tube-type cameras. As the contest continues, CCD technology is gaining.

June

Theme: NAB convention replay

Editorial (page 6)
• Missouri showmanship
(Can FCC chairman Sikes, deregulation, effective competition and reassignment of spectrum co-exist with video delivery services via the phone companies?)

FCC update (page 8)
• Children's TV standards adopted for broadcast, cable; limit on advertising on children's programming; compliance assessed for renewals; public inspection file to summarize efforts toward children.
• FCC relaxes financial interest, syndication rules; defines range of aspects on rights of ownership, syndication, relationships between networks and co-producers and handling of in-house productions.

Strictly TV (page 10)
• High-definition audio coming to TV (Part 1)
(Improved audio will bring digital audio to TV receivers when they include digital decoders; ISDN (Switched-56) service could bring high-quality audio now.)

re: Radio (page 12)
• Applying vectors (Part 2)
(Vector addition permits signal amplitude, phase in calculations to determine voltages, currents in resonant circuits.)

SBE Update (page 14)
• SBE activates job line for members; situations wanted are not included.
• Best Chapter nominees accepted for 1991; categories include Newsletter, Newsletter Editor, New Member Growth, Frequency Coordination Effort, Technical Article or Paper and Regional Conference.
• Contract engineering dilemma examined; training program in development for engineers, displaced from jobs in stations, to better understand the field of contract engineering.

Circuits (page 16)
• Building with microcontrollers (Part 10)
(UARTs, framing errors in data transmissions and error detection are described.)

Troubleshooting (page 18)
• DAT maintenance (Part 4)
(Adjustments of DAT systems include tracking voltage, head drum phase generator, auto track-finding, VCO free-run adjustment, RF record level and playback EQ, A/D-D/A offsets and balances.)

Management for Engineers (page 20)
• Time management (Part 2)
(Paperwork is a major project for many managers; an organized system to handle papers and records helps.)

NAB '91 in review (page 26)
by Skip Pizzi, technical editor
Transitions at NAB came as new developments in audio, including DAT applications, digital FM audio from source through STL to transmitter, recordable CDs, data compression, signal processing, test/measurement and integrated automation and processing. TV seeks wideband systems for high-definition, high-efficiency transmission, stereo audio, digital video and effects, integrated automation, interactive TV and more uses for PCs.
Digital audio broadcasting (DAB) highlighted European Eureka 147 and US Acorn DAB venture, while HDTV World '91 presented the NHK Technology Exhibit, a museum-of-the-future of DBS, 3-D HDTV and other demos of high technology.
Ray Dolby comment should be heeded by the industry - consider the needs and wishes of consumers when designing new services and hardware.

The Pick Hits of NAB '91 (page 36)
by Rick Lehtinen and Skip Pizzi, technical editors
Radio Pick Hits: Belar Wizard FM modulation monitor; Broadcast Electronics CORE 200 automation controller; Eventide VR2400 DAT logger; Harris PT10FM transmitter with Digital 50 FM exciter; Moseley DSP 6000 digital STL system; Northeastern Communications Products DRYGEN transmission line dryer; Orban Optimod-FM 8200 audio processor; Pacific Recorders & Engineering Productionmixer; Potomac Instruments 1901 digital AM antenna monitor; Shure FP410 automatic mic mixer.
TV Pick Hits: Abekas A51 digital effects system; Avid Technology 200 series Media Composer; Digital F/X Video F/X system; Magni Monitor; Odetics TSC90 cartridge machine; Panasonic AJ-D350 1/2-inch digital VTR; Tektronix 1730 D waveform monitor; VGV DX-120 composite digital switcher; Videotek TV1710 waveform monitor and Wheeler-Rex Handy Bundler tie-wrap unit.

The Gulf War: Special Report (page 50)
Broadcast Technology in the midst of war
by Peter Hammar, Hammar Communications
Aug. 2, 1990, launched an invasion of Kuwait and the most extensive electronic and satellite news-gathering project the world has ever seen. Military and media found parallel experiences in preparations, learning to exist and problems of maintenance in a desert environment. Establishing communication links brought satellite technology into full play, while camcorders fought battles of incompatibilities.

Show of Shows: New from NAB '91 (page 78)
by Carl Bentz, special projects editor
Over 1,577 new and enhanced products and services for the video and audio production and the broadcast industry were introduced at NAB '91.

July

Theme: Audio Technology Update

Editorial (page 6)
• Montreux - Trés Bien
(New 3-D graphics and titling products, 16:9 625-line PAL transmissions and three proposed digital video recording formats brought excitement to Montreux ITS.)

FCC Update (page 8)
• FCC studies multiple station ownership; possible changes for 12 AM/12 FM rule; revision of contour overlap and duopoly rules; policy to encourage joint ventures between competing stations; raising of minority ownership limitations.
• FCC amends settlement cap rules; eliminates settlement payments after a hearing begins.
• New hearing procedures clarify rules streamline the comparative process; clarifications on fees, the Ruarch policy, dis-

covery/integration statements, policing comparative grants, pioneer preference.

Strictly TV (page 10)
- High-definition audio coming to TV (Part 2)

(ISDN, two 64kbyte digital signals, message channel and data compression can bring digital audio to TV; compression involves frequency, temporal masking of sound that would be unheard.)

re: Radio (page 12)
- Applying vectors (Part 3)

(Vector arithmetic calculations in parallel resonant circuits.)

SBE Update (page 14)
- Office nominees: Richard Farquhar, president; Jerry Whitaker, vice president; Bill Hineman, secretary; Robert Goza, treasurer.
- Candidates to sign an agreement to fulfill the requirement of the society to the best of their ability; candidates are reminded to realize that office holders face a good deal of work as well as some financial and personal responsibilities.
- Convention sites approved; 1992, San Jose, CA; 1993, Richmond, VA.
- Congressman Ritter, to speak at SBE convention, is only member of Congress with doctoral degree in engineering.
- Ennes Foundation donation from Intertec for educational programs.

Circuits (page 16)
- Building with microcontrollers (Part 11)

(Z-8 microcontroller as remote control element for a U-matic VTR, linked by RS-232.)

Troubleshooting (page 18)
- DAT maintenance (Part 5)

(Dropouts, noise spikes signal that head cleaning is needed; elapsed time meter is a useful component; keeping a tape fully wound to one reel and keeping transport guides clean avoid damage to DAT tape.)

Management for Engineers (page 20)
- Time management (Part 3)

(Protect your time and help accomplish your required duties; learn how time escapes; the problems of interruptions may require that you close the door to other events, but without offending.)

Digital radio: the first five years (page 26)
by Skip Pizzi, technical editor
Digital radio began in Boston in 1986; Eureka 147/DAB was first demonstrated in September 1988; today, eight designs await a decision on digital radio transmissions in the U.S. Questions involve economic policies, spectrum usage and data reduction methods. The article compares eight formats. (*Related information*: "Evaluating data-compression artifacts.")

Testing digital audio devices (page 38)
by Richard C. Cabot, Audio Precision
Analog equipment tests digital devices that use analog inputs and outputs, unless the device malfunctions internally. Methods to isolate faulty circuits and descriptions of responses expected when various sections of the device operate improperly are given. Technicians should understand analog and digital measurement techniques and realize their appropriate applications.

Digital audio processing (page 46)
by Robert Orban, Orban/AKG Acoustics
Digital processing has advantages unattainable by analog methods, but exhibits disadvantages, involving A/D conversion steps or loss of bits. Digital equalizers represent a source of non-ideal results from processing.

Digital audio signal distribution (page 54)
by David Bytheway, BTS
Distribution of digital audio signals offers new problems for audio technicians. A review of the AES/EBU standard examines difficulties in a plant-wide digital audio distribution system.

Preparing for disaster (page 62)
by Martin Sacks, WGAY-FM/WWRC-AM
Planning for disaster is almost as unpleasant as the disaster, but paybacks are well worth working for. Finding contingencies before a major fire blazed through his facility, the author offers steps for disaster preparedness. (*Related material*: problems of tower safety and operation with standby generators.)

August

Theme: Video Technology Update

Editorial (page 6)
- It's already good enough

(A Montreux announcement of three new videotape formats met mixed opinion. Costs involved and questions in the timing of the announcement prompt a review of current delivery systems and receivers. Will viewers pay for something they can't see?)

FCC Update (page 8)
- Main studio rule tightened; requirement for one full-time manager, one full-time staff person at the main studio during normal business hours.
- FCC redefines "effective competition" for cable for regulating basic cable service rates by local franchising authorities.
- FCC modifies TV "satellite" standards, full-power stations rebroadcasting all or part of the programming of the parent station; case-by-case considerations involve public interest criteria: no city-grade overlap between parent and satellite; provision to otherwise unserved areas; no alternative operator ready/able to construct/purchase and operate the satellite station.
- FCC studies EBS toward a goal of implementing a system of receivers activated only for emergencies of a certain type or in a certain area.

Strictly TV (page 10)
- Clip those peaks

(Transmitted pictures are degraded if peak white exceeds 100 IRE units [12.5% of full carrier]. Hot spots, high-frequency overshoots from enhancement are sources of image degradation and cause excessive contrasts with loss of detail in dark areas.)

re: Radio (page 12)
- The case of the drifting DA

(An errant array exhibited a current phase shift following a time lapse after power was applied. Apparent cause was swampy soil of the array site.)
(An AM tower for mounting an LPTV antenna poses problems unless the AM tower is grounded and shunt-fed.)

SBE Update (page 14)
- SBE working to save 2GHz auxiliary band, after the FCC requests SBE frequency coordinators to determine where existing 2GHz services could be relocated, if the band was reallocated. SBE opposes reallocation, declines willing cooperation.
- Members survey learns more about those who serve as independent contract engineers for multiple stations; an educational program to assist those members is under development.
- Ennes workshops planned for convention; techniques and newsroom automation; other subject areas to be featured are RF transmission systems, RF circuit theory, video measurements, digital broadcasting and engineering management.

Circuits (page 17)
- Building with microcontrollers (Part 12)

(Electrical interface between the microcontroller and remote-control connector requires protection against electrostatic discharge and spurious radiation.)

Troubleshooting (page 18)
- DAT maintenance (Part 6)

(The head assembly of DAT machines will require replacement approximately every 1,000 hours; other replacement items include pinch roller, capstan assembly, reel table assembly, brake bands or pads and guide assemblies.)

Management for Engineers (page 20)
- Time management (Part 4)

(Procrastination is inefficient; do the task when you think of it; tackle the project you don't want to do now; get organized; schedule an anti-procrastination time.)

Comparing the options in HDTV (page 26)
by Rick Lehtinen, technical editor
HDTV is a technological puzzle. Should it be analog or digital? What is needed to put HDTV on the air at the local affiliate level? The article describes systems and options being examined in the United States.

Integrating HDTV into NTSC (page 38)
by Mike Overton, Tektronix
HDTV will arrive gradually at the local level, first from network feeds. Down-conversion and up-conversion will offer advantages and extend the time before major investments to the new technology will be required. A large degree of signal instability exists with HDTV, compared to NTSC.

Converting PC video to NTSC (page 46)
by Paul McGoldrick, Magni Systems
A PC video source requires correct timing of the signal from the computer environment to that of RS-170A, CCIR 601, RP-125 or other standards.

Digital audio workstations diversify (page 56)
by Skip Pizzi, technical editor
The digital audio workstation (DAW) marketplace has grown into a diverging array of equipment. The most common trait is the hard disk random access technology with software, allowing non-destructive editing.

Applied Technology (page 68)
- D-3: The ½-inch digital format, 8-14 code modulation and track layouts are described.

September

Theme: Audio-Video Control Systems

Editorial (page 6)
- Never mind that the sky is falling

(Problems, ignored or unrealized, do not solve themselves. Inexperienced and part-time technicians cannot give the level of maintenance of a full-time technical staff.)

FCC Update (page 8)
- Signal leakage on aeronautics band forces Kansas cable system shutdown; operation resumed after repairs comply with FCC standards.
- FCC studies efficacy of TV rules, pending changes in technology, competition in the video marketplace, direct revenue support for some providers and increasing availability of national programming sources.
- Digital voice encryption permitted in RPU service using F1E FM and G1E PM ITU emission types; nominal occupied bandwidth to be 20kHz.
- Main studio, time-brokerage abuses gets fine for West Virginia FM station; meaningful management, staff presence requirement and other violations noted.

Strictly TV (page 10)
- Using D-2's enhanced functions

(Preread editing, compositing and graphics features on D-2 VTRs reduce time required for some productions.)

re: Radio (page 12)
- Detuned at last

(A saga of tower tuning (March and April) ended with a detuning skirt and detuning box. When practical parameters were found for tower currents and phases, a partial proof on the antenna pattern permitted a return to direct measurement of power.)

SBE Update (page 14)
- Election time with position statements given for eight director candidates; Terrance Baun, Michael A. Fast, Paul Montoya, Troy Pennington, Robert Reymnot, Ed Roos, Frederick Baumgartner, Keith Kinter.

Circuits (page 16)
- An in-depth look at analog ATR circuits (Part 1)

(Recording bias current circuit.)

Troubleshooting (page 18)
- Optimizing 2-track analog ATRs (Part 1)

(Correctly operating bias circuits are critical to recording performance.)

Management for Engineers (page 20)
- Time management (Part 5)

(Procrastination and avoidance are habits that must be overcome to effectively manage your time.)

Advantages of 3-stage switcher design (page 26)
by Marc S. Walker, BTS
As crosspoints in a routing switcher increase, so does complexity and cost. A multistage concept in larger arrays can reduce cost significantly, by nearly 50%. The discussion examines the theory and practice of the multistage design.

Implementing multiformat routing switchers (page 46)
by Dan Mazur, Di-Tech
With digital and analog component and composite video and multilevel digital and analog audio, signal distribution routing becomes complex. A virtual matrix maps relationships between required levels of switching and may avoid major rewiring of the existing distribution system.

Fiber-optic routing switchers (page 50)
by Jack Guedj, TriQuint Semiconductor and Bob Grant, Integrated Switching Systems
Fiber-optic routing includes greater bandwidth, lack of EMI problems and ground loops, greater signal coverage without reamplification and less need for signal reclocking.

Integrating multiple control systems (page 66)
by Roald Steen, instructor
For economic reasons, many facilities have centralized control capabilities. Automation technology, appropriate signal and control interfacing and PCs offer new methods to achieve full facility control from a single or limited multiple control points. (*Related material*: audio console automation, operational requirements on mixing system with dynamic and snapshot modes.)

The on-line/off-line interface (page 78)
by Bill Ferster, Editing Machines Corporation
Off-line editing permits material to be reviewed and an initial edit decision list to be made before booking time in the post production room.

Archiving for productivity (page 86)
by Rick Lehtinen, technical editor
A well organized system to maintain information and video footage is essential for the news department.

SBE show preview (page 92)
• SBE convenes in Houston
(Overview of '91 SBE National Convention, *Broadcast Engineering* Conference.)

SMPTE show preview (page 94)
• SMPTE celebrates 75th anniversary in LA
(An overview of activities planned for 133rd SMPTE Technical Conference and Equipment Exhibition.)

Applied technology (page 96)
• Affordable digital audio processing
(The methods, requirements of equipment in digital signal processing for audio.)

October

Theme: Profitable Technical Management

Editorial (page 6)
• You could be next . . .
(Will FCC regulation enforcement catch you off guard?)

FCC Update (page 8)
• FCC fine schedule computes relative gravity of offense as percentage of maximum forfeiture amount ($25,000); additional criteria for upward, downward adjustments account for other circumstances.

Strictly TV (page 10)
• PCs for TV (Part 1)
(Personal computers are effective for some TV production and operations.)

re: Radio (page 12)
• Antenna systems, Part 1
(Historical information traces horizontal, vertical and directional radiators, grounding and tuning stubs.)

SBE Update (page 14)
• Bylaw revisions focus on management, membership, directorship terms, membership dues payments and administrative details.

Circuits (page 16)
• An in-depth look at analog ATR circuits (Part 2)

(EQ compensates head effects of varying frequencies with linear tape motion.)

Troubleshooting (page 18)
- Optimizing 2-track analog ATRs (Part 2)

(Degraded playback audio caused by faulty or misadjusted EQ.)

Management for Engineers (page 20)
- Working smarter (Part 6)

(Working intelligently calls for improved management of meetings and sometimes a proper attitude.)

The 1991 salary survey: the complete picture (page 26)
by Brad Dick, editor
Radio salaries show small increases for management, operations is viewed overall; Top 50 engineers found an increase, while Top 100 and beyond saw decreases. TV management saw no increase, but engineering rose slightly and operations dropped.

Engineering can be a profit center (page 52)
by Marvin Born, WBNS stations, Columbus, OH
Portions of the engineering sector can bring in revenue – equipment and tower space rental, diplexed signals to multichannel antennas or real estate sales and leasing are suggested areas. Consider fees charged for services rendered and cost controls; examine new vs. used equipment purchases.

Competing for your job (page 64)
by Richard Farquhar, Television Systems
If you were required to interview for your position, would you qualify? Reappraisal of personal and technical qualifications, and keeping abreast of the industry and technology need serious consideration.

Engineering software for PCs (page 70)
by Joseph D. Mahedy, Computer Assisted Technologies
Software specifically for the technical side of engineering proves helpful in system planning and design; other programs aid in engineering management, budgeting, cost analysis and general operations.

Software management (page 78)
by Steve A. Rowell, WOFL-TV
An inventory of microprocessor-based equipment and the current software version permits a quick assessment of equipment capabilities. Ideally, in the area of operations, the facility should develop a "format" with everyone using the same database, word processor, spreadsheet and so forth.

Testing coaxial lines, Part 1 (page 82)
by Don Kolbert, KLSE-FM/KZSE-FM
An oscilloscope and a pulse generator can check coaxial cable in search of impedance mismatches, faulty connectors, opens or shorts and the location of the fault. The article discusses alternatives to expensive test equipment for coaxial maintenance.

Station-to-station (page 88)
- LMS modification enables second feed

(The primary requirements to convert an automated playback system serving both coasts into a 2-feed system with separate signals for each coast required some changes to equipment as well as enhanced software.)

Applied technology (page 92)
- Advanced sound localization processing

(Results of psychoacoustical research coupled with spatial enhancement devices provide control over reflection, diffraction and resonance to aid artificial sound localization.)

Field report (page 94)
- The Ampex ACR-225 auto cassette system is examined.

November

Theme: Annual Station Maintenance Report

Editorial (page 6)
- Gutsy move

(SBE and RTNDA plan to combine the exhibitions of their conventions in 1993.)

FCC Update (page 8)
- FCC Commissioner Sherrie Marshall, at the NAB's Radio 1991, offered positive forecasts "for surviving and perhaps even thriving" with DAB. Many questions await those wanting to implement DAB.
- Entrepreneur's preference urged in comparative hearings for a party who successfully pursues an FM allotment through the commission's rule making process. At least three rule making petitions advocate adoption of such a preference, and NAB has filed supporting comments.
- FCC chairman advocates "video dial tone" allowing local telephone companies to offer customers access to a multiplicity of video services, including 2-way interactive services.

Strictly TV (page 10)
- PCs for TV (Part 2)

(TV multimedia generally implies a computer controlling several pieces of audio and video equipment for display on monitors or conversion to computer data.)

re: Radio (page 12)
- Antenna systems (Part 2)

(Early AM antenna systems, isolation problems and vulnerability to lightning engendered by "above-ground" nature led to the development of the shunt-fed antennas and folded unipoles.)

SBE Update (page 14)
- Richard Farquhar assumes position of president; Jerry Whitaker becomes vice president.
- Accomplishments during Brad Dick's presidential tenure include director and officer accountability, hiring of an executive director, development of a strategic plan for SBE, increasing society membership.
- SBE and RTNDA to hold joint technology exhibition at 1993 convention in Miami.
- Korean Broadcast Engineers and Technicians Association (KBETA) sign affiliation agreement with SBE.
- Delegations from Mexico and the Philippines attended the SBE Convention and made contact with SBE leaders.
- The 1991 SBE Convention was a joint event with the Texas Association of Broadcasters (TAB) annual meeting. 109 SBE and 31 TAB exhibitors found a larger audience than had been predicted.
- The Committee for Digital Radio Broadcasting (CDRB) meeting and digital radio sessions included a report by the Canadian Broadcasting Corporation on field tests with Eureka 147 system.
- The society elected three directors in annual election. Michael Fast, Baltimore, Troy Pennington, Birmingham, AL, and Frederick Baumgartner of Indianapolis, were chosen by the membership. Returning directors are Terrence Baun, Milwaukee, Paul Montoya, Denver and Edward Roos, Palm Beach, FL.

Circuits (page 16)
- Taking Analog ATR EQ one step further (Part 3)

(Active EQ improves recording and gives the benefit of lowering the apparent signal-to-noise ratio.)

Troubleshooting (page 18)
- Optimizing ATRs, tape path failures (Part 3)

(Tape-path failures appear as frequency response problems, S/N degradations or high-frequency instabilities. The physical balance of a tape path is delicate.)

Management for Engineers (page 20)
- Meetings of value, how to organize a meeting (Part 7)

(To make meetings as painless as possible, they should have a purpose. If you ask your staff to take an hour from their work, organize the meeting for a purpose and set goals to be accomplished.)

Analog troubleshooting basics (page 26)
by Roald Steen, instructor
In analog troubleshooting, proceed from the simplest to more complicated causes. Make sure all parts are plugged in, turned on and connected; that switches are in the right positions and making proper contact. Check faulty equipment whenever possible by substitution. Parts dealing with high current levels often are sources of failure.

Monitoring the serial digital signal (page 32)
by Ken Ainsworth, Tektronix
Serial digital video equipment can use existing coax wiring for installations. High bandwidth requirements, noise and distortion affect digital transmission systems differently than analog systems. These differences can surprise the video engineer who ventures into serial.

Caring for high-power tubes (page 48)
by Brad Dick, editor
A few simple steps increase the life of transmitter tubes and save money. Guidelines for tube care include background material on tube components, proper operating techniques and safety considerations. Numerous pointers will help to lengthen the operating life of your tubes for normal operating conditions.

Rebuilding TV transmitters (page 60)
by Don Newman, GE Support Services
The task: to inspect, clean and rebuild aging and deteriorating transmitter cavities. The station saved the expense of replacing transmitters.

Testing coaxial lines, Part 2 (page 68)
by Don Kolbert, KLSE-FM/KZSE-AM, Rochester, MN
A time domain reflectometer measures impedances and identifies faulty cable fittings and connectors by sensing impedance mismatches. The most important parameters include surge impedance, dielectric constants and the velocity of propagation.

Building fiber-optic transmission systems, Part 1 (page 78)
by Brad Dick, editor
Fiber-optic cable provides cost-effective solutions to problems in audio and video applications. These solutions improve quality in a low-cost form. This article describes the technical requirements for a fiber-optic system with background on fiber materials. *Related material*, "The case for fiber," "Fiber-optic STL systems."

Field Report (page 98)
- Continental XL-301 AM transmitter

Special Supplement - Power System Protection Alternatives (page 92)
By Jerry Whitaker, editorial consultant
Disturbances on the AC power line – outages, surges, sags, transients – combine to create an environment that can damage or destroy sensitive load equipment.

December

Theme: Views on State of the Industry

Editorial (page 6)
- More bang for the buck

(Couldn't one combined trade show do more for the industry with less cost in time and manpower?)

FCC Update (page 8)
- The FCC adopted revisions and adjustments to AM rules and policies aimed at improving health and ensuring survival of the AM service.
- The commission selectively opened 10 frequencies in the expanded band, 1,605-1,705MHz, to those AM stations that significantly contribute to congestion and interference in the existing band.
- Steps were taken to improve the quality of service in the existing AM band.
- To reduce interference, FCC encourages discontinuance of operation of marginal stations by issuing tax certificates to stations shutting down in exchange for payment by other licensees. The commission will relax multiple ownership rules for applicants proposing facility changes that would reduce interference to co-channel or adjacent channel stations.
- FCC to relax rules pertaining to Travelers Information Service to allow for the authorization, on a secondary basis, of such stations on any AM frequency.
- The commission proposes reducing required minimum length of the Emergency Broadcast System (EBS) 2-tone attention signal to eight seconds.
- In a program to streamline the regulation of wireless cable, the FCC changed the rules it adopted for the service in 1990.

Strictly TV (page 10)
- TV stereo intermodulation

(The stereo light on viewers' MTS TV sets is triggered by intermodulation in common amplifier transmitters.)

re: Radio (page 12)
- In the digital radio spectrum hunt, L-band gets a look, then the hook

(The spectrum for new digital radio broadcast services has yet to be decided. Original thoughts about L-band have changed.)

Technology News (page 14)
- Storage for high-resolution digital video

(The need to provide the amount of data storage necessary for high definition video has resulted in new concepts for magnetic and optical media, including combinations of the two technologies.

Circuits (page 16)
- An in-depth look at analog ATR circuits Tape path motor control (Part 4)

(Most analog ATRs use supply reel, take-up reel and capstan drive motors governed by microprocessor-based servo controls.)

Troubleshooting (page 18)
- Optimizing 2-track analog ATRs (Part 4)

(Wow and flutter are audible signs of disturbances in tape motion.)

Management for Engineers (page 20)
- Working smarter – Conducting meetings of value (Part 8)

(Most business meetings either represent management at its best or management at its worst. Successful meeting management combines understanding and practice.)

State-of-the-industry forecast (page 26)
by Brad Dick, editor
Manufacturers say they are selling hardware, and many expect a turnaround is imminent. Based on this survey, the industry checkbooks remain closed with stations seemingly afraid to invest in their future.

View from the top (page 32)
by Jerry Whitaker, editorial consultant
Is new technology moving too fast for the standardization process? The increasing pace of development represents a significant challenge to standardizing organizations around the world, such as SMPTE. Engineering vice president Stanley Baron comments on the problem.

Profiting from technology (page 42)
by Skip Pizzi, technical editor
New technology means business, if its applications are understood. Expenses can be reduced with new telco offerings, automation, PC software and on-line services, inclined-orbit satellite transmission and less power-hungry hardware. Revenue-producing services include rental of tower and RF assets, rental of satellite, studio and remote facilities, new telemarketing options and upcoming wireless interactivity.

Inner conductor replacement for rigid transmission lines (page 58)
by Kerry W. Cozad, Andrew
Normal wear of rigid coax affects the inner conductors and connectors (bullets). Heat generated by RF energy occurs on the inner conductor, resulting in accelerated oxida-

tion of the copper, and abrasion of contact surfaces at the bullet connections.

FM intermodulation effects: A case study (page 58)
by Robert D. Greenberg, FCC
An interference called RITOIE results from complicated interaction of stations' signals inside listeners' radios. Although an engineering matter, it may escalate into legal battles and cause listeners to tune away.

Building fiber-optic transmission systems Part 2 (Page 64)
by Brad Dick, editor
Specifying a fiber-optic cable requires 38 specifications to be defined under two main groups — cable specifications and fiber or optical specifications. Installation and environmental concerns are noted under cable specifications.

Applied Technology (page 70)
- A logical approach to transmitter design (Power efficiency in UHF TV transmitter design brought klystron pulsing, the Klystrode, MSDC klystrons, the IOT tube and renewed efforts with tetrodes. Digital transmission offers a new approach for high power, simplicity and higher efficiency.)

SBE Update (page 74)
- The society's sixth national convention, deemed a success for exhibitors and attendees. Total attendance – 3,367, with 151 exhibitors.
- SBE awards – The 1991 Chapter Awards named Bryan, TX, Best Attendance Ratio, Most SBE-certified members; Huntsville, AL, Largest Growth in 1991; Indianapolis, Best Chapter Newsletter; Manchester, NH, Best Newsletter Editor award; Madison, WI, Best Technical Paper by a Local Chapter and Best Local Frequency Coordination effort.
- Martin (Sandy) Sandberg, Dallas, honored for his years of service to SBE certification in his own chapter.
- SBE president Richard Farquhar and RTNDA president David Bartlett announced a collaborative effort in the 1991 SBE and RTNDA conventions. 1993 convention (Miami) will combine exhibitions.
- An engineer occupying a mandated seat on the Federal Communications Commission (FCC) came closer to reality, with creation of H.R. 3501 by Don Ritter, R-PA.
- National Public Radio (NPR) announced use of its satellite network to provide training opportunities to current and potential broadcast engineers everywhere NPR's satellite signal can be heard.
- Recent bylaws revisions approved by a margin of 7:1 by the voting members.

For Your Information

The Manufacturer Name/Address and Product Category sections of the *Broadcast Engineering Equipment Reference Manual* can be provided on 3½- or 5¼-inch floppy disk. The Name/Address portion is in a DOS ASCII comma-delimited format, making it importable into your database manager. The Category section is provided in an ASCII text format, allowing it to be loaded into any word processing program for searching.

This On-Disk directory can be purchased for a non-refundable cost of $100. Residents of California, Colorado, Kansas, Illinois, Michigan, Minnesota, New Jersey, New York, Ohio and Pennsylvania must include appropriate sales tax. Checks payable to **Broadcast Engineering** must be included with your request before it can be processed. Mention your preferred disk size. Your order should include your street address, not just a PO Box.

Address requests for this information to:
BROADCAST ENGINEERING
Carl Bentz, Special Projects
PO Box 12901
Overland Park, KS 66282-2901

or send your order by Fax to:
Carl Bentz, Special Projects
913-541-6697

Allow two weeks for delivery in the continental United States.

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ERM Update

Information appearing in the *1992 Broadcast Engineering ERM* was based on material returned from manufacturers responding to questionnaires sent in June 1991. We do not automatically repeat information in *ERM* from previous years, if responses are not returned. Note that not every manufacturer of a product category is shown in the Specs tables. The following additions or discrepancies apply to the recently published *Equipment Reference Manual*. Contact the manufacturers directly or use the Reader Service Nos. for more information about their products.

Audio Limited **528**
21-36 33rd Road
Long Island City, NY 11106
718-728-2654
• Wireless microphones

Auditronics **529**
3750 Old Getwell Road
Memphis, TN 38118
901-362-1350; Fax: 901-365-8629
• On-air, production audio mixers

BURLE INDUSTRIES, INC. **530**
Tube Products Div.
1000 New Holland Ave.
Lancaster, PA 17601-5688
717-295-6096
• Transmitting tubes

BURLE INDUSTRIES, INC. **531**
Security Products Div.
1000 New Holland Ave.
Lancaster, PA 17601-5688
717-295-6123
• Security system equipment

Chyron **532**
265 Spagnoli Road
Melville, NY 11747
516-845-2046; Fax: 516-845-3895
• Titlers, Graphics Systems

Consultronics **533**
269 Portage Road
Lewiston, NY 14092
716-754-8250; 800-267-7235
(Canadian office call: 416-738-3741
or Fax: 416-738-3712)
• Audio Test System.

Continental Electronics **534**
PO Box 270879
Dallas, TX 75227
214-381-7161; Fax: 214-381-4949
• Please note: Model 316F-1 AM transmitter, 418D-2 AM transmitter and Model 817A FM transmitter were included in the Specifications section in error. Contact Continental for additional information.

Cooper Industries/Belden Div. . . . **535**
2200 US 27 S.
Richmond, IN 47374
317-983-5200; 800-BELDEN-1
Fax: 317-983-5294
• Please note: A typographical error appears (Benden) in Audio/Mic Cable, Camera Cable, Coaxial Cable, Connectors, Fiber-optic Equipment and Patch Panels, Accessories categories.

Matthews Studio Equipment Group **536**
2405 Empire Ave.
Burbank, CA 91504
818-843-6715, 213-849-6811
Fax: 213-849-1525
• Camera support, Grip, Lighting products

Nady Systems **537**
6701 Bay Street
Emeryville, CA 94608
415-652-2411; Fax: 415-652-5075
• Wireless Microphone Systems.

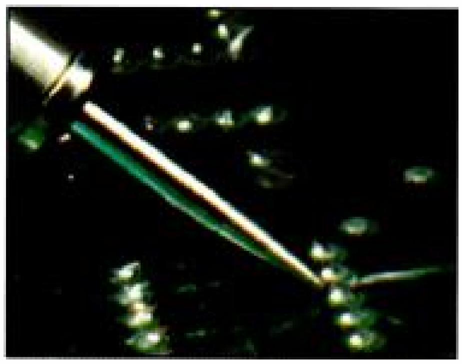
Netcom **538**
1465 Palisade Ave.
Teaneck, NJ 07666
201-837-8424
• Consulting, Facilities, System Design

Ramko **539**
3501-4 Sunrise Blvd.
Rancho Cordova, CA 95742
916-635-3600; 800-678-1357
Fax: 916-635-0907
• On-air Audio Mixers

Telex Communications, Inc. **540**
9600 Aldrich Ave. S.
Minneapolis, MN 55420
612-884-4051; Fax: 612-884-0043
• Single, Multichannel Wireless Microphone Systems.

Companies wishing to be included on the mailing list for the next *Broadcast Engineering Equipment Reference Manual* should write to: **Directories Editor, Intertec Publishing, PO Box 12901,** Overland Park, KS 66282-2901

Station to Station



Interformat A/B switch uses all ICs

By Jack Kline

In today's competitive news arena, picture quality is more important than ever. At WHTM-TV, Harrisburg, PA, a commitment to quality led to the adoption of the Betacam format for ENG operations, an upgrade from 3/4-inch.

Whether a station converts from 3/4-inch to 1/2-inch all at once, or gradually adopts 1/2-inch equipment, the transition always presents the same problem: How can the news department continue to access 3/4-inch archive or file video while operating in a 1/2-inch world?

Kline was a maintenance engineer for WHTM-TV, Harrisburg, PA, when he completed this project. He is now a maintenance engineer at WGAL-TV, Lancaster, PA.

News editors can waste time and money by jockeying between various format editing booths and endlessly dubbing, or they can use an interformat editing system. This article details the construction of such a switch.

User's choice

Editors can combine present-day and archive video by using an interformat A/B switch. This switch relieves the frustration caused by multiple-format projects and saves time during edit "crunch" periods.

An edit bay configured for interformat work uses both a 3/4- and 1/2-inch machine on the playback side, and edits to 1/2-inch. The editor clicks a switch to select the desired playback format, then routes the desired machine's video and audio outputs, the 8-pin monitor output and the 9-pin remote-control data through an A/B switch and into the record deck. (See Figure 1.)

Theory of operation

Although A/B switching isn't new to broadcasters, it recently has become possible to build an all-IC switch. CMOS analog devices for switching data and audio have been available for several years. Video's bandwidth used to require either relays or diode gates. New video chips now are available from suppliers, such as MAXIM (Sunnyvale, CA) and GENNUM

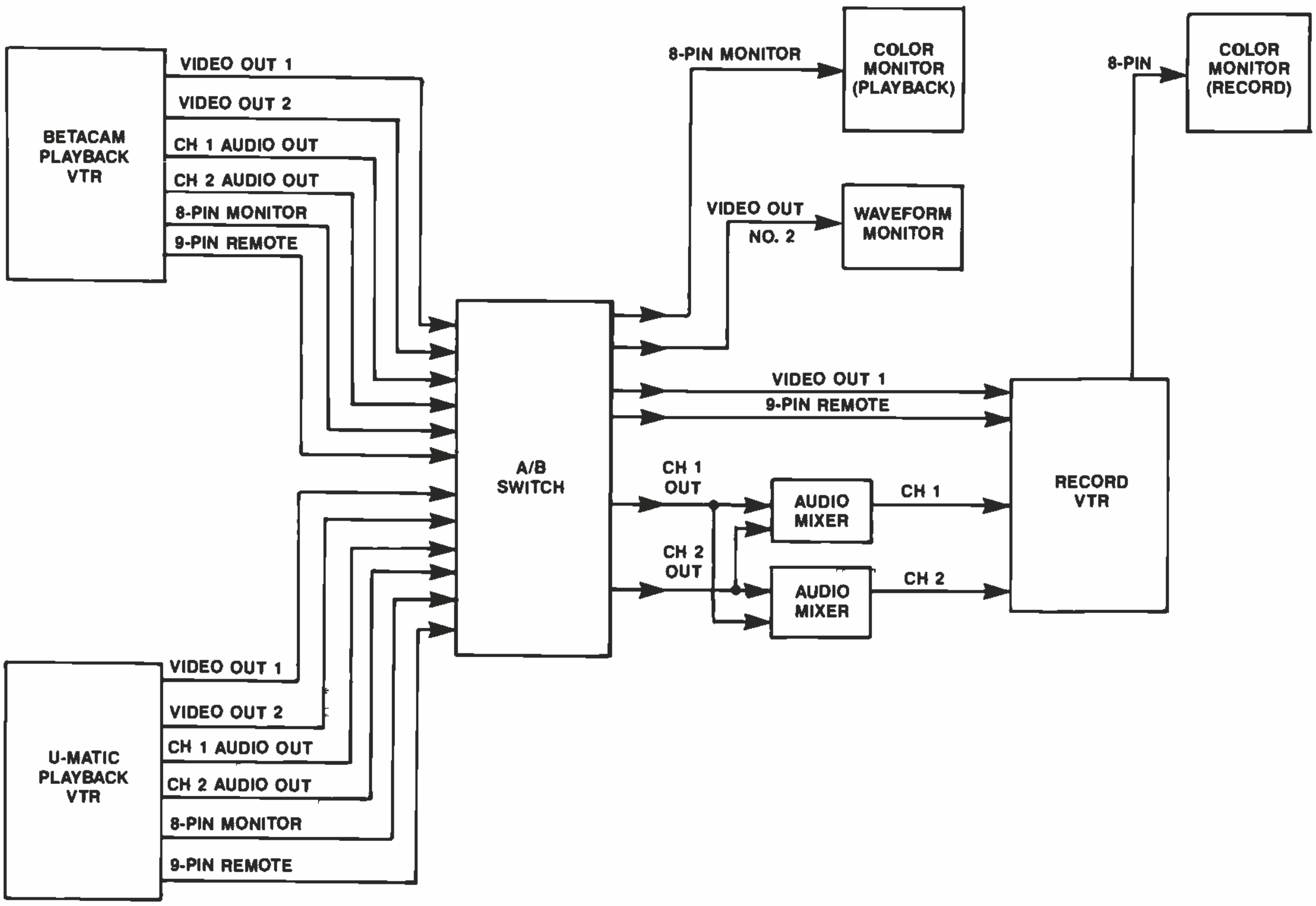


Figure 1. System block diagram of interformat A/B switch.

(Burlington, Ontario). These devices simplify video routing and will probably appear in commercial equipment soon.

In this project, MAX 453 ICs are used to switch video, MAX DG303 ICs are used to switch audio, and CD4053s are used to switch machine remote-control data. (See Figure 2.)

News editors can waste time and money by jockeying between various format editing booths and endlessly dubbing, or they can use an interformat editing system.

The 453 IC is a 2-channel video multiplexer. This project uses three of these chips to switch the VTR's video outputs 1 and 2, and the video portion of the 8-pin monitoring cable.

With the circuit values shown, the video amp has a gain of 2. This yields 2V out of the IC and 1V out of the series terminating resistor. This gain setting ensures transparency at video frequencies. According to specifications, with a gain of 2, the IC's output is flat to 25MHz. The 6.8pF capacitor in the feedback loop compensates for package capacitance.

The DG303 IC is a dual SPDT/TTL-compatible CMOS analog switch. Each IC is capable of switching one balanced audio channel. Three of these ICs are used to switch channel 1 output, channel 2 output and the audio portion of the 8-pin monitoring cable. However, because this is an unbalanced signal, only half of the IC is used. The diodes in series with the power supply protect the device against a possible latchup caused by uneven rise times between the $\pm 12V$ rails.

Two CD4053 analog switch ICs change the signals on the 9-pin remote cable. One IC switches the XMIT+ and XMIT− signals, and one switches the RCV+ and RCV− signals.

Control and power

The control of the system is simple. When wired as shown, all the ICs will be in the "B" position when the control switch is open. Closing the switch applies +5V to the control pins, placing the switches in the "A" position.

Although the simple toggle switch shown in Figure 2 works fine, a later version of this project used a push button to control a TTL latch that controlled the ICs. An LED shows which format is selected.

The video ICs take $\pm 5V$, audio ICs take $\pm 12V$, and the remote IC takes +5V. Power supplies that provide these voltages are available in most mail-order electronics catalogs for less than $40.

An 8″ × 12″ chassis will hold the power supply and electronics board. The box should be fairly large because of all the connectors. Place the remote A/B selector switch in a position convenient for the operator.

The interformat A/B switch...relieves the frustration caused by multiple-format projects and saves time during edit "crunch" periods.

Construction and performance

After breadboarding to prove the design, the project was built onto a small PC board.

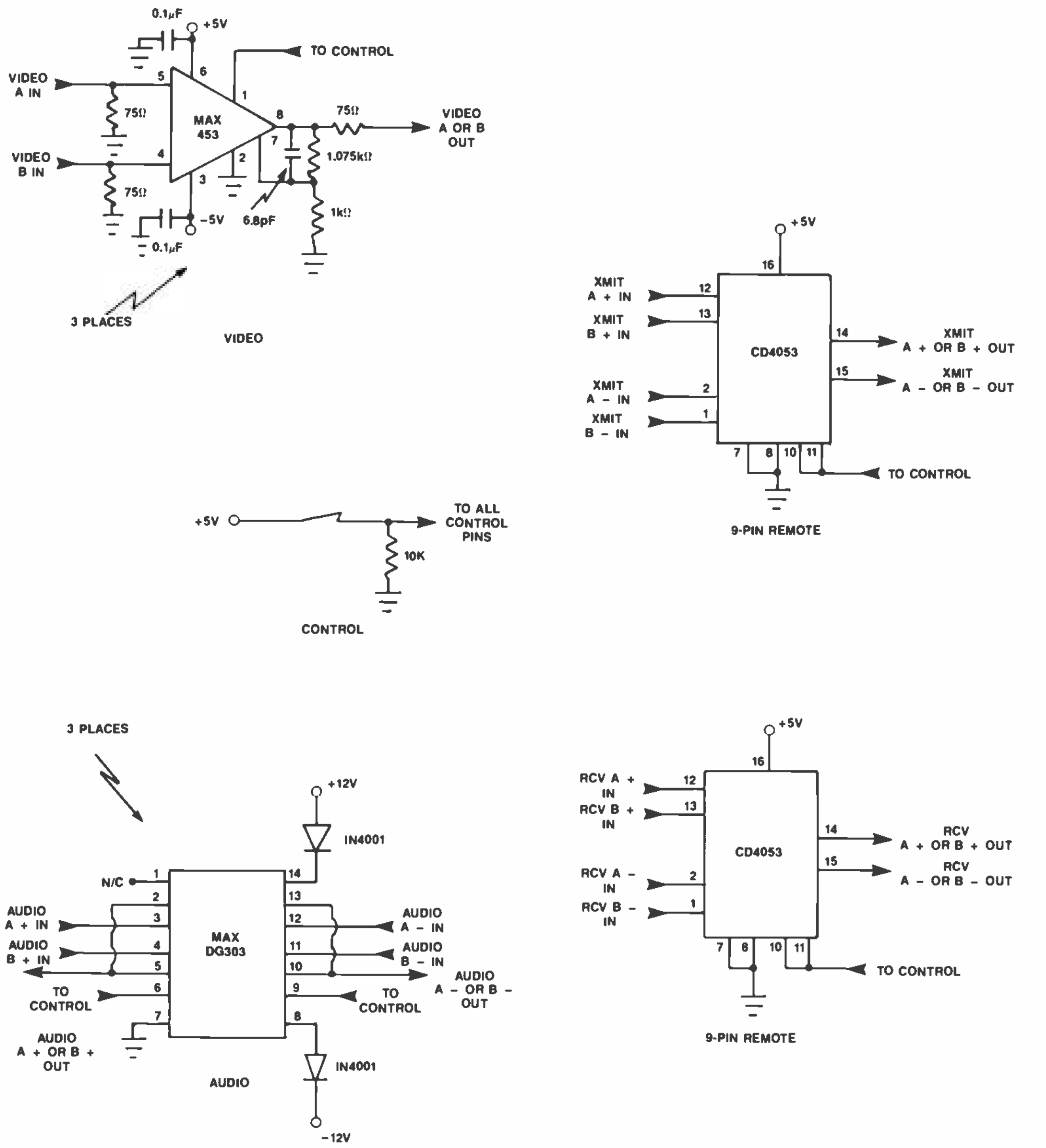


Figure 2. *Detailed drawing of circuit connections shows simple control circuit.*

The potential exists for crosstalk between the various signals. To avoid this, keep all PC foil traces as short as possible. Video leads into and out of the circuit board should be made using miniature coax, with lead lengths kept as short as possible. Audio interconnections should use shielded, twisted pairs. Use plain hookup wire between the board and the DIN connectors for the control lines.

Two of these systems are in service. One has been in service for two months, and the other for nine months. Both seem to be performing well. Note that A/B switching of playback decks is not the only application for this project. With a few changes, for example, the circuit could switch two VCRs into one TBC. Used creatively, this circuit could be the basis for a number of other station applications.

■

Industry Briefs

BUSINESS SCENE

Microwave Networks Incorporated (MNI), Houston, has been selected to provide a microwave transmission system for a cellular communications network that will cover metropolitan Lima, Peru.

Acrodyne, Blue Bell, PA, has sold two 30kW UHF transmitters to NC Television, Channel 36, Maracaibo, Venezuela.

Sony, Montvale, NJ, has sold a Sony APR 24, 24-track recorder to D&D Recording, New York.

Magni Systems, Beaverton, OR, has been awarded a contract for multistandard test and measurement equipment by STAR TV, Hong Kong.

Lyrec's (Skovlunde, Denmark) duplication line, which includes a Master P-4400, four slave units and mastering and quality-control equipment, has been chosen by Galvomat, Herk-de-Stad, Belgium.

Canon, Englewood Cliffs, NJ, has sold Latin America's first Canon J33aX11b IAS to Radio Cadena Nacional, Bogata, Columbia. An ENG lens, the J14aX8.5B IRS, was also purchased.

A.F. Associates, Northvale, NJ, has designed and installed a second customized Radamec-EPO robotic camera system for QVC Network, West Chester, PA.

Vistek, Bucks, England, has sold the largest digital routing system in the United States to Modern Videofilm, Burbank, CA.

Pinnacle Systems, Santa Clara, CA, has sold its 2100 series production video workstation to the NBC news channel in Winston-Salem, NC, and to WYSM-TV, an independent station in Lansing, MI.

Pinnacle has also sold six Prizm video workstations to six facilities in the United States: Centurion Video Productions, Metuchen, NJ; DCP Communications Group, Princeton, NJ; National Video Post, Anaheim, CA; L&L Productions, Alberta, Canada; and P&P Studios, Stamford, CT.

Three additional Prizm video workstations were sold to KCRA-TV, Channel 62, an independent broadcaster in Burbank, CA.

The BBC has also purchased a Prizm video workstation for its facility in Bristol, England.

Dynatech Colorgraphics, Los Angeles, has sold a DP4:2:2 video workstation to Crawford Design/Effects, Atlanta.

Ampex, Redwood City, CA, has sold 27 ADO 100 3-D digital effects systems to Italian broadcaster RAI-TV, Rome.

Aurora Systems, Santa Clara, CA, has sold its first AU/280 Commander to Video Arts. Aurora Systems also sold its 100th AU/280 system to KNXV-TV, Channel 15, Phoenix.

Canon U.S.A., Englewood Cliffs, NJ, has sold one J20X super lens to KBHK-TV 44, San Francisco, three J20X super lenses to Canada's TV Ontario, and one J20X super lens to QVC Network, West Chester, PA.

Canon has also sold six studio/field lenses to Canadian-based CanWest Broadcasting.

Dynatech NewStar, Madison, WI, has sold a NewStar II computer system to the

Canadian Broadcasting Corporation, Montreal.

CMX, Santa Clara, CA, has sold more than 110 of its OMNI 1000 video editing systems, with worldwide deliveries exceeding 45 systems.

Vistek, Bucks, England, has sold a VMC standards converter to Worldwide Television News (WTN).

Acrodyne Industries, Blue Bell, PA, has delivered a Channel 2, 10kW transmitter (TRL/10KA) to Korea for the Armed Forces of Korea National Network (AFKN). The transmitter will be used as a standby.

Harrison Systems, Beltsville, MD, has completed the final phase in the high-efficiency upgrading of the 220kW Harris transmitter system in operation at the Maryland Public Television's Annapolis facility. The completion ends a continuing 3-year project to reduce transmitter operating cost, improve reliability, improve signal performance and extend capitol facilities life.

Tannoy, Ontario, Canada, will install 14 System 15 DMT reference monitors inside broadcast control rooms being built for the 1992 Summer Olympics in Barcelona, Spain.

Sony, Park Ridge, NJ, has sold three DVR-2000 D-1 recorders, a DVS-8000C switcher and a DME-5000 digital effects generator to Atanor, a post-production house based in Madrid, Spain.

AMS Industries, Lancs, England, has sold an AMS Logic 1 console and AudioFile Plus to Thames TV.

AMS has also sold an AMS VCS to BBC Radio for the Maida Vale studios in London.

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

Panasonic, Secaucus, NJ, has sold 31 AJ-D350 VTRs to Group W (Westinghouse Broadcasting Company) for use in two of its TV stations — KYW-TV, Philadelphia, and KPIX-TV, San Francisco.

In addition, Panasonic's MII format has been selected by Spartan Radiocasting Company's WBTW-TV, Florence, SC, for expansion of its creative services division's post-production facilities.

C-Cor/Comlux, Mountain View, CA, has sold a fiber-optic system to NBC, New York.

Audiotechniques, New York, has delivered a sizable order for professional audio equipment to SAV Entertainment, Moscow.

Comark, Colmar, PA, has sold a CTT-U-70SICR transmitter to WQLN-TV 54, Erie, PA. This is the world's third IOT-equipped transmitting system.

Ampex, Redwood City, CA, has announced that it will introduce and deliver a total digital component technology system in 1992. It will be called DCT, and at the heart of this CCIR-601 system will be a new format digital component tape drive, companion tape cartridge and video production switcher.

The M.S. Russin Group Ltd., a consulting firm, has been formed by Mort Russin. The company specializes in the area of remote positioning devices, which includes robotics, optical interface and equipment for video conferencing. The address is 7648 Lexington Club Blvd., Suite A, Delray Beach, FL 33446-3427; phone 407-496-0993.

Cycle Sat, Forest City, IA, and **Telesat Canada** have formed a technology transfer agreement for Cycle Sat's automated satellite delivery system for TV commercials. Under the agreement, Telesat has the exclusive right to use the Cycle Sat hardware and software system in Canada.

Gentner Electronics, Salt Lake City, has changed its name to Gentner Communications Corporation to reflect the company's goal to help people "improve communication through innovation."

Accom, Menlo Park, CO, has acquired Axial Corporation. The operations of the companies will be merged under the Accom name, creating a single entity. Axial will continue to exist as the name for the editor product line.

Harris, Melbourne, FL, has acquired Midwest Communications' Systems and Radio Frequency divisions. The businesses will become part of Harris' communications sector.

SpaceCom Systems, Tulsa, OK, has finalized an agreement for a second transponder on the Hughes Communications satellite SBS-6. SpaceCom will use the transponder to serve its FM Squared transmission customers beginning this month.

Paltex International, Tustin, CA, and **BTS**, Salt Lake City, have signed an agreement that names BTS as the exclusive U.S. and international distributor for the Paltex Dyad^2 composite digital mixer/keyer system.

Sola, Elk Grove Village, IL, has expanded its manufacturing facility in Fort Payne, AL, by 40,000 square feet.

Eastern Microwave Inc. (EMI) has relocated its office. The address is 5015 Campuswood Drive, East Syracuse, NY 13057; phone 315-433-0022.

Sony High-Definition Facilities (SHDF), Culver City, CA, has opened its doors to the Hollywood production community, making high-definition technology readily available to West Coast program producers. SHDF is located on the Sony Pictures Studios lot. It is an independent operating entity, and its services are open to all Hollywood studios and program producers.

Netcom has relocated to an expanded facility with more than 3,000 square feet of available assembly floor space. The address is 1465 Palisade Ave., Teaneck, NJ 07666; phone 201-837-8424.

CMX, Santa Clara, CA, has offered an open invitation to call the CMX Computer Bulletin Board at 408-988-4398. The bulletin board is a public service of CMX, dedicated to the post-production industry. Use of the board is free, and everyone in the industry is welcome to use it.

Lexicon, Waltham, MA, has announced that a broad array of enhancements to the Opus digital audio production system are now shipping, and are in use by customers in the United States, Europe and Japan. The enhancements are contained in Opus Version 3.0.

Pinnacle, Santa Clara, CA, has named the following companies as marketing representatives for its 2100 series video workstation: Progressive Marketing, Anaheim, CA; Jerry Garber & Associates, Wheeling, IL; The Karden Group, Apollo Beach, FL; and Bay Roads Marketing Group, Sharon, MA.

Lightning Master Corporation, Clearwater, FL, has appointed Lawrence Behr Associates (LBA Group), Greenville, NC, as its distributor for South America, Central America and Mexico.

Audi-Cord Corporation, Normal, IL, has been purchased by Andrew M. Rector from Carl L. Martin. Martin will continue with the company to ensure a smooth transition.

Alcatel Telspace has relocated its headquarters. The address is 5 rue Noël-Pons, Nanterre Cedex 92734; fax 33-1-46.52.32.34.

Yamaha, Buena Park, CA, has opened a West Coast professional digital products demonstration facility at the Ocean Way studios complex.

Optical Disc Corporation, Santa Fe Springs, CA, has named Keesler Air Force Base, located in Mississippi, as certified recording center for the production of recordable laser videodiscs (RLVs).

Whitenton Industries, Houston, has announced the expansion of Midwest Audio Marketing, its North Central U.S. representative, and Marketing Concepts, its Central U.S. representative. Midwest Audio Marketing has expanded to include Minnesota, Wisconsin, Illinois, Indiana, Michigan and Kentucky. Marketing Concepts has expanded to include territories in Texas, Louisiana, Oklahoma, Arkansas, Kansas, Missouri and Nebraska.

B&K Precision Instruments, Chicago, has appointed Joseph Electronic, Niles, IL, as distributor for its "Pro-Line."

Perma Power Electronics, Chicago, has been awarded Patent No. 5,053,910 for its coaxial transmission line surge suppressor.

Broadcast Communications Systems has relocated its headquarters to New Glarus, WI.

Bexel, Burbank, CA, has entered into a friendly merger with British-based Vinten Group. Bexel's management will continue unchanged.

PEOPLE

Leo Zucker, a patent attorney in White Plains, NY, has received his second U.S. patent for a channel-compatible high-definition TV (HDTV) broadcasting system. His proposed system embodies the concept of frequency reuse now applied in satellite TV channel allocations, and solves the problem of confining an HDTV video signal within currently allocated 6MHz-wide TV channels.

Barry Cohen, Debra Buck Huttenberg and **Kinsley Jones** have been promoted to positions with Andrew Corporation, Orland Park, IL. Cohen is general manager, broadcast products. Huttenberg is customer relations manager, and Jones is distribution sales manager.

W. Kent McGuire has been appointed international and Western U.S. radio and TV sales representative for Circuit Research Labs, Tempe, AZ.

Daniel McGinley has been appointed engineering manager for Mitsubishi Professional Electronics Division, Somerset, NJ.

Rex A. Reed has been named president of Critical Communications, Salt Lake City.

Janice Haigney has been appointed Eastern regional manager for the Broadcast Division of Digital F/X, Mountain View, CA.

Emil Handke, Lee Pomerantz and **Roberta McKeehan** have been appointed to positions with Otari, Foster City, CA. Handke is national sales operations manager. Pomerantz is export sales manager, and McKeehan is industrial product sales coordinator.

Arthur Hill has been named vice president of executive accounts for Vyvx, Tulsa, OK. He also serves as general manager for First Video, a Vyvx NVN service.

Stanley M. Baron has received the Society of Motion Picture and Television Engineers' (SMPTE) 1991 David Sarnoff Gold Medal Award for his contributions to the advancement and standardization of digital TV imaging processing, graphics, and the automation of tape library record and playback systems.

Thomas Jenny and **Vencil Wells** have been appointed to positions with the Studer Division of Studer Revox America (SRA), Nashville, TN. Jenny is vice president and general manager. Wells is Western regional manager.

Peter Marshall has been named president of Keystone Communications, Salt Lake City.

Thomas Daly has been promoted to marketing manager, professional video products, for the Magnetic Products Division of Fuji Photo Film U.S.A., Elmsford, NY.

Dr. Floyd Toole has been appointed vice president of acoustical research for Harman International, the parent company for the JBL, Infinity, Pyle, Audax, EPI and automotive OEM lines of loudspeakers.

William Marriage has been named sales engineer for Vistek Electronics Limited, Buckinghamshire, England.

Jess C. Rodriguez has retired as president of Stainless Inc., North Wales, PA. He serves as a consultant to the company.

Jack Long and **Rich Fiore** have been appointed to positions with Emcee Broadcast Products, White Haven, PA. Long is director of sales, and Fiore is regional sales manager.

Fred Yando and **Derek Davis** have been appointed to positions with Nakamichi. Yando is vice president, sales and marketing. Davis is vice president, operations.

Bob Adams, senior design engineer of audio converter products for Analog Devices, Norwood, MA, has been awarded a Society Fellowship by the Audio Engineering Society (AES).

Dean C. Leeson has been appointed marketing/product sales support specialist for camera products for BTS, Los Angeles.

L.E. (Ed) Shivitz has been named project manager, 3M sound products project, 3M national advertising for 3M, St. Paul, MN.

Allan R. Lamberti has been named vice president of North American sales for Microwave Networks Incorporated (MNI), Houston.

Jeff Peters, Gary Bosiacki, Mike Rangitsch and **Frank Olson** have been appointed to positions with Telex, Minneapolis. Peters is national sales manager. Bosiacki is Western regional sales manager. Rangitsch is Eastern regional sales manager, and Olson is sales specialist.

Doug Davidson, John Duty and **Gene Sudduth** have been added to the sales staff of Dynair, San Diego. Davidson is Eastern regional sales manager. Duty is central regional sales manager. Sudduth is sales manager for the company's newly established Southern region.

Dave Collie has been named manager of Western operations for Solid State Logic, New York.

Joe Ryan has been promoted to national sales manager for BASF, Bedford, MA.

Steve Cheung has been appointed sales and marketing manager for Audio Processing Technology (APT), Belfast, Ireland.

SBE Update

Frequency coordinator list update

By Jerry Whitaker

The frequency coordination efforts of SBE are well known; they have drawn praise from many quarters in the broadcast industry. The foundation of the society's work in this area is the dedication of the local frequency coordinators.

These efforts are of special significance this year, with the national political conventions during the summer, and the elections in the fall. Managing the Part 74 airwaves is a major undertaking that requires advance planning and cooperation. Your first line of support is the local SBE frequency coordinator.

The SBE has just released a new, updated list of frequency coordinators. If you have any questions or need further information about the frequency coordination efforts of the society, please contact the SBE national office at 317-253-1640.

Whitaker is a technical writer based in Beaverton, OR, and is vice president of SBE.

FREQUENCY COORDINATOR LIST

Alabama	Birmingham	Frank Giardina	
Alaska	Fairbanks only	Eric Nichols	907-488-2216
	Radio-State	Derek Edmondson	907-563-3555
	TV-State	Frank Mengel	907-563-7070
Arizona	State	Karl Voss	602-965-3506
Arkansas	Little Rock	Richard Duncan	501-682-2386
	Ft. Smith	Don Patrick	501-646-6141
California	North	Mark Manuelian	415-398-5600
	San Jose (2GHz & up)/SF	Don Sharp	415-561-8996
	San Jose (2GHz & down)/SF	Chuck Waltman	415-291-0202
	Sacto. Valley (2GHz & up)	Fred Lindsay	916-441-2345
	Sacto. Valley (2GHz & down)	Kent Randles	916-925-3700
	Salinas/Monterey	Karl Kauffman	408-422-3500
	Redding/Chico	Terry Green	916-343-8461
	North Coast	Phil Moore	707-523-1369
	San Diego	Tom Wimberly	619-279-3939
	San Diego (450MHz only)	John Barcroft	619-279-1360
	Fresno	Randy Stover	209-226-0341
	San Joaquin	Les Lester	209-577-8701
	South	Howard Fine	213-962-7841
Colorado	Denver	Mark Smith	303-832-5665
		Bulletin Board	303-341-0129
	Grand Junction	Chuck Hendrickson	303-248-1315
Connecticut	State	Edward Nelson	203-243-4757
		Local B.B.S.	203-243-4950
Delaware	Northern	Larry Will	609-530-5069
D.C.	Washington (1GHz down)	John Banks	301-984-6000
	Washington (7GHz)	Glen Laham	301-267-9003
Florida	Central	Don Anglin	407-629-5105
	Miami	Fred Zimmerman	305-751-6692
		Bulletin Board	305-828-7907
	Northeast	Cary Martin	904-393-9863
	Palm Beach	Jim Johnson	409-842-1077
	W. Palm Beach	George Danner	407-844-1212
	Tampa Bay	Ralph Beaver	813-287-1047
	Tallahassee	Scott Clark	904-893-3127
Georgia	State	Ernie Watts	404-827-1987
Hawaii	State	Craig Miller	808-943-1715
Idaho	Northern Area	Greg Schwarz	509-328-9084
	Nampa	Andrew Suk	208-467-3301
Illinois	State	Ken Steininger	312-943-3321
	Quad Cities	Rick Serre	309-764-8888
	Rockford	Doug White	815-964-9336
	Springfield	Bruce Harrold	217-787-4756
Indiana	Lowre	Charles Sears	317-878-5311
	Motor Spdway (April & May)	Tom Allebrandi	317-241-2500
	S. Bend/SW MI	Mike Kaufman	219-233-3141
	B.B.S. (For info. call)	Charlie Sears	317-878-4069
Iowa	Ames	Ed Powers	515-294-5376
Kansas	All except Kansas City	Lloyd Mintzmyer	913-483-6990
Kentucky	Louisville	Eric Burgman	502-582-7840
	Louisville	Eric Burgman (Alt.)	502-582-7763
	Paducah	Jim Franklin	502-442-8214
Louisana	Baton Rouge	M. Patton & Assoc.	504-292-4189
	New Orleans R&TV	Fred Barrett	504-486-6161
	Monroe & NE	Mark Wilson	318-342-5556
	Shreveport	Rick Benson	318-425-8692
	Lafayette	Mac Dula	318-231-5668
Maine	State	Robert L. Stessel	207-732-4366
Maryland	Baltimore	J. Rowland Kraft	301-338-6647
Mass.	Boston-RI	Joe Sweeney	617-787-8640
Michigan	Central	Larry A. Estlack	517-887-8088
	Lower		
	Upper Peninsula	Larry A. Estlack	517-887-8088

	Grand Rapids	Dave Gale	616-451-2551
	Bulletin Board	State Wide	616-530-0821
	Southwest	Jim Lies	219-258-5483
	Detroit Area	Russ Harbaugh	313-642-6226
Minnesota	State	Mark Persons	218-829-1326
Mississippi	(None on record)		
Missouri	West half & Kansas City	Joe Snelson	913-677-5555
	St. Louis	Sam Caputa	314-727-2160
Montana	Great Falls	Gregory A. Fugat	406-761-8816
Nebraska	Mid-Nebraska	Jerry Fuehrer	308-743-2494
	Eastern Area	William Seier	402-474-8033
	Platte Valley	Larry Gunther	308-532-2222
Nevada	Radio/TV/MW	Jack Smith	702-435-5555
	Bulletin Board	Jack Smith	702-452-6095
		James King	702-831-6900
New Hampshire	State TV	Bill Bumpus	603-868-1100
New Jersey	Northern	(See New York Metro)	
	Southern	Larry Will	609-530-5069
New Mexico	State (1GHz & down)	Al Deme	505-243-2285
	State (1GHz & up)	Philip York	505-243-2285
New York	Central	George Braungard	315-425-5555
	Metro (1GHz & up)	Earl Arbuckle	212-210-2555
	Northwest	Paul Deeth	716-546-5670
	Northeast	(none on record)	
	Albany/ Schenectady	Fred Lass	518-346-6666
	Metro (1GHz & down)	Joe Fedele	212-975-2408
	Long Island	William Schleinitz	516-481-8000
	Binghamton/ S. Cent.	Gino Ricardelli	607-770-4040
	Buffalo	Hank Volpe	716-845-6100
N. Carolina	Greensboro/ Hi Point	Allen Boaz	919-759-2316
	Raleigh/Durharl	Jim Davis	919-684-6232
	State TV (1GHz & down)	Gary Liebisch	919-790-6315
	State TV (1GHz & up)	Harvey Arnold	919-549-7272
	Charlotte	Stu Albert	704-527-4152
	Fayetteville	Van Clough	919-486-4991
N. Dakota	State	Mark Persons	218-829-1326
Ohio	Central	Robert Dye	614-644-1714
	Eastern	Tom Hamilton	614-374-9647
	Northeast Co-op	Ed Miller	216-431-5555
	Northeast Co-op	Tom Miller	216-431-8888
	Southeast	Rick Ervin	614-593-1113
	Southwest	Rick Walsh	513-224-1501
	Northwest	Bill Rossini	419-244-8321
	Youngstown	David Davidson	800-950-9766
Oklahoma	Oklahoma City MW&TV	Ted Newcomb	405-478-3000

	Oklahoma City Radio	Dennis Orcutt	405-478-5104
	Tulsa	Richard Hardy	918-627-4607
Oregon	Western & Central	Bob Moore	503-231-4222
Pennsylvania	Central Radio & TV	Rick Markey	717-393-5851
	Northeast	Ron Schacht	717-779-3349
	Southeast	Larry Will	609-530-5069
	North Central	Skip Smith	717-323-5360
	Philadelphia	Larry Will	609-530-5069
	Pittsburgh area	Jack Linder	412-242-4300
Philippines	All areas	Martin Faustino	
Puerto Rico	All areas	E. Rodriguez-Velez	809-878-1275
Rhode Island	Providence	Robert Beatrice	401-955-9525
S. Carolina	Greenville	Jerry Massey	803-271-9200
	Columbia	Fayne Anderson	803-796-9060
South Dakota	State	Mark Persons	218-829-1326
Tennessee	Memphis TV	Pat Lane	901-458-2521
	Nashville Radio	Watt Hairston	615-256-0555
	Nashville TV	Randy Cain	615-871-6947
	Knoxville	Frank Folsom	615-573-6171
Texas	Austin TV	Reed Daughtry	512-451-1559
	Austin Radio	Jim Henkel	512-397-1410
	Corpus Christi	Steve West	512-883-6511
	Dallas	Gerry Dalton	214-920-1900
		Bulletin Board	214-647-0670
	East 30-40 miles	Butch Adair	214-597-5588
	El Paso (1GHz & up)	Pete Warren	915-533-2911
	El Paso (1GHz & down)	Algie Felder	915-851-3382
	Houston TV	D. Saenger/ R. Goldy	713-771-4631
	Houston Radio	Bill Cordell	713-438-3838
	Houston	Bulletin Board	713-284-1090
	San Antonio Radio	Paul Reynolds	512-615-1925
	San Antonio TV	Harold Friesenhahn	512-226-4251
Utah	Salt Lake City	John Dehnel	801-575-5555
Vermont	State	Brooks Brown	802-362-4800
Virginia	Norfolk Radio & TV	Sperry Davis	804-446-1000
	Richmond Radio & TV	Allen Kass	804-780-3400
	Roanoke TV	Ronald Smith	703-344-0991
	Chesapeake	Dave Deslar	804-547-7414
Washington	Eastern	Greg Schwarz	509-328-9084
	Seattle/W. Wash.	Jack Barnes	206-443-8322
	Southeast	Felipe Olvera	509-735-8369
W. Virginia	State	James Murphy	304-296-0029
Wisconsin	South/Central	Chris Cain	608-271-4321
	Milwaukee	David Janzer	414-476-4200
	Northeast	Jim Rammer	414-766-0616
	LaCrosse	John Wittenmeier	608-788-3050
Wyoming	State	Roger Hicks	307-856-6944

New Products

Cart system maintenance
By Ampex

• **Automatic scanner conservation:** software update for ACR-225; algorithm determines optimum scanner operation from play list; scanner is activated only when necessary; up to 800% increase in scanner life possible.

Circle (351) on Reply Card

Coax, waveguide reference
By Andrew

• **Illustrated guide:** discusses electrical, building and fire code requirements of coaxial cable and elliptical waveguide; summarizes cable categories defined by National Electrical Code and their applications.

Circle (352) on Reply Card

Video monitoring
By ASACA/Shibasoku

• **CM201N, CM141N:** auto setup video monitors; high-resolution shadow mask with in-line dot CRTs; auto setup option uses light probe to sense and store manual settings for five color temperature memories; standby feature disables HV circuit only.

• **TG71AX generator:** NTSC, PAL signal source with built-in functions and storage for custom patterns; composite, Y/C, Y/R–Y/B–Y and sync drive outputs.

Circle (353) on Reply Card

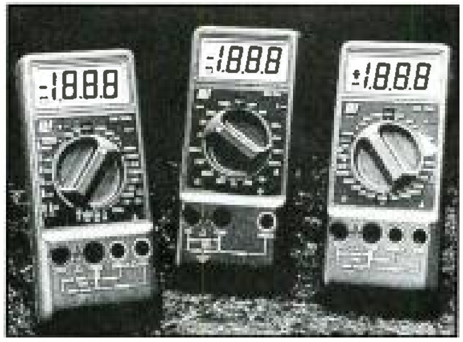
HDTV still-store
By ASACA/ShibaSoku

• **ADS-7800 MO system:** combines AMD-1340 high-speed magneto-optical disk drive with VM41A6 HDTV video processor; stores 200 HDTV stills on a disk with 0.7s random access; rewritable disk technology; 15Mbyte/s data transfer rate.

Circle (354) on Reply Card

Hand-held digital multimeters
By Beckman Industrial

• **DM15XL, DM10XL, DM5XL:** large LCD readout; 10A current fuse protection; input jack warning signal; safety tester feature; series covers signals to 20MHz; DC volts to 1kV, AC volts to 750V; resistance, diode test and continuity modes.



Circle (355) on Reply Card

Slow-motion system
By BTS

• **EVS LSM:** live slow motion by EVS Systems (Belgium); continues to record live images while being used to show slow motion and frozen frames; total storage of 100 images; line interpolator cancels interfield flicker; frame interpolator smooths slow motion; 4:2:2 recording with 525/60 or 625/50 output.

Circle (356) on Reply Card

High-speed signal conditioning
By Comlinear

• **Monolithic OP amps:** CLC411 device with 250MHz bandwidth, 2,300V/μs slew rate and ±0.1dB response to 30MHz for HDTV signals; CLC430 device with 55MHz bandwidth, 2,000V/μs slew rate for NTSC or PAL video applications; both are ±15VDC devices.

Circle (357) on Reply Card

Satellite downlink equipment
By ComStream

• **ABR200:** digital audio receiver; 20kHz stereo CD-quality audio uses MUSICAM compression algorithm; 128, 192, 256kb/s data rates with 35-65% reduction in satellite space segment costs; usable with Ku- or C-band operation.

Circle (358) on Reply Card

Test signal source
By Rohde & Schwarz

• **Model SMGL:** generator with broadband power amplifier produces –118dBm to +30dBm range from 9kHz through 1GHz; settling time less than 15ms; RF sweep mode; for crosstalk, crossmodulation, intermodulation measurements, determining antenna characteristics, amp linearity.

Circle (373) on Reply Card

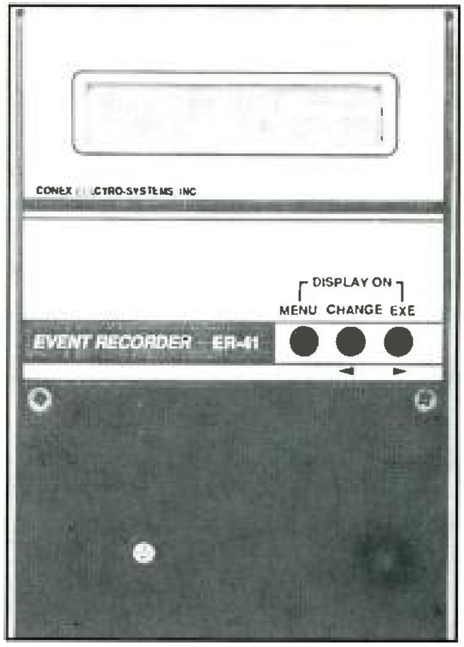
Video compression feature
By Digital F/X

• **Disk F/X:** video production system using Intel DVI compression technology implemented by New Video Corporation; expands disk capacity from minutes to hours in magnetic or optical disk media, and permits higher-resolution images to be stored.

Circle (361) on Reply Card

Security equipment
By Conex Electro Systems

• **ER-41 event recorder:** 4-channel unit detects time and date of events signals by a contact closure; each channel may retain information from 65,000 events; serial interface to interconnect PC.



Circle (359) on Reply Card

Equipment reference
By Contact East

• **Fall 1991 catalog:** illustrates a wide variety of tools and test equipment for electronic equipment; includes static protection products; communications test equipment.

Circle (360) on Reply Card

Digital audio editing
By Solid State Logic

• **ScreenSound enhancements:** EDL scan imports CMX edit decision lists and distributes source material on system; autoconform loads material based on timecode information; VariTime time compression and expansion with pitch compensation; IEdit for variable control of crossfade edits; magneto-optical drives; disk store expansion packs.

Circle (378) on Reply Card

Automation network

By Generation Technologies

• **Newstrak:** software for Sony Betacart LMS; permits decks to be shared between several users; maintains eight independent playlists running simultaneously; any event can be revised at any time; cooperative venture with Louth Systems.

Circle (362) on Reply Card

Data routing, distribution

By Jem-Fab

• **Model DSW-128:** machine control management routing switcher; for delegation and control of RS-422 and RS-232 data signals; time-sharing, large system management programmable from PC.

Circle (363) on Reply Card

Instrument reference

By John Fluke Manufacturing

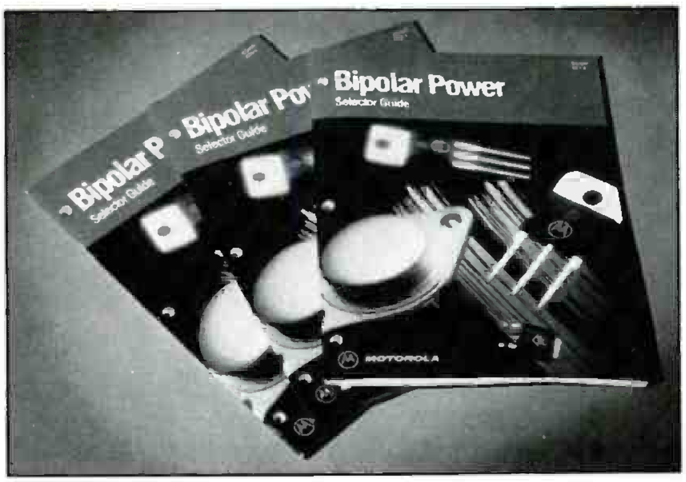
• **1991 catalog:** 15-page publication, "1991 Electrical/HVAC-R Service Equipment" describes multimeters, thermometers and accessories.

Circle (364) on Reply Card

Power device reference

By Motorola/Media Relations

• **Transistor selector guide:** data and cross-reference information for bipolar power transistors; 700 standard off-the-shelf items included, including audio and CRT deflection devices.



Circle (368) on Reply Card

Communications analyzer

By Telecommunications Techniques

• **T-BERD 209OSP:** combines bit error rate test set, VOM, TDR functions; T-carrier analyzer for T1 outside plant applications; measures voltage, simplex current, resistance for DC tests; assists in locating cable faults.

• **DS3 interface adapter:** expands capabilities of FIREBERD 4000, 6000 communications analyzers to handle DDS, T1, FT1, DS3, data interface and wide area protocol analysis.

Circle (381) on Reply Card

Machine control system

By TimeLine Vista

• **MicroLynx:** audio-video transport synchronizing system; for two transports; MIDI, SMPTE time-code generators; two wideband readers; MIDI-to-SMPTE synchronizer; compute control port with direct Macintosh interface; keyboard with LCD display.

Circle (382) on Reply Card

Product brochure
By MCL
• **30004 C-band TWT HPA:** booklet contains important information about 3kW satellite communications uplink HPA system.
Circle (365) on Reply Card

Video keyer
By MicroSearch
• **Chroma*Key*:** video peripheral device for use with Amiga PC and gen-lock equipment to super live video over computer graphics; no RAM or software required.
Circle (366) on Reply Card

Audio production mixer
By Solid State Logic
• **SL 8000 G:** audio console designed for use in television, music recording and motion picture formats; ready for 3-D music processing; Ultimation moving fader/VCA system; automated joystick pan with left, center, right and surround control for all channels.

Circle (379) on Reply Card

Audio control unit
By Neotek
• **Broadcast fader package:** group of optional functions to make the audio mixer more productive; focuses on gain, mute, fader switching, overpress cue function, fader logic, live mic sensing and in-place solo function.
Circle (369) on Reply Card

FO equipment information
By OFTI
• **500-4CLT-1000:** data sheet describes cleaving tool to scribe fibers prior to polishing during preparation of connector terminations; factory set for OFTI STC and XTC connectors.
Circle (370) on Reply Card

PAL signal decoder
By Microtime
• **Dyna-Comb decoder:** digitally designed unit separates PAL composite signals into components with maximum bandwidth and low cross-component contamination level; 10-bit sampling at 177.73MHz; 12-bit internal processing; 62dB S/N rating.
Circle (367) on Reply Card

Audio signal processor
By Valley International
• **Dynamite²:** combines compression and peak limiting with gate or expand functions; L.I.D. circuit emulates the human ear with complex and simple waveforms; anticipatory release computer reduces pumping and breathing effects.

Circle (383) on Reply Card

Power resistors
By OHMITE
• **Hi-Rel glass resistors:** inductive, non-inductive and super non-inductive series; glass-jacketed metal film for meter multiplier use; Meg-O-Max high-voltage, high-resistance devices; ferrule terminal power wire wound resistors; 15W-150W in 5% and 10% values.
Circle (371) on Reply Card

Videoconferencing equipment
By PictureTel
• **M-8000 multipoint bridge:** ties ISDN, switched and dedicated digital networks into one videoconference call; supports IDEC integrated dynamic echo cancellation, SG3 compression; covers data range of 112-384kb/s.
Circle (372) on Reply Card

EDL software
By Viewpoint Software
• **VideoStore:** for building of decision lists off-line using various Sony edit controllers with disk files to 999 events; list management, notepad feature; may include play speed, effects registers, audio channels 3 and 4, and GPO data.
Circle (384) on Reply Card

Audio processing devices
By Yamaha/Systems Technology Division
• **MAGIC chip set:** adds audio mixer and CD ROM interface to multimedia audio & game interface controller (MAGIC) board; includes MIDI control, audio compression and waveform synthesis functions for PC-based multimedia or other applications using a PC bus.
Circle (385) on Reply Card

Subcarrier signal device
By SCA Data Systems
• **RD-57 RBDS generator:** proprietary LSI chip with 16-bit microprocessor controller; develops 57kHz subcarrier signal with access to a complete set of RBDS functions.
Circle (374) on Reply Card

Satellite product
By Scientific-Atlanta
• **Model 9708:** integrated receiver decoder; compatible with S-A B-MAC encryption and VQ video compression technologies, while supporting current analog transmission; also compatible with TDM and FDM digital transmission formats.
Circle (375) on Reply Card

Camcorder, lens
By Canon USA
• **LX-100:** ½-inch CCD camera with Hi-8 recorder; 450-line resolution; interchangeable lens feature using the VL mount or EOS adapter to use auto focus 35mm SLR lenses; through-the-lens white balance; dust seal on tape transport door; stereo, zoom mode microphone; wireless remote control.
• **Interchangeable LX-100 lenses:** CL 5-15mm f/1.6-2.6 3×; 8.6-69.6mm f/1.4-1.8 8×; 8-120mm f/1.4 15×.

Circle (390) on Reply Card

Broadcast automation control
By Sentry Systems
• **Format sentry:** 3-mode capabilities for live assist, full automation and satellite integration with reels, carts, R-DAT, CDs and hard disk audio sources; for IBM/compatible PCs; 12 stereo random-access sources standard, expandable to 24 sources; optical isolation; silence sensing.
Circle (376) on Reply Card

Fiber measurement equipment
By Siecor
• **2001 HR OTDR upgrade:** module for optical time domain reflectometer covers

1,300nm single mode material; integrated printer creates trace showing fiber faults; disk drive permits trace storage.

Circle (377) on Reply Card

Videotape editing control

By Strassner Video Enterprises

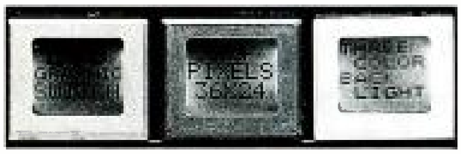
• **CMAX video editor:** PC-based control system uses AT-style hardware, V-LAN machine control and standard color-coded keyboard and screen displays; expandable to 6-transport roll configurations for online PC-based editing. Upgrade software Version 3 available for previous CASE controllers.

Circle (380) on Reply Card

Graphic indicators

By C.Itoh Technology

• **D880 programmable LCD switches:** low-power backlighted LCD with 864 pixel array shows 18-character or less message; blink/non-blink and color of backlight can be changed to alert operators of switch or control circuit status; controller for 48 switches includes RS-232/422 communications.



Circle (389) on Reply Card

Digital signal distribution

By Alpha Image

• **Alpha 232S:** 32×32 serial routing system; may be expanded to larger array sizes if required; based on previous model 264S 64×64 system.

Circle (386) on Reply Card

Enhanced battery care

By Anton/Bauer

• **MP-4D charging system:** expands the MP-4 charger with DM4 discharge/battery valuator module featuring testing modes for all batteries; NPCM module permits four snap-on and four NP-type batteries to be connected to the charger simultaneously.

Circle (387) on Reply Card

Titler enhancement

By AVS Broadcast

• **Master Type Face Library:** complete library available by subscription from installed, compact AVS-encoded format for ManuScript and FloatingPoint titlers; faces may be authorized over phone line with special password system.

• **LogoCompose option:** for editing and adapting any Master face or creation of multicolor logos, which may be used as characters.

• **601 interface:** permits 4:4:4:4 RISC design FloatingPoint to be used in CCIR 601 facilities.

Circle (388) on Reply Card

Video monitor setup

By Philips TV Test Equipment

• **PM 5639:** color analyzer for alignment of color temperature in picture monitors; incorporates dielectric inference filter simulating human eye characteristics as a standard observer; hand-held portable unit is battery operated.

Circle (399) on Reply Card

DP/MAX workstation enhanced

By Dynatech ColorGraphics

• **Real time features:** compositing, editing, layering functions for video workstation; permits matte recording, real time color correction and chroma-key; operator may manipulate sections of an image with a video paintbrush.

• **Morph upgrade:** additional tools to automate and increase speed of the system's ink and paint functions.

Circle (391) on Reply Card

Solid-state recorder

By Getris Images

• **ARAMIS Venice silicon recorder:** option permitting real time recording of video with (60s+) or without (10-120s) digital key information; 4:4:4 or 4:4:4:4 architecture; up to 10 layers of animation; automatic rotoscoping feature.

Circle (393) on Reply Card

Audio delay system

By Hotronic

• **Model AU202:** 2-channel delay covers 20Hz-20kHz spectrum with 16-bit resolution at 44.1kHz sampling; stereo with 0.01s, 0.1s and 1s increments to 9s overall delay; obscenity delete function; balanced inputs and outputs on XLR connectors.

Circle (394) on Reply Card

Status display

By Image Video

• **UMD-1000 under-monitor display:** 0.75-inch 3-color display mount under a monitor for status indications; display units to 28- or dual 14-character models; RS-232/422 control with variable flash rate and color control; interface to Image Video routing switchers.

Circle (395) on Reply Card

HD image workstation

By Eastman Kodak

• **Electronic Intermediate:** prototype high-resolution image computing workstation; allows electronic manipulation for video effects and other post-production functions in film work; 3,656×2,664-pixel digital stage includes 10 bits per color; compositing and matting through special license with Ultimatte Corporation.

Circle (392) on Reply Card

Video decoder/transcoder

By Microtime

• **Model TD-1:** dynamic digital comb filter transcoder and decoder converts composite analog video to D2 component digital format, simultaneous conversion of composite analog to component analog video; 10-bit sampling at 4× subcarrier; parallel D-2 at 10-bit or rounded 8-bit output; integrated synchronizer with 2-, 4-field memory.

Circle (397) on Reply Card

Synchronizer, test option

By Tektronix

• **VS-210:** video synchronizer with 4-field memory; synchronizes without decoding to avoid artifacts; 10-bit A/D and D/A converters with 8× sampling rate; bypass feature for VITS lines; RC-210 remote-control unit; audio delay port for 118-AS for timing corrections.

• **VM700A Option 21:** camera measurement package tests tube and CCD cameras; includes CCD defect analysis, colorimetry, gamma/detail, fixed-pattern noise and frequency response check.

Circle (403) on Reply Card

Signal transmission system

By Vyvx

• **Vyvx NVN system:** a nationwide signal distribution and transmission system for television; includes "last-mile" connection, tying end-user analog signals into the network at "local" TV switching centers (TSCs); A/D, D/A conversion occurs at TSCs; overall network operation is through DS-3 technology.

Circle (406) on Reply Card ■

Continued from page 34
each other. The telco will charge for patching a cable between them, but chances are the patch will stay in place for months at a time. The rate for such switcher-to-switcher patching is usually low.

For whom the Bell's toll

The telephone industry is easily capable of expanding into these new video services. Regulatory caps limit the profits telcos can take each year. This means they often have plenty of money available for system expansion and capital reinvestment. It is generally estimated that the telephone industry plows back $20 billion into improvements each year.[1] At this rate, they could quickly become video-capable.

Regulatory caps limit the profits telcos can take each year. This means they often have plenty of money available for system expansion and capital reinvestment.

Unfortunately, according to some analysts, the telcos' goal may be more than becoming a keeper of switches.[2] Some feel that telcos will attempt to develop a national *video dial tone*. In this service, residential customers could dial up the video they want on demand. Such a network offers good potential for program producers, because it would increase the demand for programming. However, the plan could include a deadly caveat for broadcasters. Allowing telcos to serve programming to the home may allow them to do away with middlemen, such as networks and affiliate TV stations.

Therefore, telco's digital and fiber solutions may become a 2-edged sword. They carry the short-term benefits of reduced remote signal transportation charges and higher quality. But they may do so at the expense of the broadcast industry itself.

References

1. Wilson, Carol and Inan, Czatdana, "Domestic Review and Forecast," *Telephony*, Dec. 17, 1991, pp. 31-42.
2. Karpinski, Richard, "Video Applications Come into Focus," *Telephony Supplement: Supercomm Wrap-up*, April 1991, pp. 22-25.

Acknowledgments: The author wishes to thank Tom Marchito, engineering supervisor, ABC Radio, Washington; Peter Doherty, operations producer, ABC Washington Bureau; Tom Bentsen, NASA, Advanced Video Systems Development, Washington, DC; Kelly Williams, manager of TV engineering, NAB, Washington, DC; Howard Meiseles, vice president of engineering, Vyvx, Tulsa, OK; Dana Inan, associate publisher, *Telephony* magazine, Chicago. ■

Continued from page 4
1212 ext. 2737. Or write to NPR Training — SBE Certification Course, 2025 M Street, N.W., Washington, DC 20036.

NAB announces engineering management seminars

The National Association of Broadcasters (NAB) is sponsoring its 27th annual Management Development seminars for broadcast engineers, Feb. 9-14, at the University of Notre Dame in South Bend, IN.

The seminars will be directed by Richard D. Cupka, president of the Cupka Corporation, and will offer Management I, which will include topics on interpersonal communication, leadership style and projecting a professional image. Management II topics will include motivation and personality assessment, performance improvement and a review of Management I.

Participants who successfully complete either seminar will receive 3.4 CEU points.

Included in the registration fee is tuition, housing for six nights on campus at Notre Dame's Morris Inn, all instructional materials, Sunday evening reception and dinner, Monday luncheon and Friday evening graduation banquet. The cost is $1,675 for members and $1,850 for non-members.

Call NAB Science and Technology at 202-429-5346 for more information and a registration brochure.

HDTV conference returns to Vegas

Top high-definition TV (HDTV) experts from the United States and the world will return to Las Vegas April 13-16 to compare notes, innovations and share the latest trends in advanced television as part of HDTV World '92.

The National Association of Broadcasters is organizing the second annual HDTV World Conference, a stand-alone feature to NAB's larger broadcast convention, scheduled April 12-16 in Las Vegas. Building on the success of last year's HDTV conference, this spring's event will focus on the practical and economic challenges of advanced television, among other issues.

The 4-day conference will offer presentations on HDTV technical trends and recent innovations, programming techniques and alternate media uses. Among the session highlights, topic areas will include: *HDTV Proponents for a Terrestrial Transmission Standard, Programming and Production Techniques and International HDTV, Implementation of HDTV, HDTV Delivery Systems, Digital Video for HDTV Tutorials, Audio and Ancillary Services* and *New HDTV Technologies*. ■

Preview

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.

- **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.

- **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.

- **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.

March...

NAB CONVENTION PREVIEW

- **NAB Engineering Conference Preview**

A summary of the major technical papers and issues to be addressed at the convention.

- **Exhibitor Roundup**

A complete roundup of exhibitors that will be attending the show, along with the products they plan to display.

- **Exhibitor Map**

Once again, we return to Las Vegas. And as always the *BE* map is the attendees personal guide to the show floor.

- **Facility Design Special Report**

An examination of the hardware requirements to distribute multiformat signals. Many of today's facilities will have to handle more than one type of signal (composite, component).

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