BROADCAST engineering

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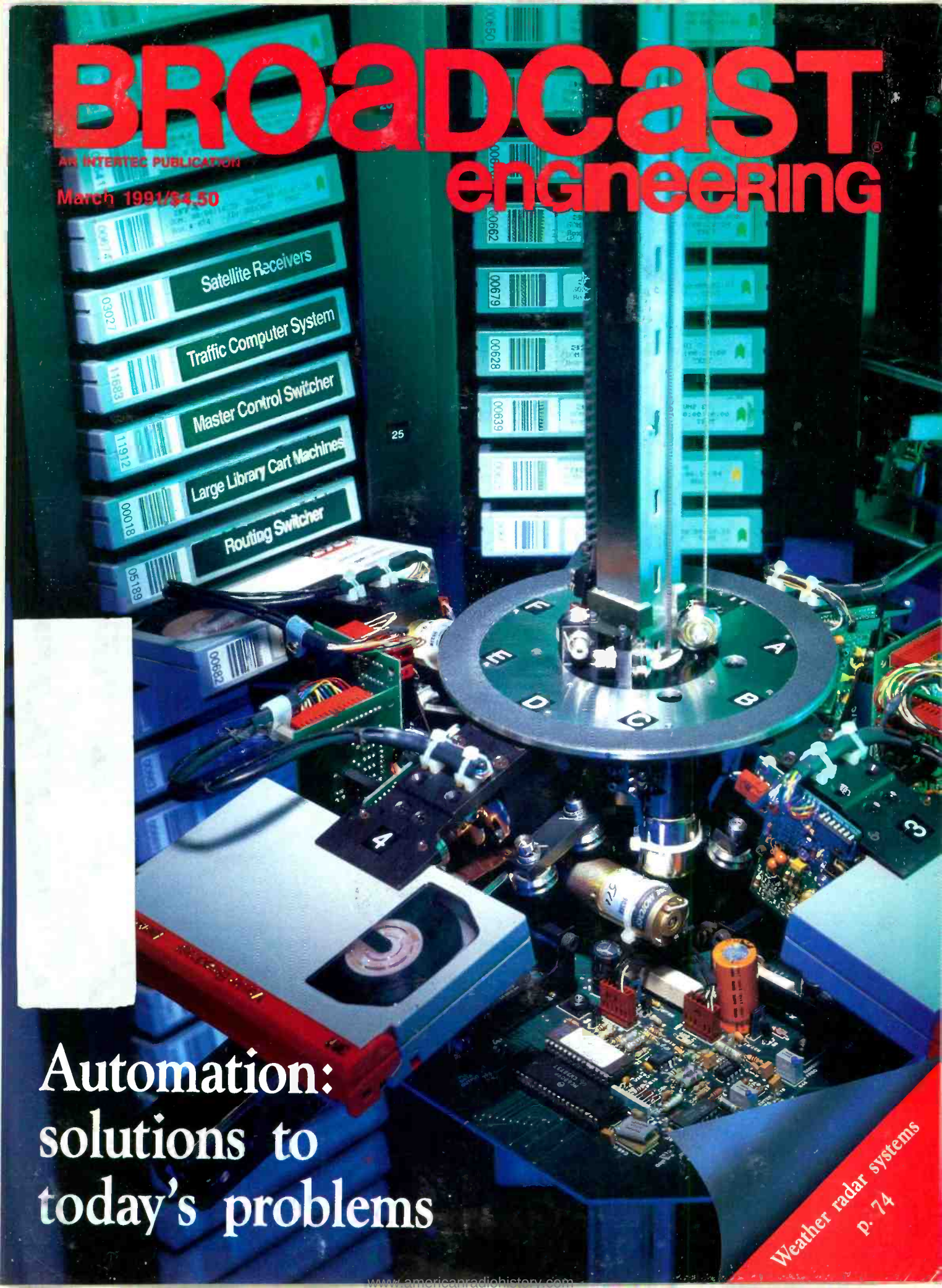

Automation: solutions to today's problems

Weather radar systems p. 74

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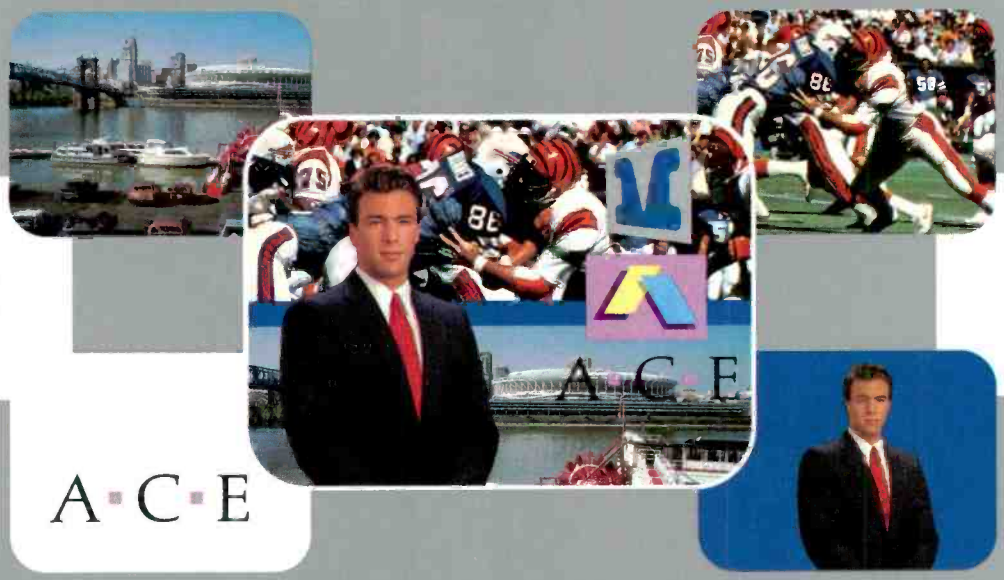

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April 1991 • Volume 33 • Number 4

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AUTOMATION: SOLUTIONS TO TODAY'S PROBLEMS

Automation continues to make inroads as facilities search for ways to operate more efficiently. As pressures to deliver higher profits and improved-quality signals (all at a lower cost) increase, engineering managers look to assisted operation as one effective tool. This month's special report looks at how automation can provide a cost-effective solution to the problems faced by today's stations.

DEPARTMENTS

FEATURES:

OTHER FEATURES:

ON THE COVER

Station automation often begins with video library systems. Modern systems can store and play flawlessly hundreds of commercials without operator intervention. This is only one area where the use of automation can improve facility operation and management. (Cover credit: Kim Bracken, *BE* graphic designer. Photo courtesy of Odetics.)

It's time for new directions in television audio.

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Circle (5) on Reply Card

By Dawn Hightower,
senior associate editor

SMPTE streamlines engineering process

A revised set of procedures for the work of SMPTE engineering committees has been approved by the board of governors of the Society of Motion Picture and Television Engineers (SMPTE). These new procedures are expected to reduce the minimum processing time for SMPTE standards, recommended practices and engineering guidelines to just under one year. Key changes in the procedures include the elimination of one redundant approval stage, reducing the requirement for consensus from two committee stages to one while maintaining due process at both levels, enlarging the role and authority of the engineering directors and the steering committees that they chair, and enlarging the authority of the standards committee.

In addition to consolidating and clarifying the old procedures, the new procedures officially recognize what has long been perceived by the industries that use SMPTE engineering documents: that they are final, approved documents in their own right. SMPTE standards will continue to be forwarded to other standardization organizations for their adaption under their own procedures.

Some technology committees have been restructured to better organize the work currently under way and seen for the future, and a new committee on hybrid technology has been formed to work on film/electronic and advanced moving image technologies. The committee on new technology has been eliminated, with new and developing technologies to be considered within the appropriate technology committees.

The new administrative procedures are being implemented immediately; the changes in the technology committee structure will take effect Jan. 1, 1992. All of the work currently being done in the society's engineering committees will continue with some of the subgroups reporting to different technology committees after the first of the year.

EIA supports testing of ghost-canceling standard

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) has announced its support of the evaluation and testing of ghost-canceling hardware in the United States.

The process of ghost-canceling employs special circuitry contained within TV sets to adjust received TV signals and eliminate or greatly reduce ghosts. This special circuitry uses a training pulse that is transmitted from the broadcasting source as a reference to eliminate the unwanted images, which are reflected from buildings and other objects.

Currently, efforts are under way by the EIA, the National Association of Broadcasters (NAB) and the Advanced TV Systems Committee (ATSC) to arrive at a standard.

SBE agrees to modifications of Docket 90-500

On March 11, the Society of Broadcast Engineers (SBE) filed reply comments on Docket 90-500, concerning the definition of frequency-congestion in the broadcast auxiliary services and the cable TV relay services.

The SBE has agreed to two modifications to the original filing: 1. The society has agreed to an extension of the Oct. 1, 1991 deadline for "grandfathered" microwave stations to upgrade their transmitting antennas to Category B in non-frequency-congested areas.

2. The SBE agrees that the congested area criteria proposed in Docket 90-500 would not be appropriate for extension to the private operational fixed service (POFS). This is because a widespread infrastructure of volunteer, industry-sponsored frequency coordination committees in the POFS does not exist. Without such an infrastructure, the discretion proposed to be given to local frequency coordinating committees, to act as "safety valves," is not possible. The SBE, therefore, concludes that the commission will continue to be burdened with preparing updated public notices of frequency-congested areas for POFS stations, and notes that eight years since the last notice already appears excessive.

See the SBE Update on page 14 for more detailed information on Docket 90-500.

|:-)))))

BROADCAST engineering

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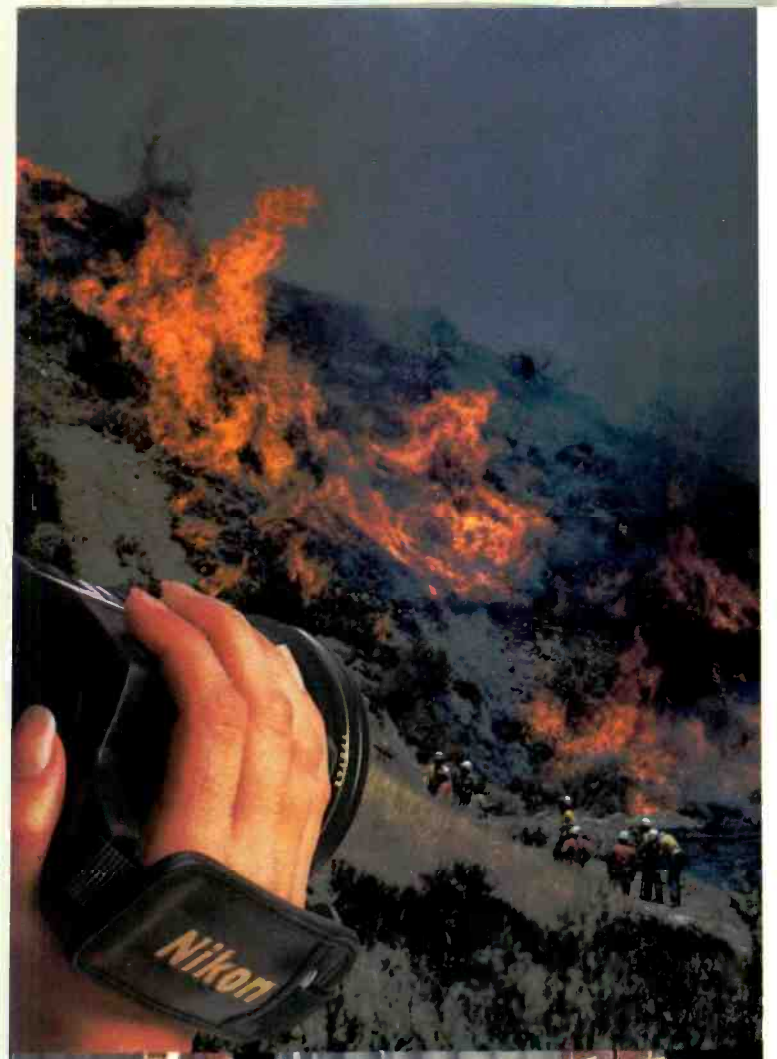

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ELECTRONIC IMAGING

Circle (6) on Reply Card

Buggy whip technology

As broadcasters continue to enjoy the benefits of improved technology, an important member of our industry remains locked in the days of buggy whips and hoop skirts — the FCC.

Until recently, the Federal Communications Commission's position on many matters was simple — marketplace rules. That was the easy way — no pain, but also no gain. However, some things shouldn't be controlled by the marketplace and one of them is technical standards. A recent example illustrates this point.

Measuring modulation, specifically peak modulation, has been an issue for broadcast equipment manufacturers, broadcasters and the commission for years. Often, the procedures and techniques used were the subject of much debate. Beginning in the mid-1980s, the issue seemed to quiet down (no pun intended). However, technology, moving in fast-forward mode, has recently renewed the controversy and created a technological problem for broadcasters.

On Jan. 31, the commission issued a public notice regarding modulation measurement for FM stations. The notice was an attempt to put to rest any questions about how to properly measure FM modulation.

The notice states, "Despite the technical differences, it has been the experience of the commission that all commercially manufactured monitors with which it is familiar produce satisfactory results which agree substantially with the commission's rules." Sounds good, doesn't it? After all, aren't all modulation monitors pretty much the same? Well, if you ask a manufacturer or station engineer this question, you might find some disagreement.

Modern, high-speed circuitry and improved design have made it possible to measure modulation with more precision than ever. The newer equipment also allows stations to increase modulation to higher levels than ever. This alone isn't the problem. Case history seems to indicate that there may be very real differences in the results produced by different measurement techniques.

It has been reported that in one test, a station compared peak modulation using a pre-1983 modulation monitor to peak modulation using a new, higher-precision monitor. To further investigate the issue, the station measured peak modulation using the commission's technique (wideband discriminator output into an oscilloscope).

In this test, the newer type monitor allowed for about 1dB more peak modulation than the older monitor would have permitted. However, at the same time, this increased level of modulation showed up as overmodulation on the oscilloscope measurements. The peaks were high enough that they could be captured by an oscilloscope camera.

The concern here is not with the new modulation monitors, but with the FCC's inability to cope with new technology. If the new, high-tech monitors can legally allow a station to squeeze more loudness out of the station's signal, that's great. But, what happens if the increased modulation levels give the *appearance* of overmodulation when checked by the FCC's old-fashioned methods?

The recent notice leaves plenty of room for questions — not something that's in the best long-term interests of anyone. Technical issues need careful, thorough and fair investigation. No one benefits when the FCC issues public notices that may not have answered all the pertinent questions.

The notice clearly shows the FCC's need to move into the 1990s. Shouldn't the policing agency be at least as technologically up-to-date as the industry it regulates? Don't you find it interesting that the commission uses 1950s technology to measure 1990s broadcasting equipment?

Something's wrong when our regulatory agency is 40 years behind the industry in technological sophistication. A well-equipped and properly funded FCC technical staff will benefit us all in the long run.

Brad Dick

Brad Dick,
editor

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Circle (7) on Reply Card

FCC opens OFS to wireless cable

By Harry C. Martin

The Federal Communications Commission has amended its rules to allow entities eligible in the Operational Fixed Microwave Service (OFS) to use the 6MHz-wide, point-to-point channels in the 18GHz band to distribute video entertainment material. In addition, the FCC has eliminated its restriction on the number of channels that may be assigned at 18GHz for this purpose.

Last year, the FCC had removed other barriers to the development of wireless cable. It narrowed the definition of "cable system," which now must obtain a local franchise before it is permitted to construct a video distribution system, and encouraged Congress to enact legislation that would ease the entry of alternative multichannel video distributors into the marketplace.

This latest deregulatory effort is significant for two reasons. First, by having access to point-to-point frequencies at 18GHz, wireless cable providers eligible in the OFS will be able to expand their operations and increase their market presence. Second, by eliminating the 4-channel-per-transmitter-site limitation, these entities will be able to compete more effectively with cable systems, which typically are offered at least 50 channels.

The FCC said that increased access to microwave spectrum was needed so that satellite master antenna TV (SMATV) operators and similar alternative multichannel delivery systems could compete effectively with cable systems. Spectrum at 18GHz is particularly well-suited to this purpose because it is appropriate from a technological standpoint, and the necessary equipment is already available. The 18GHz band is currently being used by CARS licensees for distribution of video entertainment programming from cable system receive points to cable head-ends.

However, there are some roadblocks. According to OFS rules, many alternative multichannel delivery systems are being required to construct separate head-end facilities at each location they wish to serve. Financial constraints, zoning restrictions, terrestrial interference, satellite line-of-sight problems and building-owner restrictions often preclude the installation of these facilities, thereby thwarting the growth of these operations. Such constraints upon the physical expansion of OFS systems foil the market expansion of OFS eligibles and decrease their competitive potential. It is hoped the assignment of appropriate microwave spectrum will reduce the impact of these problems.

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

Hearing reform rules deferred

The commission has deferred the effective date of the rule changes it announced last December, which adopted procedural reforms designed to expedite the resolution of comparative hearing cases, including the early payment of hearing fees. The reforms also eliminated settlement payments after a hearing begins and limited them to expenses before the hearing. (See the "FCC Update" column in February 1991.) The procedural changes were scheduled to become effective Feb. 13 and the settlement limitations were scheduled for March 21.

However, several parties have appealed these changes. The Federal Communications Bar Association and other organizations are urging the FCC to permit applicants to recoup their expenses through settlements at any time during the hearing process. This would curb abuses of the system that have occurred as a result of the FCC's previous policy of permitting unlimited settlements, but would provide a reasonable incentive for post-hearing settlements.

The new rules will not become effective until the appeals are decided. This will prevent the disruption of ongoing proceedings if the commission decides to further amend any of these rules.

Tower painting and lighting enforcement

Late last year the FCC conducted a nationwide enforcement effort to assess and improve compliance with its tower painting and lighting requirements. Fines totaling more than $350,000 were assessed as a result of the sweep. The commission has recently reminded licensees about the importance of meeting these regulations. In 1990, the agency distributed a bulletin on the subject, and sent letters to all licensees explaining their responsibilities. Other educational efforts included the release of public notices and industry news articles explaining the agency's regulations.

New FM translator rules effective

New rules governing FM translator service became effective March 1. These new rules reflect a comprehensive re-examination of the the service and clarify and revise a number of subjects, such as ownership and financial support of translators, methods of selecting translator applicants, defining a "major change" in translator coverage areas, use of commercial and auxiliary band frequencies, interference criteria and technical requirements for translators.

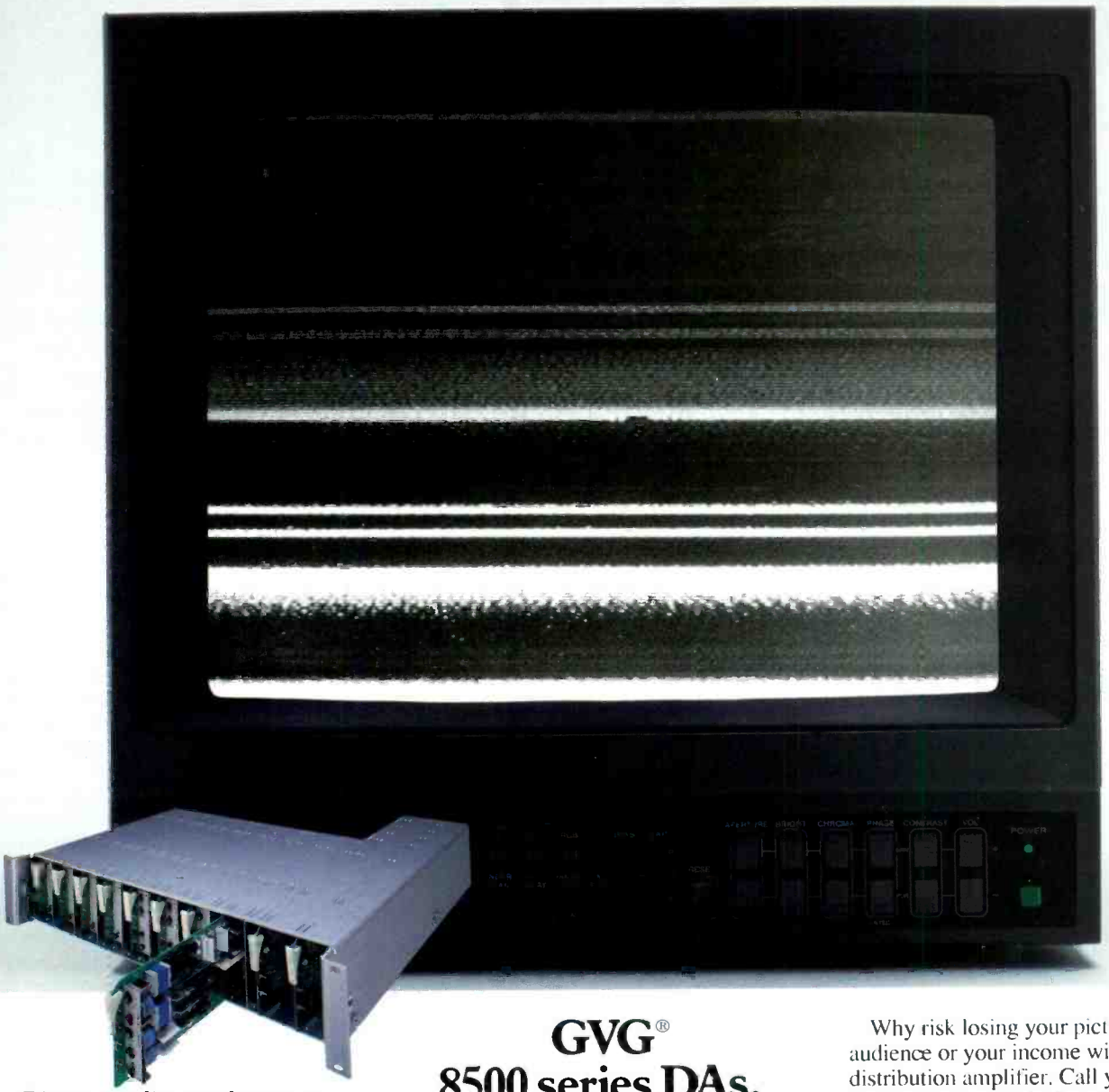
A freeze on application filing acceptance for new FM translator stations or for modifications in the commercial FM band (channels 221 to 300) will remain in effect until May 1, 1991. Applications that were deferred pending the adoption of the new rules must be amended to conform to the new rules by July 1, 1991.

Until the freeze is lifted, the only applications that will be accepted for filing will be applications for changes for existing or authorized non-commercial facilities that operate in the reserved band (channels 201-220). These applications still must conform to the new rules. Until the updated form (FCC Form 349 —"Application for Authority to Construct or Make Changes in an FM Translator or FM Booster Station") is available, applicants must use the current version of the form. However, applicants must attach exhibits containing the additional information required by the new rules.

AM Radio	4,986
FM Radio	4,402
FM Educational	1,442
UHF Commercial TV	564
VHF Commercial TV	553
UHF Educational TV	229
VHF Educational TV	124

Table 1. Broadcast station totals as of Jan. 31, 1991.

It's amazing what some people will sacrifice for a cheap DA



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Circle (8) on Reply Card

Keeping hard disks up and running

By Steve Gibson

Hard disks are often a source of great frustration. Even though engineers repeatedly warn station personnel who use PCs to back up their hard drives regularly, their warnings often go unheeded. Engineers must then console those who receive that disturbing message: "sector not found."

Although regular data backup is the first line of defense, other unseen errors can cause hard disk failure. This column outlines some common disk problems, and then offers some possible solutions.

What can go wrong?

All hard disk drives have one or more surfaces that are coated with magnetic material. Each surface is subdivided into several tracks, and each track is further divided into smaller pieces called sectors.

Sectors begin with special sector-addressing information and are followed by 4,096 databits that are organized into 512 bytes. Drives that use modified frequency recording (MFR) encoding store 17 sectors per track, and those that use run-length limited (RLL) encoding squeeze 26 sectors into each track.

When a drive searches for a sector, it first moves the heads to the proper track and reads it continuously until it locates the proper sector-addressing information. The heads then read the data from the sector location.

Sector-addressing information is written to the disk's surface during a process known as low-level formatting. The low-level format defines the location of the tracks and sectors on the disk's surface.

One of the major causes of hard disk failure is the aging of the low-level format. If the head is old and can't read the sector location information, it can't locate the data.

Every time the information in a sector changes, the entire sector is rewritten. This refreshes the data's magnetic image. The sector-addressing information, however, is never rewritten. It sits quietly, slowly fading, until the day comes when the disk controller is unable to locate the sector. This is what has happened when DOS sends those unnerving "sector not found" messages.

Alignment drift is another cause of hard disk failure. The head positioner is a mechanical device and, with use, may drift. This gradual misalignment, however, doesn't always hurt data readability because newly written data is still close to the read/write head's path. But misalignment can drastically affect the drive's ability to find sectors. With time, the drive's heads can drift far enough from their original alignment that even newly written data cannot be found.

A solution to both of these problems is to completely back up the disk's contents, reformat the disk, and then restore its contents. Some experts recommend doing this every three months. Still, there are some errors that even this cannot solve.

One of the major causes of hard disk failure is aging of the low-level format. If the head can't read the sector location information, it can't locate the data.

Floating defects

During the manufacturing process, a scanner locates the disk's defective areas. The first time the drive is low-level formatted, the formatter flags the sectors with defects so that the DOS filing system will skip over them.

If the head/track alignment has drifted, defects that were once in the middle of tracks will appear to float out of harm's way into the zones between tracks. This frees once defective sectors for data storage. These new defects, previously unseen between tracks, now migrate directly into the new track locations. This causes sectors that were dependable to become unreliable.

In order to prevent this, it may be necessary to rewrite the sector's information, rigorously test the new tracks for defects and then feed the DOS filing system updated information.

It may be necessary to not only rewrite the sector information, but also to rigorously test the new tracks for defects.

What can be done?

Refreshing a disk's low-level formatting information can go a long way toward keeping a computer system reliable. Complete backup and restoration, however, is time consuming, and may endanger your data. One viable alternative is to use a non-destructive reformatting program. These programs take the data off the track, and temporarily hold it in the computer's memory. They rewrite the sector-addressing information to eliminate the head/track misalignment and then rewrite the data.

Some of these disk maintenance programs also check the new tracks for defects. They may move files to make them contiguous, which also makes them easier to find. Some programs allow the user to tune the drive for maximum throughput and others can recover data even after it seems lost.

Active approach

Engineers should take these steps to ward off data disaster at their own facilities. They should always remember that preventive maintenance on hard disk drives can allow years of trouble-free operation and that these disk programs are an easy way to simplify the maintenance process.

Gibson is president of Gibson Research, Laguna Hills, CA.

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If You Were Dropped 6 Feet, Head First, Would You Still Be Able To Cover The Story?

Circle (9) on Reply Card

Part 2

re: Radio

An adventure in tower detuning

By John Battison, P.E.

In last month's column, we discussed the addition of FM and LPTV antennas to an existing AM tower array. After weighing all the options, it was decided that a new tower for the FM and LPTV services would be constructed at the AM site. Now we must consider what effect the new tower will have on the AM pattern.

Our story continues

The proximity of the new tower to the existing array makes it inevitable that either the pattern will be affected, or those critical arbiters of FCC grace — the monitor points — will be out. (It is also possible that both could occur.) It was decided that three drop wires would be used to form the detuning skirt on the new tower in a standard "reverse-folded monopole" type of installation. The detuning network cabinet would be located at the base of the tower for easy access.

Three 10-inch angled iron arms would be extended from the tower top, below the FM and LPTV antennas, and stranded copper wire would be brazed to the end of each of these. The wires would be spaced from the tower legs and held in position by insulators fabricated from hose clamps and other available materials. At the bottom of the tower, about five feet above the ground, a ring, or loop of solid copper wire would connect the three drop wires in a circle. The wires would be placed in insulators and turnbuckles to maintain tautness.

The detuning circuit — a simple series resonant-tapped inductor and fixed capacitor circuit — would be mounted in a weatherproof metal box that would be secured to the tower. The lead from the drop wire bottoms would pass into the detuning box via a feedthrough insulator.

Best laid plans

But winter weather has interfered with these plans. Rain, snow and ice have dramatically slowed construction on this project. Currently, the footings are in and guy foundations poured, but the field is a quagmire and there is no tower to detune. Nonetheless, here is a description of what work will be done as soon as the weather clears.

First, immediately before the new tower is erected, all antenna and transmitter parameters will be adjusted to license specifications, and monitor points will be read on the AM station. Common point impedance and current will be measured and logged.

As the new tower goes up, monitor points will be read and antenna parameters checked. As the height increases, the monitor points may begin to go out and power may need to be reduced to keep them within limits. Phasor changes will likely be required to stay legal.

Extreme precaution will be taken when the FM and LPTV antennas are installed to ensure that all coaxial cables are firmly bonded to the tower. It is critical that all tower lighting wiring be installed in metal conduits that are securely bonded to the tower. The neutral must be grounded to the tower. Bypass capacitors should also be installed on the hot lines.

Because of the AM station's low power, and the new tower's distance from the AM array, no problems of excessive radiation exposure are anticipated. A sharp lookout for arcs and sparks will be maintained. If any are seen on the new tower, AM power will either be reduced or shut down to prevent injury. (See "Radio Frequency Radiation," *BE*, February 1991.)

The FM and LPTV transmitters will be installed in the concrete block building at the base of the tower, and input and coaxial cable connections will be made. Each transmitter will be tested into a dummy load after midnight with the AM transmitter on full power. If any AM interference to either the FM or TV signal is observed, corrective work will be performed before going onto the new antennas. Once these tests are completed satisfactorily, the transmission lines will be connected to the transmitters, and program tests will begin. Meanwhile, phasor and antenna parameters will be readjusted, and monitor points will be read.

Detuning the new tower

Tower detuning will begin by placing the field intensity meter (FIM) on top of the metal cabinet that contains the detuning network. The lid (antenna) will be close to the drop wire coming from the skirt loop, and will go through the feedthrough insulator. After tuning the FIM for the station's frequency, it may be necessary to reduce power to prevent overload. This should be carefully monitored throughout the process to prevent damage to the FIM.

After checking carefully for excessive RF on the inductance and clip lead, the tapped coil will be tuned for resonance, as indicated by maximum current in the detuning skirt, and maximum reading on the FIM. If an RF bridge is available, the network could be adjusted for approximate resonance before starting the detuning process. This would become a starting point, and might speed the process.

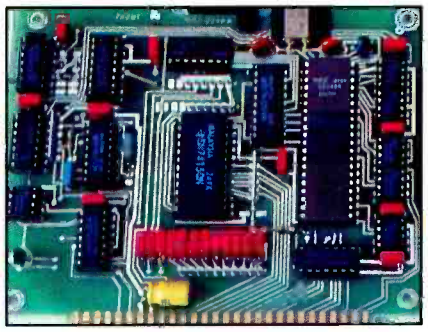
The detuning may have an effect on the AM phasor tuning. Therefore, the transmitter parameters may require adjustment after the initial detuning/tuning. Monitor points will be read, and with any luck, they will be in. If they are not, observers with FIMs and CB radios will be placed at the two monitor points, and the detuning will be continued according to their information. After a final tweak of the phasor and other controls, the major detuning will have been concluded. Common point impedance and current will be measured, logged and adjusted as needed. FM and LPTV signals will be checked at various locations for reception, and all transmitters will be checked again for interference. If all has gone well, this will conclude the project. The AM will be back with licensed parameters and monitor points in. The FM and LPTV stations will be perking, and only their license applications will need to be completed.

Plans such as this help to circumvent the commission's requirement that a partial proof be satisfactorily completed before the new FM or LPTV operation begins. Performing the prescribed partial can sometimes hold up a project for a long time. As shown here, there are ways to avoid that.

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

Part 8

Circuits



Building with microcontrollers

Introducing serial communications

By Gerry Kaufhold II

In the first part of this series, which began in September 1990, I discussed the advantages of using microcontrollers for station projects. Also included in that column was a block diagram of a typical single-chip microcontroller that had an on-board serial communications channel.

In the October column, the project was begun by listing the 12 steps critical to designing a successful microcontroller project. In that and the next six parts of this series, I discussed the first five steps on the check list: selecting a microcontroller, studying its documentation, connecting it to a power supply, choosing the crystal for the operating frequency and interfacing it to EPROM and RAM memories. We are now ready to begin step six: Interfacing to a serial communications link.

The serial communications channel of the Z-8 is fairly sophisticated. The UART controls serial-to-parallel conversion of bits.

With the popularity of low-cost personal computers, many engineers have access to a departmental PC. This column will discuss a serial interface that permits the Z-8 microcontroller project we have been working on to "talk" to an IBM-compatible PC.

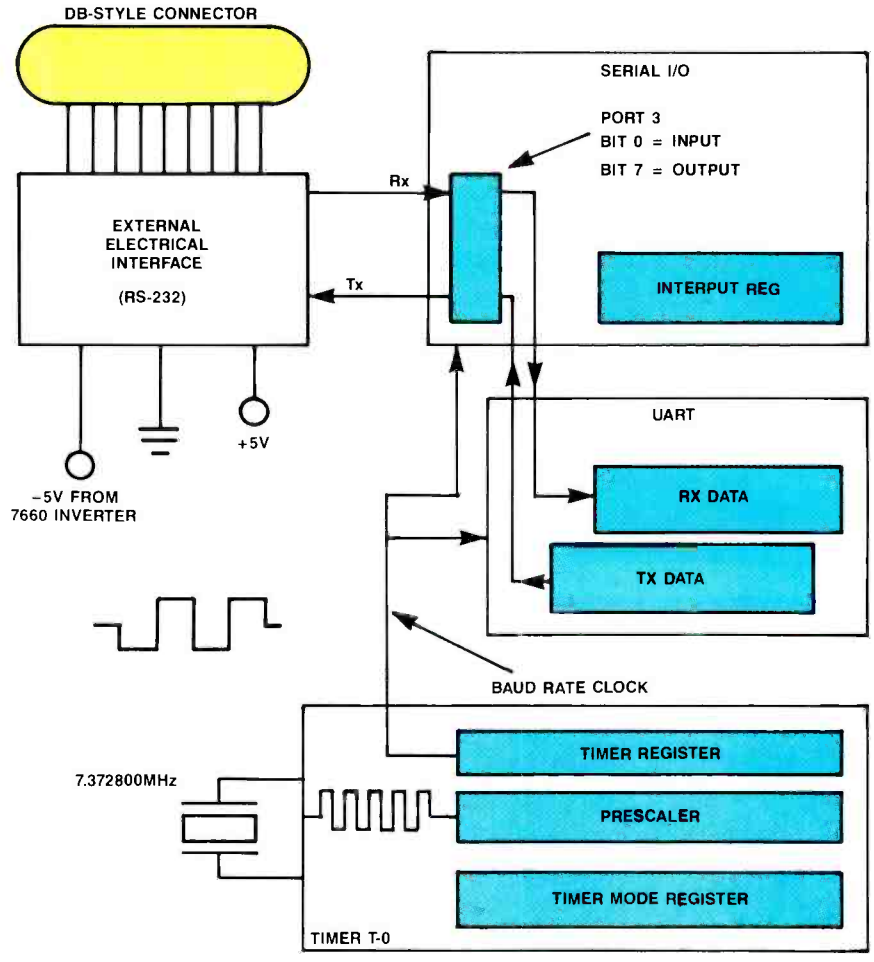


Figure 1. *Block diagram of the serial communications section of a typical microcontroller. The timer circuit drives the UART and serial interface. An external interface chip puts the signal onto the interconnecting cable.*

The serial communications interface

The Z-8 serial communications channel, the universal asynchronous receiver/transmitter (UART), is fairly sophisticated. (See Figure 1.) The crystal and timer T-0 establish the operating frequency. The UART controls serial-to-parallel conversion of bits. The interrupt register tells the Z-8 when each character is ready. Port 3 provides the inputs and outputs from the Z-8 package to the external interface chip.

This external interface chip provides one of a variety of electrical levels that go to the personal computer via a connector and a cable.

Frequency selection

In last November's column, I examined the crystal oscillator section of the Z-8 microcontroller. With that information in mind, the crystal frequency should be 7.372800MHz for serial communications with a personal computer.

To make debugging as simple as possible, set the baud rate at 300 bits per second. Once the interface is working properly at this low speed, it is easy to increase the operating speed.

Next month I'll discuss how the UART works, and then describe how to interface to the personal computer's serial port.

Kaufhold is a market development engineer for SGS-Thomson Microelectronics, Phoenix.

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Defining "frequency congested"

By Bob Van Buhler

In February 1990, the SBE filed a petition requesting that rulemaking determine a strict definition for the term "frequency congested." Although the term is used in FCC regulations to specify technical requirements for site equipment, the regulations do not clearly state what it means.

Antenna criteria

The newly defined term would be used as a yardstick to determine what sites should be classified as congested. Using the classification, the FCC could specify the type of antenna to be used for point-to-point microwave links in the 2GHz, 7GHz, 13GHz, 18GHz and 31GHz broadcast auxiliary bands.

In response to the petition, the FCC has issued a "Notice of Proposed Rulemaking" which in turn, has raised many questions. To gauge the industry's needs, the society distributed the full text of the commission's NPRM, the original petition and a cover letter to each of its 115 SBE-affiliated coordinating committees. The committees reviewed the information and made a list of standard metropolitan statistical areas (SMSAs) that should be excluded from the "congested" classification. They also listed other sites that contained heavy RF traffic that should be classified as congested areas. In many cases, according to the committees, little need exists to require grandfathered fixed links to upgrade equipment to more spectrum-efficient Category A antennas, as defined in the rulemaking.

Using the committees' results, the SBE filed comments in response to Docket 90-500 proposing a 4-level exemption scheme. The first exemption level would be the FCC's list of exempted SMSAs. The second level would be a market-specific list. For exemption, less than 70% of the channels in the SMSA should be fully used.

The suggestion that a third level be established was added to the document. This exemption would be based on a written request by the local frequency coordinating committee that a particular SMSA be added to the exemption list.

The fourth level would be the individual licensee who could request exemption for an individual fixed link. The licensee would have to demonstrate that the continued use of a lower-performance Category B antenna would not inhibit the use of the channel by additional users. The proposal also asks that the FCC require concurrence from the local frequency coordinating committee for exemption of the particular link involved.

One concern expressed by coordinators was the ability of some existing structures to accommodate larger, upgraded antennas. To solve this, the SBE has proposed the use of a structural exemption. The exemption would require a registered structural engineer, or an engineer employed by the tower manufacturer, to provide documentation that the tower cannot safely bear the additional windload of larger, upgraded antennas. This requirement is designed to inhibit licensees from filing for exemption to avoid the expense of installing higher-performance antennas.

The comments also deal with the different situation that exists for aural STLs. In the United States, there are approximately 15 radio stations for every TV station. However, there is currently only one band suitable for aural STL and intercity relays for radio use. On this basis, many of the exemptions proposed for TV point-to-point links are not recommended by coordinators for the 950MHz aural STL band.

Many frequency coordinating committees also pointed out the need for receiving antenna standards. The use of higher-performance receive antennas would further ease interference and congestion on the auxiliary bands. Such a move is as important to providing interference-free links as transmitting antenna standards.

The appropriate place for new standards on receive antennas, according to the SBE, is an additional rulemaking dealing with that issue. The current docket focuses on defining congested areas, not antenna standards.

The SBE's comments have also included a series of maps showing proposed exempted counties in all 50 states. They also provided a list of exempt and non-exempt SMSA counties by state. The detailed maps for filing by the SBE are suitable for inclusion in FCC rules without modification.

Copies of the complete 90-500 filing, which includes the maps, are available from SBE secretary Paul Lentz. Orders may be placed by calling 419-882-5906. The cost is $15 for SBE members and $25 for non-SBE members.

The SBE comments on Docket 90-500 were compiled and produced by the FCC filings committee under the guidance of board member and committee chairman Dane Ericksen, P.E., of Hammett and Edison, San Francisco.

Membership renewal time

It's time once again to renew your membership. Current members were mailed a renewal form on March 1. If you haven't received yours, call the SBE office at 317-842-0836.

What has the SBE done for you this year? Let's look at the record. In this past year, the SBE newsletter gave members an inside look at controversial issues within the SBE and the industry. Columns from board members and officers and letters from readers were included to help SBE members better understand the rapidly changing broadcast world. A new feature, "Memo to Managers," was added to the newsletter to give your GM reasons your station should support engineering and the SBE.

SBE members were surveyed to determine their needs and interests for the first time. The society is using this information to develop additional programs and services.

Also, the hiring of professional management has made the implementation of several other new services possible and has brought managerial expertise to the society. Your chapter chairman now receives a monthly report from Steve Ingram. In addition, your frequency coordinator and certification chairman receive timely information relating to their committees.

SBE officials are working hard to serve and represent you. Continue your participation in the communications engineering profession by renewing your membership today.

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

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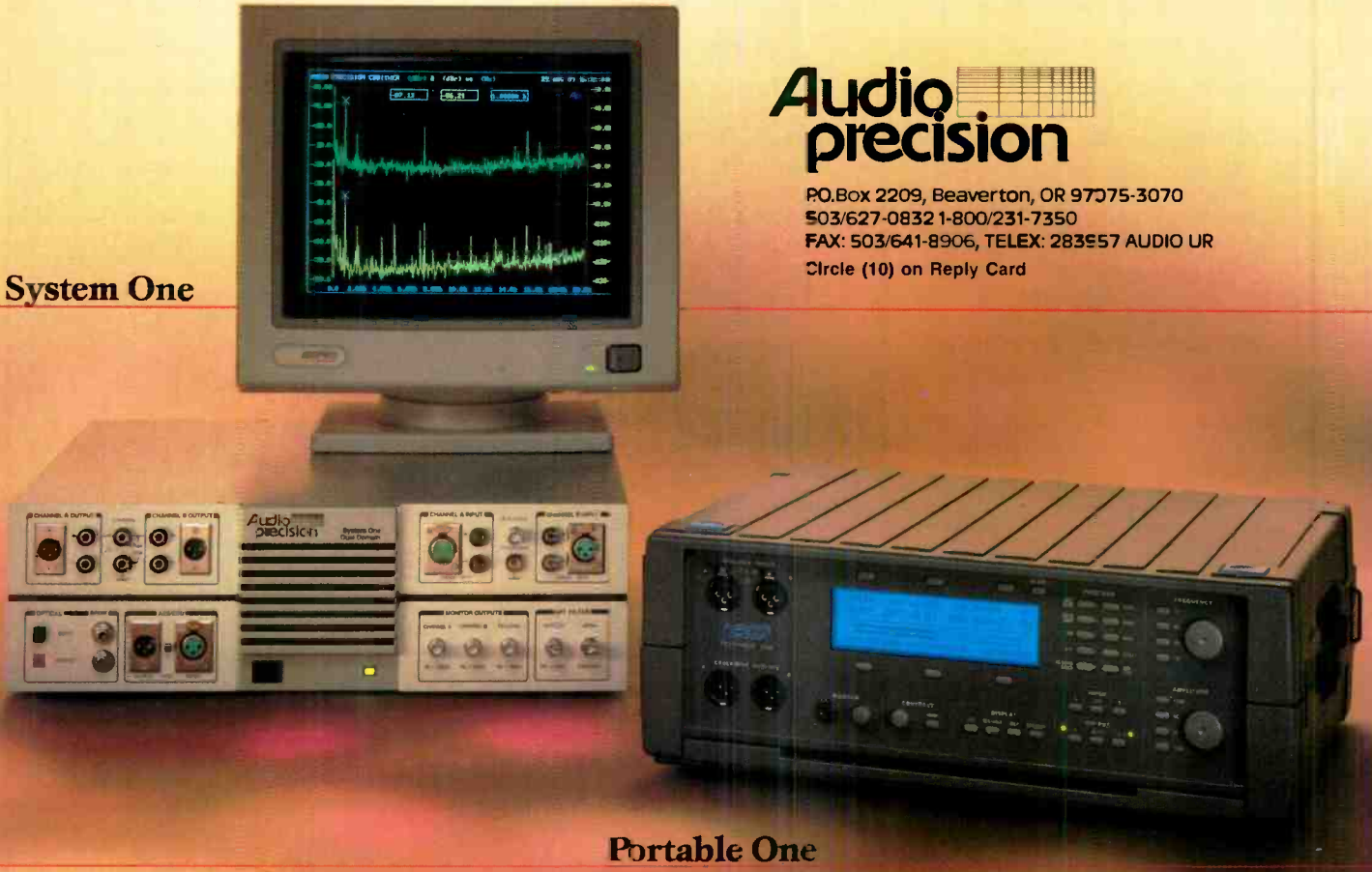

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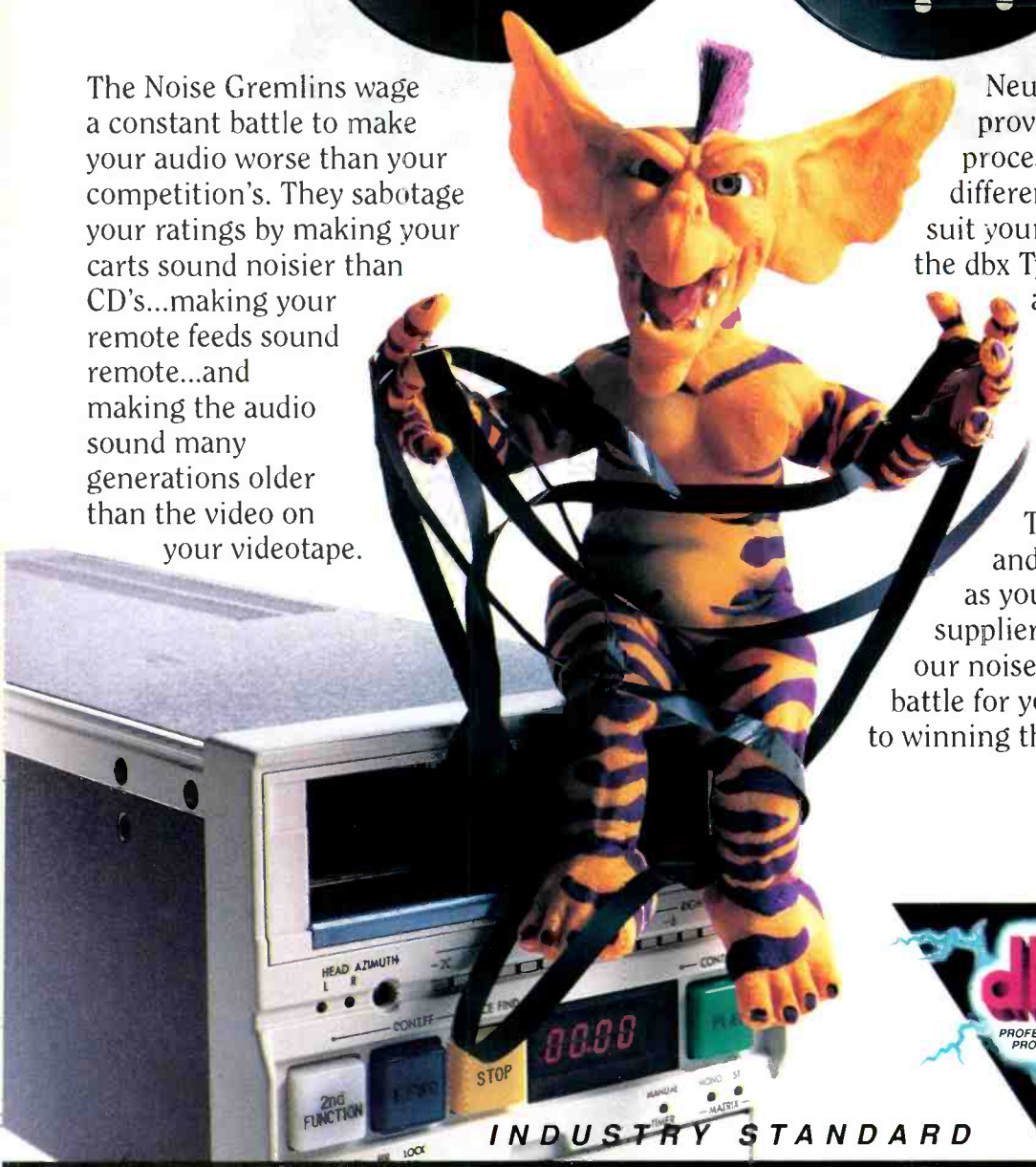

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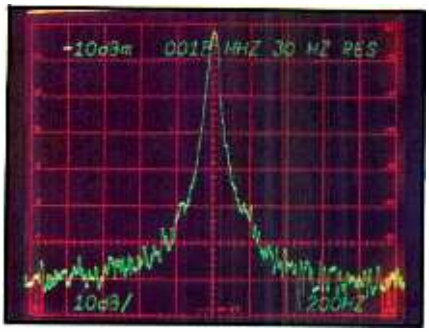
Part 2

Troubleshooting



DAT maintenance

Tools of the trade

By Richard Maddox

For most studio managers, tape deck maintenance is an easily figured part of the budget. But when it comes to preparing a DAT maintenance budget, the standard audio recorder rule book no longer applies. The maintenance budgets, schedules and equipment requirements of DAT machines are more similar to those of VCRs than to those of reel-to-reel or cassette machines.

Table 1 lists the most commonly required items used to align and service the most popular DAT hardware.

Although this isn't a long list, and many of these items are commonly found in audio facilities, it is the cost of DAT testing equipment that makes maintenance so expensive. For example, a head checker costs approximately $150. DAT test tapes cost from $50 to $80 each, and most models require two or three different tapes for complete alignment. You also need to add a torque tape or two at $150 each, an error checker jig (one of the better investments) at $30, a hold-down jig at $70 to run tapes when the elevator assembly has failed, and service manuals at $25 each. With all of this, it is easy to see how basic maintenance supplies for one DAT model can cost around $800. Remember, this figure does not include the price of a dual-trace, delayed sweep with 30MHz or more, which is critical to alignment.

It is also important to consider that this total must be applied to each type of DAT hardware the facility uses. Many of these items, particularly the more expensive ones, are designed specifically for one manufacturer's products. It is clear to see that gearing up for DAT maintenance is an expensive proposition, particularly if the facility has equipment from different manufacturers.

The alternatives to the investment needed for in-house DAT maintenance are not encouraging. In most areas, the only viable option is to rely on factory service, which typically has slow turnaround time and is expensive because trained DAT servicers are not in abundance.

Choosing an oscilloscope

The requirements for a good DAT scope are the same as those for RF, video or computer servicing — the faster, the better. Dual-trace with delayed sweep is somewhat standard in 30MHz or faster scopes, and, therefore, is required for DAT service. A bandwidth of 30MHz is as slow as a DAT servicer can run and still be able to see all waveforms reliably. Therefore, a 60MHz scope is recommended by some manufacturers.

The scope also must be able to trigger external signals in the dual-trace mode, and should have a dual time base. Scope probes should be switchable between X1 and X10.

Other test gear requirements

A function generator or audio test set is also required. Variable-frequency and variable-level sine wave output is needed, and test sets that can also read the level and frequency of a returning signal are extremely handy.

An accurate DMM is essential, because critical adjustments in the ±1mV range are frequently needed. An ideal unit would contain a frequency counter and dB meter, even though any DMM that can measure below 1mV accuracy can be used.

Although it is specified in some manufacturers' DAT service manuals, a distortion meter is not mandatory. The meter is primarily used to set the digital-to-analog converter's DC offset and MSB (most significant bit) for minimum waveform distortion. This can easily be done without a distortion analyzer. In most cases, simply viewing the output waveform on a scope will show distortion, because the signal will either be within spec or noticeably distorted.

Hand tools

If possible, purchase the Japanese ISO No. 1 and No. 2 screwdrivers. Their tips are slightly different than the typical U.S.-made Phillips screwdrivers. These drivers are a must when using any Japanese Phillips-head screws that are stamped with the small dot that signifies an ISO type.

Jeweler's-type small Phillips and flatblade screwdrivers are also essential because there are many tiny screws in DAT transports. One manufacturer sells a guide adjustment screwdriver that is nothing more than a chopped and channeled flatblade, for about $30. For a cheaper alternative, use a hacksaw, file and smoothing stone to shape a small flatblade that might be found in the bottom of a toolbox. The guide adjustment screwdriver is actually no more than a small version of a VCR guide adjustment tool.

Next month, we'll look at some DAT alignments, including tape guide alignment and head drum replacement.

DAT MAINTENANCE TOOLS

- ISO No. 1 and No. 2 screwdrivers (Japanese-style Phillips)
- No. 0 and No. 00 Phillips screwdrivers
- No. 0 and No. 00 flatblade screwdrivers
- Tape guide adjustment screwdriver
- Ceramic coil adjustment tool
- Chamois tip swabs (Chemtronics CC50 or equivalent)
- Cotton swabs (3- or 6-inch wooden-stick type)
- Alcohol
- Freon (or Trichloroethane)
- Rubber cleaner
- Metric hex set*
- 30MHz (or faster) dual-trace scope
- Frequency counter
- Audio oscillator
- DMM (with dB readout) or AC voltmeter
- Distortion analyzer
- Two X1/X10 scope probes
- Balanced/unbalanced match box
- Service manuals*
- DAT error indicator board*
- Hold-down jig
- Head checker*
- Test tapes (many manufacturers offer tapes with test signals or parameters of RF envelope, ATF, level and function, PG reference, error rate measurement and linearity)*

* Denotes items specific to one DAT manufacturer or model.

Table 1. Common items used to align and service DAT hardware.

Maddox is technical manager at Media Management Associates, Lynnwood, WA.

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Learning to say no

By Judith E. A. Perkinson

In your personal and professional life, you probably often find yourself saying yes to requests when you really should have said no. Although this can be annoying in your personal life, it can be disastrous in your professional life. Saying yes when you should say no affects your time management, increases your stress level and diminishes your ability to be an effective manager.

Why do you say yes when you should say no?

Sometimes it seems as though it is easier just to say yes. You do not want to make a stand and are uncomfortable saying no to a request. You may succumb to peer pressure. Others may always seem to say yes and you don't want to feel left out, or people you respect or are afraid of tell you to say yes.

Often, you say yes because you are embarrassed. For example, a person will ask you at a moment when it is terribly awkward for you to say no. Other times, people will ridicule you with comments such as, "What's the matter, can't you handle it?" to force you to comply with their requests.

Why do you feel uncomfortable saying no?

There are many reasons why you may be uncomfortable when you say no. Each of them is deeply embedded in your feelings of yourself and in the people around you.

- *Acceptance.* Everyone wants to be accepted and valued. Often, you think, "People do not like to be told no. If I am the one who does it, they will not like me."
- *Reciprocity.* No one is totally independent. "You scratch my back, I'll scratch yours" is one agreement that is actually a kind of insurance that someone will help you when you need them.
- *Kindness.* Most of you see yourselves as kind people. You tend to say, "I don't mind being nice if someone really needs the favor."
- *Responsibility.* Often you feel that if the person asking has problems after you refuse, you are somehow responsible. This is not true. The requester has the problem, and just because you had been asked to help, does not mean you are responsible for the problem.

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

The effect of a yes that should have been a no

There is a heavy price to pay for saying yes when you should have said no. On the emotional side, the increased stress, coupled with the related anger, takes its toll on your mental and physical health. On the professional side, the disruption of your schedule and the loss of control over your work load takes its toll on your efficiency and performance.

- *Stress.* Additional stress is often generated from more responsibility, schedule adjustments and time pressures.
- *Anger.* You can become angry at yourself and others because you feel used, because you allowed someone to use you, and because someone else feels that it is OK to use you. This anger is rarely productive. Rather, it diminishes your efficiency and hurts your interstaff relationships.
- *Time management.* Constant adjustments from unwanted requests can either leave you with less time to do your work, or result in the rest of the staff picking up the added responsibility.
- *Operational control.* Special requests disrupt normal work flow and diminish operational efficiency. When it becomes habitual, it takes control out of your hands and puts it in the hands of whoever is making the requests. It gives others permission to be poor managers and forces you to assume their responsibilities.

When to say no

Sometimes special requests are legitimate and should be granted, even when you wish you could say no. Learning when to say no is a critical skill. Before you respond, examine each request in terms of impact, time, need and the source of the request.

Impact. Ask yourself, if I say no, will the job get done? If I say yes:

- does it disrupt the system significantly?
- does it set a troubling precedent?
- do I have the resources available to honor the request?

Time. Ask yourself, if I say yes:

- do I have the time to do it?
- will doing it disrupt other responsibilities?
- if I assign it to someone else, what impact does it have on the work flow?

Need. Ask yourself, if I say yes:

- what message have I sent to my subordinates, co-workers and other department heads?
- is there a real need? as defined by whom?

The source. Ask yourself, is this a person who:

- frequently asks for exceptions?
- avoids or dumps responsibilities?
- is learning the job and needs the experience of meeting a deadline or working in real-life situations?
- is learning the job and could use a little temporary support?

Finding a balance

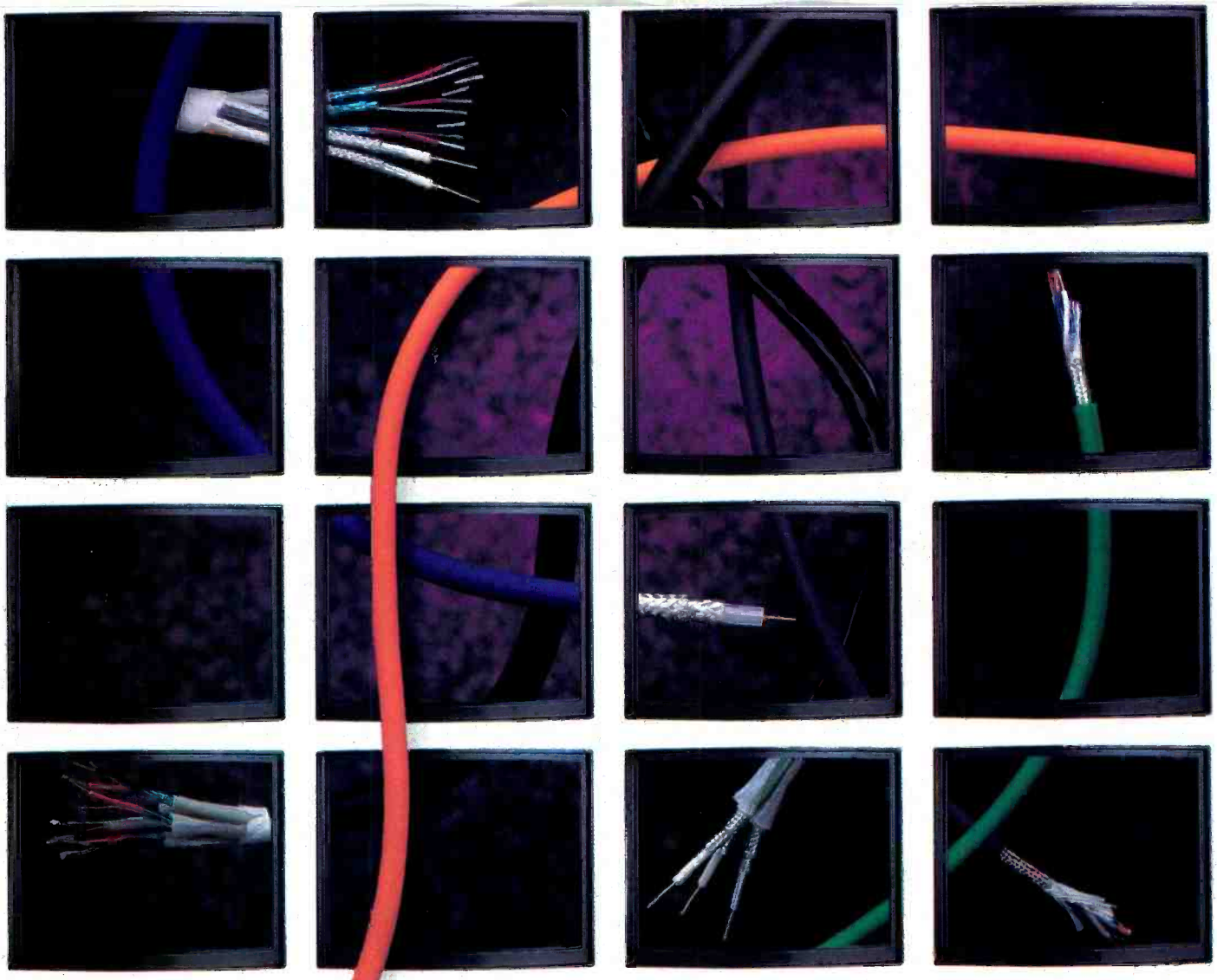
You may know people who automatically say no to everything. This is as counterproductive as saying yes when you don't want to. People who always say no quickly lose their credibility. More important, they lose administrative control. Almost any staff can find a way to develop an informal system to circumvent the no. The secret to success is balance.

How to say no

Many times, how you say no will determine the effect of your decision. First, get hold of your own feelings. Do not cloud the issue with anger, blame or frustration, and do not personalize either the request or the consequences of your refusal.

Be clear. Don't say "maybe" to avoid no. If appropriate, explain the reason for your refusal. This lets people know there was a reason for your response. They don't have to agree with you, but their resistance and resentment is minimized when they understand your reasons. At the same time, avoid pat answers because they create unnecessary resentment.

There are many times in your life when you should say no. Learning how and when to say it gives you more control over your work load, reduces stress and makes you a better manager.



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Has improved technology ever eliminated your job? It happened to me. Years ago, I worked for the telephone company. You know, back in the dark ages when Ma Bell was the only phone company in town.

A part of my job was to remove disconnected telephone equipment. From complex PBX systems down to the single-line residential telephone, if the service was disconnected, I was supposed to remove the hardware. Being young and not so savvy, I felt I had it made — a good, secure job and the future looked bright. Little did I know that the position I held would soon be eliminated by new technology.

I recall learning of something called the modular jack. It was touted as the answer to installing and removing telephones. Once implemented, all the phone company had to do was turn on the line from the central office. Home owners would install and remove their own equipment. Imagine the money the phone company would save in installation and removal costs.

I thought it could never happen. Telephones were too complex for mere humans to understand. Technology couldn't eliminate my job.

Needless to say, I was wrong. A small piece of improved technology, the modular jack, helped revolutionize the way customers and telephone companies operated. In the process, the job I once held was eliminated. Even so, I think most would agree that the customer was a primary benefactor of the new development.

The reason for this long-winded (and true) story is to show that sometimes even small improvements can produce dramatic results in the way business is done. Similar improvements have taken place in broadcasting. One of the most common devices seen at facilities today is the satellite dish. Think of the tremendous benefits that technology provides. The Gulf War is an excellent example of how modern satellite communications can change how an entire world receives information. Satellite technology swept through the electronic media, providing tremendous benefits for radio and TV stations, cable systems and, most important, the consumer.

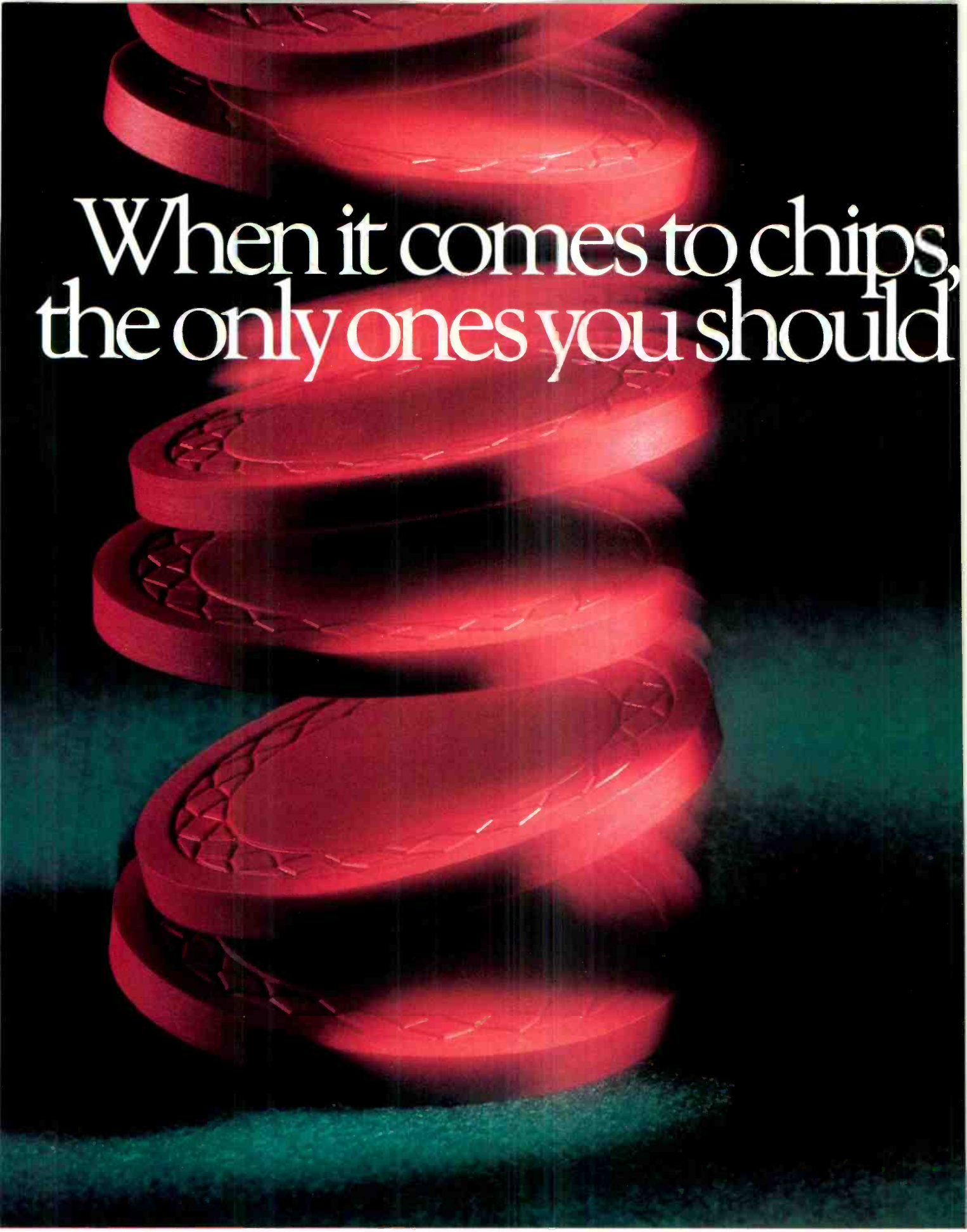
One currently moving technological front lies in automation. As radio and TV stations search for ways to perform on-air and production operations faster, cheaper and with higher quality, automation is increasingly seen as an answer.

Automation is more than executing repeated tasks reliably. The real power of automation lies in its ability to interconnect with other devices, thereby forming intelligent systems to integrate the tasks that must be performed in broadcast and production facilities.

Today's savvy engineering managers and GMs see automation as an answer to increased operating costs. Although reduced labor is one factor considered, there are many other benefits to automation technology.

In this month's feature lineup, we look at how automation can provide answers to some of the problems faced by today's managers and engineers. The answers typically lie in the effective and well-conceived implementation of the proper automation technology. Learn how your facility's operations can be improved through automation. From concept to implementation, the answers to implementing automation are provided here.

Brad Dick,
editor



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vertical smear to a mere −140dB in the BVP-370 and −105dB in the BVP-270. Taken together, these features combine to give you the highest quality CCD imager available.

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Purchasing automation: a manager's guide

Will your station benefit from an automation system?

By Steve Walker

Purchasing a radio automation system can be a somewhat frightening, not to mention expensive, process. Usually, it represents a step into unfamiliar technology. As with many new technologies, few station or engineering managers know all the answers. More likely, those going through the process for the first time probably don't even know what important questions to ask of potential vendors.

First, I'll outline an effective procedure to determine if automation makes economic sense for your station. Don't assume that simply installing any automation system will immediately reduce your operating costs. Nor will such equipment necessarily allow you to eliminate most of your on-air staff.

Second, you will learn some important questions you should ask equipment and programming vendors. Asking the right questions may avoid expensive mistakes, not to mention embarrassing on-air mistakes.

Walker is operations manager at Broadcast Automation, Dallas.

The role played by automation varies with each station. Although automation can be an effective way to decrease operating expenses, it should be implemented with caution by station management and engineering.

This article contains a feasibility worksheet that can help a station determine how much overhead can be reduced by using an automation system for various dayparts. Using this worksheet will provide a clear picture of whether investing in an automation system is worthwhile. It will also help you decide which systems and formats will fit into your station's budget.

Points to consider

Before conducting a purely financial analysis, you should answer the following questions. The answers will help you determine your station's basic automation needs. Some of these questions are best answered by station or engineering management, and some by automation vendors.

1. *On what media is your chosen format available?*

Possible options include cart, compact disc, DAT, reel-to-reel, 1/2-inch videocassette and satellite. The answer will define the hardware format for your system.

2. *What promotional material will come with your syndicated format?*

Many formats provide jingles, liners and promotional materials that will be of great use to your station. Some formats will not work well without these materials. You should consider carefully how to best take advantage of these support services. This may also affect your choice of equipment.

3. *Should you create your own format?*

In this case, you must decide what program format to use, and obtain all the program materials as soon as possible. Remember that you will have to transfer the material to your selected playback medium. Don't try to put your automation system on the air until the entire music library is prepared.

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AUTOMATION FEASIBILITY WORKSHEET

1.	Current monthly programming payroll.	1	_____
2.	Estimated monthly cost of automation equipment.[1]	2	_____
3.	Estimated monthly cost of syndicated format.	3	_____
	Or if you plan to produce your own format:		
4.	Monthly cost of producing your own format.[2]	4	_____
5.	What dayparts are you considering automating?		
	MORNING DRIVE: Current morning drive payroll	5a	_____
	MIDDAYS: Current midday payroll	5b	_____
	AFTERNOON DRIVE: Current afternoon drive payroll	5c	_____
	EVENINGS: Current evening payroll	5d	_____
	OVERNIGHTS: Current overnight payroll	5e	_____
	WEEKENDS: Current weekend payroll	5f	_____
	Total the costs listed on 5a through 5f and enter on line 5g.	5g	_____
	(Line 5g, therefore, represents the amount of on-air payroll that could be saved each month by automation.[3])		
6.	Subtract line 5g from line 1, and enter on line 6. *This is the amount of on-air payroll still required with automation.[4]*	6	_____
7.	Total lines 2 through 4 and enter on line 7. *This is the monthly cost of the automation system.*	7	_____
8.	Total lines 6 and 7, and enter on line 8. *This is your monthly cost of programming operations with automation.[5]*	8	_____
9.	Enter line 1 (monthly programming payroll) on line 9.	9	_____
10.	Subtract line 8 from line 9 and enter the amount on line 10. *This is the amount of overhead that could be saved each month by automating the indicated dayparts.*	10	_____

FOOTNOTES:

1. Lease or loan payment.
2. Include cost of production studio time and operator(s), plus materials and fees for air talent used in preproduced elements.
3. If any of 5a through 5f are "live-assist" mode operation, subtract cost of board operator or talent for this daypart(s) from line 5g.
4. Assumes the station retains its present salary structure for air talent.
5. If line 4 = $0, and line 3 includes price of satellite-delivered service, and one or more of 5a through 5f are planned as "live-assist" mode implementations, enter cost of producing local programming for this daypart(s) in line 4, and recalculate. (See article text, "Points to consider," item 4.)

4. *Will you automate all dayparts or just selected ones?*

Many stations keep certain profitable dayparts live to enhance their competitive positions. The automation can still be used for music and commercials during those dayparts (the so-called "live-assist" function), but little or no payroll savings will result. The automation system may, however, reduce on-air mistakes. Note that if the station uses a satellite-delivered music service, the automation system cannot provide music in the "live-assist" mode unless supplementary music sources are available on the system.

5. *Will you have someone on site at all times who can be responsible for updating weather announcements, changing liner carts and adding new spots?*

Yes, but it can be a secretary, someone from the sister station, a bright minimum wage worker, intern or even the general manager. "Babysitting" the automation system will normally take only a few minutes every few hours. For overnight and weekend operation, different systems offer varying amounts of "walkaway" time (a term for how long the system can operate unattended). Be sure you know how much walkaway time the system provides.

6. *Should you buy or lease your automation equipment?*

Leasing may provide extra benefits in some cases. It leaves your bank line of credit open for emergencies and usually results in lower monthly payments than a bank loan, so consider the options carefully. If you lease, don't forget to ask about the payoff clause. However, purchasing may allow you to take advantage of cash discounts. Depending on your situation, there may be tax advantages either way.

7. *Do you have adequate engineering help to maintain the automation equipment?*

Automation equipment, whether traditional or high-tech in nature, requires someone with knowledge about its operation and maintenance procedures. The best maintenance is usually provided through a full-time technical staff.

8. *Is the automation company you're considering reputable?*

Get answers to the following questions:

- How long has the vendor been in business?
- How long has the product/service been on the market?
- How many stations use its system?
- Will the company provide you with a list of its customers?
- Is installation and training available, and if so, at what cost?
- How much of its system's hardware is custom fabricated, and how much is "off-the-shelf?"

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9. *How much space will the equipment require?*

To speed the installation and training process, you'll want to make room for the equipment before it arrives. Make sure you allow plenty of space for operation and maintenance. Will any additional power, audio or control wiring be required? Will personnel access and security for the space present any problems? Remember also that the automation system's control functions and possibly the audio will be digital, so consider these additional points:

- Will existing ventilation to the space be adequate?
- Is the space subject to high RF levels?
- Is the AC power feed for the system clean and stable (this is extremely important)?

10. *Is the system expandable?*

This is perhaps the most important question of all, and one that is often overlooked. You may not want to stay with your chosen format indefinitely. If you decide to change, can you still use this automation system? Expandability is also not a simple yes or no issue, because it can refer to a number of different levels in the system. Can you add different types of audio source equipment, or will you have to start over?

What control protocols are used? Can the CPU be upgraded? Can the system software be easily updated or changed? Can other data storage components and peripherals be easily interfaced? Does the system have digital audio input and output (DIO) capability?

Other factors affecting the cost of automating

Now that you've answered some basic hardware questions, consider the human side of the equation. Answer the following questions to get an idea of how the system might affect personnel and your current business computer. The answers to these issues will further affect your final decision.

- What is the cost of maintaining the automation equipment?
- Will automation free important personnel to perform other needed duties, such as sales ("soft-dollar" savings)?
- Will this automation system interface with your traffic/billing system to automate that process as well?

Consider also that the initial cost of producing your own format will be higher than the cost of maintaining the format.

Finally, the operations/production manager or another appropriate staff member will have to be designated as automation administrator, and take charge of the automation system.

Feasibility worksheet

The simple worksheet on page 28 will help you determine if automation is an economically feasible alternative for your radio station. First, enter the appropriate figures in the spaces provided, and then perform the simple calculations shown. Some educated guesses will be required in a few places. You will also have to contact vendors to get approximate costs of automation equipment and syndicated formats or music services.

Use this worksheet as a starting point for determining how complete or partial automation might benefit your station. It is also highly recommended that you obtain references from syndicators and equipment suppliers. Be sure you understand the players first — some companies only make hardware, some only sell programming, and some do both. Among programmers, some offer their material to stations on prerecorded media, and some use satellite delivery. To save yourself time, learn about each company's strengths and weaknesses from its references first. Then you can visit or call vendors that seem appropriate and ask your questions.

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Implementing PC-based automation

A do-it-yourself approach to cost-effective, customized and reliable automation.

By Michael D. Rich

Many stations are looking for ways to reduce overhead without compromising quality. One way to achieve this goal is with do-it-yourself station automation through PCs. Although the PC or "microcomputer" does not have the power of a mainframe or minicomputer, it does have enough to do the job for most station automation applications, and at a reasonable price. The most distinguishing feature of the microcomputer is that its central processing unit (CPU) is on a single computer chip, which accounts for its small size and low price.

When selecting a microcomputer system for station automation, there are several key points to keep in mind. They include flexibility to use off-the-shelf hardware and software, ease in upgrading, redundancy, and availability of local repairs. Regarding hardware type, anyone who has looked into applicable hardware and software will find a wide variety available for the IBM-type computer. Among these, the most appropriate CPU types are those based on INTEL microprocessors 80286 and 80386 SX.

Rich is president of Media Computing, Phoenix.

Interface standards

Normally, microcomputers communicate with the outside world through input/output (I/O) devices, such as a keyboard, mouse, video display screen, printer or modem. When it comes to communicating with the station's character generator, satellite receiver, switcher, VCR, teleprompter, cart machine or robotic camera, a little more creativity is required. Nevertheless, the vast majority of (but *not* all) remote-controllable equipment uses one or more of only three communication techniques — RS-232, RS-422 (SMPTE) or TTL.

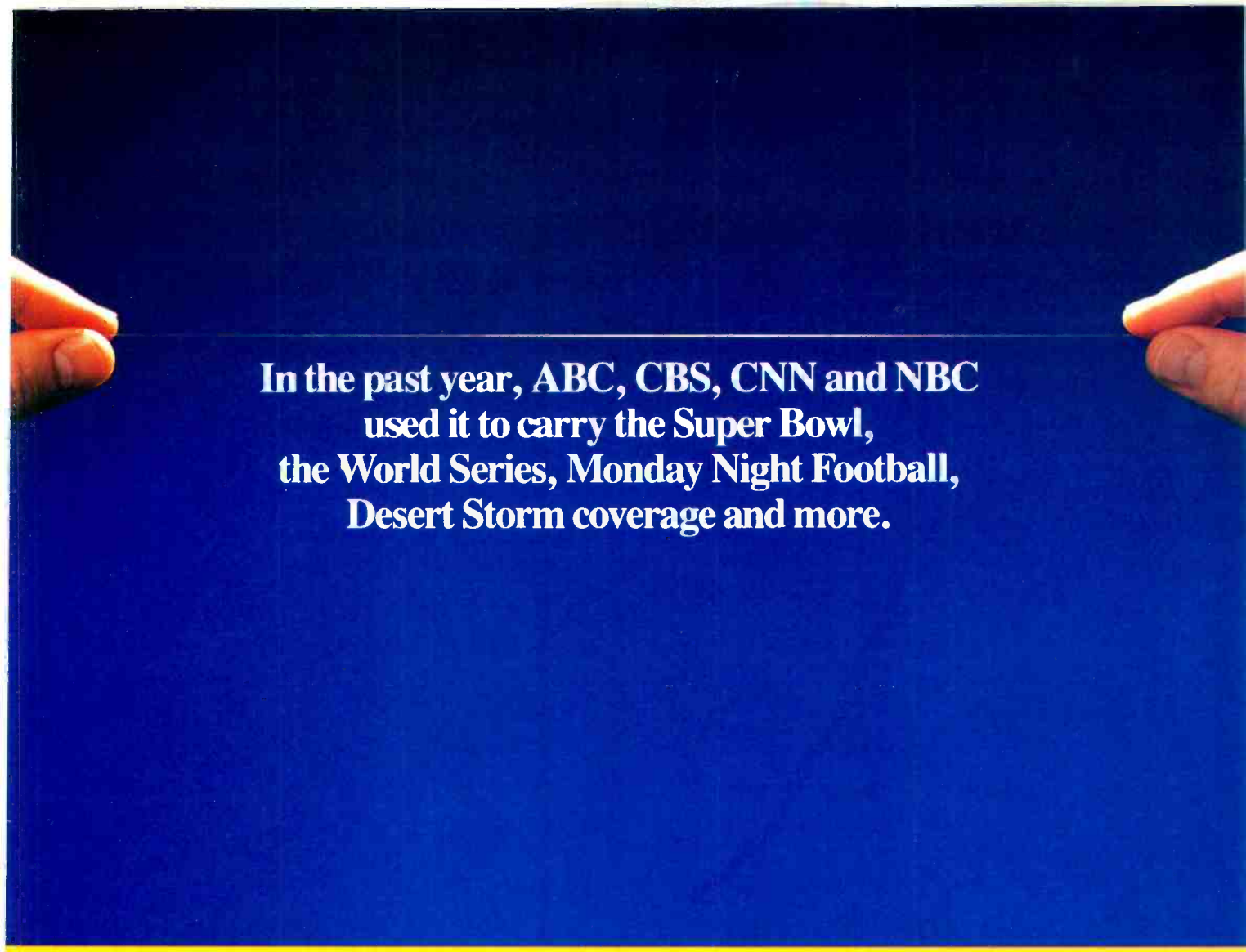
RS-232. In August 1969, the Electronic Industries Association (EIA) released its RS-232-C standard for "interface between data terminal equipment and data communication equipment employing serial binary data interchange." The international counterpart to this standard is known as the International Telegraph and Telephone Consultative Committee (CCITT) V.24. Except for some differences in nomenclature, it is similar to RS-232-C.

This standard defines an interface between a data terminal equipment (DTE) device (for example, computer, printer and terminal) and a data communication equipment (DCE) device, such as a modem, for the transfer of serial data. The standard is defined in terms of:

- Electrical signal characteristics. The voltage and current specifications, how these voltages relate to logical 1s and 0s, and the maximum transmission speed (20,000 bits per second).

- Interface mechanical characteristics. The assignment of 21 circuits to certain numbered connector pins and cable limitations (maximum 50 feet in length and 2,500pF of capacitance).

Continued on page 36



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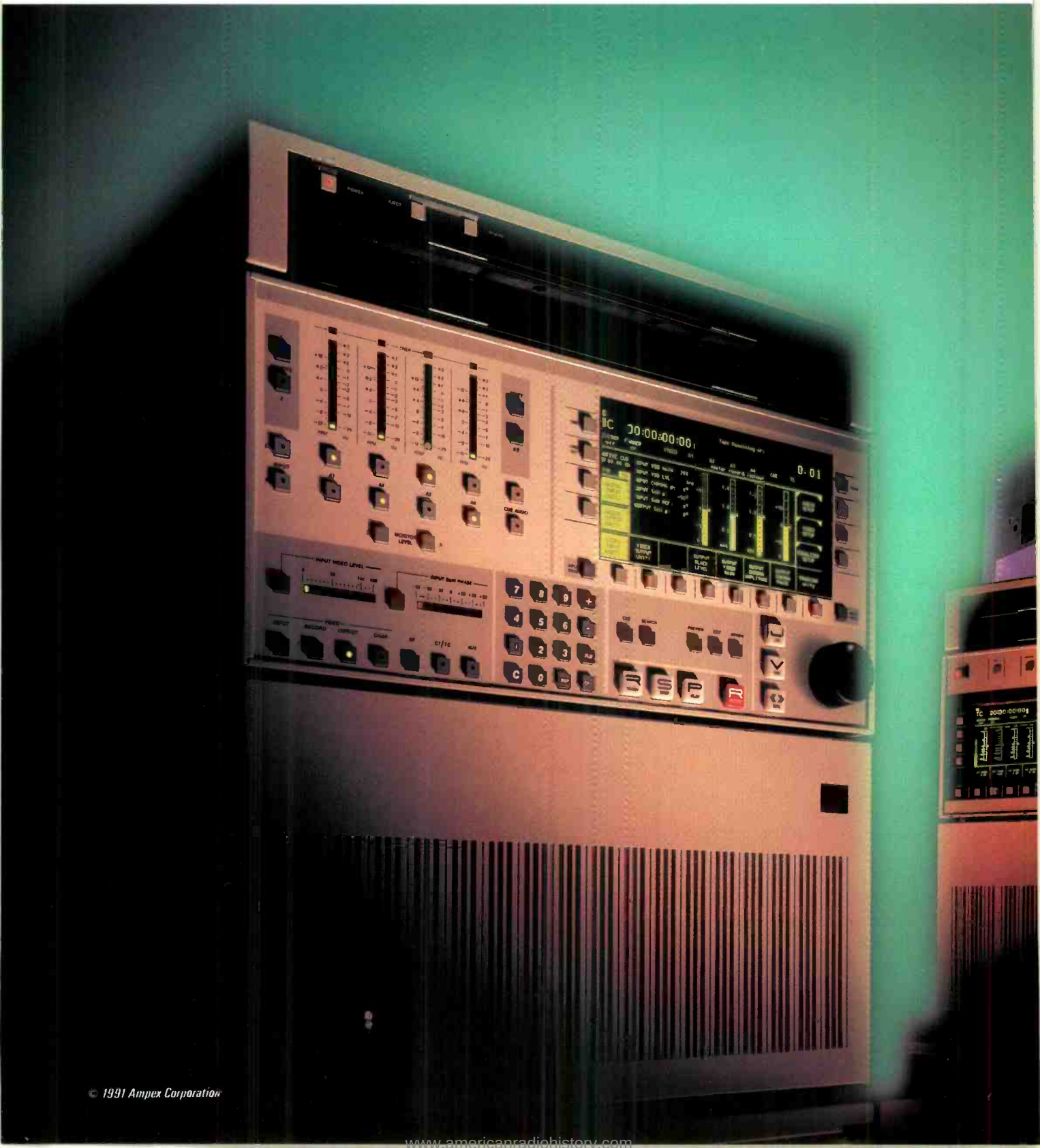

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That's why we designed an entirely new scanner for our D2 machines. And we managed to do it with an effective wrap angle of less than 180 degrees, so only one pair of heads is on the tape at any time. And we need only four head pairs for record/play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

To precisely handle all three D2 cassette sizes, we designed a unique vertical elevator and reel drive system.

To handle the tape gently yet be able to accelerate it to 60X play speed in less than one second (versus two to three for any other machine), we designed frictionless, air-lubricated tape guides.

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All this was no accident, of course. This transport mechanism was over five years in development. And the production version in all our recorders is actually the sixth generation design.

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Continued from page 32

• Functional description of the interchange circuits. The names and functions of the electrical circuits used.

• Standard interfaces for selected communications systems. Definitions of modem to terminal interfaces that are rarely used today.

Some of the aspects not addressed by the standard include:

• Type of data coding (ASCII, Baudot or EBCDIC).

• Character length (five, six, seven or eight bits).

• The number or type of start and stop bits or characters, and the type of parity or error-checking scheme.

• No provision was made for direct DTE to DTE interfaces, which are quite common today, and most likely the type of interfaces you will be using between the PC and the station's equipment.

When it's time to connect to a piece of broadcast equipment through its RS-232 port, the first thing you will need to find is its protocol documentation. Typically, this information is proprietary, inaccurate, incomplete, inconsistent or non-existent. This, added to the fact that the RS-232 standard is not really standard, is sure to give you hours (if not days) of challenging new opportunities, excitement, frustration and terror.

RS-422. Almost a decade after the EIA unveiled the RS-232-C standard, it released the RS-422-A standard in December 1978 for the "Electrical Characteristics of Balanced Voltage Digital Interface Circuits." The RS-422 standard is fully compatible with CCITT Recommendations V.11 and X.27.

This standard defines an interface between a DTE and a DCE (which is now defined as data circuit-terminating equipment) for the transfer of serial data. The standard also applies to "any point-to-point interconnection of serial binary signals between digital equipment." RS-422-A is defined in terms of:

• Electrical characteristics. A balanced voltage interface circuit consisting of the generator, the balanced interconnecting cable and the load.

• Environmental constraints. This includes data signaling rates up to 10Mbits and cable lengths up to 4,000 feet (at slower rates).

• Circuit protection. Generator and receiver (load) devices should not be damaged by open or short circuits.

• Optional grounding arrangements. Defines two signal ground alternatives and shield grounding.

The RS-422 interface is recommended for baud rates more than 20k, and for distances greater than 50 feet. Do not be concerned with a piece of broadcast equipment designed to be controlled via RS-232 that is more than 50 feet away. There are inexpensive off-the-shelf devices that can convert the RS-232 signal to RS-422, then at the other end of the long run, convert the signal back to RS-232.

The PC platform provides a basis for much of today's broadcast automation.

SMPTE. The Society of Motion Picture and Television Engineers (SMPTE) formed technical committees to develop standards that could be used for digitally controlled broadcast equipment. The electrical and mechanical characteristics of the machine control interface are defined in the SMPTE 207M standard, while the software protocols are defined in the SMPTE RP113 standard. Electrically, the SMPTE standard is similar to RS-422.

Hooking up a piece of broadcast equipment through its RS-422 port using SMPTE protocol is considerably less challenging than its RS-232 counterpart. The SMPTE standard is readily available, making any troubleshooting or customizing a more straightforward process.

TTL. Transistor-transistor logic (TTL) can be used, directly or indirectly (through relays or opto-isolators), to control and/or sense status of various types of broadcast equipment. TTL may even be used to control and/or monitor equipment not designed for external communication. The following are some examples of TTL applications:

• Contact closure monitoring.
• Period and pulse width measurement.
• Event and frequency counting.
• Binary-coded decimal (BCD) interfacing, created by putting four TTL ports together with some programming.
• Using the general-purpose interface (GPI). Many pieces of equipment have a GPI designed to be attached to a remote switch. When this switch is pressed by an operator, it triggers the remote-controlled device to do something. A TTL interface can be substituted for the switch, and a PC can be substituted for the operator (or at least the operator's finger).

Interface cards

On the system board (motherboard) of most PCs, there are several open connectors called expansion slots. These slots are used to connect any optional equipment to the PC through the use of interface cards (expansion boards). An astonishing variety of cards can be stuffed into these PC expansion slots.

RS-232 and RS-422 interface cards come in many varieties. For example, it is possible to communicate with up to 16 different RS-232 devices through *one* interface card. For talking to multiple RS-422 SMPTE machines, an intelligent card designed to handle up to eight devices at high data communication rates can be used. The intelligent boards (those with on-board processors) will handle much of the processing overhead associated with the more demanding multichannel communications at high speed.

TTL interface cards also come in many varieties. However, the selection is not as wide and varied as the serial cards. A single card can contain nearly 200 programmable I/O channels. A single, inexpensive card can handle 32 input and 32 output channels. For more information regarding the use of PC-based control cards, see the continuing series of columns in "Circuits," which began in the September 1990 issue.

Through these methods, a simple PC with just a few slots available can control a large amount of station equipment.

Local area networks

If station automation needs require more than one computer, or if remote-control instructions must come from more than one location, consider a local area network (LAN). A LAN links a number of personal computers together. This allows network users to share equipment and information. Some important LAN parameters include:

Speeds. Inexpensive LANs that run on the PC's RS-232 port are available. They usually limit throughput to 9,600 bits per second or less. Faster transmission is too much for serial ports to handle. An alternative is to use one of the many available internal adapter cards to route the I/O datastream between the PC and the network cable via their own port. These types of LAN adapter cards can reach speeds of 10Mb per second. The choices

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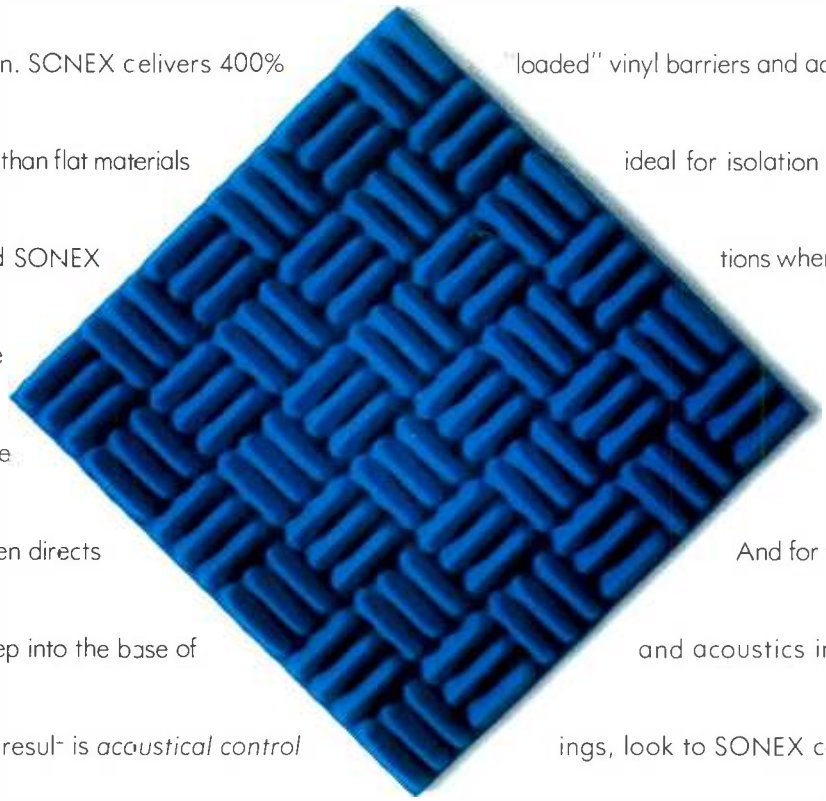

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available offer several different performance/price alternatives.

Topology. Topology refers to the physical layout of a network. To find the best topology for a particular situation, you must take into account the location of the PCs, cable run alternatives and budget. Four basic interconnection topologies include: bus, star, daisy-chain and ring networks. (See Figures 1-4.)

Bus LANs are either of the linear topology, in which all network stations tap into a single line of cable, or the daisy-chain type, where the LAN passes "through" each PC and there are two network connections at each PC. In a ring network LAN, PCs are arranged in a closed loop, and a message may have to pass through several other PCs before reaching its destination. Star network LANs connect all PCs to a central location, not directly to each other.

A particular LAN can also combine two or more of the above topologies to arrive at the most appropriate and cost-effective approach.

or more components fail, the others can continue their work. As more work is added, more computers can join in. Therefore, as the system's workload increases, its processing power (its ability to do the work) also increases. If the processing job can be divided into individual tasks (such as controlling individual pieces of broadcast equipment), then distributive processing is the suggested approach.

I suggest using the centralized processing method ("putting all your eggs in one basket") for work that cannot be divided into separate tasks. For example, determining a major airline's flight schedule is an ideal application for a central mini or mainframe computer.

Automation possibilities

How do you determine if a particular task is a good candidate for PC automation? This is a good question, but not a tough one. If the task has an identifiable and repetitive pattern, it is a good candidate for automation. If a task cannot be done by a person because of too many simultaneous actions or critical interactive timing, it is also a candidate for PC automation, but only if it occurs on a regular or frequent basis.

The following are some specific examples of possible automation at a typical broadcast facility.

Continued on page 42

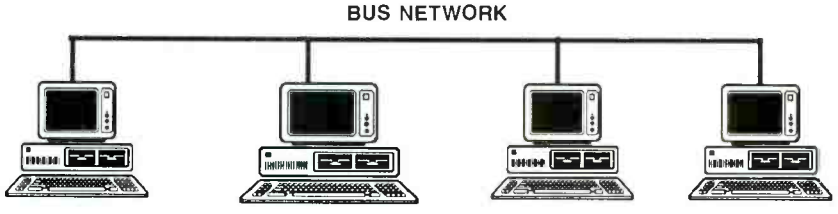

Figure 1. *Linear bus LAN topology in which all network stations tap into a single line of cable.*

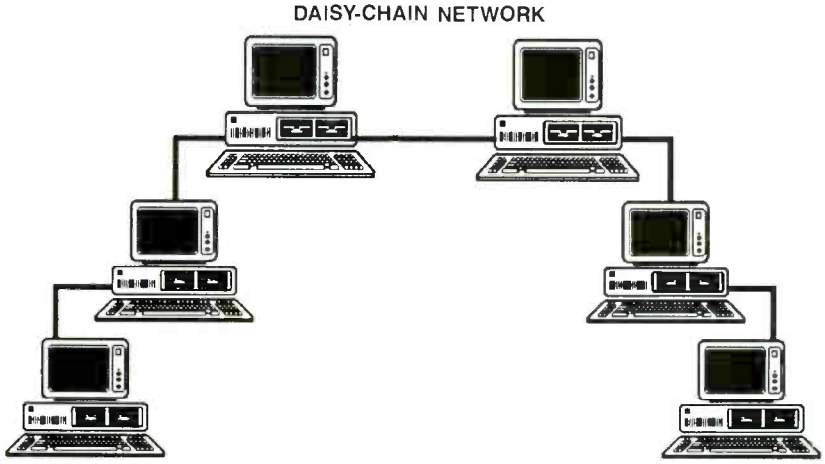

Figure 2. *Daisy-chain bus LAN. Note that two network connections exist at each PC.*

Processing methods

Two types of data processing methods are *distributive* and *centralized*. The distributive processing method divides the work to be done, and spreads it out among multiple computers. This means that no one unit is central or critical. If any one

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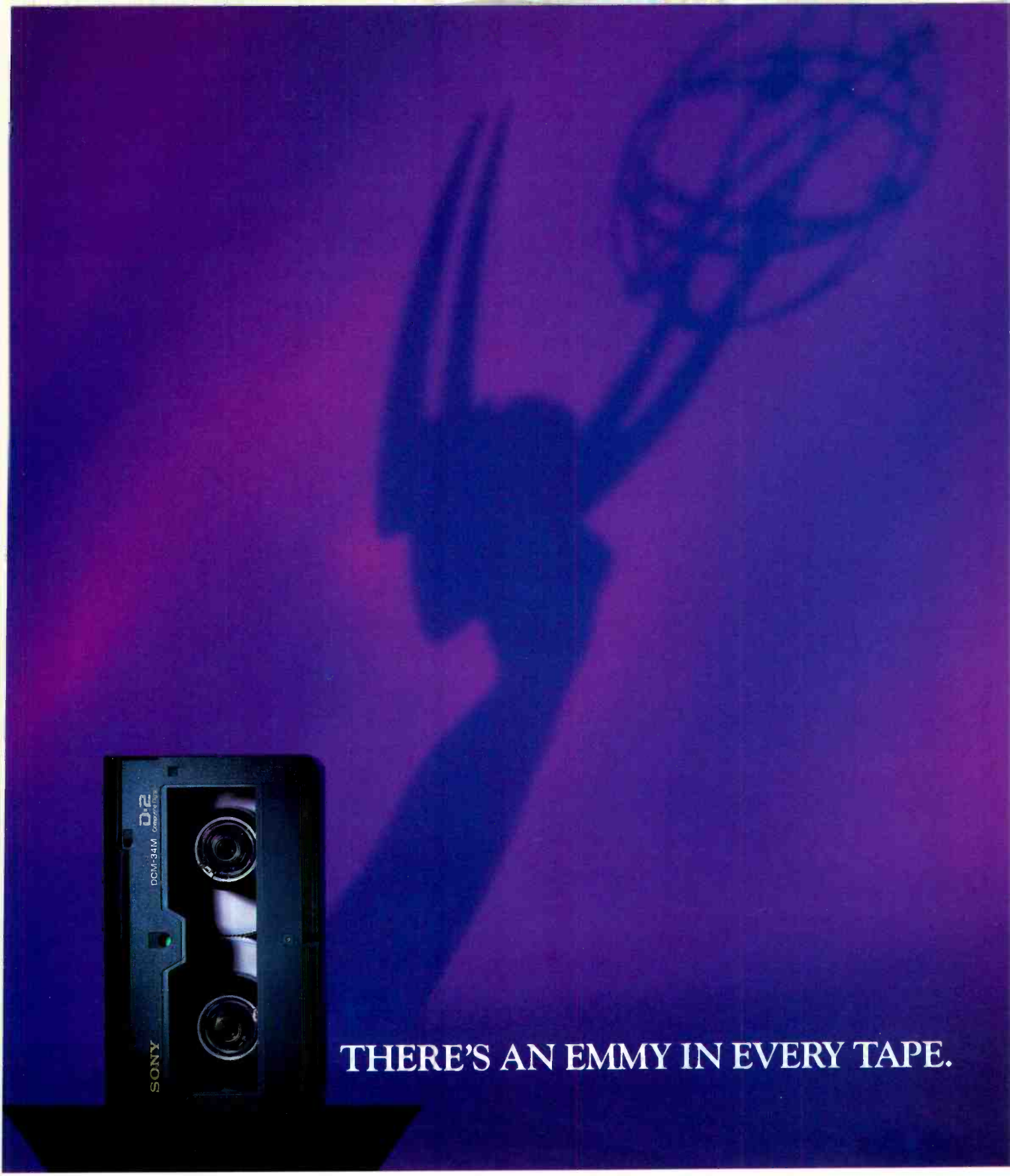

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Continued from page 38

Master control

Weather emergency crawls. Most weather emergencies seem to occur when a character generator operator is not available. This means someone in master control has to figure out how to get a crawl out of the CG before the storm passes through. With PC automation, a graphic artist can select the font, color, positioning and speed of the crawl. In addition, a CG operator can program the PC to execute the crawl, all in advance, during normal business hours. When the storm hits, master control only needs to type in a simple command or the text of a message on the PC's keyboard, and leave the rest to the automation system.

Recording satellite feeds. This is a classic example of a pattern that is identifiable and repetitive. It tends to bore people, and, therefore, may lead to mistakes. The pattern: Aim the dish at a particular satellite, tune to a particular transponder and record on a particular tape machine, starting and ending at specific times. The repetition: Do it every day.

Network tape delays. This is similar to recording satellite feeds, but more sophisticated. The system records on multiple tape machines, rewinds and plays back after a delay.

General machine control. Much of today's broadcast equipment is designed to be remote controlled. Remember, if a machine is used in a particular pattern and that pattern repeats, you probably can automate its use.

News applications

Wire service management. Wire services require labor-intensive searches through rolls and rolls of copy paper. Automating this process enables the newsroom to receive wire copy directly into a

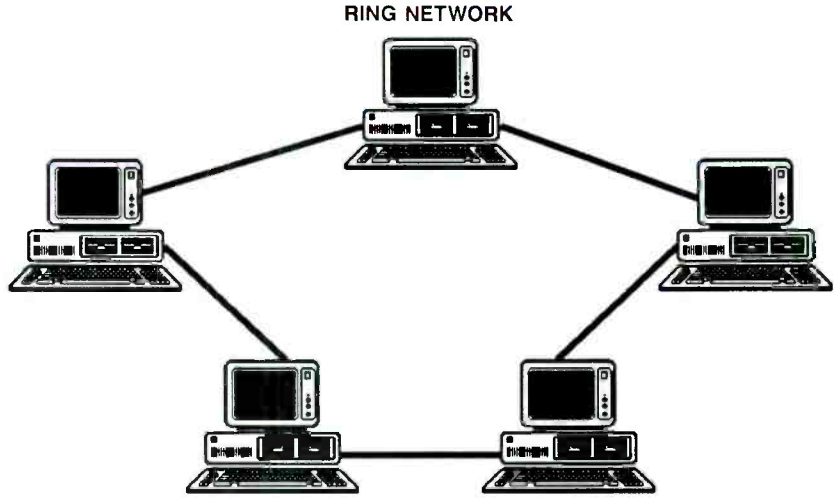

Figure 3. *Ring network LAN. PCs are arranged in a closed loop, and a message may have to pass through several other PCs before reaching its destination.*

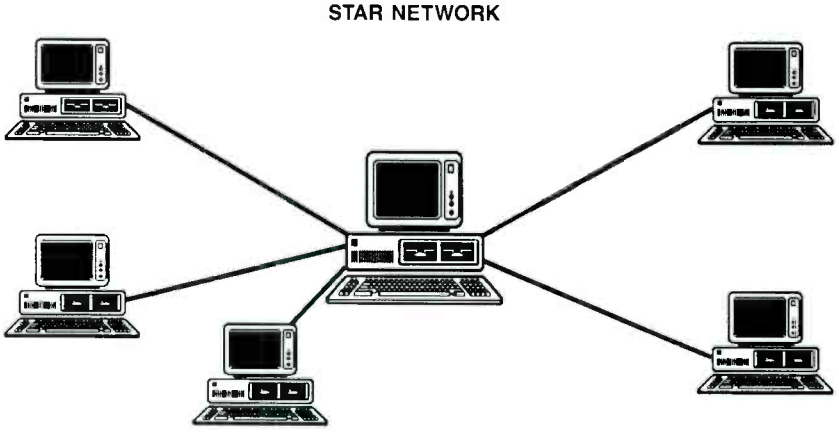

Figure 4. *Star network LAN. All PCs are connected to a central location, they are not connected directly to each other.*

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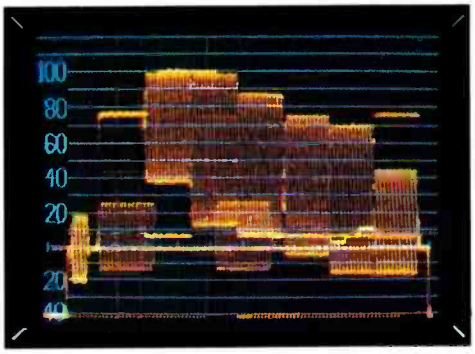

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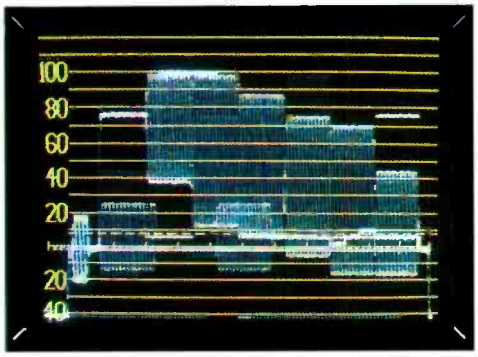

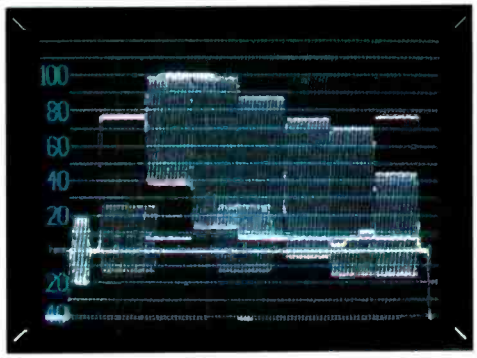

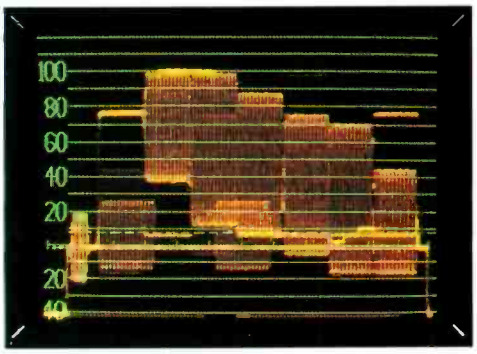

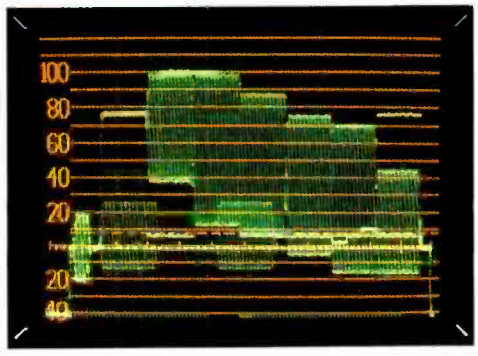

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PC. Stories can then be retrieved from easy-to-read summaries by news category or via key word searches.

Rundowns. In a manual environment, the news producer rundown is also a labor-intensive effort. The producer must correctly calculate backtimes, and then each time a change is made, must recalculate them. An automated rundown automatically calculates backtimes based on the show length (regardless of the changes made on stories' sequence or lengths); allows easy content changes by inserting, deleting and moving information; displays constant status of calculated show length (too long or too short); and can provide special keys (macros), so the producer can easily enter frequently used words or phrases.

A simple PC with just a few slots available can control a large amount of station equipment.

Script creation. Using an off-the-shelf word processor to write scripts can automatically format copy into script format and allow for easy changes (no strike-overs) in the text. Macros can be defined for frequently used phrases to reduce the number of keystrokes required by the reporter.

Prompting. Prompting can be completely electronic (no paper) by using the electronic versions (files) of the scripts, and displaying them directly to the prompter screens. Going a step further, the rundown program can automatically order the electronic scripts for the prompter. When changes in story order are made in the rundown, the prompting order will also be changed.

Closed-captioning. Closed-captioning can be automated by linking it to the automated prompter. As information is displayed in the prompter, it can be sent to the closed-captioning system. Therefore, as the speed of the prompter changes, the speed of the closed-captioning can change.

Supers generation. Supers or captions can be automated by having a program scan all of the scripts (in rundown order) for super information, then translating it to something the character generator can understand and loading it onto the CG. This can be used not only for news, but also for sports, weather and school closings.

Elections. Automation can be accomplished by scanning wire service stories for election data. Then, the data stripped out of the stories can be converted and loaded onto the character generator — all without human intervention.

Tape archives. Toss out your index cards and tape library lists. Automate tape archives through the use of off-the-shelf database software. This provides you with the ability to search for information by key words, ranges of dates, reporters or photographers in seconds instead of hours.

Phone directory. The same off-the-shelf database and strategy previously described can be used here, substituting contacts for tape numbers.

Assignment desk. Automation of the assignment desk can also be accomplished with off-the-shelf database software. Assignment information can be entered into the system and posted with some future date. An assignments report is then generated each day, showing all of the assignments for that day. The entries could have been made last week or last year.

Electronic mail. E-mail can reduce the paper flow throughout the newsroom or station. It is simple to use, and provides a fast means of communication for sending an advisory to staff, specific individuals, or for simple notes between staff. (See "Trends in Newsroom Automation," page 48.)

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Administrative applications

Off-the-shelf traffic systems can produce traffic reports, sales reports, tracking of bumped spots and other data. The traffic system can be linked to accounting systems to handle accounts payable, accounts receivable, payroll, general ledger and more.

Scheduling software is also available. It can track staffing, studios, rooms or pieces

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of equipment. It can also display their availability, help arrange and rearrange meetings, schedule rotating shifts, provide for days on/off, and keep on top of other logistical tasks.

Inventory systems can also be implemented from off-the-shelf packages. These can monitor the station's stock of depletable items and their costs, and track receipts, quantity on hand, and amounts allocated or on order. Long-term inventory records and analyses can also be prepared, which helps to optimize cash flow and determine "just-in-time" reorder points.

Programmable automation system

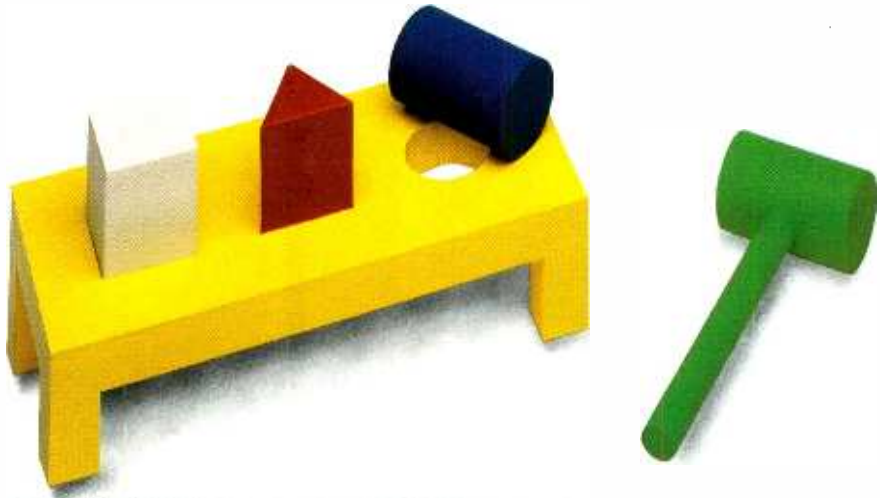
Until 1988, automation systems were designed and programmed to perform their various tasks before they were delivered to the user. Now, true user-programmable automation systems are available. The publisher provides a programming language (the automation equivalent of BASIC, COBOL, C or PASCAL), and rules on its use; the rest is left to the user. A programmable automation system language includes commands such as PLAY, STOP, TIME-CODE SENSE, POSITION TO, FONT 4, RED, CENTER ROW, IF..., THEN..., ELSE... and the like. For example, a portion of a VCR control system might look like this:

```
100  TIME-CODE SENSE
     DISPLAY TIME CODE
     IF TIME CODE IS LESS THAN
     28:50:00 THEN 100
     REWIND
200  STATUS SENSE
     IF STOP THEN 300
     TIME-CODE SENSE
     DISPLAY TIME CODE
     GOTO 200
300  EJECT
     DISPLAY "Done with tape"
```

Just as you could use BASIC to program an accounting system, a time management program or a computer game, the automation programming language can create a network tape delay system, a system to automate weather emergency crawls, control robotic cameras or cart machines and more. The user can design the information entry screens, the general look and feel of the system — the whole thing from start to finish. The system will have an opening menu of the various applications that have been programmed. The user selects a task to run, and away it goes.

If station automation needs require more than one computer or control location, consider a local area network (LAN).

No two broadcast facilities are alike, but most of them do a lot of the same things every day. Automation with the PC approach discussed here can assure that any broadcast organization can apply the advantages of computer control to its facility, with the specific level, method and cost that it desires, while retaining an open-ended potential for growth in the future. |:-)))|



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Trends in newsroom automation

PC-based systems and machine controllers are making news.

By Skip Pizzi, technical editor

The automated newsroom is changing fast — a unanimous impression held throughout the industry. In a world previously populated by mainframes, minicomputers and large proprietary platforms, the switch is on to PC/LAN systems and an open architecture approach. Newsroom computers are also extending beyond the realm of text, and into the rest of the news studio hardware.

The trend toward PCs seems to be primarily cost-driven. The larger systems of the past have nearly saturated their relatively high-end market, which is limited to networks and mostly major market stations. PC/LAN systems provide a lower cost entry point and easier incremental growth, making newsroom automation more attractive to the smaller operation. The increase in computer literacy that has come about at these stations from their use of computers in other areas (and concurrent reduction in "technophobia" among staff) has also paved the way for the PC/LAN approach. Furthermore, the increased capability and reliability of PC hardware has enabled such systems to rival the performance that was only possible from bigger systems in the past.

Basic system functions

Within this new framework, however, most of the basic elements of a newsroom computer system have not changed. They still include:

Newsroom automation involves more than text editing. Shown here are terminals of the WHDH-TV newsroom system, which is integrated with stationwide automation. (Courtesy of WHDH-TV.)

- *Wire capture.* An interface to incoming newswire services that loads and manages wire stories directly to data storage (typically magnetic hard disk), replacing all teletype machines.

- *Script writing/filing.* A word processor optimized for news copy writing, display and storage.

- *E-mail.* An electronic message system between users on the system.

- *Assignment.* An electronic assignment board for delegating, managing and scheduling stories and crews.

- *Archiving.* A filing and database system for storing copy and tape ID information from previous stories, typically including heavy cross-referencing ability.

Machine control

What is new in terms of function involves the expansion of the newsroom computer beyond the pure data collection

and manipulation range, into the full newscast delivery mode. New means of intelligent interconnection are being developed between the newsroom computer and the other automatable hardware elements used in a TV news broadcast, such as switchers, VTRs/VCRs, video library management systems, audio mixers, character generators (CGs), still-stores, captioning equipment, and even robotic camera control. This function is included in most of the newly developed PC-based systems, but it is also being featured as a proprietary hardware and software upgrade to older mini/mainframe systems. In either case, the control of outboard hardware isn't simply a matter of switch closures and control voltages, but an interactive, smart function performed by one or more dedicated PCs or proprietary microprocessor-based controllers. Each carries out orders from — and reports status back to — the main newsroom computer or network. (See Figure 1.)

Theoretically, this type of system allows anyone at any terminal to program commands into a story or rundown that controls everything used in the newscast. For example, as the lead copy to a report is read by an anchor, the camera zooms in a bit, and the anchor's name flashes across the bottom of the screen for three seconds. Then, the camera pans left to make room for a slide over the shoulder that is called up and switched in, and an already cued videotape is prerolled then taken (video and audio), and the announcer's microphone is closed. All of these commands (and more) could be written along with the anchor's copy, and updated just as easily. However, actual applications may not be as comprehensive or easy. In some facilities, this level of control may raise jurisdictional flags.

In fact, manufacturers of these systems report that providing these functions in a comprehensive, flexible and reliable way is quite a challenge. The wide variety of "automatable" hardware in use at stations, and the variation in the control protocols used, make the attainment of complete

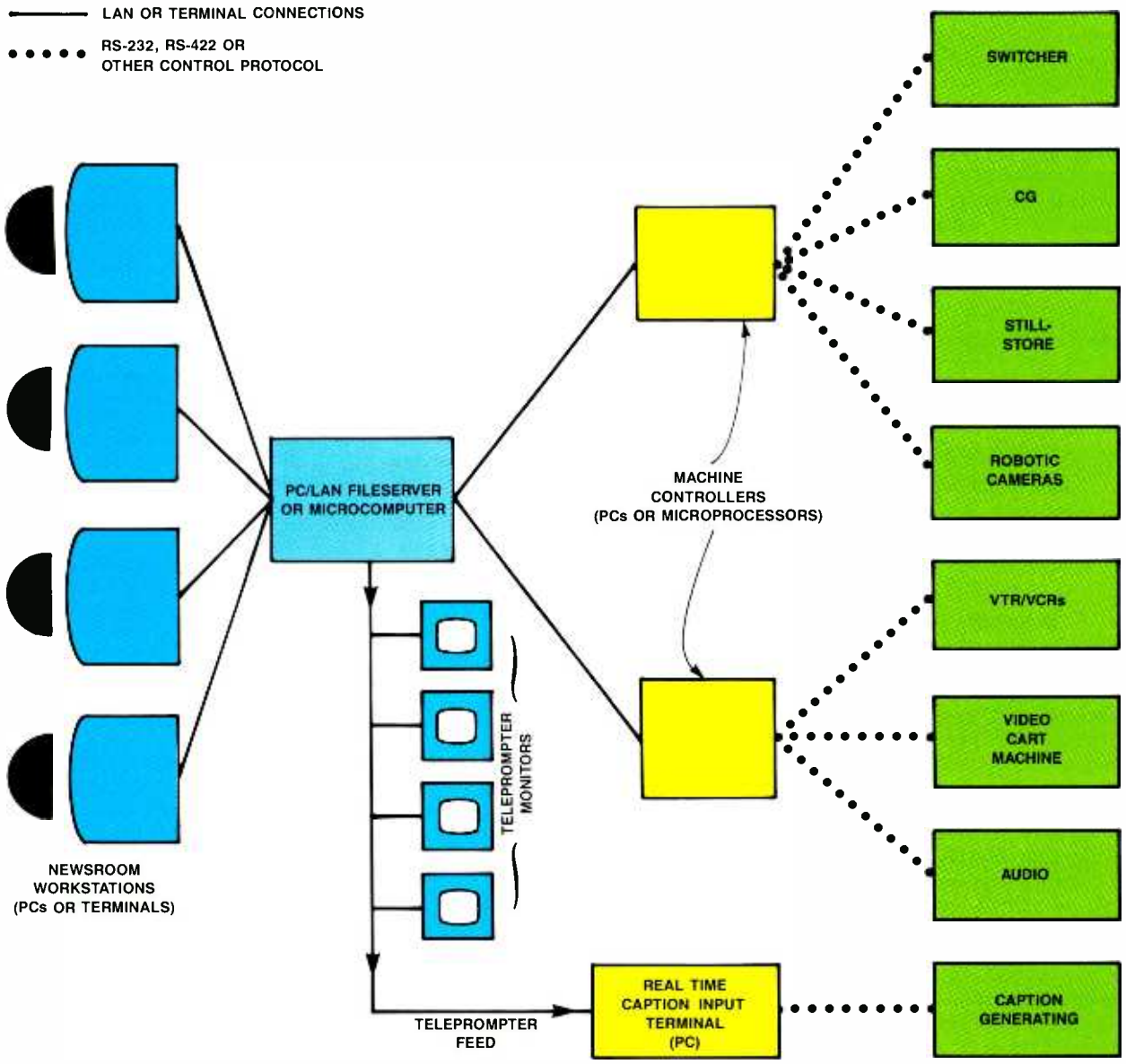

Figure 1. *Basic block diagram of newsroom computer system, including machine control.*

newscast automation difficult. Some newsroom automation companies limit the peripheral hardware that their systems will support. Others offer optional services for custom software packages to control unusual equipment or configurations. No matter what hardware is used, every station does things a little differently. Therefore, customizing is the rule, not the exception.

The trend toward open architecture in hardware and software may simplify these matters. In addition to easing hardware interface and configuration problems, it could permit the simple upgrading of software by including another company's application. This approach would allow an incremental cost breakdown of the system and provide for affordable expansion as needs grow. A greatly simplified model for understanding this approach is to consider it as an overgrown PC. Adding a pop-up calculator is a simple commercial software upload, and properly controlling an outboard device within an application is like loading the right printer driver file.

In the case of a CG, some systems now allow the newsroom terminals to fully emulate the CG keyboard, avoiding all need for data re-entry or manipulation by the CG operator.

Newsroom automation is no longer being measured against savings in paper, ribbons and copiers.

Reliability is critical

Speed and redundancy are issues of special consideration in a newsroom automation system. No matter how much resistance is shown to a system's introduction at a station, once one is installed and adjusted to, a much louder cry from the staff will go up if it fails (especially close to airtime). To avoid slowdowns and crashes, systems must be specified with sufficient capacity and redundant design. Projecting needs for a newsroom computer system based on current non-automated newsroom output is a common error. Typically, newsroom output can double within the first few months of a computer system's implementation, and its capacity can be sorely taxed. This increase in productivity is one of the great advantages of newsroom automation, but system capacity must be large and fast enough to handle such quick and early growth. For PC/LAN systems, star, ring or dual-bus systems are preferred to a chain system in which one terminal's failure can lock up the entire network.

Assessing a system's value

Newsroom automation is no longer being measured against savings in paper, ribbons and copiers, but in terms of increased output per staff position and in reduced on-air errors. Although the latter is not really a tangible commodity, it can pay dividends in a competitive position. A similar attribute involves fast and comprehensive archival access, in which the station that voices-over file footage on a late-breaking story does a better job than the straight talking heads that the competition used.

An automation system may replace some lower echelon staff, but often it frees the staff for more creative work. It can also perform functions that no practical number of staff could, on a reliable basis. This can also be turned to competitive advantage. Full, real time closed-captioning on all newscasts is a good example of this. One new PC-based product in this area combines the teleprompter feed of a news-

On the horizon

By Karl Renwanz

TV stations need no reminding about the increased competitiveness of their business. Most major markets today have two-thirds cable penetration, which spells big competition for viewers. With VCR use on the rise and many cable systems offering 80 channels or more, broadcasters are struggling to maintain their revenue shares. As more stations face the difficulty encountered on the revenue side, engineering and operations management must find new ways to do old jobs. Objects on the technology horizon must be brought into focus in order to maximize internal efficiency and reduce costs.

Integrated technologies

Up until now, machine control has simply been a hardware interface between the newsroom computer and devices, such as character generators and still-stores. These technology displays made great NAB exhibits, but often failed in the real world. Writers and producers had to include complicated, and sometimes, obscure "macro" sequences in their scripts to load and partially control these devices. Often, an operator was still required to control on-air recall, so the savings were not as great as predicted.

It is time to stop talking about system interfaces and make them happen. At WHDH-TV in Boston, various available technologies are being integrated in order to redefine efficiency. In the next year, advancements in machine control will be made that will offer TV stations the opportunity to realize true efficiency.

Truly useful systems will offer easy ways to choose from on-line databases of style sheets for character generators and on-screen display of graphics. Novices will be guided by prompts and the hypertext help displays from state-of-the-art software.

Advanced users will find powerful customizing tools at their disposal. On-line help will be customized for each particular task. Routine or repetitive tasks will be minimized or fully automated. Character displays and all scripts will automatically be spell-checked. Robotic camera shots, when inserted into the script, will be instantly checked for possible time conflicts or collisions. This will prevent any attempt to do something that cannot be done. The same rules will follow when a producer makes a change during the broadcast.

Air operations personnel will have their program logs automatically downloaded via computer to the air operations playback machine, which does automatic conflict resolution internally, makes the necessary digital dubs, and stands ready to perform all breaks — all without human intervention.

Investing in this technology allows even large market stations to have only one operator run master control and air operations playback with accuracy. Satellite recording can be done by a self-contained machine that houses all the necessary tapes for recording satellite feeds, automatically steering the dish to the appropriate satellite, choosing the transponder and subcarriers, and routing the signals into the recorders. The off-satellite recording schedule, generated in the programming department, is downloaded to the record machine and automatically recorded, including a backup (if required), and stored for later broadcast The playback function occurs automatically when the program log calls for the program to air.

News and programming show production will occur in an environment filled with computers and fully interactive machine control. With current systems offering scripting, electronic prompting, captioning and some character generator interfaces, what's around the corner offers a new frontier. The measurement of success will go beyond a good demo by reducing operating costs at a station, along with a more automated, error-free broadcast schedule. In reality, this means operating your facility with less personnel.

Renwanz is vice president, engineering and operations, WHDH-TV, Boston.

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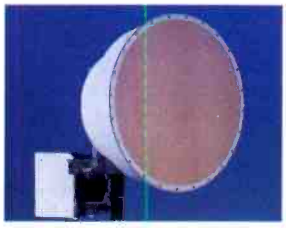

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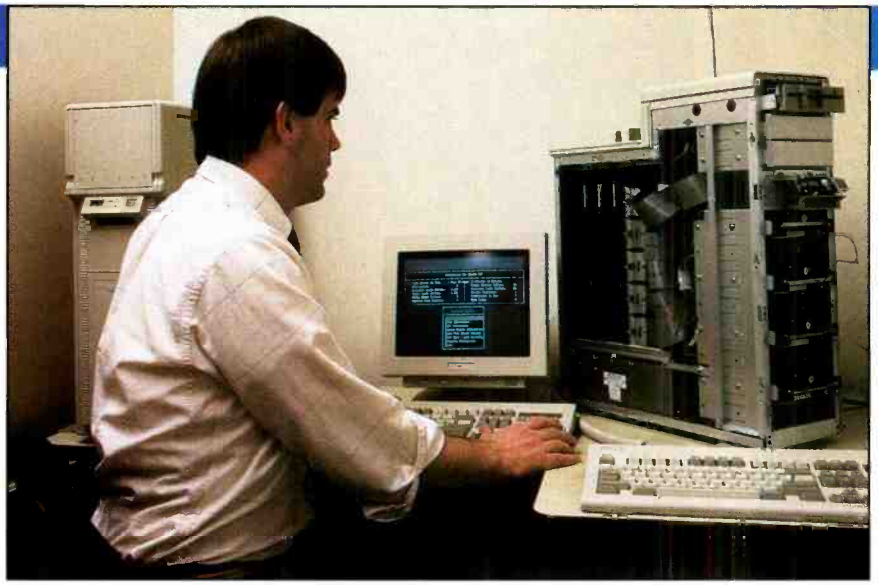
Continued from page 50
room computer with a "steno" keyboard input function for real time transcription of live interviews or actualities, and delivers this complete newscast text to the station's closed-caption generator.

Among future applications for newsroom automation may be SNG receive automation, featuring computer-controlled dish-pointing, demod tuning and recorder start-up. Another foreseen option involves multiple output streams, for the newsroom of the future that may be producing newscasts and news feeds for more than one broadcast station or network/cable channel simultaneously.

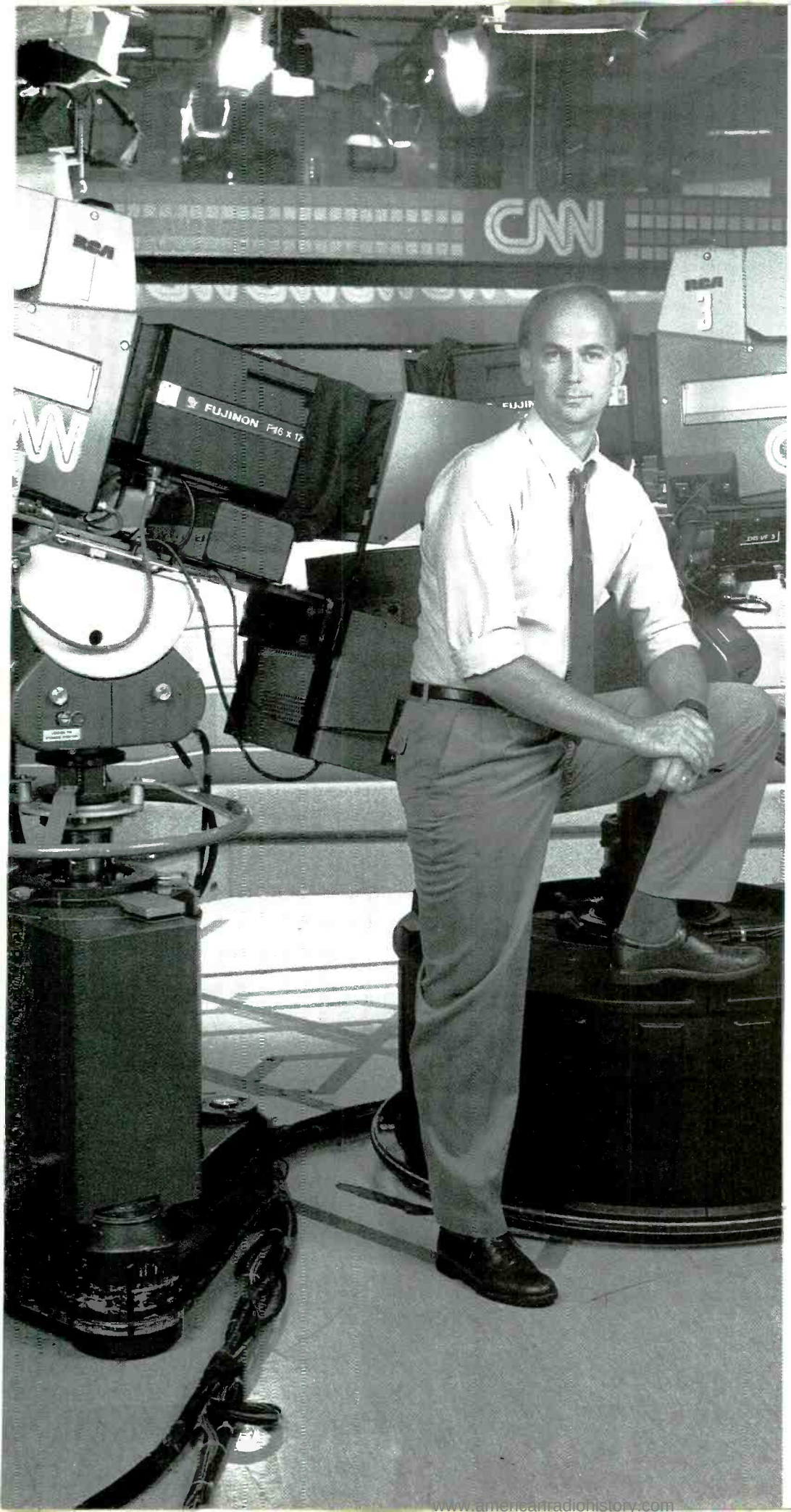
The PC approach to newsroom automation will indeed allow a wider scale of users to employ its many virtues in their journalistic pursuits. Modular expandability is an asset of these systems, but the prospective purchaser should bear in mind that such expansion will have finite technical limits. In addition, a PC/LAN approach may reach an economic point of diminishing returns even before it hits hardware limitations, when compared to comparable, up-to-date minicomputer/distributed terminal architecture. The rate and scope of projected newsroom and budget growth will have great bearing on this decision.



Modern newsroom systems may be run by PC-based computers, as shown here, or minicomputer platforms. Both designs offer the user certain advantages. (Courtesy of WHDH-TV.)

The wide variety and changing nature of TV news operations today dictates the industry's need for these multiple approaches. It also compels engineering personnel to thoroughly study the advantages and values of any system under consideration, for present and future needs.

Acknowledgments: Thanks to Matt Danilowicz, Dynatech NewStar; Bob Paulson, AVP Communication; and Skip Boucher, Basys Group, for their help in compiling this article.



REMOTE? DID SOMEONE SAY REMOTE?

For CNN, the world's number one news network, *remote* is as close as A-F-A.

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From its headquarters in Atlanta, where it operates eight EPO robotic cameras—which utilize the AFA Roboped for an average of 18 hours a day—CNN can control the movements of two of the four cameras in its studio in Washington, D.C. and three of five cameras in its studio in New York City. And each of these systems can be controlled locally, too.

Of course, CNN's Andy Parsons knew exactly what he was doing when it was determined that robotic cameras were necessary for CNN to stay on top of the news *and* its competitors. Parsons and the world's number one cable news network reached out to A.F.Associates for the world's number one robotic camera control system—**the Radamec EPO!**

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RoboCam 2

The latest adventures of TV's cybernetic eyes.

By Skip Pizzi, technical editor

The corona shot of a solar eclipse accompanies a droning pedal tone. But the visual turns out to be an underlit soda can shot from above. This becomes clear as the camera drops down alongside the now frontlit can, showing its familiar logo. The camera angle quickly changes again, moving downward and tilting back to look up at the side of the can steeply from below. The can begins to spin. Now, the camera starts to move around the spinning can in the opposite direction, creating an odd sense of motion against the starry background. Continuing its rotation, the camera moves back to its original position, looking down at the can. On the scratch soundtrack, Strauss' "Also Sprach Zarathustra" comes to a crescendo.

It's another day at the office for RoboCam, now on patrol in a big-time commercial production studio. The client is thrilled with the shoot (after the 17 takes it took to get the dry ice entrance right), and can't wait to get the tape to post. But RoboCam is already being programmed for the next gig, in which mice will sing while riding in the back of a little pickup truck. "Better get an exact count on those mice as they come in," the studio manager muses. "Boy, the stuff I have to worry about in this job...."

Since *Broadcast Engineering* magazine's last in-depth look at robotic cameras ("RoboCam," April 1988), robotic camera technology has matured from its earlier whiz-bang initiation to a more considered tool of the trade. Its applications have been widened, and its hardware and software refined. As the novelty wears off, the true advantages of robotic cameras are being realized by manufacturers and users.

Robotic cameras are now marching beyond the newsroom and into the production studio where they are being considered for soap operas, game shows, other studio productions and increased remote sports applications. Other systems are also being developed for legislative chamber uses.

The studio applications have special appeal because of the robotic camera's attribute of repeatability. When the same scene is reshot several times because of other miscues, at least the camera work can be relied upon to be flawless and identical on every retake. Game shows often have fast-paced and recurring camera moves, with large zoom ranges on (relatively) stationary subjects — perfect for a robotic system.

For the field, the trend is toward smaller, lighter and more durable systems, with special emphasis on quick and easy setup. Pan/tilt and zoom/focus speed are also increasing in order to allow the wider and faster movement often required in sports coverage.

Another refinement in robotic studio cameras involves their capability for instant switchover back to manual operation. This saves time in a multipurpose studio when converting from an automated to a non-automated production. Camera heads needn't be dismounted from their robotic pedestals to be operated manually. Instead, they can be removed from robotic control with the flick of a switch on

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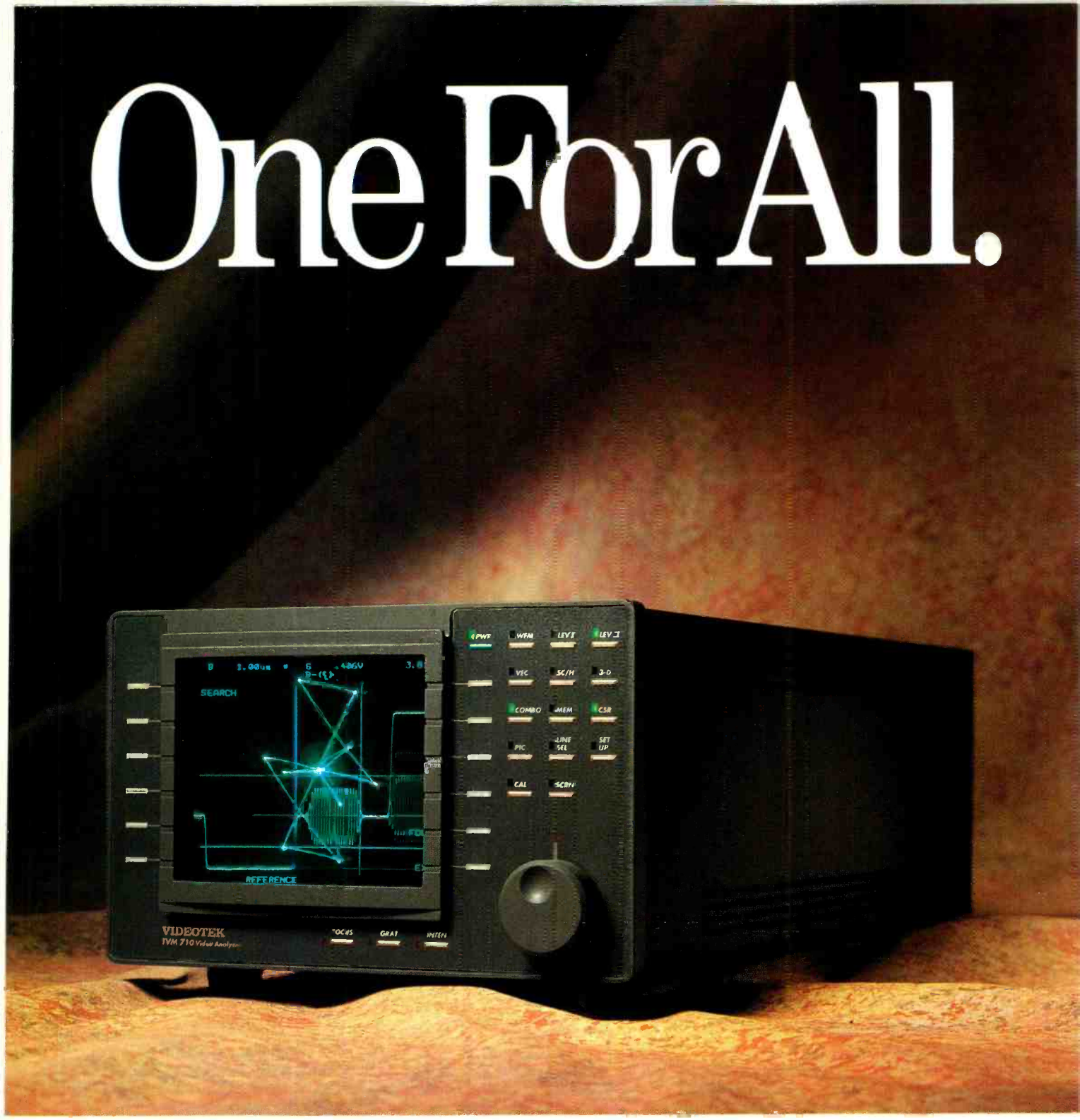

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the camera pedestal, or with a few keystrokes at the control position. This disengagement from the system can be limited to one or more cameras, while others in the studio remain under robotic control. Beyond simply adding to a studio's versatility and productivity, this feature can come in handy in case of an emergency or other unexpected/unrehearsed events.

Control improvements

Much revision has taken place recently in the control systems for robotic cameras. Improved control surfaces, including some with touchscreens, allow easier operation and a wider range of control. They also allow easier use of a large number of preset operations and their "editing." This function will prove most useful in studio applications where a large number of long, and possibly complex camera moves will be stored, recalled and updated. A visual screen display makes it easier for a robotic camera operator to take full advantage of the system's abilities in this type of situation.

A related refinement involves larger storage capacities for preset situations, which can then be recalled from memory to occur at specified times (or manually taken), with automatic transitioning. In this case, the system can decide how to get from one preset to the next and determine the speed required to do so. This can be particularly advantageous in the shooting of a commercial, where numerous repeated live-action takes with fast and complex camera moves may be required, while the talent clock ticks or the client watches. The repeatability and fine adjustment potential of a robotic system might prove helpful in these cases, where robotics are not so much a cost saver as a production-enhancing tool.

Connectivity has also been considered, as progress toward totally integrated automation continues. Although no industry standard control protocol or language exists, individual robotic manufacturers seem to be paying closer attention to the slaving of their systems to another computer's commands. On a related point, the ability to control a set of robotic cameras in one studio from any of several different control points has also been accommodated in recent systems.

A wider universe of users

A true broadcast-quality robotic system is still a major investment. Most manufacturers define this level of system as one that can move more than one camera at a time, with pan, tilt, zoom and focus movements at the speed and quality typical of top-notch broadcast camera operators. Such systems must also have the mechanical ability to handle cameras up to 250 pounds. A typical system of this ilk consists of three or more cameras with full pan/tilt, zoom/focus and height control on a large X–Y array.

However, smaller systems may have practical and cost-effective applications in state or local legislatures, and in teleconferencing rooms. These systems almost certainly will not require the expensive X–Y grid, and may be able to make do with less sophisticated controllers. Only one or two cameras may be employed, and these with only pan/tilt control. Mov-

Robotic cameras are marching beyond the newsroom and into the production studio.

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ing just one camera at a time probably won't put the system at a disadvantage in these applications. Smaller and lighter cameras will likely be used in these systems, further lowering the pedestal expense.

Those kinds of systems, or something between them and the full-blown broadcast-quality types, may be in the cards for smaller news operations in the near future. Their cost savings may be justifiable in the fairly short-term, and their around-the-clock availability, consistency and quality may also be advantageous. Camera operators and managers take note, however. These systems still need programmers and operators, and who better to fill these slots than experienced camerapeople with the requisite (minimal) computer literacy?

A lower cost and more modular system approach has also emerged, in which features can be added individually and gradually. Again, this allows a wider range of users to consider a robotic system. Add-on height modules for fitting on standard manual camera pedestals seem to be a popular item in this category. This is probably because of the modules' ability to add height control at a much lower cost than full pedestal replacement, which had previously been the only way to implement such a facility.

A modern robotic camera system, such as the one shown here, can provide improved control, while simultaneously reducing operating costs. (Courtesy of WHDH-TV.)

Although the sophistication of robotic camera systems has not yet peaked, the hardware's potential base of applications has certainly grown, and will probably continue to do so. Meanwhile, the cost-effectiveness of robotic systems remains a fluid issue. It deserves frequent reconsideration, given the types and prices of available hardware vs. station budgets and operational issues. Any station looking at a new automation system or upgrade in the near future should think seriously about these devices. RoboCam is still out there, and it's getting stronger all the time. Maybe it's time to give it another look.

Acknowledgments: Thanks to Richard Cooper of A.F. Associates, and Jim Wolfe of Vinten Broadcast for their help in compiling this article. |:-)))|

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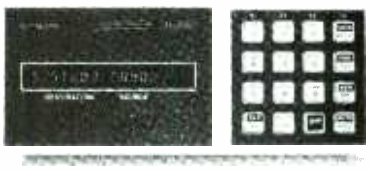

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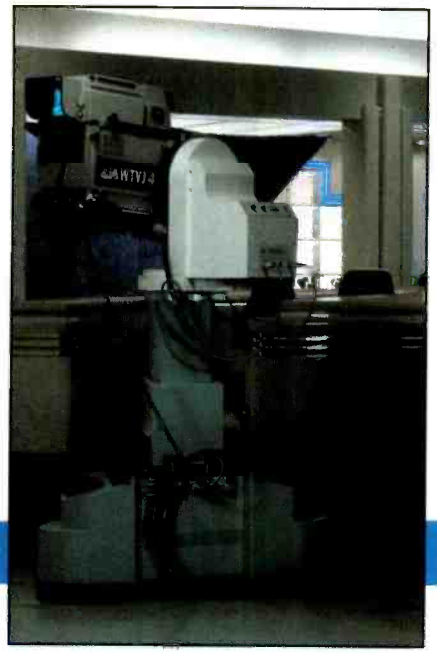

Automated station libraries: a systems approach

By Rick Lehtinen, technical editor

A properly implemented library system can offer many benefits.

Choosing the right library system is a complicated process. The systems tend to be costly, complex and, like most rapidly advancing technologies, hard to get a fix on.

Station management must consider technical and operational issues when choosing such equipment. Will it work well with the existing equipment? Will it be hard for the operators to get used to? Can it interface directly with the station traffic system, and end redundant paperwork and duplicated effort?

This article approaches library system selection from a systems point of view. It will discuss how automated libraries work, and it will offer some tips on what to look for when buying one. Some of these technologies overlap. Understanding the systems will help station management effectively weigh its options.

The elements of a library system

A library system consists of several subsystems working in concert. (See Figure 1.) These include:

• *Media.* The media used in library systems at this time is cartridge-based videotape. Enclosing the videotape in a cassette makes it more impervious to dirt, faster to handle and easier to store.

The primary issues in media are choice of format and quality of tape stock. Format choice is made for you with most robotics systems. Whatever material the station wishes to use in the library system must first be dubbed into the system format. This does not completely exclude other formats. Most library systems have provisions for controlling an external tape machine or machines. However, an operator must load and unload the extra machines each time a different reel is required.

Some manufacturers can build systems using a format of the user's choice. One system even claims to be able to use two formats simultaneously.

Tape quality issues are avoided most readily by having a second source of supplies. Tapes for most formats are available from more than one manufacturer, but it pays to check before committing to purchase.

• *Robots.* Beginning with the venerable TCR-100 and ACR-25, stations have used robotics to load and unload cassettes into tape transports. These have been custom devices in some cases, and adaptations of existing industrial robots in others.

The robots generally consist of robotic

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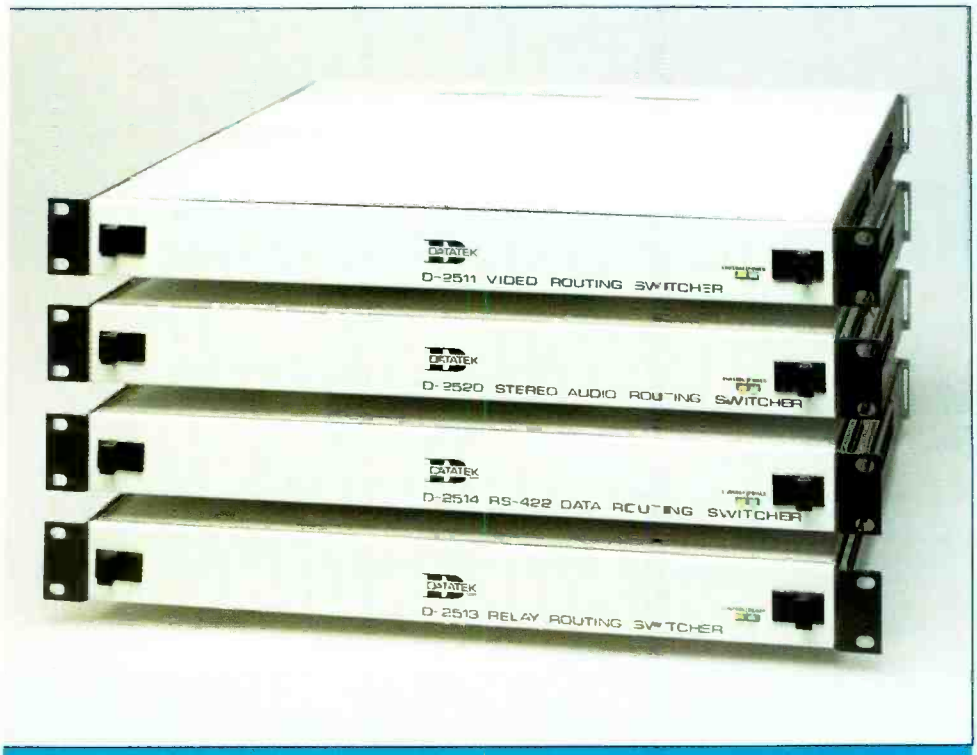

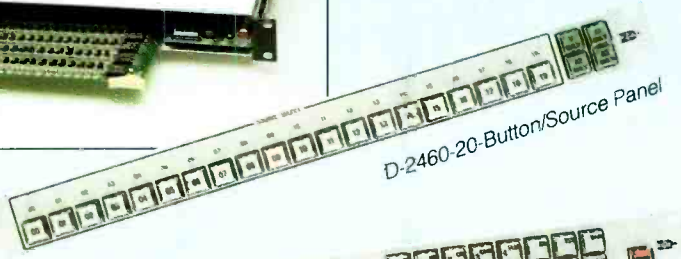
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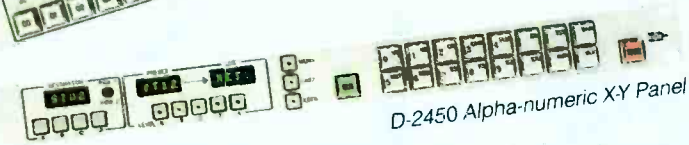
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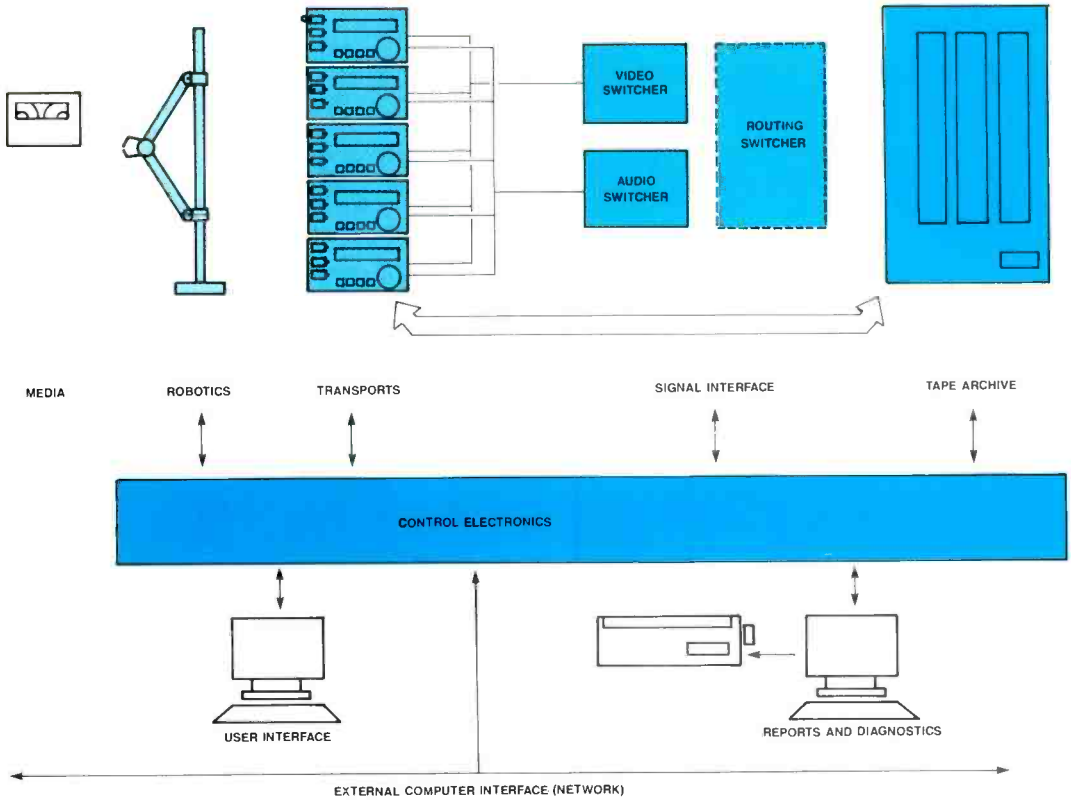


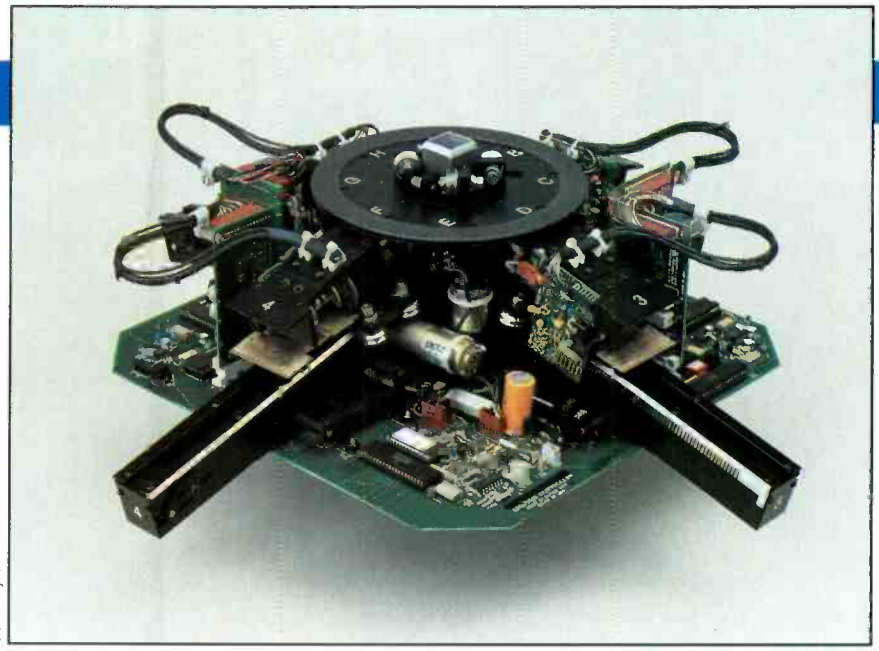
Figure 1. *The library management system can be viewed as a group of subsystems that work in concert. Media is placed in transports by robotics, signal electronics process the signals, and storage systems accommodate idle media. The control electronics system orchestrates the whole.*

arms that are end-fitted with actuators equipped for handling cassettes. Some of the robotic arms are X–Y devices, which can move up and down, left and right, inside of a matrix consisting of pigeon holes where cassettes can be stored. Other robots have a rotational capability in either the cassette storage carousel or in the robot. In either case, the robot's job is to find the right cassette, grasp it and carry it to the correct tape transport. When a tape is finished, the robot returns it to its storage slot.

Some actuators are single-fisted, meaning that they must deal with tapes one at a time. They grasp a tape, go somewhere with it, and put it down before grasping another. Other actuators have two or more fists. They can carry a desired tape to a transport, remove what is already there with the second actuator, then load the proper cassette.

The type of actuator will determine the efficiency of the system and, to some extent, its robustness. If a grasping mechanism fails, the system may be able to get by without it by operating in a slower mode.

• *Transports.* Early cart machines used dedicated transports that the manufacturers had adapted to fit the short turnaround time needed for spot playback operation. The modern practice is to use standard tape decks for tape transport and signal processing. Some systems use modified versions of decks that are side loading.

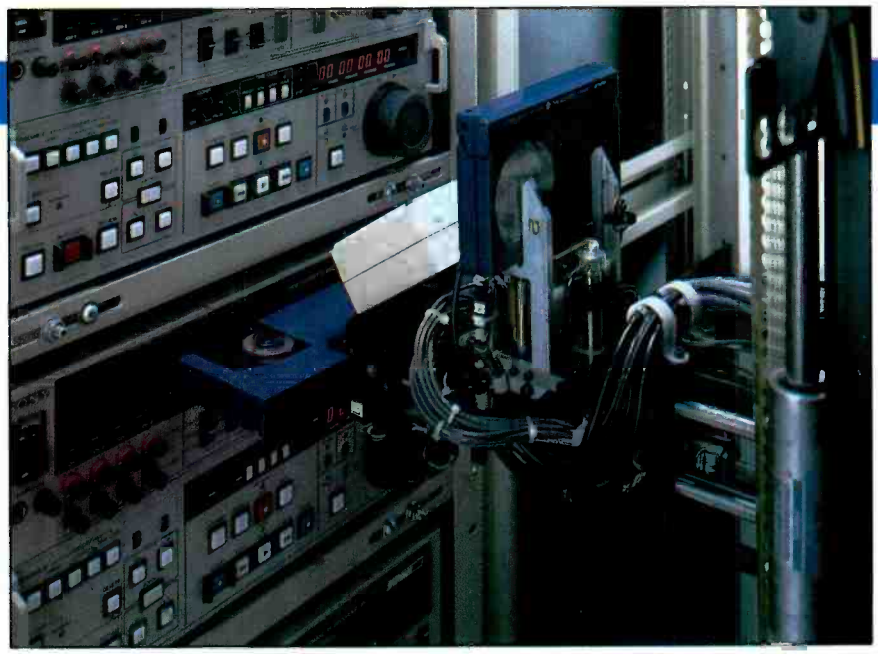


Courtesy of Odetics

The robotic elements used in the various cart machines and library systems come in several configurations. This robot travels up and down in the archive along a central column. The hub rotates into position as required, and the four grippers slide in and out along their individual guides.

Others separate the transport from the electronics, joining them with a wire harness. Some manufacturers claim their systems require no modifications to the decks.

• *Signal interface.* Most cart machines provide a switching system to select the correct decks to the on-air channel and preview channel. The cart machine may also have the ability to switch input signals into decks used for recording. Some systems even have the ability to interface with a routing switcher. This means the system can direct the flow of its signals to appropriate destinations, and acquire signals for recording from various sources without human intervention.

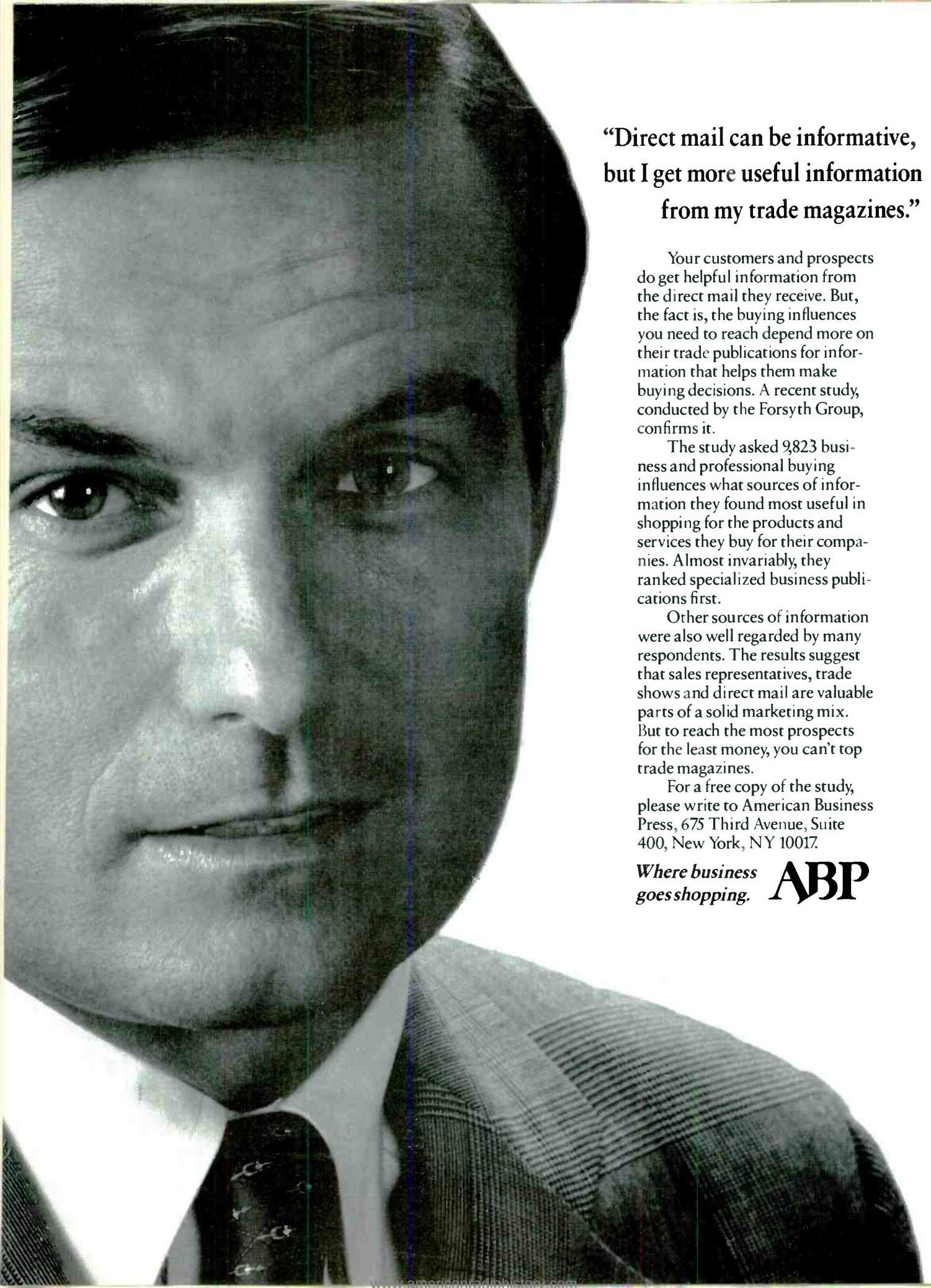


Courtesy of Basys LaKart

Some robotic systems use proven industrial robots that have been adapted to the task of transporting cassettes and loading them into tape transports. This system's multiple actuators are programmable to work with more than one format at once.

• *Control electronics.* The cart machine's central processor determines when to load which tape, where to load it, and when to roll it, rewind and reshelve it. The control electronics section gets its guidance from the user interface, external computers (for example, traffic systems, automation systems and news control stations) and local operator commands. (See the related article, "End-to-End Station Automation," p. 70.)

Another important function of the control system is archive management. What procedure does the system use to determine if it stores a tape? Does the system have the intelligence to store the most-used materials in areas that are closest to



"Direct mail can be informative, but I get more useful information from my trade magazines."

Your customers and prospects do get helpful information from the direct mail they receive. But, the fact is, the buying influences you need to reach depend more on their trade publications for information that helps them make buying decisions. A recent study, conducted by the Forsyth Group, confirms it.

The study asked 9,823 business and professional buying influences what sources of information they found most useful in shopping for the products and services they buy for their companies. Almost invariably, they ranked specialized business publications first.

Other sources of information were also well regarded by many respondents. The results suggest that sales representatives, trade shows and direct mail are valuable parts of a solid marketing mix. But to reach the most prospects for the least money, you can't top trade magazines.

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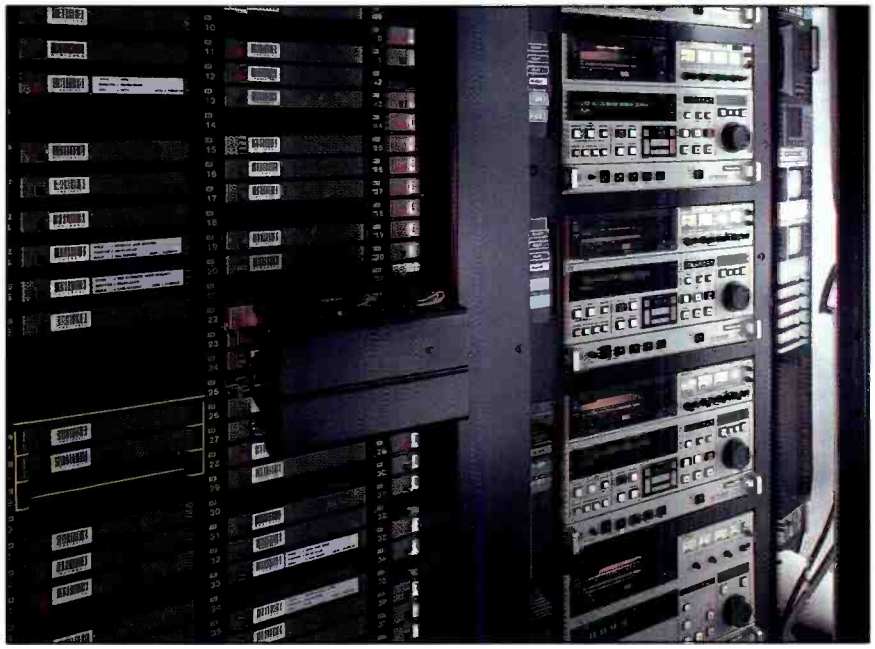
the transports? Can the system purge itself, pulling up for the operator tapes that are expired or rarely used?

• *User interface.* The operator needs to know what the library system is up to at all times. Users can access this information and control the system via the user interface. The user interface also presents warnings and alarms when faults occur, or when a condition exists that will require human manual intervention or decisions to resolve.

• *Off-line storage.* There are several ways to keep track of tapes that are important to have, but aren't used as often. The simpler, but more costly, option is to add more storage space to the library system. Another storage option is to automate tape tracking by marking tapes and storage locations with bar code layers. Users access a database that tracks the location and contents of a tape, making it possible to find desired footage quickly.

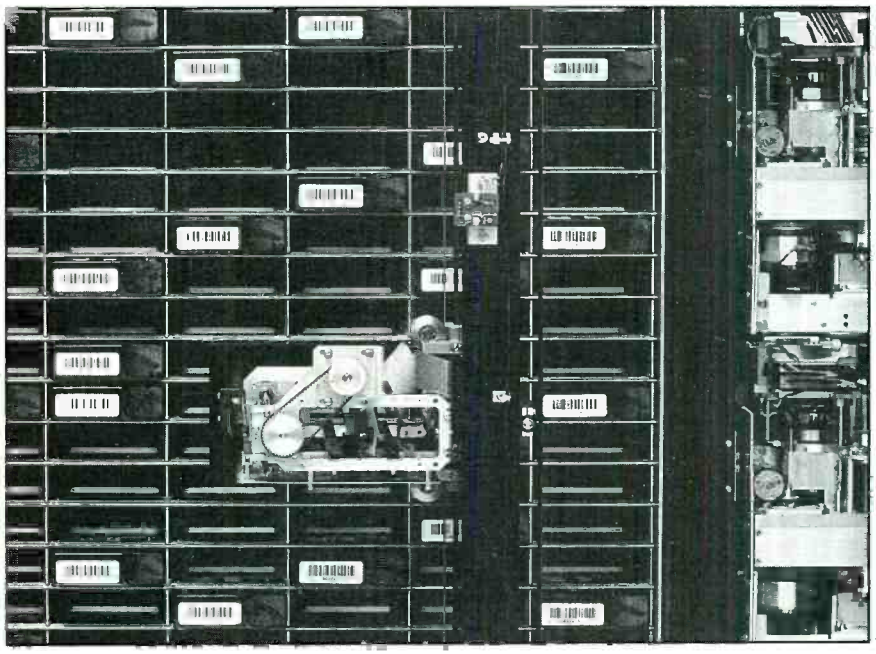
• *Report generation and diagnostics.* The computer that controls the library system probably also has the intelligence to track the number of tape passes or to know the age of the cassette. A periodic report of aged tapes can give the operators what they need to know to sensibly refresh the inventory.

Station management may desire other reports, some of them unique. Custom software written for each application is prohibitively expensive. Some systems enable custom report generation by providing an interface to commonly available database engines. This allows users to access library system data in whatever form makes the most sense to them.



Courtesy of Panasonic

This robot is equipped with a dual manipulator. Robot height is controlled along the vertical column, which moves left or right as needed. In systems with additional storage modules, a single actuator robot feeds tapes to a transfer area, from which this robot can pick them.



Courtesy of Ampex

This X–Y robotic picker travels on the back side of the tape storage matrix. The tape transports are side-loading for robotic operation, front-loading in emergencies. Each transport contains its own record and playback electronics. The functions normally associated with the deck's control surface are performed at the system's main operating panel.

One library system uses no tapes or transports. Rather, it is a database. Each tape is cataloged as first, a physical device; and second, by the material it contains.

Overlapping technologies

In library systems, as in travel, there are many roads to Rome. The use of robotic systems for loading commercials and news packages is proven, albeit expensive.

Not all broadcast facilities can support fully robotic systems. With modern electronics, it is feasible to achieve a portion of the capability of the larger systems using much more economical technology. There are caveats to such a route, but astute management teams should at least be aware of other options.

One technique is to load multiple events per cassette. Time code on the cassette allows a personal computer to locate the first frame of each commercial (actually a short fade from black). On cue, the computer rolls the spot and readies the subsequent machines. To avoid conflicts, such as having spots farther apart on tape than the time available to shuttle, frequently used spots appear more than once on the tape.

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*SIAT tests 19 different audio parameters, including intermodulation distortion. Up to 10 parameters can be included in a 5-second test.

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One system of this type was proposed for a dual-channel low-power TV application in Northern California. (See Figure 2.) The system was designed to provide commercial insertion in a syndicated satellite programming service. Of note is that the main console of the user interface was situated in Southern California, and it operated the system by modem. Broadcasters who desire local ad sales on translators or relayed broadcasts may also find this technology useful. Similarly, stations that find themselves present in a market, but not dominant, may find investigating this technology a fruitful exercise.

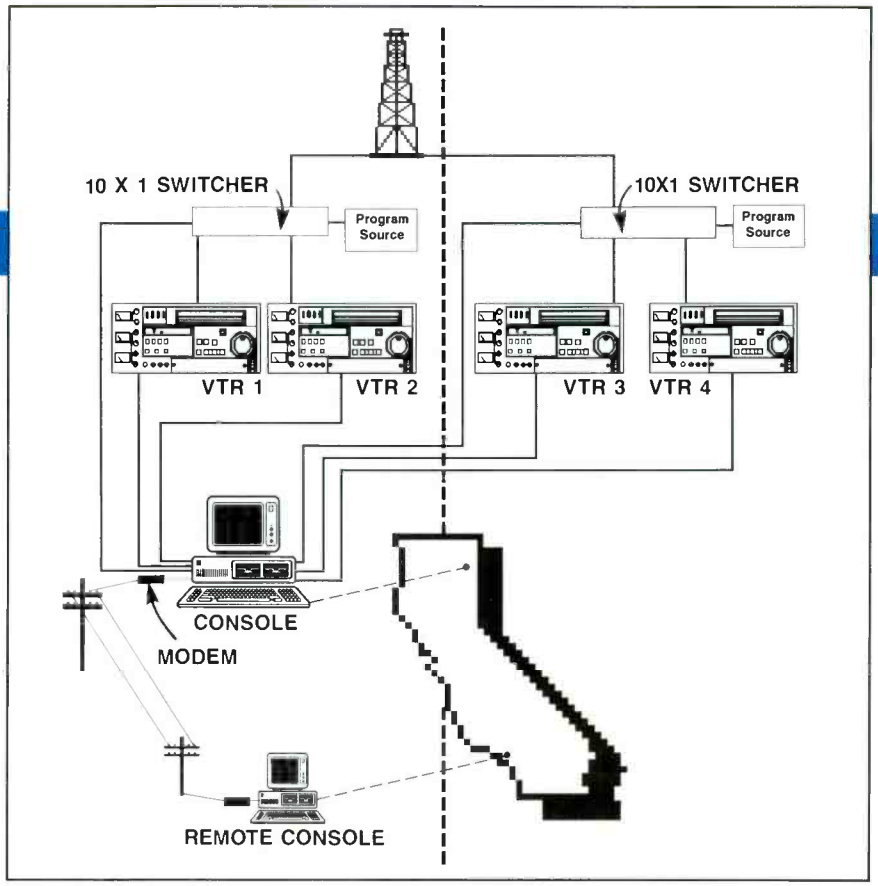


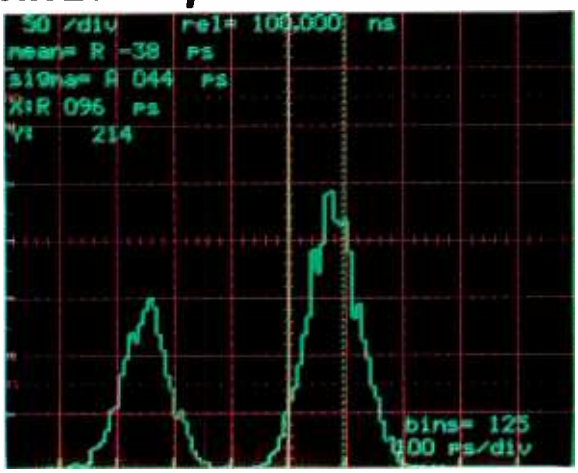
Figure 2. One lower-end library system uses multiple-event-per-cassette recordings, operated under computer control. This system, operated by modem, was designed to program commercials for two LPTV transmitters running satellite syndicated material. (Courtesy of Media Computing.)

On-line or off-line

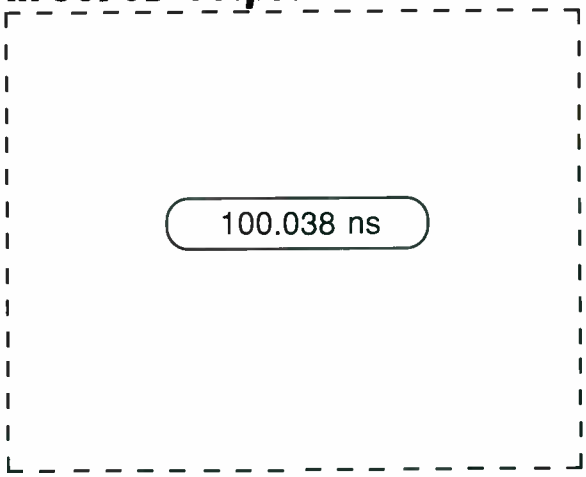
Another overlapping technology is archiving. A library management system consists of tape decks and their associated media storage system. If the archive is part of the cart machine, as duplicate towers

A picture is worth a thousand points in a time interval measurement.

SR620 Output



HP5370B Output



The SR620 brings graphic statistical analysis to time interval and frequency measurements. The SR620 shows you more than just the mean and standard deviation - multimode frequency distributions or systematic drift for example. Histograms or time variation plots are displayed on any X-Y oscilloscope, complete with Autoscale, Zoom, and Cursor functions. Hardcopy to plotters or printers is as easy as pushing a button.

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End-to-end station automation

No library system is an island. Automation yields the biggest dividends when it smooths the path between all aspects of station operation, from ad sales to playing spots, to mailing the invoices. Automation offers potential savings in station sales, logging, bookkeeping and billing.

The game as it is played

To a large degree, the TV industry is sales driven. Stations make money by selling a product — air time. Today's technology makes it possible to shorten the loop between the sale of a spot and the collection of the invoice.

Today, when advertisers decide to buy an ad, they tell their advertising agency. The agency's media buyer requests *availabilities*, lists of advertising opportunities, from station salespeople.

After the salesperson writes an advertising order, the contract goes to the station log generation system, which fills the availabilities. The log goes to the master control operator, who loads the library system. At the appointed time, the station library system plays the commercial. An *as-run report* records what commercials have played. If for some reason a scheduled spot does not play, the master control operator files a *discrepancy*. The traffic department reconciles the spots played with the orders and informs the accounting department when to issue invoices.

Closing the loop

Availabilities are a station's bread and butter, yet stations rarely automate availability generation to any real degree. In some stations, a salesperson must wait days to learn if there are any spots to sell. As clients change orders, and as program lineups shift, availabilities come and go. It is possible for a salesperson to sell a flight of commercials, only to find that the availabilities for them have disappeared.

Automating the traffic department to the point that salespeople can find availabilities in real time could greatly increase station efficiency. To be able to do so from the desktop or over the phone would be even better.

After the availability is filled, someone transfers the sales information into the traffic computer. If the salesperson had entered the data on a computer at the point of sale, this transfer could be electronic. This would simplify the work of clerks and reduce the possibility of errors.

A few stations have already automated the interface between the cart machine and the traffic computer. Still, this union could be tightened. In many stations, tired dub operators must create tapes and type in data for bar code labels in off-prime hours. The fewer times a human has to handle data, the better.

Advanced library management systems have the ability to ship as-run logs to the traffic computer for posting. This avoids another stage of data handling.

Putting the required network in place would not be beyond the skill level of a computer-literate engineering department.

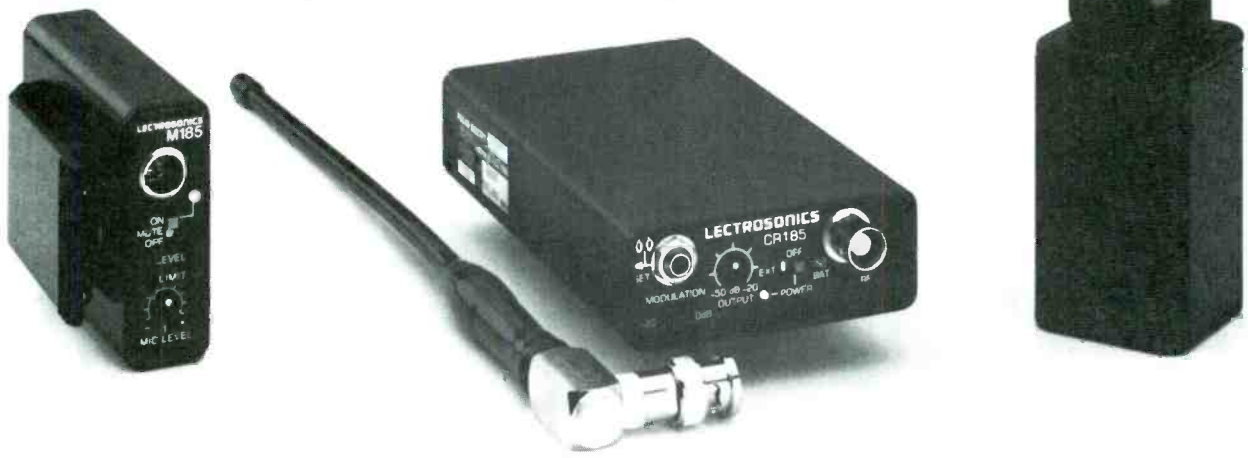
Anticipated results

It could be argued that the best place to locate terminals that list station availabilities would be in the ad agencies themselves. If agencies could pick their own spots and build their own packages, station salespeople could move into a consultative role. Freeing the salespeople from mindless paperwork would give them more time to build relationships with clients and expand their business.

One expert has estimated that entering data about a spot once, and operating from a common database thereafter, could decrease errors by 20% to 40%. Station management would be intolerant if engineering made errors with four out of 10 spots. It might be time to automate these other functions to increase station efficiency overall.

Acknowledgments: *BE* wishes to thank Joe Harris, NBC owned and operated stations, New York, for his assistance in preparing this material.

Who makes the best ENG wireless microphone system?

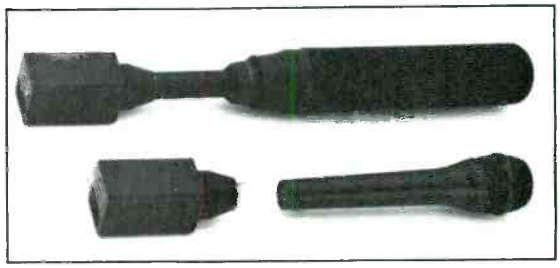


The best mini-receiver . . .

The CR185 offers a six-pole helical resonator front-end, followed by narrow-band crystal IF filtering at 21.4 MHz. This provides unmatched selectivity and sensitivity, and minimizes drop-outs and interference. A balanced, XLR output interfaces with any professional camcorder.

The best belt-pack transmitter . . .

The M185 is a highly refined belt-pack transmitter. It matches any input requirement and provides "phantom power" for almost any lavalier microphone via a standard 5 pin jack. The belt-clip is constructed of machined aluminum and steel parts, spring-tensioned for a secure fit on any belt or fabric. Audio level LEDs are provided on the control panel for accurate level adjustment.



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The H185 introduces new flexibility to your ENG operations. It makes any hand-held or shotgun mic with an XLR connector wireless. The microphone body becomes part of the antenna circuit, forming a very efficient RF radiator. The audio input level is indicated by two LEDs next to the microphone coupler. These LEDs are clearly visible with the microphone attached for accurate level adjustment.

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All external parts are constructed of machined aluminum for ruggedness and durability. Shock-mounted crystals are used in the IF filtering and oscillators for reliable operation. The transmitters and receiver are built for the real world of hard knocks.

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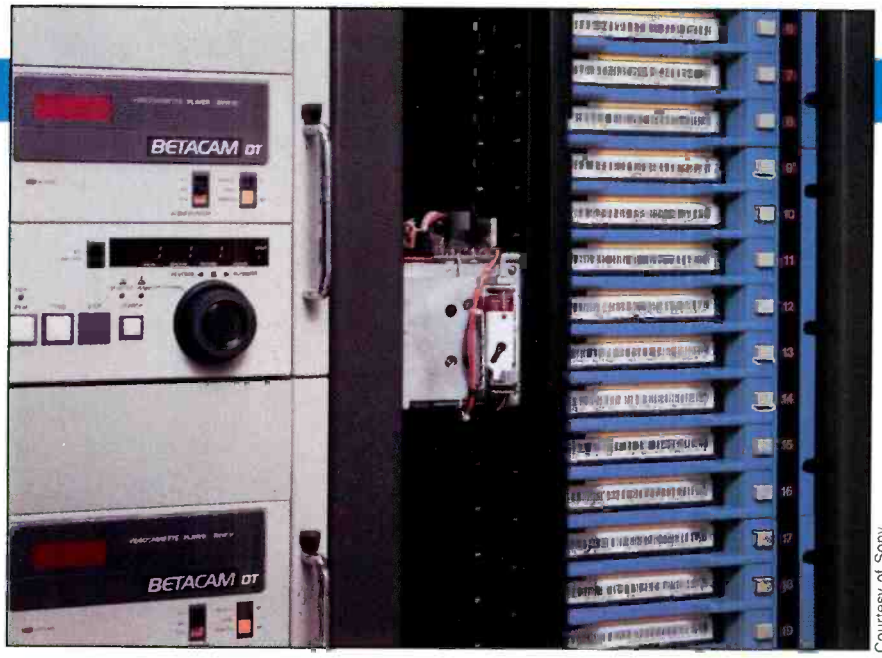
and extra storage modules, the archive is *on-line*. If the archive consists of tapes stored in shelves with some sort of access system, analogous to a card catalog, it is *off-line*.

One library management system uses no tapes or transports. Rather, it is a database. Each tape is cataloged as first, a physical device; and second, by the material it contains. Housekeeping information, such as the age of the tape or number of passes, is contained in the portions of the file associated with the tape cassette. Users can search the tape's contents using key words. This makes it easy to determine which cassette contains the desired material. The system then provides the location of the cassette, which it tracks by a system of bar code labels applied to the cassettes and to their storage locations. Portable bar code readers make it easy to update the location information.



Courtesy of Sony

This robotic elevator moves vertically in the space between the storage bins and the side-loading tape machines. A bar code reader in the elevator identifies the tape, which is marked by a bar code label pasted to the back edge of the cassette housing.

Automation centerpiece

Library systems are becoming the center of the automated station. Station decision makers can no longer evaluate potential library management systems in a vacuum. Station leadership can only generate accurate purchase decisions by considering how the subsystems in a library management system relate to the whole of the station.

Continued on page 90

In control.

Take control of news and program feeds with the new Agile Omni Broadcast satellite receiver.

Capture virtually any C/Ku band feed by manually or remotely selecting the preset satellite format and transponder position. The receiver automatically sets the satellite RF center frequency; full/half transponder channel spacing; I.F. filters; antenna polarity; audio subcarrier bandwidth, center frequency, and de-emphasis; and video polarity.

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Circle (50) on Reply Card

Weather radar update

New services will help station forecasters reign supreme.

By Rick Lehtinen, technical editor

Just as any other part of news gathering, weather forecasting has undergone changes. Some changes have been regressive — for economic reasons, many stations no longer have their own weather staffs. Instead, they buy their weathercasts prepackaged from a central provider. Other changes have been aggressive — the Doppler radars recently purchased by some stations can peer into the heavens and detect the embryos of potentially deadly tornadoes. They can often see the danger and warn the public faster than the National Weather Service (NWS).

Doppler radars can peer into the heavens and detect the embryos of potentially deadly tornadoes. They can often see the danger and warn the public faster than the National Weather Service.

There is merit to both approaches. This update on weather radar technology will describe the government's next generation of weather detection and information dissemination equipment. It will also touch on some reasons the self-reliant station may want to consider installing its own weather radar. Finally, this article shall overview an exciting compositing technology that allows viewers to fly through storms — without leaving their armchairs.

Next generation tools

The National Weather Service is undertaking a massive modernization program. Some say it is the most extensive revamping in the service's hundred year history. The result will be better weather information for everyone.

Four main elements to this modernization program include: the Next Generation Radar System (NEXRAD), the profiler network, the Automated Surface Observation System (ASOS) and the next generation Geostationary Operational Environmental Satellite (GOES NEXT). (See Figure 1.)

NEXRAD uses Doppler radar, which can detect weather phenomena, and also give quantified data about what it sees. The system consists of 175 installations, shared between NWS, FAA and the Department of Defense/Air Weather Service. (See Figure 2.)

Unlike the existing NWS radars, from which any interested party can obtain a feed by merely attaching a wire, NEXRAD data is distributed by four private sector providers, a system called the NEXRAD Information Dissemination System (NIDS).

The profiler network is a series of vertical radars that gather atmospheric profiles at 6-minute intervals. This takes the place of the older weather balloons and supplements radiosondes.

ASOS will take the place of the hourly reporting done by NWS at airports and other facilities. ASOS will provide 1- and 5-minute updates of various meteorological parameters.

GOES NEXT will provide atmospheric soundings, and high-resolution imaging capability (1km visible and 4km infrared). Five GOES NEXT satellites are called for,

The National Weather Service is undertaking a massive modernization program. Some say it is the most extensive revamping in the service's hundred year history.

with at least two on-line at any one time.

The primary output of these new services will be data — lots of it — up to 11,000Mbytes/day.[1] Supercomputer

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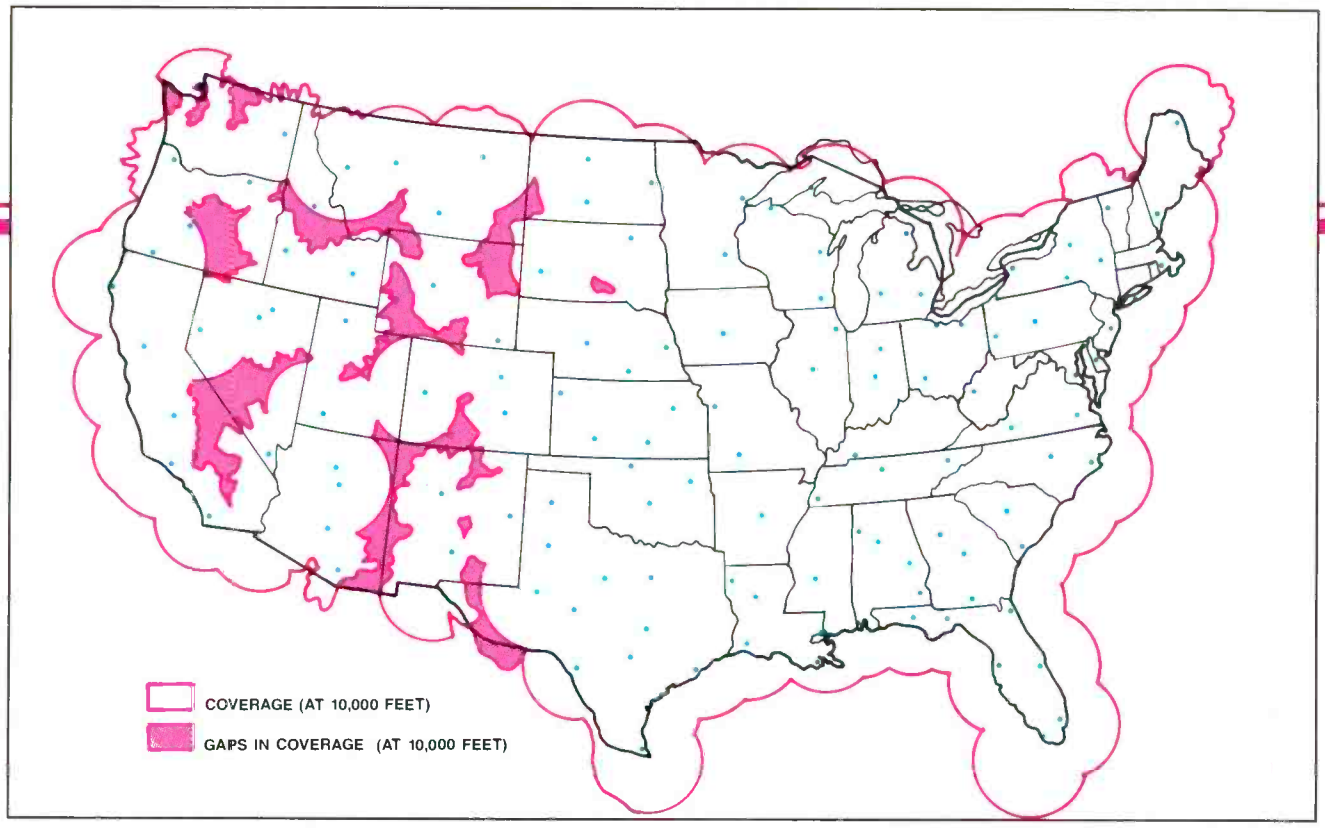
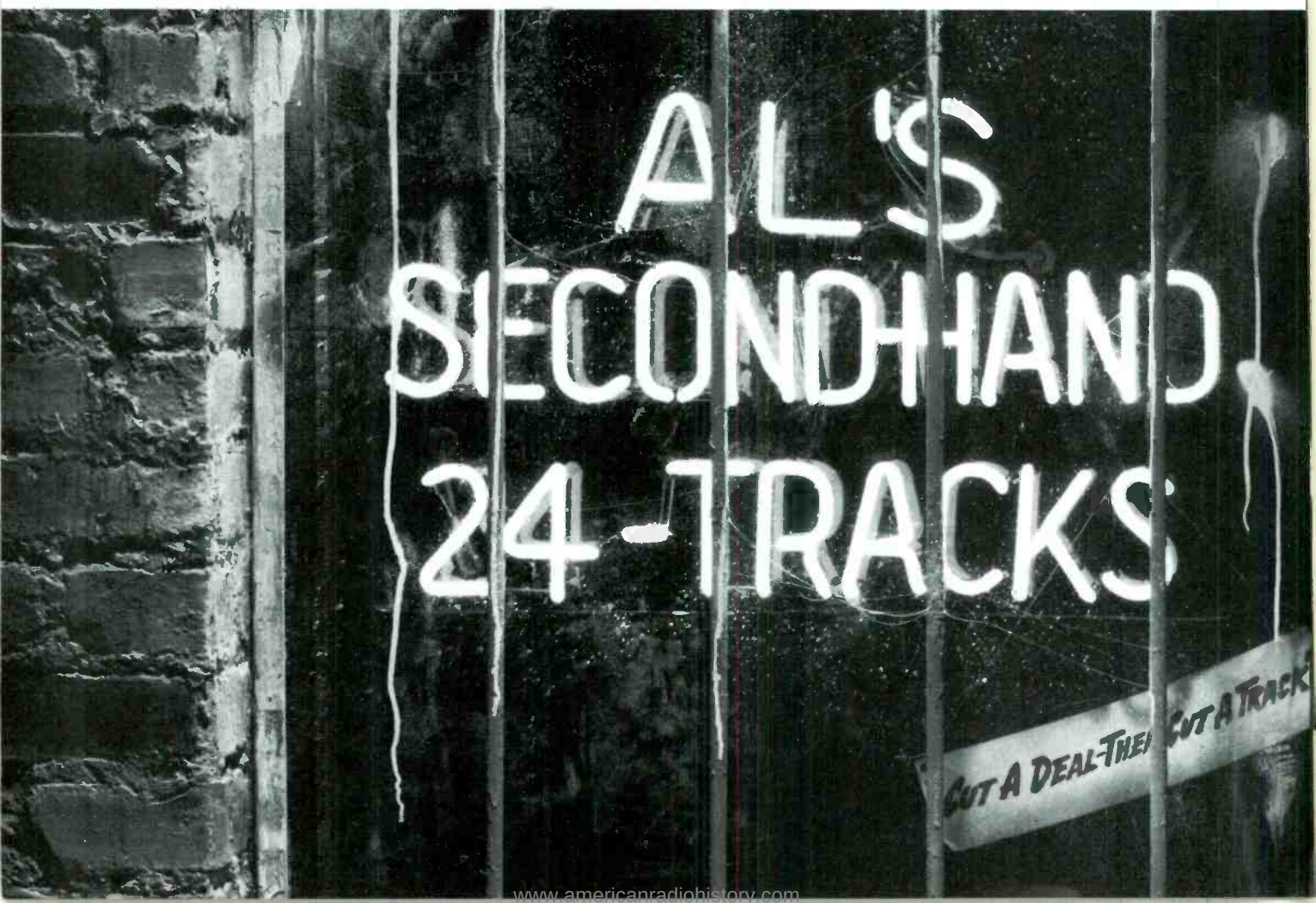


Figure 2. *The National Weather Service intends to deploy nearly 175 NEXRADs. The network gives better and more even coverage than the existing system, which tends to hug the coastlines and areas of greatest population.*



of integrating weather data to new heights. The system uses 3-D computer animation to zoom the viewer through continuously updated computer models of the weather. The weather data comes from integrating satellite images, radar images and ground-based observations.

Figure 3. Landsat satellite photos, such as this one of Minneapolis-St. Paul, can provide detailed base maps over which to present weather information. (Courtesy of EarthWatch Communications.)

Other data sources will be integrated as users request them.

The first step in creating the system's unique presentations is to obtain an accurate elevation plot of the area in question, and correct it for curvature of the earth. Extra realism and accuracy can be obtained using Landsat earth observation satellite data. Users can change base map colors to correspond to the turning seasons. (See Figure 3.)

Next, the database is given a layer of lines — freeways, borders, outlines of lakes and rivers. These give the viewer a general frame of reference. (See Figure 4.)

When it is time to make a flight, the operator plots the course. The computer then simulates a flyby, maneuvering the user through the city and surroundings. The whole time, the computer is integrating live weather data into the images. (See Figure 5.)

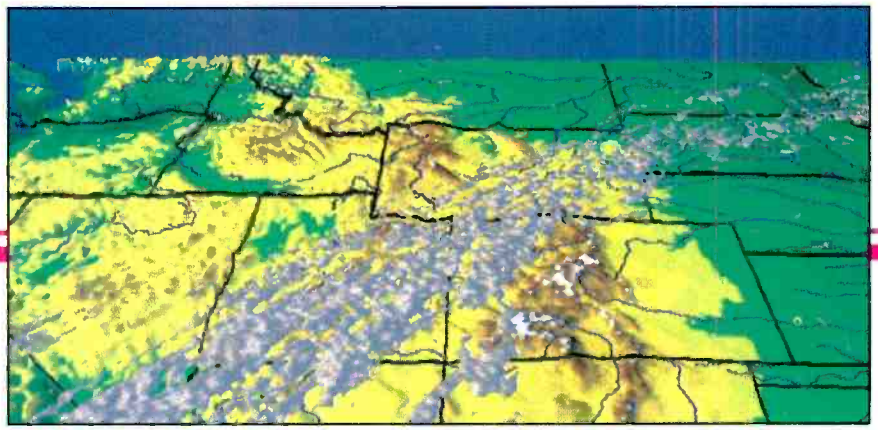
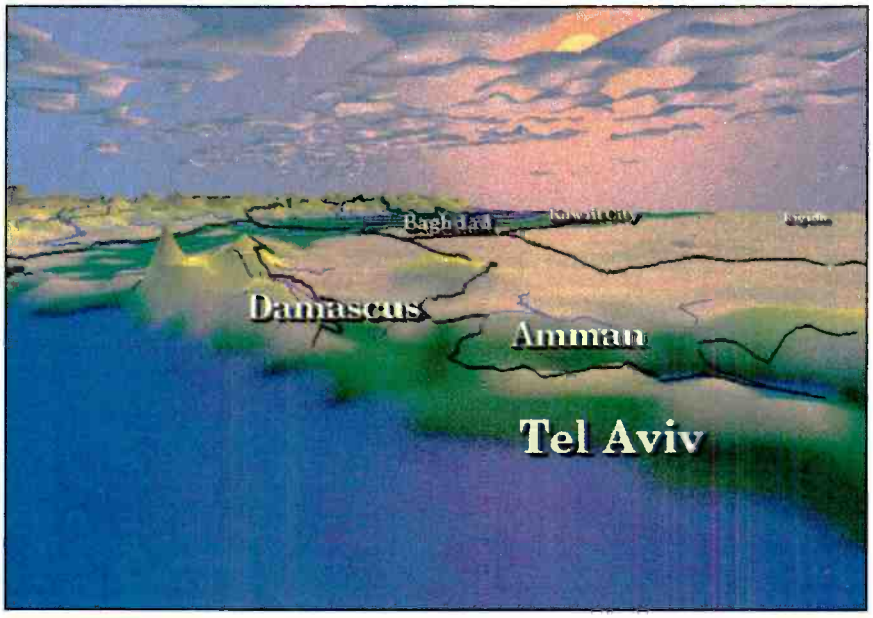


Figure 4. Geographical feature lines help viewers to identify locations of weather activity. This regional image covers approximately a 5-state area, centered over the Rocky Mountains. (Courtesy of EarthWatch Communications.)



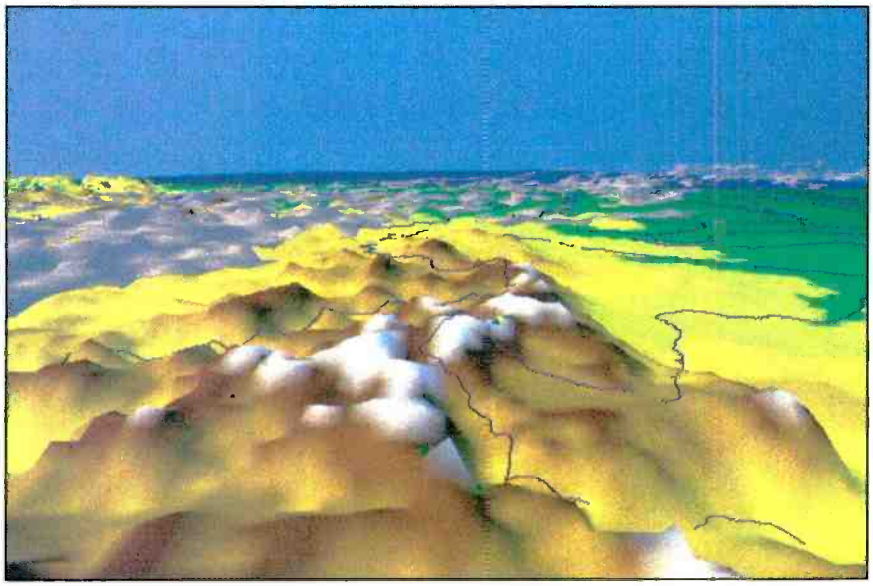


Figure 5. Integrating weather information, and then providing the means to electronically fly through it, creates the ability for unique news and weather stories. (Courtesy of EarthWatch Communications.)

For situations requiring further detail, users can add architects' CAD files showing the contours of city skylines. In this way, the weather is not only brought into focus, but the system can be used to visualize spot news such as fires, traffic tie-ups and chemical spills.

Complex frames that take time to render are recorded using single-frame animation techniques common to computer graphics systems. Using a more powerful computer, the journey can take place in real time.

In one system, the computer simulates a flyby, maneuvering the user through the city and surroundings. The whole time, the computer is integrating live weather data into the images.

Broadcast views?

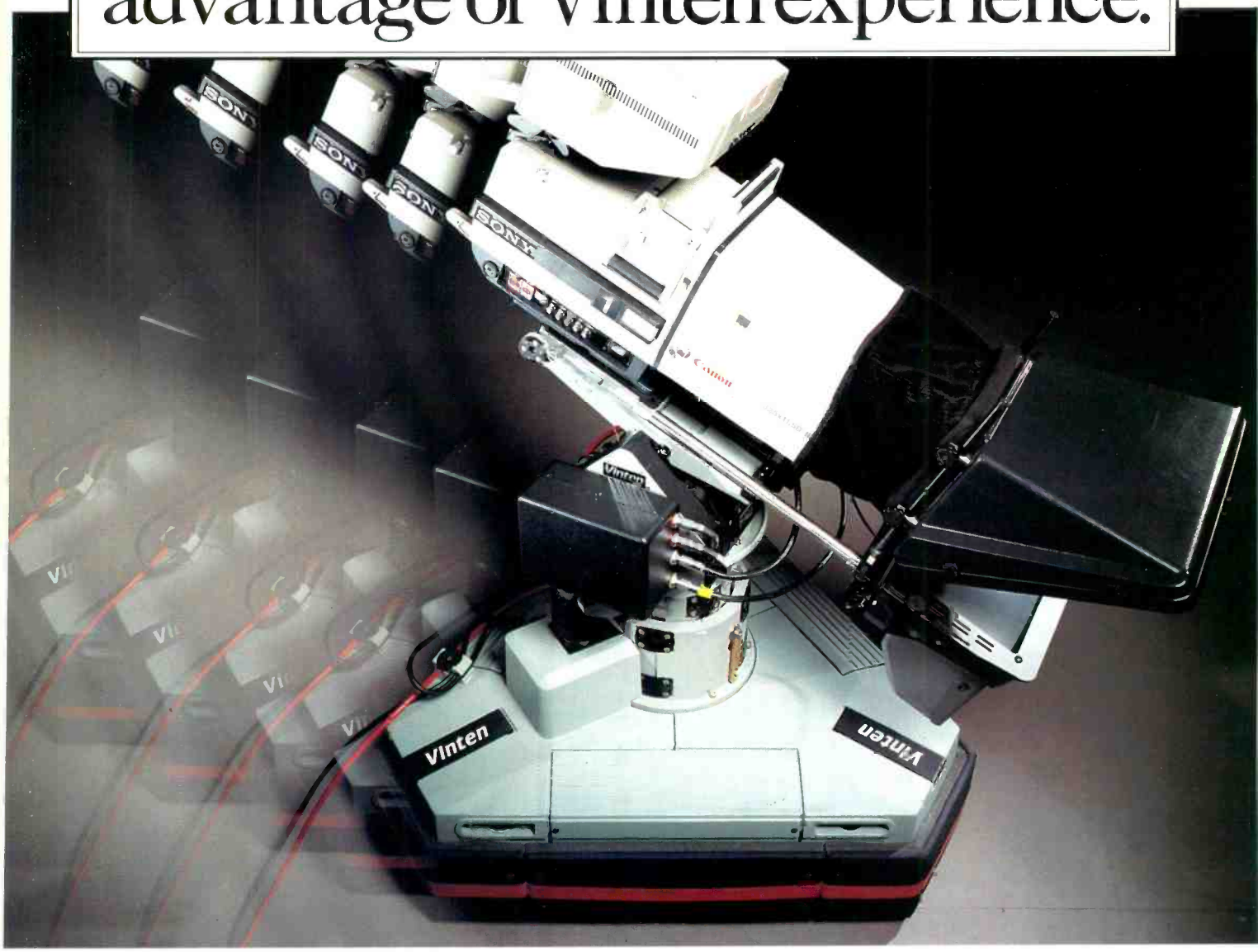
Although television is uniquely equipped for weather coverage because the weather images can be broadcast on air, many radio stations have made use of up-to-date weather information as a way of heightening listener interest. One such promising service is electronic lightning strike data, in which a PC and modem are used to display location and intensity of strikes, in real time, over a base map of the station's listening or viewing area. (For further information, see "LPATS: Striking Displays for Thunder Showers," August 1988, p. 42.)

Footnotes

1. Glickman, Todd, "The Weather Information Explosion: How Will We Cope?" Preprint volume of the sixth international conference on Interactive Information and Processing Systems, Feb. 5-9, 1990, Anaheim, CA.

Acknowledgments: The author wishes to thank Todd Glickman, WSI Corporation, Billerica, MA; Gene Rubin, Enterprise Electronics, Enterprise, AL; Raymond Durand, Technology Service Corporation, Santa Monica, CA; Mike Carelli, National Weather Service, Silver Springs, MD; and Paul Douglas, EarthWatch Communications, Long Lake, MN.

Only one robotic system has the advantage of Vinten experience.



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Circle (65) on Reply Card

Providing safety information to your viewers

By Brad Dick, editor

A problem for broadcasters and cable companies is the rapid delivery of emergency information. The process usually involves receiving notification from a weather radio, typing the message into the CG, and then switching it on air. The problem is that the process can often take too long.

Although it may take awhile, broadcasters can usually address the notification problem relatively simply. There is usually enough staff on hand to at least type a message on the CG for a crawl. That's not the case with cable, MMDS and some closed-circuit systems.

Unmanned operation

Cable system head-ends, for example, often go unmanned for much of the day. Only those systems that provide local evening news programs may have the personnel on hand when needed to alert viewers.

Where broadcasters have only one channel to worry about, cable systems may have 50 or more channels of video. A solution to this dilemma is an automatic message system. Such a system would permit the automatic and simultaneous display of various messages on all cable channels.

New devices are available to help automate the switching and machine control functions necessary to display the needed information. This equipment is useful not only in cable systems, but also MMDS, ITFS and government and industry closed-circuit TV systems.

PCs to the rescue

Once again, the PC-based platform provides the brains for the automation. A block diagram of a typical installation is shown in Figure 1.

The heart of the system consists of control devices, which provide several (in this example four) channels of character generation, titling, audio-follow-video switching and contacts for machine control. Grouped together, they handle all of the channel sources for the cable or broadcast/closed-circuit system.

It's advantageous to provide selectable forms of message display. This allows less important messages to be crawled across the bottom of the screen while important messages are placed full-page on each video channel. In some cases, audio alert messages are available. A versatile system allows the audio to be switched into the controller by the PC upon command. This allows audio and visual alerting to the viewer. This dual signaling is important because you want to also provide warning to those in your audience who may be deaf or blind.

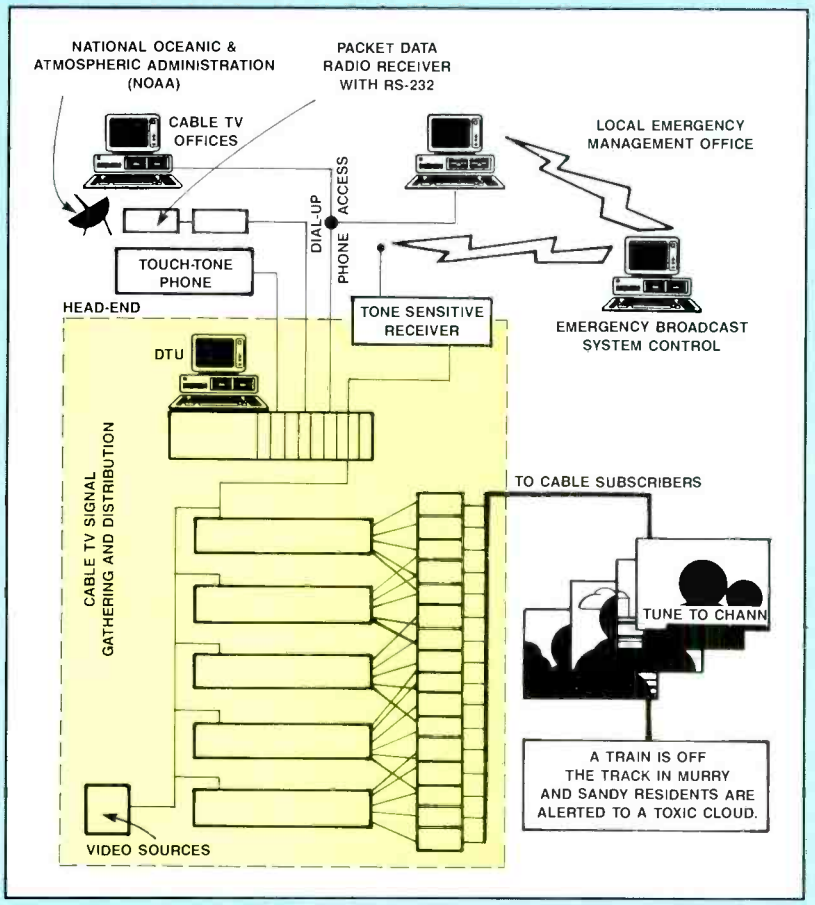


Figure 1. *A typical cable system, MMDS or closed-circuit TV system requires that safety information be displayed on all channels at once. Shown here is a method that permits simultaneous display of stored and custom messages from several control points.*

Who's in charge

Now that an alerting system has been developed, how is it activated?

In this example, four separate activation inputs are provided. Not all of them would be required in each installation. Most systems would provide for touch-tone telephone control. This would allow, for example, the emergency management office to activate the message system and provide an audio message to viewers. Simple dial access is all that is needed.

The cable TV office or broadcast/closed-circuit control room could also activate the system through a dial input. Similarly, the same control could be provided to local emergency management personnel via a computer and dial line.

Sophisticated control

Both of the activation methods require that a person be available to alert the system's viewers. Unfortunately, it might take many minutes for the authorized personnel to reach their control points. In these cases, an alternate activation method is needed.

Using EBS as the control signal, a receiver at the head-end detects the alert tones and switches all channels to the alerting message. This could include a preprogrammed video message and the EBS audio message. Viewers would be told to tune to a particular channel for more information.

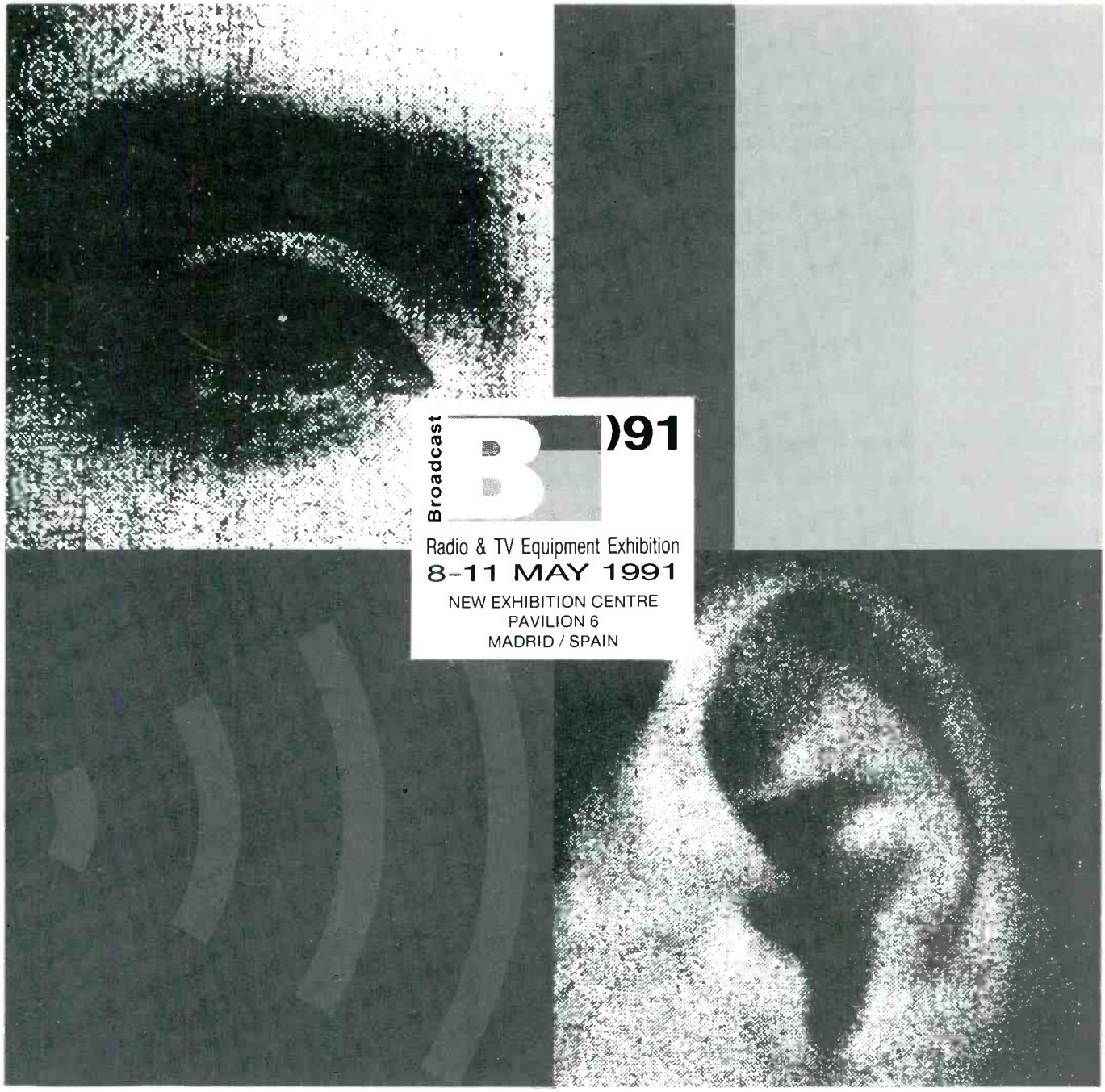
A more sophisticated alerting method is under development in California. In this system, packet radio data is used to alert public health, law enforcement and government officials, radio and TV stations. The digital transmission method, based on technology used by amateur radio, allows everyone to receive the same message at once.

Receivers connected to a typical computer printer provide hard copy to the announcer or official. This helps ensure that correct information is broadcast. This transmitted data could even be inserted directly into a CG and crawled across video at the local TV stations.

Another advantage of such an activation system is the ability of more than one public safety, weather or enforcement agency access into the warning system. Such a feature permits each of the different authorized agencies to concentrate on its area of expertise.

As broadcasters and cable systems look for ways to better serve their audiences, safety alerting technology such as this becomes another important tool.

Acknowledgment: Thanks to Ken Lawson, Quanta, Salt Lake City, for his help in preparing this article.



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Circle (58) on Reply Card

Engineering profit centers

Engineering can play a major role in the broadcast profit picture.

By Skip Pizzi, technical editor

Creative accounting notwithstanding, there are only two ways to improve a station's or production facility's bottom line: increase income and reduce expenditures. These two principles are the guideposts for all business growth.

Returning to basic business elements, today's engineers must reach beyond their traditional role of implementors and become market researchers and profitability analysts. Engineers can suggest new revenue-enhancing operations for their stations to undertake, and can recommend alternate methods of current operation to reduce costs. The engineer's perspective is particularly and perhaps uniquely valuable to management, because it is based on the reality of the station's hardware environment. No other staff position shares this level of knowledge in the station's hard assets and capabilities. Therefore, it behooves the engineer to serve an employer's needs in new ways, with bottom-line principles and a "can-do" and team-player approach. (See "View From the Top," December 1990.)

Some basic guidelines

Cutting costs to the bone must be countered with an acknowledgment of its effect on the station's competitive position. However small the market, no station operates in a total competitive vacuum. Brutally hacking at the expense side of the ledger often causes new problems to arise, perhaps washing out or even overtaking savings with lost revenue.

The best approach to reduce expenditures that an engineer can recommend is replacement technologies. New equipment and services may allow reductions in operation cost, but be prepared for a good deal of inertia and resistance toward changing from "the way it's always been done."

Engineers should continually assess station operations with an eye for simple, repetitive processes performed by the staff that might be automated. Often, stations may already own sufficient computer hardware to do the job, and some new software or peripheral hardware might be all that is needed.

Automation can help in much of the administrative and traffic/logging operations, and there are plenty of systems to choose from. Again, many operate on standard PCs. Program automation systems are a bigger decision, but remember that daypart automation or live-assist options are possible as smaller increments to full-time, full-blown automation. (This month's issue features a detailed look at automation, with the series of articles beginning on page 22.)

Enough with cost cutting. Increasing the revenue side of the ledger also has some merits, because none of the sacrifice or pain that often comes with cost cutting is involved. Perhaps more importantly, gross revenue increases are generally looked upon favorably by owners and investors because they signify growth, even if the net line is somewhat flatter. They also indicate an aggressive approach, perceived as vital in a soft market.

Staff assets

The common wisdom that "a company's most valuable assets are its workers" has not faded with time. But a new spin has been put upon it. It is now, "a company's most *expensive* assets are its workers." It is true that some valid moves toward improving the bottom line will often involve the replacement of some staff positions with automated hardware. Broadcasting does have a number of areas in which today's hardware can perform with equal or higher reliability than human operators. The rising cost of health care and other employee benefits have put management on the lookout for these applications. The humane employer will concurrently offer retraining or placement assistance for displaced workers, and these expenses should be included in any automation project's cost assessment. Nevertheless, engineers face tough decisions regarding recommendations of automated functions that will save the company money, but that will also eliminate jobs. Consider that it is only the most basic and repetitive processes that can be replaced, and these positions probably face the same fate at every other equivalent facility. In many cases, automation may not provide the "hard dollar" savings of staff reductions, but rather the "soft dollar" savings in time freed for employees to perform more meaningful and worthwhile duties. The

Rental of a station's SNG vehicle to networks or to non-broadcast companies for teleconferences can produce favorable returns.

station and the affected employees benefit from this kind of growth.

On the other hand, engineers must ensure that their own interests are considered by management. There's nothing wrong with looking out for yourself. In fact, it is essential. Make sure management knows what an important part of the team its engineer is. Developing a new profit center is certainly one way to do it. The competence, commitment and professionalism that such "partnership" actions demonstrate should not go inadequately compensated.

Money-makers

Perhaps a more exciting, but riskier, approach is the way many stations are diversifying their operations. Using basic business principles, stations can assess the needs of the marketplace in areas peripheral to their basic broadcasting function, and expand their services to fill those needs. A concurrent assessment should be taken of any underutilized station assets, such as tower space, computers, phone lines, staff time, licensed channel bandwidth, satellite up/downlinks, remote equipment and office space or other real estate holdings. Often, a good fit will be found between excess capacity at the station and needs in the market. In other cases, unfilled marketplace needs may warrant some capital investment on the station's part to capture market share.

• *Tower space.* This traditional income producer for broadcast properties is still a favorite. Even with the advent of cable and other wired services, another boom in transmission antenna space requirements can be expected as LPTV grows, and HDTV simulcast and digital radio systems become real. Major growth in cellular telephone and paging services is also forecast, along with upcoming "personal data services." Remember that microwave relay and other non-broadcast tower or high-rise locations may hold value for rental, especially for 2-way services.

The engineer's perspective is uniquely valuable to management.

• *Auxiliary spectrum.* Although it's not the "screamer" it was once forecast to be, FM SCA is still a solid revenue enhancer in many markets, primarily for paging and other data services. (See "FM Subcarriers in the 1990s," October 1990). Recent progress in this area has increased the number of music or data services possible on a given subcarrier by a factor of four.

For TV stations, the vertical blanking interval (VBI) has become a place for auxiliary data services as well. Some industry observers feel this function has yet to be fully exploited in most markets.

An even more underutilized option is the second audio program (SAP) channel available on stereo TV broadcasts. Here, a continuous, wideband audio service can be provided, either as an adjunct to the regular TV program or as a completely separate service. (All MTS-capable TV receivers and VCRs can receive the monaural SAP signal in place of the standard stereo audio channel with the flick of a switch.) Not many U.S. TV stations currently operate a SAP channel, and most of those that do are using it for the noncommercial Descriptive Video Service

(DVS) offered by PBS for visually impaired members of the TV audience. A few markets also offer Spanish language translations of some programs on SAP.

Revenue-enhancing possibilities with SAP might include running separate audio commercials in a second language during translated programs; providing a continuous audio service completely separate from the video for "narrowcast" delivery of specialized audio training programs (VCRs can record SAP audio); or for a continuous "service" channel such as weather, stock market updates or news headlines.

• *Teleport services.* Any satellite dish a station operates can generate additional income. Receive-only downlinks can be used to "hand-off" programming to other non-satellite-equipped stations or end-users via local telco paths. The end-user pays for the telco line, and the station collects easy money for simply tuning a demodulator and throwing a patch. Uplinks have even more potential to serve customers on a permanent or ad-hoc basis. Make sure any networks the station is affiliated with know of its ability and your willingness to feed programming. Find out about upcoming events in the area that may have national interest, then contact all the networks that use the satellite(s) reachable by the station's dishes. As major-league sports expand, market these services to other league cities for backhaul of away games. Commercial production houses or studios now routinely import live voice talent from studios in other cities. Offer such a service to local recording studios and agencies that might find themselves on either end of that kind of setup.

The best approach to reduce expenditures that an engineer can recommend is replacement technologies.

• *Excess capacity technical services.* Technical staff and facilities are rarely booked around the clock. Studio time, remote recording services, SNG vehicles and live ENG or sports services can be leased to other users, thereby taking advantage of your equipment and your experienced operators. The reliability of this approach over the use of a pick-up crew and rental facilities/equipment is a major marketing advantage. Local radio and TV commercial production and post-production are obvious initial applications. Recording and editing of local businesses' demonstration, promotion and training videos may also be a lucrative way to fill excess facility hours.

One significant application of a station's excess capacity is in the growing area of closed-circuit business feeds or corporate teleconferencing. Many companies like the idea of the teleconference, but lack the facilities, capital or expertise to go it alone. Offering turnkey teleconferencing service from their premises using the station's SNG or other remote equipment makes the process work for these companies. Alternatively, a station's studios might be used. The station's existing telco interconnection and/or satellite facilities can play a major role. Some of the new digital compression systems and telco data lines now available can also be quite useful for audio

and video in the teleconference market. Data line brokers can prove helpful, especially when setting up multicity conferences.

In these areas, it is especially important to know your limits, in the volume and in the types of work accepted. Clients who are used to working with facilities that specialize in post-production may expect more than a typical station's staff or facilities can provide. Even if the caveats to a station's services are clearly stated and accepted, no paying customer likes to feel shortchanged. Only do what can be done well and on schedule. A real "customer service" attitude among the staff is essential on these projects. Remember what the real business of the station is. No outside work should be undertaken that will affect the station's ability to do its best as a broadcasting entity, especially regarding its reaction to breaking news and emergencies. Peak facility usage is not required every day, however, and common sense has guided some stations to profit from putting their *truly* excess facilities to work.

Tower space rental continues to be a top revenue producer for many stations. (Courtesy of Antenna Specialists.)

An underutilized option is the second audio program (SAP) channel available on stereo TV broadcasts.

• *Telemarketing.* A number of new business opportunities are applicable to broadcasters involving telemarketing services. A simple one involves the station operating one or more call-in lines with short announcements — time and temperature, weather forecast, sports scores, lottery results, ski or beach reports, concert listings, news headlines or public service announcements — accompanied by a commercial message. Voice mail or standalone RAM banks can be used, increasing reliability, flexibility and call capacity over earlier tape-based systems. Converting from tape systems to random access hardware can cut the number of phone lines needed in half, to serve the same approximate number of callers per unit of time.

Engineers face tough decisions regarding recommendations that will eliminate jobs.

Another call-in process involves the listener/viewer poll. Instead of asking the audience to call one 800 number for "yes" and a different 800 number for "no," a new approach uses a single 900 number. In this case, the station can collect on the call instead of paying for it. The caller either speaks to a live operator or records an opinion via touch-tone. Through a relatively new telco feature known as *real time automatic number identification* (real time ANI), the caller's number is identified and recorded immediately after each call. The number is reverse-matched to the caller's name and address for billing, but the station can also use the caller list as a marketing tool, selling or renting it to other vendors. Because callers know they have to pay for the call to record an opinion, they can be considered a "committed" person (and thus a "quality" prospect), and can even be sorted pro or con on the issue, or by location.

Call-in telemarketing can also contain an interactive element. Here, a voice-mail system directs a caller through a menu of available announcements, each accessed by a touch-tone code. These announcements can range from the time/weather/sports types to straight commercial messages. The commercials can be of any length, and sold as adjuncts to on-air spots or separately. Listeners can leave comments or questions for the sponsor if so desired. Orders for products or services may even be taken. These systems record the number of calls each message

receives, and this data can be passed along to sponsors.

For the extremely aggressive operation, a broadcast station can take the ultimate telemarketing plunge into *call-out* services, or what some in the industry call "telebroadcasting." Here, a station takes advantage of its existing computers, multiple phone lines, administrative staff and audio production capability, and goes into a peripheral automated telemarketing business. Companies have sprung up that offer a wide variety of software and business ideas for such "unattended" operations. These range from community surveys, political announcements, lead generation and direct advertising, to services that check in on home-bound adults or latch-key kids. Other functions can include automated appointment reminder/verification for doctors' offices, emergency community alerts and fund-raising efforts. In some markets, operating a voice-mail system for another small company (such as a real estate branch office or consulting company) can also be profitable. In this case, running the computer and phone system on the station's UPS or backup generator system can be a powerful selling tool.

The days of sitting passively at the bench and waiting for broken equipment to come in are over.

Many other opportunities involving application of technology may exist now and in the near future that will allow broadcasters to improve their market positions. As the broadcast industry adjusts to current conditions, so to must the broadcast engineer. The days of sitting passively at the bench and waiting for broken equipment to come in are over. The engineer of tomorrow will be a proactive, savvy operator, applying technology to the marketplace and serving the mission of broadcasting in the best and most efficient way possible.

Acknowledgments: Thanks to Angela DePascale of Northern Transdata Networks, Corinne Weber of SCA Data Systems, Marvin Born of WBNS-AM/FM/TV, Joe Snelson of KCTV-TV and David Carr of KHOU-TV.

Continued from page 72

Twelve questions to ask when selecting a cart machine

As large library management systems have become more complex, so has the process of evaluating one manufacturer's system against another. The decisions are numerous, and critical. Today's cart machines are more than replay systems — they play an integral role in efficient management of station operations.

To simplify the decision process, discuss the following areas carefully with each of the vendors whose system you are considering:

1. *Define your needs.*
Are you looking for increased reliability, that is, fewer make goods? Or are you looking to maintain the current reliability with less cost?

2. *How many of your spot playback problems are due to tape machine-related errors?*
No one likes to point fingers, but could improvements in station traffic and accounting systems prevent a significant number of errors?

3. *Will the cart machine talk to the rest of the station?*
Automation is no longer a function of loading cassettes and rolling tape. When the accounting and traffic systems can't communicate electronically with the cart machine, the station's progress is hindered. Determine the manufacturer's capability and experience when it comes to dealing with software.

4. *Does the system feature a significant fault monitoring and recovery capability?*
If the robot quits, is there a reliable way to load and play tapes? What protection will you need to keep minor power interruptions from confusing the robotics? Does the system have any provisions for helping you recover from faults?

5. *Is the user-interface intuitive — does it help the operator when things go awry?*
An easy-to-understand user-interface simplifies operator training.

6. *How easy is it to make last-minute changes?*
Is the system flexible enough to accommodate last-minute additions or deletions?

7. *What is the right-sized library for your station?*
Some managers prefer to have every cart in the machine, ready to roll at a moment's notice. Others feel that careful archiving will allow recall of little-used material fast enough for normal operation. Compare the cost of increasing the on-line storage with the risk of losing revenue because a tape is not readily available.

8. *Does the system's database software use an open architecture in a common form?*
Although most systems generate standard reports, there are often needs for special reports unique to a given station or group. Find out what it takes to gain access to this information in your proposed systems.

9. *What is the tape format? How much do you need to budget to accommodate the system's format in your station?*

10. *Work through the financial analysis of each proposed system.*
Most of the cart machine manufacturers have worksheets designed to help determine if their system makes the most sense in your application. Work through several of these. The differences that will show up will be enlightening. As you discuss them with the various sales representatives, you will open further lines of thinking that hold the key to making the right choice.

11. *Try to consider everything, in addition to the obvious engineering factors.*
If you know why a system won't work, speak up. But if two systems seem to have equal merit, look for subtle differences between them. Which system draws more power? This is important for sizing the UPS. Which system generates the most heat? This is important for HVAC system planning. Which system occupies the most floor space? How much cassette storage space does each system require?

12. *What do current customers say?*
Does the manufacturer make it easy for you to speak with other users of its system? If these users experienced problems, was the manufacturer's response satisfactory?

A final note, different manufacturers may use the same terminology to describe a particular feature. Only by understanding your own station's operational practices, and comparing the cart machine's ability to function as an integral part of the system, can you be assured of making a good investment.

Acknowledgments: The author wishes to thank Ray Baldock, Odetics, Anaheim, CA; Mike Rich, Media Computing, Phoenix; Roland "Skip" Boucher, Basys LaKart, Newton, MA; and Irene Nesbit, Nesbit Systems, Princeton, NJ.

People

Robert Trabue Davis, manager of promotions and advertising for Yamaha Corporation of America, died Jan. 23. He was 56.

Davis was a member of the Audio Engineering Society (AES), Acoustical Society of America, and the Society of Motion Picture and Television Engineers (SMPTE). He was especially active in the AES, serving as chairman for the 72nd convention, workshops co-chairman for the 81st convention, and exhibitor liaison for the 89th convention. In 1984, he received the AES Board of Governor's Award for his work in the society.

A Robert Trabue Davis Scholarship Fund has been established to benefit the Central Kentucky Youth Orchestras, 161 North Mill Street, Lexington, KY 40507.

John Webb has been appointed national sales manager for Fujinon, Wayne, NJ. He is responsible for coordinating all sales activities in North and South America. He is directly responsible for the performance of the company's regional sales managers and other sales personnel. He will also participate in sales promotion activities and in the development of marketing strategies.

Steven Bonica has been named vice president of the Audio Video Systems Group for Panasonic Communications and Systems, Secaucus, NJ.

Steve Rolls has been appointed marketing engineer for Grass Valley Group, Basingstoke, England. He is responsible for supporting the company's business opportunities in Eastern Europe, and the distributor network in the Middle East and Africa.

Dave Doherty and **Bhaskar Pant** have been appointed to positions with Sony, Montvale, NJ. Doherty is vice president of camera products for the Sony Business and Professional Group. He is responsible for the product management and marketing of all Sony professional cameras. Pant is vice president and general manager of systems products for the Sony Business and Professional Group. He supervises all marketing efforts that support Sony systems products.

Gordon Baxter, Greg Boren, Larry Coha, Kenneth Erickson, Max Hernandez, Harvey Mabry, R. Skip McWilliams, John Neri, Douglas Robertson, Jim Thibodeaux, Lawrence Van Camp, Ronald Williams and **Ronald Wiswell** have been appointed to positions with Panasonic Broadcast Systems, Secaucus, NJ. Baxter is district sales manager for the Pacific Northwest. Boren and Coha are system sales engineers. Erickson is district sales manager for Minnesota, Iowa, North Dakota and South Dakota. Hernandez is system sales engineer. Mabry is region manager for Panasonic's south region. McWilliams is district sales manager for the Cincinnati area. Neri is direct sales manager for the Philadelphia area. Robertson is district sales manager for Houston. Thibodeaux is Western region manager. Van Camp is direct sales manager for the Cleveland/Pittsburgh area. Williams is district sales manager for the Los Angeles area, and Wiswell is district sales manager for Detroit.

Anthony J. Mark, Eric C. Peters and **Curt A. Rawley** have been appointed to positions with Avid Technology, Burlington, MA. Mark is vice president of engineering. He is responsible for bringing new Avid products to the marketplace. Peters is chief technology officer. He directs the development of products that exploit enabling technologies. Rawley is vice president of sales and marketing. He is responsible for the worldwide sales and marketing of all Avid products.

Mitch Montgomery has been named TV district sales manager of the north central region for Harris Allied, Quincy, IL.

Matthew Weiner has been appointed professional audio sales representative for JVC, Elmwood Park, NJ. He is responsible for product management of the audio sales network. In addition, he will serve as an audio technical consultant and will be involved in marketing and promotion activities.

David Mayfield has been named vice president of operations for Abekas, Redwood City, CA.

Francis Hericourt has been promoted to chairman and CEO of Thomson Video Equipement, which is based in France. Hericourt will also serve as senior vice president of the Broadcast Group of Thomson Consumer Electronics, which includes its U.S. subsidiary, Thomson Broadcast.

William G. Robertson has been promoted to director of marketing for Quanta, Salt Lake City.

Richard W. Vieser has been elected to the board of directors for Varian Associates, Palo Alto, CA. He is the former chairman and CEO of Lear Siegler.

Bob Williams has been appointed managing director of Alpha Wire International, Elizabeth, NJ. Williams is responsible for the marketing, distribution and sales of Alpha products in Europe. |:-)))|

New products

Distribution control
By Barco-EMT GmbH

• **EMT 710:** audio routing switcher in 16×16 to 32×32 matrices; inputs and outputs may be grouped; user-assigned names identify groups with sources, destinations; RS-232/RS-422 control; may be operated in conjunction with Barco BVRS video routing switcher; 19-inch rack mounting.

Circle (353) on Reply Card

Digital signal processor
By CEDAR Audio Ltd.

• **De-Clicker:** removes clicks, ticks and other noises from audio signals resulting from scratches or other causes; operation at 44.1kHz and 48kHz sampling rates; joint project with Harmonia Mundi Acustica and Daniel Weiss Engineering.

Circle (357) on Reply Card

AC power source
By Exeltech

• **SI-250 inverter:** true sine wave power supply for mobile operations; peak current capacity to 6a for operation of nonlinear and high-reactivity loads; 3.5" ×4.5"×9" package weighs 3.5 pounds; highly regulated with switching power supply technology.

Circle (364) on Reply Card

Underground cable location
By Charles Machine Works

• **Subsite series:** underground cable, pipe locator transmitter, receiver systems; configuration can be changed for specific site environments; microprocessor with microfilter technology; digital display with audible tone.

Circle (358) on Reply Card

Stereo signal correction
By Philip Drake Electronics

• **PD5040:** monitors stereo signal path; automatically reverses right channel phase when average phase relationship exceeds preset limit; senses low or missing channel and replaces it with remaining good channel; operates in automatic or manual modes.

Circle (370) on Reply Card

Digital audio storage
By Barco-EMT GmbH

• **No. 466 MOD recorder:** 3.2-hour storage using interchangeable magneto-optical disks with Musicam data format; analog, digital interfaces, RS-232/RS-422 data interface; remote fader starting, signalization; permits control of seven drives for storage of 22.4 hours in stereo.

• **No. 460, No. 461 cart systems:** digital audio recorder with editing, copying; No. 461 is play-only unit; RS-232/RS-422 control via computer; each cart capable of 40s storage, divided into as many as eight spots.

Circle (354) on Reply Card

Wiring documentation
By Cableship

• **CRIMP+:** circuit-routing information and management program; database on hardware terminals and interconnecting cable for any wired equipment network; data includes type, size, attenuation of each cable, and identity, type, size, department and other parameters of each telephone, computer terminal, switchboard; for 80386 CPU with 40Mbyte hard disk; prints plans, diagrams of system; assists in troubleshooting faults in complex cabling networks.

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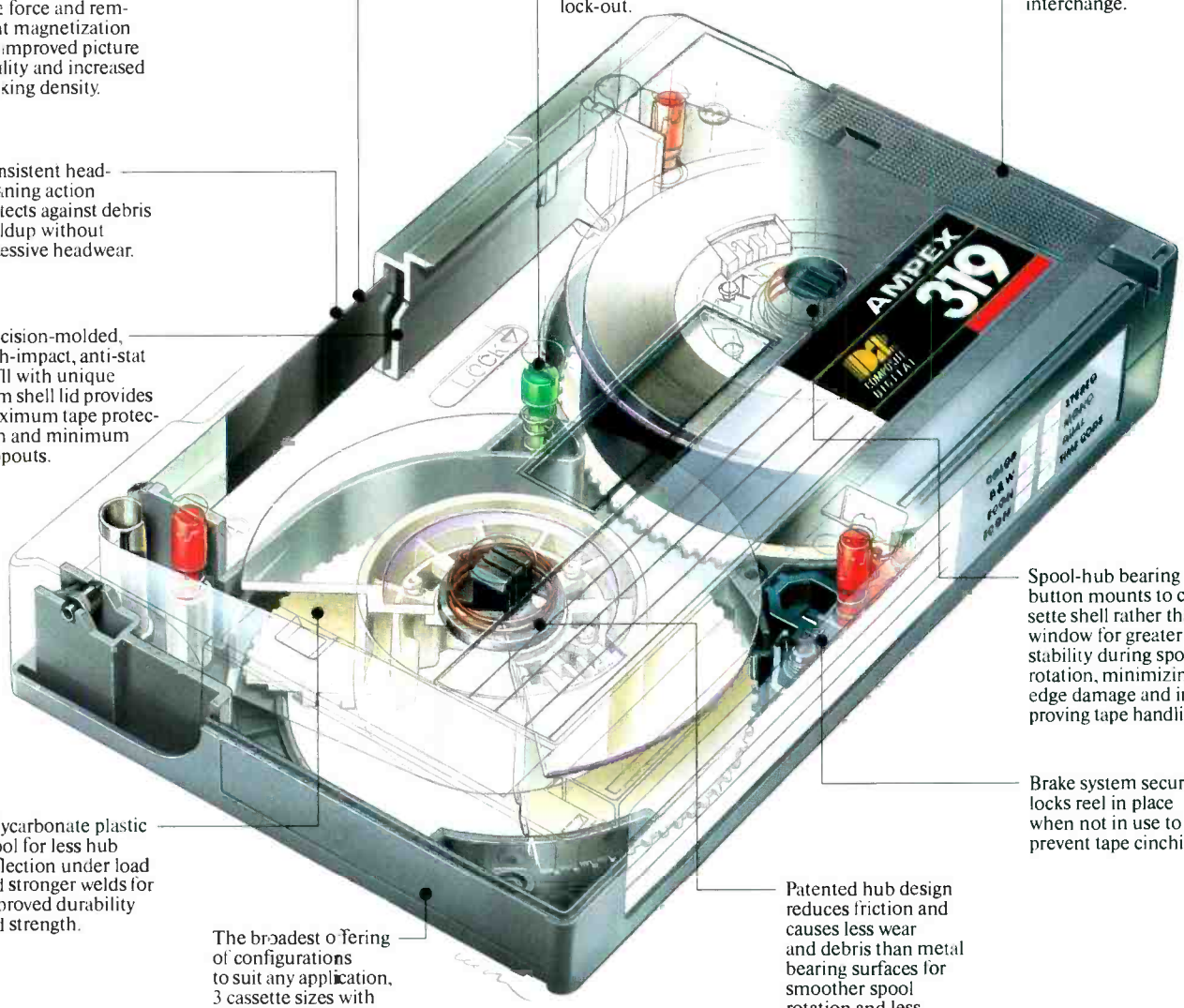
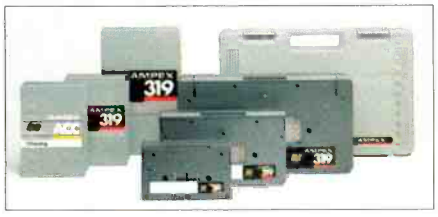
At Ampex, we engineer for today...and tomorrow.



We know that your imagination faces new challenges every day—and requires new tools to meet those challenges successfully.

Which is exactly why we created Ampex 319 Master Broadcast Videocassettes. We invented the D-2 format, and 319 is a reflection of our commitment to advanced, high-performance, digital recording technology.



With our innovative metal-particle formulation, Ampex 319 delivers all that D-2 has to offer, including images with breathtaking color and clarity, high signal-to-noise ratios, and unmatched multi-generational capabilities.

From our metal-particle tape to our patented hub to our state-of-the-art plastics, Ampex 319 represents the uncompromising vision of Ampex engineering—and our ongoing support for the uncompromising standards of today's video professionals.

Whether you've got one D-2 machine or a dozen, whether you're taking your first step into composite digital or you're running a high-end suite where digital is the standard, Ampex 319 can meet all your needs now and in the future.

And, as always, it's backed by the industry's most acclaimed customer service and technical support.

Ampex 319. Engineered for today. And tomorrow.

AMPEX

Ampex Recording Media Corporation, 401 Broadway, M.S. 22-02, Redwood City, CA 94063 (415) 367-3809

Circle (75) on Reply Card

A-V, power cable

By Clark Wire & Cable

• **CV7559 Kangaroo cable:** two 75Ω video cables, three shielded audio pairs and 16g twisted power pair; 100% foil shield with 98% tinned copper braid on video cables; all components use color-coded jackets for easy identification inside red outer jacket; 0.71-inch OD for camera cable use from 500 feet to more than 1,000 feet.

• **RCC2V3A, -AH ENG cables:** 0.492-inch OD composite contains two miniature 75Ω coax and three separate audio pairs; -AH version uses heavier video conductors for lower loss, longer runs.

Circle (359) on Reply Card

Product literature

By DI International

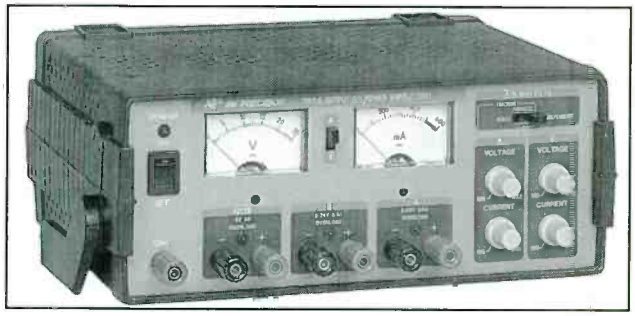
• **Panalog meters:** range of metering products from Challenger, Master and Champion series in square, rectangular formats; 3-in-1 dual-movement unit senses DC volts, current; intersection of two pointers shows power.

Circle (360) on Reply Card

Bench power supply

By B&K Precision

• **Model 1651:** 3-output DC power source offers two adjustable sources, 0-24VDC (0.5a) and a 5VDC (4a) fixed supply; selector switch permits variable sources to be used independently, in series or in parallel; heavy-duty protection circuit; autotracking voltage control.



Circle (352) on Reply Card

Video communications

By GTE Government Systems

• **PORTS-1N:** portable receive transmit system; includes TV camera, monitor, computer and printer; all packaged in suitcase with total weight less than 45 pounds; developed for government, military operation with applications for surveillance and special projects; digitizes, displays, stores color video; video compression with National Imagery Transmission Format.

Circle (366) on Reply Card

Weather broadcasting

By Modern Media Consulting

• **LPTV turnkey system:** weather graphics and 24-hour data service packed with 80286-based computer and software; may be used for live weather shows, station logos; hourly update on weather from WeatherBank; designed for LPTV stations, but may be used in other facilities; service contract available for hardware.

Circle (368) on Reply Card

AKG Acoustics, Inc.
Allen & Heath
Altec Lansing
Ampex
Analog Devices
Aphex Systems
Apogee Sound, Inc.
ART
Ashly Audio, Inc.
Atlas/Soundolier
Audio Control Industrial
Audio Precision
Audio Research & Technology, Pty.
Barron, Kennedy, Lyzun, & Assoc.
Bertagni Electronic Sound
Transducers
Beyerdynamic
Bose Corporation
Brüel & Kjær Instruments
BSS
Carver Corp.
Clear-Com Intercom Systems
Community Professional Sound
J.L. Cooper Electronics
Crest Audio
Crown International
dbx
DRV Public Address Consultants
Dukane Corporation
Eastern Acoustic Works
Electro-Voice
Gauss
Gentner Electronics
Innovative Electronic Design
Industrial Research Products
Ivie Technologies, Inc.
JBL Professional Products
The Joiner-Rose Group, Inc.
Klark-Teknik Electronics, Inc.
Klipsch and Associates, Inc.
Lester Audio Laboratories
Lexicon
Marshal Long Associates
Martin Audio
McCurdy Intercom
Meyer Sound Laboratories
MicroAudio
Neutrik USA, Inc.
Orban
Oxmoor Corporation
Panasonic Communications
Paoletti & Associates
Peirce-Phelps, Inc.
Pro Co Sound, Inc.
QSC Audio Products, Inc.
Quad-Eight Electronics, Inc.
Quality Sound & Video
Rane Corporation
Renkus-Heins, Inc.
Richmond Sound Design, Inc.
RPG Diffusor Systems, Inc.
RTS Systems
Samson Technologies Corp.
Sennheiser Electronic Corporation
Shure Bros.
Smith, Fause & Associates
Soundcraft USA
Soundtracs
Summit Laboratories
Symetrix
Tannoy
Technical Audio Devices
Techron
Telex Communications, Inc.
THAT Corporation
G.R. Thurmond & Associates
THX Group/Lucasfilm Ltd.
TOA Electronics, Inc.
TurboSound
University Sound
UREI Electronics Products
Vega
Video Design Pro
WesTech Marketing
Yamaha Corporation of America

Can you solve this problem?

You suspect a 600 ohm/600 ohm transformer is faulty, remove it from the circuit, and measure its impedance to be 20,000 ohms. Do you need a new transformer?

Solving this problem requires an understanding of audio technology. It's the kind of real problem you'll find using microphones and other sound equipment.

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P.O. Box 481
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Continuing Education Programs

Reverb, hard disk recorder

By Roland Corporation

• **R880 reverb:** digital unit with 14 separate effects modules; 28-bit processing with 16-bit I/O conversion from AES, EBU serial inputs, outputs; revert time adjustment to 99.9s; seven different types of effects.

• **DM-80 recorder:** simultaneous 4-track recording; SCSI interface for external drives; 24-bit digital mixing capability with full random access; basic system provides 18 minutes of storage, extendable to 90 minutes with expansion drives.

Circle (372) on Reply Card

Near-field references

By TGI/Tannoy

• **PBM 6.5, PBM 8:** enhanced studio monitor speaker systems; medite cabinet construction reduces effects of wood and other similar materials on high-frequency diffraction for more precise stereo imaging.

• **PS-88 subwoofer:** self-powered with 100W proprietary amplifier; correction signal removes 12dB/octave rolloff of woofers sealed in enclosures; volume adjustment; high-, low-impedance inputs; extended frequency down to 36Hz.

Circle (376) on Reply Card

Contact cleaner

By Caig Laboratories

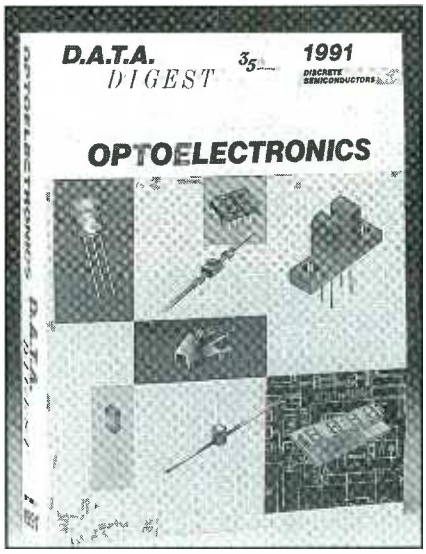
• **Cramolin PEN:** deoxidizer solution packaged in convenient PEN applicator; replaceable chisel head or round head tips; ozone-safe material is a non-toxic, non-flammable, non-corrosive cleaner; improves contact conductivity.

Circle (356) on Reply Card

Product directory

By DATA Business Publishing

• **Optoelectronics DIGEST:** 1,000-page book includes information on 29 categories of displays, indicators, optocouplers from 245 manufacturers; cross-referencing for discontinued devices to assist location of proper replacements; extensive specifications for more than 36,000 devices.



Circle (362) on Reply Card

RF, microwave components

By Richardson Electronics

• **STARs series:** strip-line terminations, attenuators, resistors by RF Products; exact replacements for system components originally manufactured by Acrian.

Circle (371) on Reply Card

Metering products

By Simpson Electric

• **Model 260-8Xi, -8XPi:** analog multimeters in ABS yellow plastic cases; mirrored scale for reduced parallax error; shows trend information not always possible with digital units; resettable overload protection circuit; 0-25VDC range to expand low-voltage measurement resolution; extends well-known 260 series.

• **Models 2871, 2872:** 3½-digit meters designed for temperature measurement; for J-type iron-constantan thermocouples; covers 0.1°F-1, 200°F and 0.1°C-650°C ranges.

Circle (374) on Reply Card

Transformer advancement

By SESCOM

• **Audio-Tran:** two series, AT-I (input), and AT-O (output); combines audio transformers with circuitry for power levels to +28dBv; distortion less than 0.005% in 20Hz-50kHz range; line level type with 10kΩ input impedance, mic type with 150Ω input; designed for printed circuit mounting.

Circle (373) on Reply Card

Expanded effects range

By Electrohome

• **JAZZ TEMPO, ENSEMBLE:** digital video effects units combined with switcher functions; control dissolves between foreground and background; programmable phase control; retrofit kit for existing systems bring them to the level of ENSEMBLE system; 4ms delay range for key output signal; expanded effects capability at reduced cost.

Circle (363) on Reply Card

Fiber-optic equipment

By T-Tech

• **Pro-Audio-fiber:** complete 2-channel fiber-optic link for analog or digital audio; DC to 65kHz analog bandwidth, digital audio bandwidth greater than that for CDs; 95dB dynamic range capability; 16-bit for analog, 20-bit for digital; includes transmitter and receiver units.

Circle (427) on Reply Card

Satellite terminals

By SSE Technologies

• **Modular system:** approach to construction of satellite terminals allows user to select those capabilities required for C-band or Ku-band operation; easy-exchange modules offer changes in HPA power output, LNC noise temperature; redundant logic options with monitor, control and remote frequency/power level selection.

Circle (423) on Reply Card

Remote-control keyboard

By Steenbeck

• **ST-5002 controller:** extends the use of the ST-5001 universal controller to operate 16mm and 35mm editing tables; dedicated keys permit operation in minutes-seconds-frames, conversions from minutes-seconds to feet frames; calculates lengths with addition, subtraction; creates loop programs.

Circle (424) on Reply Card

Power-protection software

By Sola/General Signal

• **PowerMon:** for Unix, Xenix operating systems; interface protects hardware, files from long-term outages; preserves life of UPS batteries; senses power disturbance, places on system CRT; orderly system shutdown closes all files when power reserve approaches critical point; reboots system when power is restored.

Circle (419) on Reply Card

Wireless device

By Swintek Enterprises

• **Mark 200D/CT-Q50:** on-camera listening unit with pocket receiver, earpiece; replaces wired intercoms with wireless link operating in 72MHz to 216MHz frequency range; compatible with intercom systems.

Circle (425) on Reply Card

Expanded speaker line

By JBL Professional

• **Control Micro, SB Micro:** a loudspeaker and subwoofer, respectively; Micro unit for on-console, fixed placement or other limited space monitoring; SB Micro for full range response in a compact speaker system; magnetic shielding allows placement close to computers, video equipment without noise pickup.

Circle (388) on Reply Card

Power monitoring

By Jensen Tools

• **Power disturbance analyzer:** monitors, analyzes and records 900 events with time, value, duration of each disturbance; 10-hour rechargeable battery; fuse protected; detects sags, surges, high/low averages, spikes, high/low frequency and HF noise; internal thermal printer may be used to log events.

Circle (389) on Reply Card

Terrestrial microwave

By Loma Scientific

• **LSI50ST, LSI100ST:** 50W, 100W solid-state TV transmitters; designed for ITFS, OFS, MMDS services; linear GaAs FET amplifier provides outputs between 20W to 100W; FCC type-accepted; front-panel diagnostics, broadband RF modular design.

Circle (392) on Reply Card

Surge suppressors

By MCG Electronics

• **Micro-Z circuit:** reduced let-through and surge remnant voltage with power-protected equipment; proprietary circuitry cuts internal voltage drop and minimizes external voltage drop in connecting wiring; redundant MOV modules with less than 5ns reaction times.

Circle (393) on Reply Card

On-camera prompting

By Media Technology/MTI

• **Wide-angle prompters:** camera-mounted video prompting systems; 9-inch, 12-inch and 15-inch sizes provide wide-angle viewing; 12VDC or 120VAC operation; adjustable for various camera lens/head combinations; 15-inch speech prompter for podium use features laminate or wood grain finish.

Circle (394) on Reply Card

Audio line testing

By Danbridge A/S

• **DB 301 sequence generator:** test source for automatic or manual testing of broadcast audio lines; 1Hz audio frequency resolution with 0.1dB output level control; provides pure sine wave and difference frequency distortion signals for special "near band edge" tests; remote control of eight preset test sequences and reference tones; meets CCITT 0.33 specifications.

Circle (361) on Reply Card

UHF TV power device

By EEV

• **IOT 7360:** high-efficiency inductive output tube for visual or aural power amplifier service to 60kW with figure of merit to 130% possible; air-cooled external cavities, water cooling for body and collector; density bunching of the electromagnetically focused electron beam is achieved with a grid driven by an RF cavity; beam power varies with depth of modulation; single tube continuously tunable over bands IV and V permitting faster changing.

Circle (378) on Reply Card

Component production titling

By Knox Video Products

• **K20 Plus/S graphic titler:** combines features of K20 character generator with Y/C component inputs and outputs; switching between composite and Y/C components; standard connectors follow Y/C DIN connector specifications for S-VHS equipment; 64-page memory protected through a backup power cell.

Circle (390) on Reply Card

SMD tools

By PACE

• **ThermoPik:** handpiece for PACE soldering power sources; designed for flatpack components; directs controlled heat at soldered joints instead of adjacent components; vacuum pick with finger control to lift component from board; 1-hand operation.

• **ThermoTweez:** handpiece to reflow solder and remove various surface-mount components; unit grips component for removal from board when solder is hot.

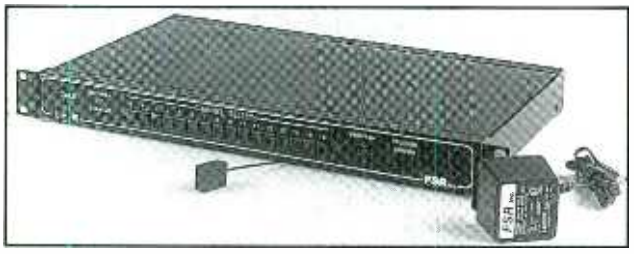
• **Mini ThermoJet:** soldering system handpiece directs jot of heated air to reflow solder with minimal damage to adjacent components; finger activation of air jet in pencil-grip design; several air-nozzle geometries to meet specific requirements.

Circle (369) on Reply Card

Multichannel remote

By FSR

• **UIR-16 controller:** universal infrared control system; 16-channel control programmable on site; fiber-optic cables couple to controlled equipment; non-volatile storage of learned codes; rack-mount configuration with UL-listed power supply.



Circle (365) on Reply Card

Interference reduction

By INDUS-TOOL

• **Noise suppression system:** series of filters for power, telephone line outlets; reduces damaging high-frequency noise that enters fax, modem connections from external sources; provides power surge protection.

Circle (367) on Reply Card

PC protection

By TrippLite

• **BC-450 LAN backup:** 450VA battery backup system; removes spikes, noise from power line, provides RFI/EMI filtering; brownout protection at 103VAC; can be used with UPS monitoring software.

Circle (377) on Reply Card

Audio, video DAT

By AIWA America

• **HD-X3000:** portable DAT recorder; 16-bit linear performance in package weighing 31 oz.; AES/EBU digital in/out interface; Cannon connectors; operates three hours, 40 minutes from internal lead acid and 10 AA-cell external power source.

• **MMD-100 VTR:** DAT recorder for still video with 450-line horizontal resolution using 8-bit architecture; wide range of inputs accepted.

• **HD-V2000 recorder:** portable DAT unit for simultaneous recording of audio and still video; capacity of 3,600 stills with audio on a 120-minute DAT tape.

Circle (351) on Reply Card

Professional services

Preview

May...

ANNUAL RF TRANSMISSION SPECIAL ISSUE

- **Directional Antenna Assessment**

Many of today's AM stations have antenna systems that need thorough evaluation. The problem is that doing so requires special knowledge and expertise. This article shows how to perform a complete analysis of an AM RF system. It also gives insight on how the station engineer can tune the system for maximum performance. This feature is the RF guidebook for AM station engineers.

- **Measuring Earth Station Antenna Performance**

Earth station antennas are often selected based on size and the assumption that "x" meters will produce the needed performance level. Unfortunately, that belief often can result in excessive costs or disappointment in the actual results. This article outlines steps to follow in the selection process.

- **Solid-State vs. Tubes in TV Transmitters**

It is no longer so easy to decide between tubes and solid-state, even in TV transmitters. This article looks at both sides of the issue.

June...

NAB CONVENTION REPLAY

- **Perspective on the Convention**

The NAB convention remains the primary event for most broadcasters and video production professionals. *BE* coverage details the key points of the 5-day affair.

- **NAB Engineering Conference Report**

Many of the technical papers presented at the engineering conference represent tomorrow's technology. Others are designed to help engineers take advantage of today's hardware. The report will highlight those papers that will affect the engineering community.

- **Pick Hits of the '91 NAB**

Our annual Pick Hits panel can help you locate the key products introduced at this year's show. A panel of independent, highly qualified judges scour the floor, looking for those unique and useful items that can help produce a winning signal for your station.

- **Show of Shows**

The hundreds of new products introduced can never be seen while you are at the show. Carl Bentz, *BE* special projects editor, relieves that burden with his detailed coverage of all the new items shown.

Classified

1991 SBE CONVENTION SCHEDULE

Plan now to attend the 1991 SBE National Convention and *Broadcast Engineering* Conference in Houston, Oct. 3-5.

- **Special NASA Tour.** This year, SBE attendees have the opportunity to see behind the scenes at NASA. Special SBE-only tours have been arranged for attendees. Transportation from the convention to NASA will be available.
- **Career Sessions.** SBE convention attendees will be offered an outstanding lineup of seminars and sessions. Coordinated by *BE* magazine, the seminars will show you how to succeed in today's market.

Schedule highlights:

Television and Radio: The Regulation Front.

Get the latest word on recent FCC rule changes for television, radio and LPTV. Find out how the FCC field office will inspect your station.

State of the Industry.

Don't miss this important session as industry leaders tell you what's coming and how to prepare for it. From tomorrow's technology to WARC-92, to the ever closer challenge from Telco, you will want to attend this session.

RF Technology.

As long as broadcasters still rely on transmitters, engineers will need to know how to select and maintain these devices. Recent developments in tube and solid-state technology could mean big changes in your station.

Automation Comes of Age.

Learn how automation will increasingly affect your station's operation. Will you or someone else direct its implementation?

New Developments in UHF Technology.

Update on high-power UHF power devices. From Klystrode to MSDC to high-power tetrodes, engineers must keep abreast of new improvements.

New Technology for Radio.

Beset by increasing competition, radio broadcasters continue to look for ways to use technology to get that extra measure of quality to capture the audience. Find out how new digital system and RF links can improve your station's operation — and profits.

New Technology for Television.

Broadcast technology for television changes almost daily. Engineers need to know how to apply the latest techniques and equipment to their stations. Don't miss this session.

Call SBE now for more information at 317-253-0122.

Classified advertising now available as Classified Display or By-the-word.

Classified Display: $107 per column inch, per insertion, with frequency discounts available. 1 inch minimum, 10 inches maximum per ad. Blind ads $40 additional. Reader Service number $50 additional. Spot color available for $150 (color determined by publisher).

By-The-Word: $1.75 per word, per insertion. Initials and abbreviations count as full words. Blind ads $40 additional. Minimum charge $40 per insertion. No agency discounts allowed for classified ads.

Contact Renée Hambleton, at (913) 888-4664, for information on frequency and pre-payment discounts. To place your classified ad send your order and materials to Broadcast Engineering, Classified Ad Mgr., P.O. Box 12901, Overland Park, KS 66212.

HELP WANTED

TELEVISION SALES/SALES ENGINEER

Position located in South Florida. Candidate should be willing to travel, have at least two years experience in sales to TV stations, dealers and production facilities. *A Willingness to Succeed and a Positive Attitude is a must.* **Send Detailed Resume and Salary Requirements in Confidence to:**

Broadcast Engineering, P.O. Box 12901 Dept 722, Overland Park, KS 66212

MAINTENANCE ENGINEER. Fox Television, KRIV, Houston, TX is seeking a maintenance engineer. Applicants must have at least five (5) years minimum television broadcast maintenance experience. Must be familiar with small format videotape and Sony betacam format. Must have FCC license or SBE certification. Interested applicants should contact: Wendell Wyborny, V/P Chief Engineer, KRIV-TV, P. O. Box 22810, Houston, TX 77227 E.O.E. 4-91-2t

KTNQ/KLVE (RADIO) SEEKS CHIEF ENGINEER. Qualifications include knowledge of digital transmitters; modern AM/FM audio processing; AM directional patterns; studio maintenance; FCC rules and regs. Knowledge of Spanish helpful but not necessary. Resumes only to: Kenneth D. Wolt, President/General Manager, KTNQ/KLVE, 1645 North Vine St., Hollywood, CA 90028. Equal opportunity employer. 4-91-1t

ENGINEER - BROADCAST APPLICATIONS

Major progressive UHF television transmitter manufacturer is seeking a Systems Applications Engineer who has broad knowledge of transmitter and RF components to work with Sales and Engineering support groups. Responsible for preparation of proposals, bills of material, and for providing technical support to Sales staff.

Comark offers competitive salary and liberal benefit plans. Send letter of interest and resume to: Comark, Personnel Manager, P.O. Box 229, Southwick, MA 01077. **EOE**

WESTINGHOUSE BROADCASTING is accepting applications for experienced engineers who are proficient in maintenance, troubleshooting, and construction with minimal supervision. An ASET/BSET/BSEE degree along with 5 years of commercial broadcast engineering experience including directional AM's and class C FM's is required. Non-degree applicants with proven credentials will be considered. We are an equal opportunity employer with a satisfying working environment offering an excellent compensation and benefits package. Mail your resume and salary requirements to KILT Radio, Engineering Manager, 500 Lovett Boulevard, Houston, TX 77006. No phone calls please. 4-91-1t

HELP WANTED

TV/RADIO SALES ENGINEERS

needed for various countries throughout Latin America. If you are interested in keeping your present job and/or have the ability to sell to engineers and managers in your own country, please reply in writing to: Broadcast Engineering, Dept. 723, P.O. Box 12901, Overland Park, KS 66212.

KIRO in Seattle has an immediate opening for a **TV News ENG Maintenance Technician.** Position requires a technical school graduate with a minimum of 3 years experience repairing, troubleshooting, and maintaining ENG equipment. Experience setting up microwave remotes and RF repair experience a plus. If you want to live in the nation's most livable city, send resume to: Debbie Wolf, KIRO, Inc., 2807 3rd Ave., Seattle, WA 98121. **EOE.** 4-91-1t

WANTED

Satellite Earth Station Operators. Military/technical experience ok. Please send resume to: S.T.A.R.S., 16250 Filbert St., Sylmar, CA 91342. Attn. Sharon Pyne. 4-91-3t

On Line Editor — #1 Market

Leading independent television station is looking for an accomplished on-line editor to work with award-winning promotion team in multi-format facilities, including new, all-digital (D2) edit suite. Candidate must have excellent creative and technical capabilites. Must be thoroughly proficient with Grass Valley 300 switcher and Sony BVE- 9000 or similar editor. Must be capable of quickly learning operation of new digital video switcher, digital audio mixer, Chyron Infinite, Sony DVR-18's. This is a cutting-edge opportunity for a proficient, visionary editor to play a key role for a leader in the broadcast field. Please send non-returnable tape, resume, and salary requirements to:

WPIX-TV
220 EAST 42nd STREET
NEW YORK, NY 10017
ATT: Human Resources Dept.

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HELP WANTED

We're looking for an exceptional Broadcast Equipment Engineer.

Contact us if you are a skilled broadcast equipment engineer eager to work with a fast-growing customer-support oriented Sony Broadcast representative.

The individual will assume responsibility for our professional equipment repair and service department. Position requires comprehensive skills & familiarity with the industry. A minimum of 3 years experience is required. Completion of Sony Broadcast training program is an asset.

Excellent salary, medical benefits, company car, performance incentive program, and upbeat working atmosphere. Sunny, southern California location. We'll help with relocation expenses.

If you're the highly motivated individual we are looking for, send or fax your resume to the address below:

sonc

425 NORTH MOSS STREET
BURBANK, CALIFORNIA 91502
TEL:818-841-9655 FAX:818-841-7649

TRANSMITTER SUPERVISOR. For UHF Transmitter in the San Joaquin Valley, California. Must have thorough knowledge of transmitters and all equipment related to a remote site. Must be in excellent health and have a good mechanical ability. Competitive salary and benefits. Send resume and salary requirements to: Chief Engineer, P. O. Box 2929, Bakersfield, CA 93303. EOE 4-91-2t

TRANSMITTER/STUDIO MAINT. ENGINEER: 3-5 yrs. experience required on transmitter & studio equipment repair & maint. UHF & FM transmitter background a plus. Send resume to WXEL Personnel, P. O. Drawer 6607, W. Palm Beach, FL 33405. EOE 4-91-1t

KFVS-TV in Cape Girardeau, Mo. is seeking a Chief Engineer. The applicant must presently be a Chief Engineer or Assistant Chief and/or have significant experience with all current TV systems. Must have FCC general class license. Send resumes to Frank Knight, Business Manager, KFVS-TV, Box 100, Cape Girardeau, MO 63702. Phone: 314-335-1212. EOE 4-91-1t

ELECTRONIC MAINTENANCE TECHNICIAN: First-rate, experienced technician, capable of caring for wide range of modern equipment in a large network affiliate. Solid technical background. Heavy experience in systems trouble shooting and repair of studio video and audio equipment, digital equipment, computer systems, Electronic News Gathering equipment, video and audio recording equipment, etc. FCC General License required. Qualified applicants, send resume to Human Resource Department, KOMO Television, 100 Fourth Avenue North, Seattle, WA 98109. Equal opportunity employer. 4-91-1t

SITUATIONS WANTED

TV MAINTENANCE ENGINEER 12 years. BSEE. studio, remote, satellite, software, Los Angeles area (818) 761-0775 4-91-1t

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons with seminars in Washington, Newark, Philadelphia. Bob Johnson Telecommunications, Phone (213) 379-4461. 05-90-tfn

HELP WANTED

DIRECTOR OF TECHNICAL SERVICES

Broadcasting Services, Michigan State University

The person hired to fill this newly created senior management position will be responsible for shaping the technical future of the engineering department of a multi-faceted telecommunication facility, which includes public broadcasting stations WKAR-AM-FM-TV, extensive campus and community cable systems and satellite uplinks.

Duties include on-going system design and expansion, maintenance, budget planning and implementation, and technical staff hiring, training and supervision.

Seeking an enthusiastic, energetic candidate with strong communication and managerial skills. Four-year degree in electronics field or equivalent experience plus five or more years of progressively responsible experience in broadcast production and distribution services required. SBE or other certification a plus.

Salary commensurate with qualifications and experience and includes excellent university benefits. For an application please contact Human Resources Systems, Employment Office, Michigan State University, 110 Nisbet Building, East Lansing, Michigan 48824 or call (517) 336-1662. Please reference vacancy number S00078. Applications will be accepted until May 1, 1991.

Michigan State University is an EEO/Affirmative Action Employer.

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Relays • Filters • Transistors
Any Parts starting with 1N or 2N

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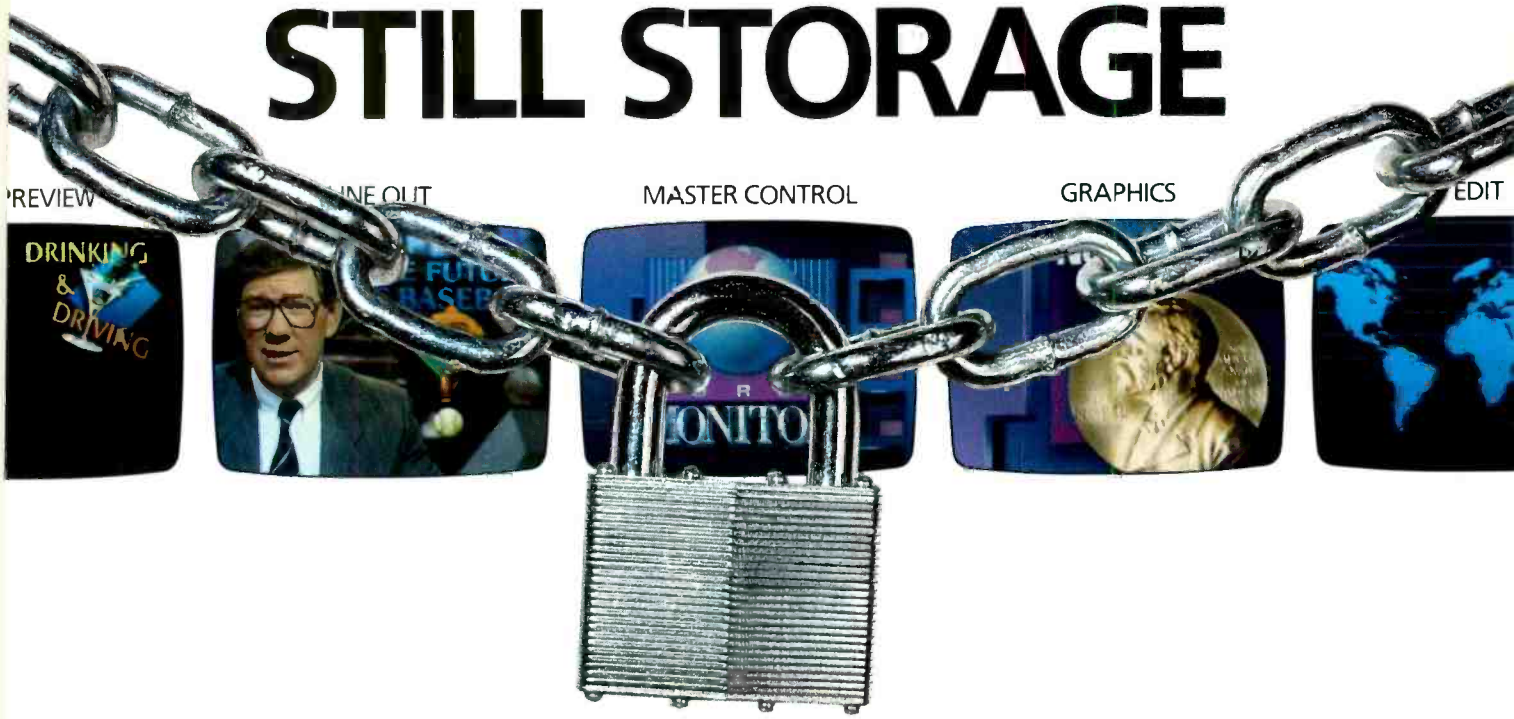

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