BROADCAST ENGINEERING

An INTERTEC® Publication

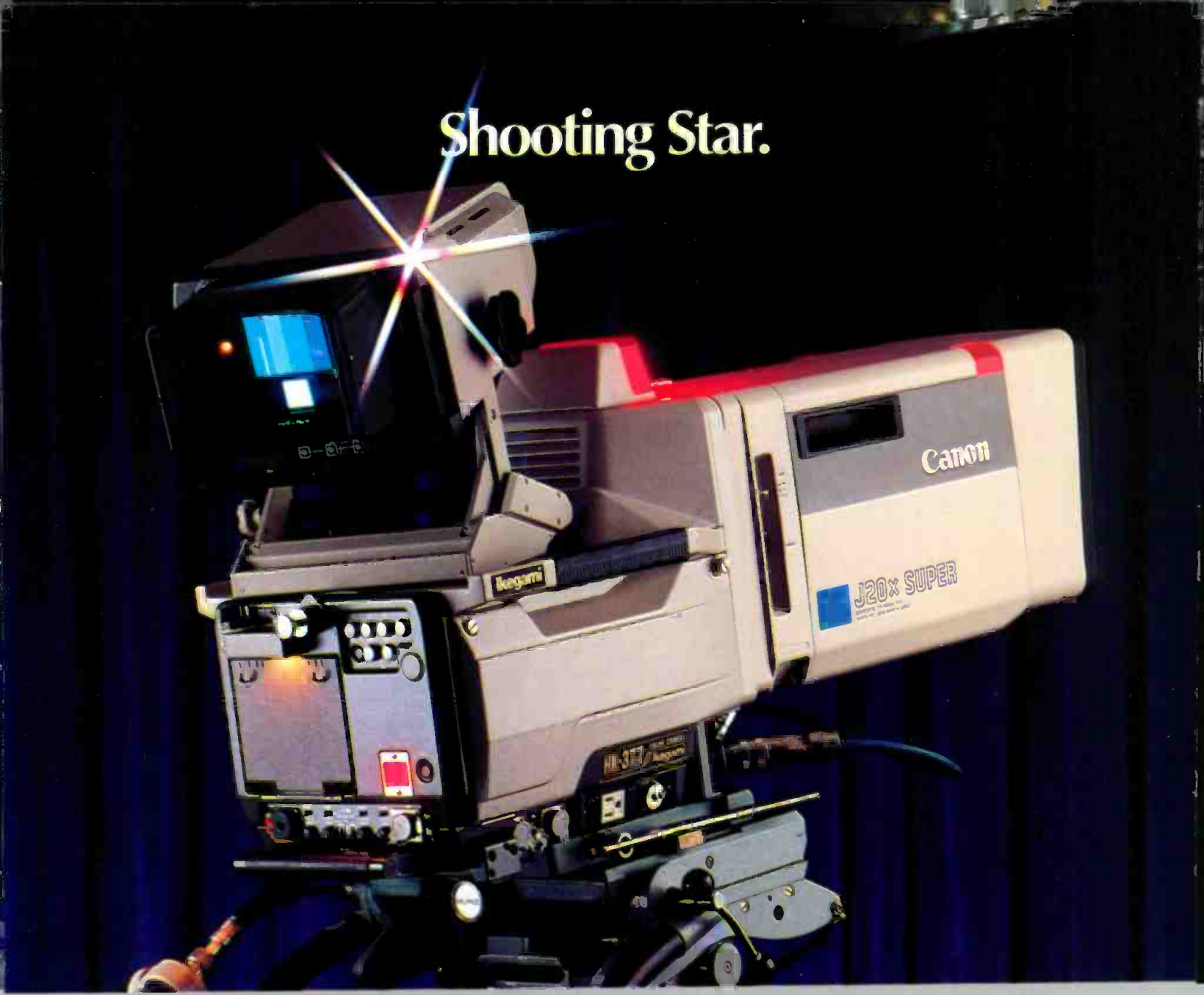
October 1994/$5.00

Managing Technology

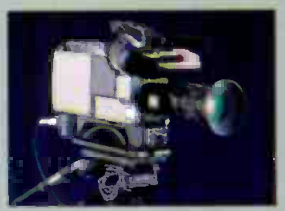
- Contract engineering
- Managing technical resources with a computer
- Optical vs. magnetic recording
- Cable/Telco/Broadcasting: Convergence or Confusion

Also Featured: Camera lens technology

Shooting Star.



The HK-377 Ultra-wideband Studio/Field CCD Camera System has the highest resolution, sensitivity and pixel count of any NTSC camera currently available. The camera employs newly-developed 2/3" FIT CCDs, each with more than 600,000 pixels. An ultra-wideband triax system with 10MHz bandwidth for each RGB channel delivers an unprecedented 900 TV Lines resolution at the base station output. The new base station has provisions for digital signal output (optional) to accommodate the demands of high-quality production.



The HK-377P portable companion offers the same performance characteristics as the HK-377 and operates through the same Base Station or can be configured for stand-alone operation.

Unique features of Ikegami's new high-end camera also include extensive remote control of detail functions, including the Skin Detail to soften the complexion and to give your stars a more youthful appearance. A high-resolution viewfinder has its own VF DTL (Viewfinder Detail) and PIP (Picture-In-Picture) circuits. The HK-377 has an AHD (Auto Hue Detect) circuit for "skin tone capture." Master Control Panels are equipped with memory card I/O Ports. A "Snap Shot File" permits control and scene file data to be written into, and read quickly, for shooting parameter replication.

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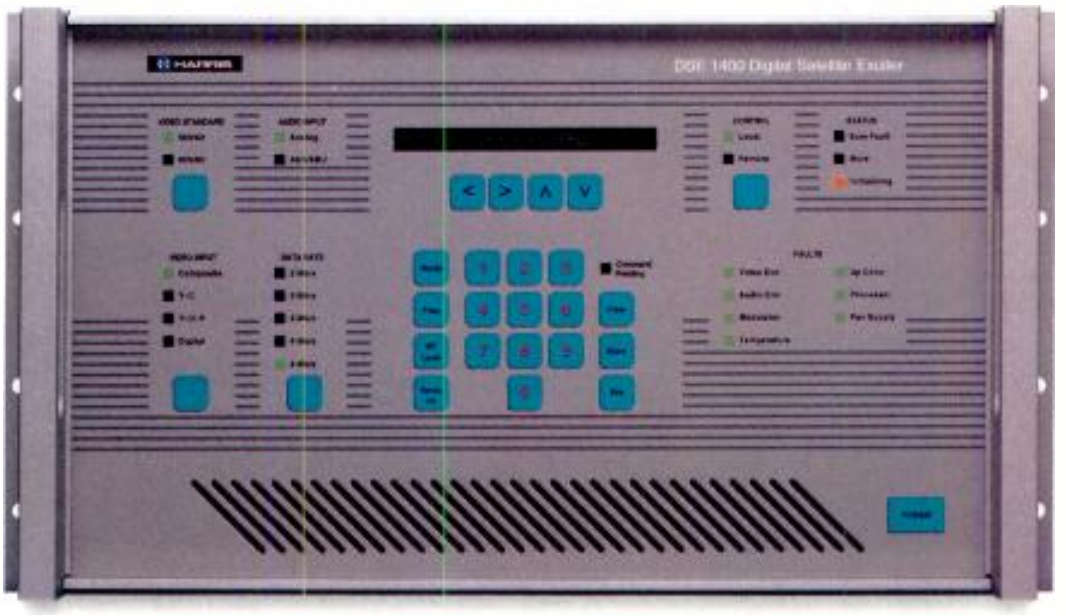

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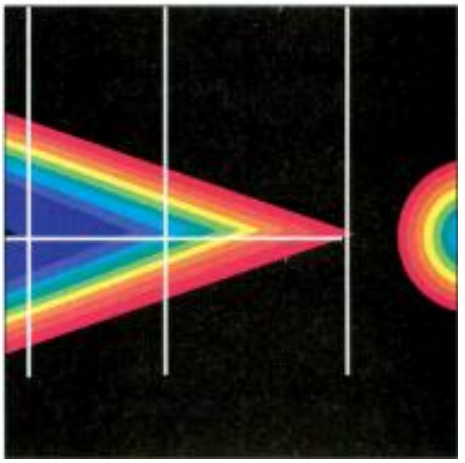

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MANAGING TECHNOLOGY:

Technical managers face an increasingly challenging task to keep their facilities up-to-date. With broadcast and production technology changing almost daily, engineers and managers must not only understand how to effectively use today's equipment, but how to plan for the transition into all-digital production. This month's issue provides guidance to those charged with managing their facility's technical resources.

DEPARTMENTS:

COLUMNS:

THIS MONTH...

ON THE COVER:

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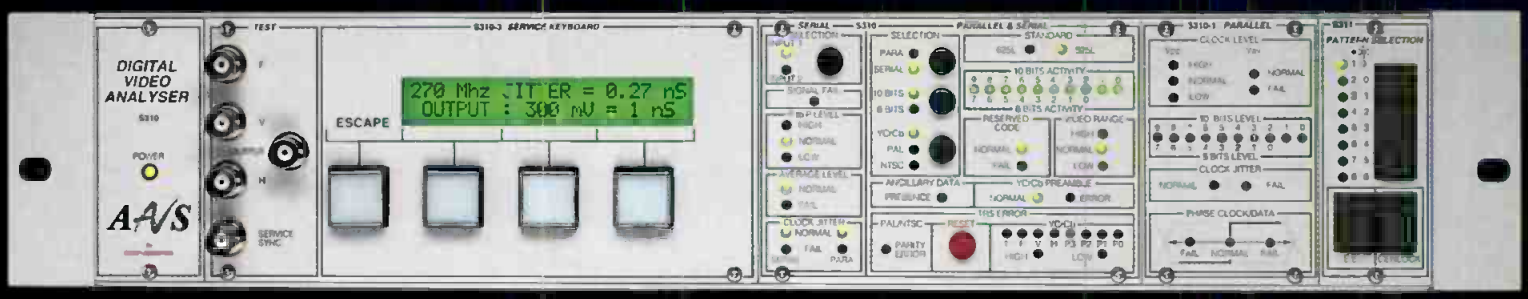

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News

By Dawn Hightower,
senior associate editor

SMPTE adopts standards for digital control network

The Society of Motion Picture and Television Engineers (SMPTE) has come to a consensus on new digital control standards for the wide range of equipment used in producing TV programs, motion pictures and accompanying audio material. The new standards will provide for high-speed/high-volume communication of control commands and status information using computer industry-standard techniques and hardware.

The Working Group on Digital Control employed a 2-stage approach. The first stage accommodates small and moderate-sized systems using a current ANSI/IEEE 802.3 (Ethernet-type) implementation. The second stage will provide operation at a higher rate with a wider range of services and features for large systems. Details of the first stage system are complete, and documents supporting it have been approved. The second stage system is under development.

The parameters of the first stage standard are the use of ANSI/IEEE 802.3 hardware connections operating at a 10Mb/s data rate, use of any of several cable and connector arrangements, User Datagram Protocol and Internet Protocol for communications control and addressing, and implementation of existing EBU/SMPTE virtual machine dialects for messaging.

The new scheme is called ESlan-1 and will provide a mechanism using gateways for interconnecting existing equipment using proprietary communications protocol at the RS-422 interface level (as well as equipment built around the RS-422-based ESbus).

The digital control scheme provides for overall facility control of functions within equipment types ranging from editors and VTRs to routing switchers, release switchers, production switchers, digital effects and graphics equipment, camera robotics and audiotape recorders.

Cable advisory group proposes joint decoder interface to FCC

A joint proposal for a decoder interface for cable-ready televisions is being submitted to the Federal Communications Commission (FCC). After more than a year's worth of work by the cable and consumer electronics industry, this recommendation reflects the primary objective of consumer electronics manufacturers, advances pro-consumer and pro-competitive policies to the FCC in relation to cable and TV compatibility.

In response to the FCC's request for a decoder interface for cable-ready televisions, the proposal specifies requirements for the interface, such as the mechanical connectors, cabling and electrical signaling. The electrical signalling includes the driving signals for the decoder, AGC control, audio and video signals, and communications protocol.

VOA distributes digital audio newscasts on Internet

The Voice of America (VOA) has begun distributing digitized audio versions of selected newscasts in Russian, Chinese and 13 other languages via the international research Internet.

The sound files offer computer users all over the world samples of international newscasts and regional reports.

In addition to Russian and standard Chinese, VOA plans to offer digitized audio in Arabic, Cantonese, Czech, English, French, Hindi, Hungarian, Korean, Polish, Slovak, Spanish, Swahili and Ukranian.

VOA text files available to users of the Internet also include program schedules, frequency information, and satellite downlink instructions for the VOA and Worldnet Television, which is situated along with VOA in the Bureau of Broadcasting of the U.S. Information Agency.

97th AES Convention

"Bridging Audio Throughout the World" is the theme for this year's 97th AES Convention. The show will be held Nov. 10-13, at the Moscone Convention Center in San Francisco.

More than 300 exhibitors will cover more than 150,000 square feet of space. Eleven demo suites along with workshop rooms will be located near the exhibits.

In addition to technical paper presentations, 14 workshops are also scheduled. Other events lined up include the technical tours, presentations from AES technical councils and an awards reception. ■

BROADCAST engineering

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

BROADCAST ENGINEERING (ISSN 0007-1994) is published monthly (except semi-monthly in November) and mailed free to qualified persons within the United States and Canada in occupations described above. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address changes to Broadcast Engineering, P.O. Box 12902, Overland Park, KS 66282-2902.

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

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Editorial

Top 10 reasons why we need HDTV

As the Advanced Television Test Committee winds down its work, the approved HDTV transmission standard looms ever closer. While every survey I've seen says broadcasters don't want it, the adoption of such a standard is a foregone conclusion. So that leaves us with somewhat of a dilemma.

If broadcasters don't want it, then why adopt it? Well, I've looked into that question and have come up with some answers.

One of the original reasons for developing HDTV was to ensure that the technological leadership of the United States was not lost to foreign competition. It was claimed that through the work on HDTV technology, a wide variety of societal technological benefits could be expected. They included the development of sophisticated data-reduction techniques, new IC manufacturing processes and a wide range of entertainment delivery and software benefits. (Not mentioned was the benefit to TV set manufacturers through the legislated obsolescence of every TV set in America.)

We were led to believe that by being the first to bring digital HDTV to the world, the U.S. could again become the technological giant. HDTV was to be the keystone to the electronics industry's grand resurrection.

Well, don't you believe it. The real reasons for having HDTV lie elsewhere. In consultation with highly placed (and unwilling to be named) sources, I've been able to identify the top 10 reasons why this country needs HDTV, and they've got nothing to do with the public reasons you've heard about.

So mark them on your 1995 calendar. That's when the transmission standard should be approved. Once it is, the real reasons for needing HDTV will come out. In the meantime, here's an advanced look at the reasons for the wide scam, high-diffusion dilemma.

Brad Dick

By Brad Dick, editor

Top 10 reasons the United States needs HDTV

10. One word: "Baywatch."
9. Zenith needs something newer than System 3 to sell TVs.
8. With his eye on a fat bonus check, Thomson Consumer Electronics executive vice president of marketing and sales, Joe Clayton, is convinced that the "HD" in HDTV stands for "hefty dividends."
7. Overall health of Americans will improve when they can see what fast food *really* looks like.
6. Will give Al Gore something new to talk about now that everyone's bored with the information highway.
5. Will be wide enough to capture the full width of Rosanne without pan and scan.
4. Bill Clinton thinks 16:9 are the odds of his re-election if he supports HD.
3. We'll finally be able to tell if that funny stuff on David Letterman's head is hair or a toupee.
2. Viewers will at last be able to read those tiny disclaimers at the bottom of auto dealer ads.

... And finally, the number one reason the United States needs HDTV:

1. Adopting HDTV means the FCC will be too busy writing new regs to levy fines.

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INNOVATION AT WORK.

FCC Update

Unattended operation

By Harry C. Martin and Andrew S. Kersting

The FCC is preparing a Notice of Proposed Rulemaking (NPR) providing for a significant relaxation in the attended operation rules for radio and television. In the meantime, stations are expected to adhere to all existing rules.

Current rules: Section 73.1860 requires that, at all times, a duty operator must be present at the station's transmitter location or studio control point. From this position, the operator must be able to observe transmitter and monitor meters and be able to make adjustments in operating parameters.

Extension meters: Section 73.1550 governing extension meters, provides a limited exception to the transmitter control requirement. If extension meters and monitoring devices are in the same building as the transmitter and no more than one floor above or below the transmitter location, the use of such meters is permissible so long as the transmitter is no more than 100 feet from the meter location.

Remote control: Another exception to the attended operation rule is provided in Section 73.1400 dealing with remote-control operations. An off-premises remote-control point can be established anywhere, including the licensee's or chief operator's home, provided the FCC is notified of the location of the remote-control point, and provided the remote operator can observe and control the operation of the transmitter. Directional AMs, however, must seek a specific remote-control authorization.

Studio rule: The main studio rule requires that all broadcast licensees, during regular business hours, maintain a meaningful management and staff presence at a main studio within the station's city-grade contour. This can be met by having a full-time management-level employee based at the main studio facility, with a clerical person present at the studio on a full-time basis. The management employee must report to the main studio daily, and be based and work there part of every business day.

Violation: In July, the Dallas office of the FCC's Field Operations Bureau (FOB) inspected an AM-FM facility that was in violation of the attended operation and main studio rules. When the FOB representatives appeared, the building was locked and the stations were operating unattended. The AM station did not change to its nighttime pattern when required. Neither station had an announcer on duty and no one was watching the EBS receiver. Pre-recorded programming and commercials were brought in periodically by an employee, but the station had no telephone or other contact point. The fines for these violations will be tens of thousands of dollars.

Relief for short-spaced FM stations?

The FCC is considering adopting an NPR, which could make it possible for grandfathered short-spaced FM stations to change sites or otherwise improve their facilities.

This initiative was begun by the engineering firms of Hatfield & Dawson, duTreil Lundin & Rackley, and Cohen Dippell & Everist. In 1991, they suggested that Section 73.213, which governs modifications to short-spaced FM stations, be changed as follows:

- To permit stations that are short-spaced to co-channel or first-adjacent channel stations to apply for maximum facilities for the class, provided the pertinent predicted *interfering* contour of the proposed modified facility does not extend any further toward the short-spaced station's predicted 1mV/m contour, or if such contour overlap already occurs, that the overlap area is not increased.
- To permit stations that are short-spaced to second- or third-adjacent channel stations to change location without regard to further short-spacing, and to permit increases in such stations' facilities to the maximum power and height permitted under Section 73.211.

Co- and first-adjacent channel: Section 73.213 proscribes any change in a short-spaced station that would extend the predicted distance of the 1mV/m contour toward the 1mV/m contour of the station to which it is short-spaced. Changing the rule to prohibit an increase in the distance to the predicted interfering contour would permit greater facilities because, as co- and adjacent stations move closer together, the distance to the interfering contour changes proportionately less than the distance to the 1mV/m service contour.

Second- and third-adjacent channels: The petitioning firms pointed out that prior to the most recent rule revision, the FCC had, at least since 1964, recognized that no significant problems would result from allowing stations short-spaced on second- and third-adjacent channels to improve their facilities without regard to short-spacing. Many grandfathered second- and third-adjacent channel short-spaced stations are located within the 1mV/m service contours of the stations to which they are short-spaced. Facility improvements and site moves under these circumstances would have little consequence in terms of interference. Permitting improved facilities in such situations could reduce interference because the improved signal might help serve areas and populations subject to interference.

Prospects for rules changes

Prospects for speedy changes to the attended operation and FM short-spacing rules are poor due to the FCC's concentration on non-broadcast issues. The agency has been occupied with cable television, PCS, IVDS and other matters. The Mass Media Bureau has had little success in getting its proposals before the FCC in this environment. ■

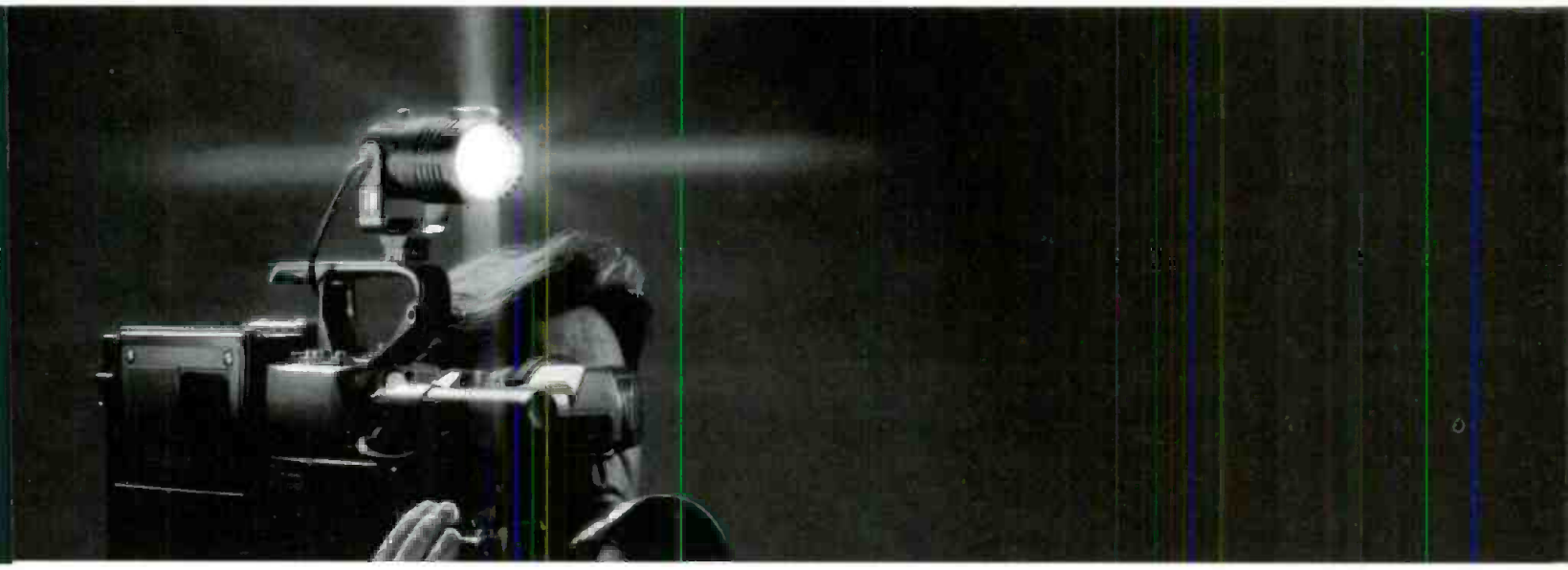
Date line

Dec. 1, 1994, is the due date for annual ownership reports for commercial stations in Alabama, Georgia, Connecticut, Massachusetts, Maine, Minnesota, New Hampshire, Rhode Island, Vermont, North Dakota, Montana and Colorado.

Martin and Kersting are attorneys with Reddy, Begley, Martin & McCormick, Washington, DC.

315g of light*

* 11 ounces



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Strictly TV

Are you in SC/H phase?

By Curtis Chan

With all the hoopla about digital video and audio technology, it is easy to forget that numerous facilities are producing quality productions with analog equipment. Because of this, this month's column will look at SC/H phase and some of the reasons why maintaining proper SC/H phase is important to an analog facility.

The importance of proper SC/H phase

RS-170A defines SC/H phase as the phase relationship of the color subcarrier to horizontal sync. There are 227.5 subcarrier cycles/horizontal line. The half cycle causes subcarrier phase to reverse every line, reducing subcarrier visibility on black-and-white monitors. Each frame has 119,437.5 (227.5 x 525) subcarrier cycles, again the half cycle causes the phase to reverse every frame. It takes two frames (four fields) to complete a color frame. RS-170A further defines that for proper SC/H phase, the zero crossing of the extrapolated subcarrier of color burst shall align with the 50% point of the leading edge of horizontal sync. For color field one, the extrapolated subcarrier zero crossing will be positive going on even lines. Although this definition is good in theory, it does little to explain the importance of maintaining proper SC/H phase.

For color field one, the extrapolated subcarrier zero crossing will be positive going on even lines.

The real impact of SC/H phase lies in the video editing environment. During VTR playback, if the off-tape color frame is incorrect relative to when it was recorded, the video's horizontal position could be displaced. This can result in loss of active picture as well as the possibility of horizontal shifts occurring at edit points. These shifts may occur at random and are most noticeable when doing match-frame edits.

Chan is president of Chan and Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

Potential problems

To achieve proper SC/H phasing throughout a facility, a little sleuthing is in order. Check all sources and derived sources for correct SC/H phase, paying particular attention to switcher inputs. Potential problem areas include sync to subcarrier time base error caused by regenerative pulse DAs. Remember that sync to subcarrier time base error is different than video time base error, because it can occur either on the reference pulses to a VTR or be recorded on tape. During playback, excessive sync to subcarrier time base error can cause horizontal line shifts of 279ns (one subcarrier cycle), which may appear as picture tearing.

First, look at the primary source, the house sync generator, and work from there. The house generator should have less than 1ns sync to subcarrier time base error, less than 10ns long-term error and stable SC/H phase regardless of mode or specified operating conditions. Cameras and other non-tape systems should maintain proper phasing, however, older units may "wake-up" improperly. If this is the case, they must be checked for proper SC/H phase each time they are turned on.

Tape machines can have problems aligning their off-tape outputs to house sync consistently. Depending on make and manufacturer, VTRs handle color framing differently. Many 1-inch machines have true color framers that operate in conjunction with a 4-field capstan servo. Some VCRs have only 2-field capstan servos but shift the TBC output +/-140ns to place the picture in the proper position. Other decks, especially older units, do not have color framers at all. If you're having trouble with horizontal shifts at edit points, consult the manuals and/or the manufacturer for the proper machine setup.

Another common source of SC/H trouble is the switcher/proc amp output. Make sure that both are correct and also check the edit controller. Many controllers have an auto color framer. Verify it is on and operating properly if problems suddenly crop up. In a properly setup facility, a properly framed edit can be determined easily by looking at the time-code numbers. All time-code numbers associated with an edit will be either even or odd. If the edit point numbers are both (for instance editing frame 20 to frame 13) the machines will not be properly color framed at the edit point. Auto color framers will shift one of the points by one frame to take care of this. Sometimes out-of-house tapes will come in with the color frame reversed with respect to time code. Some editors allow for this and will adjust the numbers accordingly. The fact that auto color framers change the edit points by a frame is usually the reason they are turned off, editors (the human kind) may want to edit exactly on a frame for an effect. The edit controller will not let them, so they turn the auto color frame capability off, which allows the editor to set the proper point, possibly creating a bigger problem – an improperly color-framed edit. One legitimate reason to turn off the auto color framer is when editing audio, but sometimes they forget to turn it back on.

Shifts at edit points may occur randomly and are most noticeable when doing match-frame edits.

Achieving and maintaining proper SC/H phase is critical to the success of an analog editing facility. With fierce competition from digital houses, touting "quality clean video," it is important for analog houses to produce the highest quality product possible. One way is to keep proper SC/H phase all around the facility, which will result in better interchange with other facilities and fewer aborted edits. ■

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Part 1

Management

Employee training

The need for employee training

By Rick Morris

Employee training is one of the most powerful tools that a good manager can use. A properly trained employee is more productive, able to do more types of jobs, and more fulfilled with his work. Unfortunately, employee training is often overlooked, cut out of the budget, or ignored; principally because of the expense and a perception that once the company invests money to train employees, they will leave. These objections are ill-founded.

Benefits of training

Training employees has several benefits including:

- Improved employee productivity through raising skill levels.
- Increased employee motivation toward the job.
- Increased promotability of employees.
- Increased awareness of the interrelatedness of station operations.
- Increased employee versatility at the number of jobs they can perform.
- Reduced costs of vacation relief coverage.
- Reduced non-productive time off.
- Reduced disturbance when an employee leaves the company.

Training is not the education of the employee; that broad-based cultural, technical, scientific, and humanistic development is beyond the resources of an individual broadcasting entity. Training involves enhancing specific job-related knowledge and skills, which the employee uses to accomplish the goals of the station and contribute to its bottom line. Training in the technical areas of broadcasting may even be tied to the use of specific pieces of equipment or specific procedures and practices unique to the station or industry.

Training makes an employee valuable to your company. An employee may have the best education credentials. However, it is the formal training that they receive, frequently extending for weeks, and informally for months, that makes them valuable to your company. Managers shouldn't become complacent relying on the initial training. Broadcasting is too competitive for front-line employees to specialize in one or a few jobs. Demands placed on managers will only be able to be met if they have a well-trained staff.

Through training, managers will have more flexibility in how to schedule their staff, what jobs they do, and how to cover for vacations. Managers may also notice that employees who receive regular training have a better attitude and are more motivated. There will be less employee burnout if they have jobs that provide a variety of interesting tasks. The more employees know, the more they can contribute ideas and solutions.

Planning ahead for training

Engineering managers are aware of the swift change in technology, changes within the industry, and the motivational and cost advantages of promoting from within the company. Because of this, managers should be planning ahead of the company needs to have employees ready to step in and operate and maintain new technology. Managers may also need to prepare for automation or combine certain jobs or create new ones. A well-trained staff never finds their skills outdated because they are continuously retraining. Many of the best managers are developed from the front-line ranks and your staff should be among those that get the promotions.

Types of training

In the broadcast and production environment, three basic types of training are distinguished by who and where employees are trained: in-house training; station-based training conducted by vendor representatives or training consultants; and out-of-house, usually vendor-based training. Many stations find in-house training to suit their needs and budgets. In-house training is easy to schedule, is more likely to be one-on-one or small groups, and is customized to your facility and procedures. It also can be less expensive. Unfortunately, it takes tremendous effort to create the "course" content and instructional materials. This involves time that managers may not have the resources to support. Instruction may need to be given multiple times to accommodate each employee. Operational emergencies may interrupt training sessions, or there may be the temptation to not complete the training and have the employee perform the work anyway.

The out-of-house approach has the advantage of not having to devote staff resources to compiling the training materials and conducting the training. Managers are likely to receive new information and a new perspective from an expert. Employees sent out-of-house can concentrate on the training without distracting influences. The disadvantages include training costs and scheduling. In-house training conducted by outside experts has a combination of lower costs and expert instruction, but sacrifices the benefits of getting the employees out of the work environment and into the training environment. If you are using manufacturers' training, cost can frequently be negotiated as a part of the purchase of new equipment or upgrading of existing equipment.

Many stations use a combination of these approaches. For example, routine operational training is often done in-house. However, advanced operational training is frequently done by bringing outside experts, usually manufacturers' representatives, while maintenance training is often done by sending maintenance personnel to manufacturers' facilities. The approach you take will depend on the type of training and your expectations for the outcome.

Staff training helps your own career

Training your staff well is a direct reflection on you as a manager. Well-trained employees are more motivated because there has been an investment in their skills and abilities. Training is a key to your management of your staff and the ability to reap department productivity and other benefits. It also is part of your own future career success. ■

Morris is an assistant professor of radio/TV/film at Northwestern University. He is a former chief engineer and a former manager of engineering and maintenance for a major TV network.

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Production

Producing for interactive

By David Leathers

Experienced producers of television, video and film are finding there is a new game in town — interactive. Clients are asking for it, and money and other resources are being poured into it. It's a new market for production and production services. And it is the first truly new market in a long time and has the potential to become the biggest one ever.

Interactive productions can take several forms. There are interactive games, CD-ROMs, interactive television, and location-based entertainment. There will undoubtedly be other permutations and variations on the interactive form as the industry develops. At this point, no one can accurately predict what the norms will be. Video producers are being asked to "produce the CD-ROM version" and some TV producers will surely be involved with interactive production.

One factor that's driving this involvement is competition. As the technology to deliver higher-quality images in interactive formats develops, developers are seeking to distinguish their products by using higher and higher production values. Images that will end up as compressed files on a game cartridge or disk are now routinely being shot in film or high-end video. Video and film producers are being hired by game companies to do the production because they need the experience and the quality that video and film professionals can provide.

But what about video producers who are interested in taking on an interactive project? What are some of the things that they will run into that are different than the world of linear production?

Interactive production

Interactive production has its own unique jargon. For instance, in a video production, the video, audio and other source materials may be referred to as "elements." In the interactive world, the word is "assets." There are also many different terms that you will encounter that emanate from the fact that this is basically a computer medium. As much as we throw around terms that describe various tape formats, procedures and equipment in the video world, the computer world is less standardized and cluttered with new terms. Even the term "multimedia" still means 18 synchronized slide projectors to many producers.

It's the first truly new market in a long time and it has the potential to become the biggest one ever.

The team and the schedule

Let's assume that you are undaunted by the terminology and are going to proceed with interactive production. How do you go about putting together the team? Basically, it's like putting together a crew for a video, movie or TV production, except that there are more job descriptions and work flow considerations.

The complexity of the programming is a big factor. An important decision that is made early in the project is whether an off-the-shelf authoring system can be used or whether custom programming is called for. Game production usually requires custom programming because the unique quality of the game relies on unique programming features. If the project is a CD-ROM that only requires a few levels of interactive branching (oops, there goes one of those terms) and doesn't require blazing speed, an off-the-shelf authoring program may fit the bill. If so, programmers may not be needed on the development team.

Another big factor is what kind of elements (assets) are going to make up the bulk of the media in the project. Each type of asset has to be pre-produced so that they are all available for the actual authoring stage. Video will be produced normally, but the additional "post-post" stage of digitizing the video assets into the right format will need to be done. Still artwork will arrive in various formats and/or be created by computer artists. Animation may need to be created and brought in as well.

The trick is having people available with the skills required by the project. Scheduling has to be tightly controlled. It's easy to run into a situation where expensive programmers have nothing to do while they wait for the completion of an element needed to build an interactive link. Snafus like this can ruin a budget.

File sizes, compression and quality

It becomes extremely important to breakdown the development script to quantify the number of assets in each category that will be required. This provides a way to determine how many people in each job category will be required over what period of time. It also gives you a way to determine what procedures to use in digitizing and compressing assets. After years in film and video where higher and higher quality levels have been sought, when producing a CD-ROM or a game, the consideration of available storage space becomes a big factor. A CD-ROM only contains 650Mbytes of data. A large part of the strategy in creating a CD-ROM involves making decisions about image quality vs. file size. More compression means more media files on the disk, but at a lower quality.

File management

When budgeting, it is important to add a substantial amount of time for file management. Depending on the complexity of the project and the number and types of assets, a lot of time can be spent locating, transferring and tracking hundreds or thousands of tapes, disks, files and other elements that grow as the project develops. It is helpful to try to standardize whenever possible. For instance, if more than one production facility is involved, try to agree on common file exchange formats (possibly DAT tapes or Syquest disks).

Like video, film or TV production, successful production of interactive projects requires understanding the technology and having a well thought out plan. ■

Leathers is president of Eye Square, Hollywood, CA, and operates the *Broadcast Engineering/Video Systems* Digital Media Lab, Hollywood, CA.

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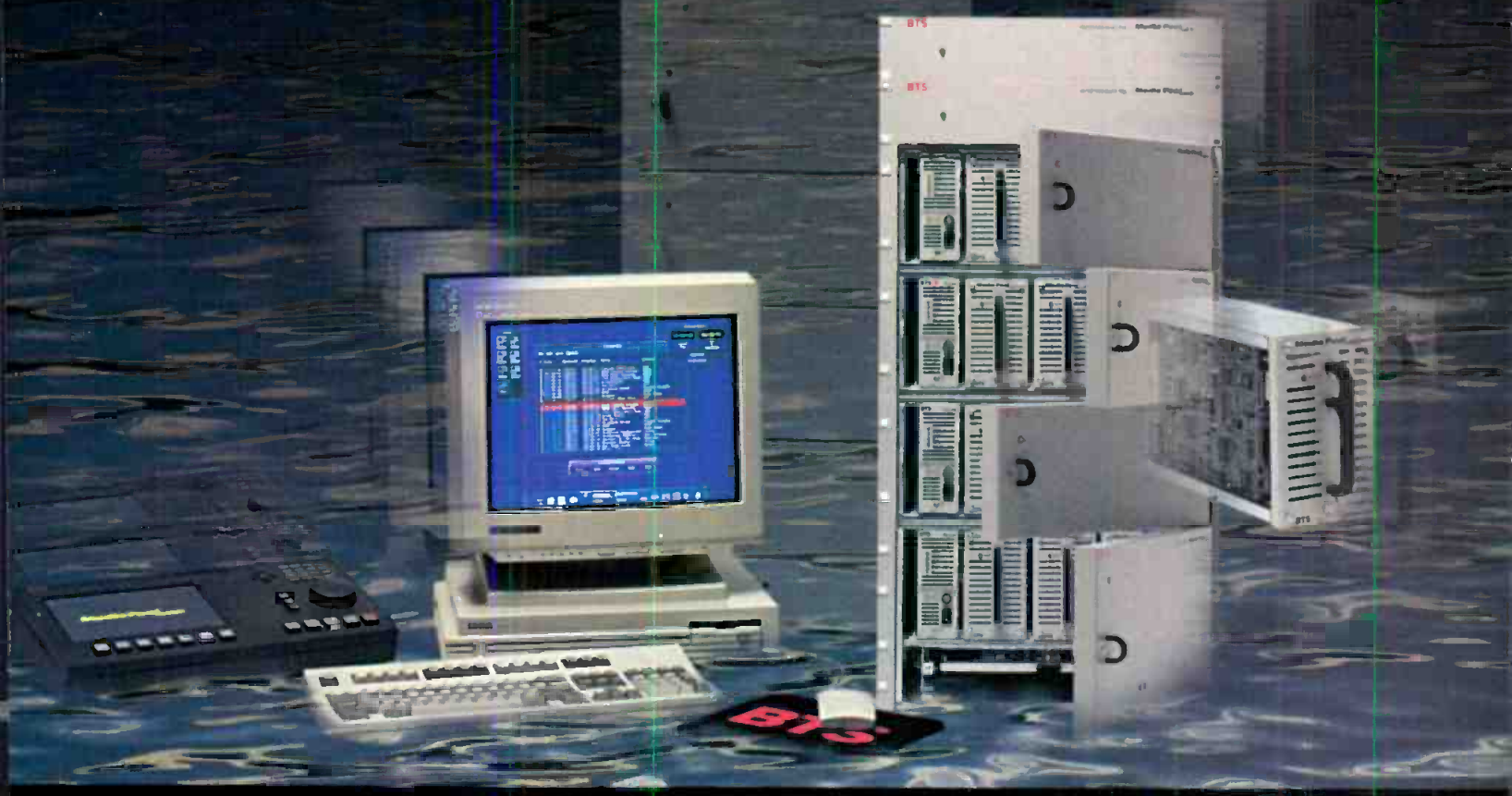

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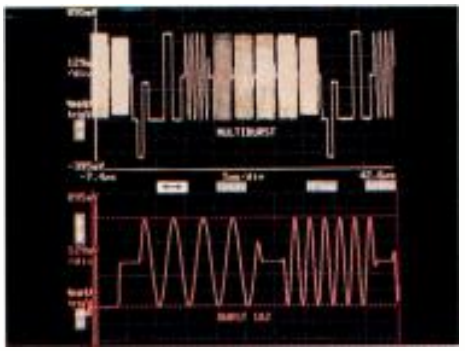
Part 4

Troubleshooting



Industrial computers

Maximizing PC system reliability

By Steve Newbegin

The need for greater reliability on the factory floor was the original reason for ruggedizing the PC. This is one reason why broadcast industry users are turning to these types of systems, especially for critical, high-profile applications where downtime can hurt. Increasing operational reliability by eliminating or reducing many of the PC's inherent weaknesses can be accomplished in numerous ways:

- *Chassis:* Steel instead of plastic improves EMI/RFI shielding. As a stopgap, some manufacturers even offer metal rack-chassis kits for mounting small footprint office-style PCs in standard 19-inch racks.
- *Convection cooling:* Radiated heat sets up a cooling air flow pattern.
- *Positive pressurization:* Filtered air intakes build higher air pressure inside the chassis, keeping airborne dust out of the system.
- *Multiple fans and filters:* These can be more efficient than the standard single fan at cooling specific chassis "hot spots" (common with Pentium and other high heat-generating CPUs).
- *Redundant power supplies:* Small, robust, dual supplies can share the system load when both are working together but, if one fails, the other can provide the output to carry the whole system load by itself.
- *Plug-in CPUs:* These offer higher MTBF (in terms of power-on hours) than active-backplane (motherboard) CPUs.
- *Watchdog timer:* This provides an automatic reset or alarm to alert the user that a system lock-up has occurred.
- *Shock and vibration dampening:* Especially important in mobile applications, this protects drives and other fragile components from premature failure.
- *Hold-down clamps:* Also important in mobile computing applications, these items secure feature cards and ensure firm board-to-backplane connections.
- *Strain relief:* Keeping tension off cords, cables and connectors prevents bending of pins or separation of wiring.
- *System security:* Lockable access to control switches and keyboard/mouse ports prohibits unauthorized entry.
- *Safety approvals:* UL, CSA and others guarantee that the product has met or exceeded minimum quality and safety requirements.
- *Warranty:* This can be useful for measuring manufacturers' confidence in their own products. PC board-level warranties, for example, typically range from 90 days to lifetime. The longer the warranty period, usually the better the quality, reliability and support.

Newbegin is sales engineer for Industrial Computer Source, San Diego. Respond via the *BE* FAXback line at 913-967-1905.

One of the most popular emerging solutions is RAID technology.

Improving data integrity

Redundancy is one of the key areas affecting overall system reliability, and that clearly includes protecting your data. One of the most popular emerging solutions is RAID (Redundant Array of Inexpensive Disks) technology. Defined in the late 1980s by computer scientists at UC Berkeley, RAID architectures may be hardware- or software-based. Reduced overall network performance may result with software-based systems, however, because they tend to tap into the processing power of the file server.

Hardware-based arrays combine multiple disks into a subsystem that appears to your file server's operating system as a single device. RAID technology allows you to write or *stripe* blocks of data across multiple, low-cost hard drives with stored parity and error-correcting codes that compensate for any failed drive within the subsystem. When such failure occurs, data is rebuilt transparently from the array's other drives in a background operation, while the host system continues to operate. Because of their high degree of fault tolerance, RAID subsystems are ideal for maintaining data integrity. For mass storage, data may be downloaded to rewritable optical drives, CD-ROMs or other appropriate media. Six current RAID compliance levels have been established:

1. Data is striped on multiple drives with no error correction codes (ECC).
2. Data is duplicated on a second drive for backup.
3. Data is interleaved across multiple drives using ECC for single-bit error correction.
4. Data is transferred to multiple drives in parallel; one redundant drive is used to store ECC information.
5. Blocks of data are transferred to individual drives; one common drive stores ECC information.
6. Blocks of data are transferred to individual drives with ECC embedded; no dedicated ECC drive is used.

RAID systems not only offer reliability improvements, but can also increase performance dramatically. For example, the time required to download a 16MB commercial segment from a single drive is significantly longer than the time needed for a RAID system, which could store the same data across multiple disks. If four disks were used in the array, a simultaneous 4MB download from each would take only one-fourth as long (assuming equivalent drives and adequate bus bandwidth). To determine which RAID architecture would be best for your application, consider the cost per megabyte of user-available disk space, storage density, transfer speed constraints and other price/performance factors that a reputable manufacturer can provide.

In summary, let your application drive the solution. Resist the temptation to focus exclusively on reducing initial capital outlay when purchasing the system. On the other hand, don't be sold on a lot of extra bells and whistles that you will probably never need. The most valuable resources may be your associates who have already traveled down a similar path. Don't be shy about asking them what works and what doesn't. You will not only profit from their mistakes, but avoid making some new ones of your own. ■

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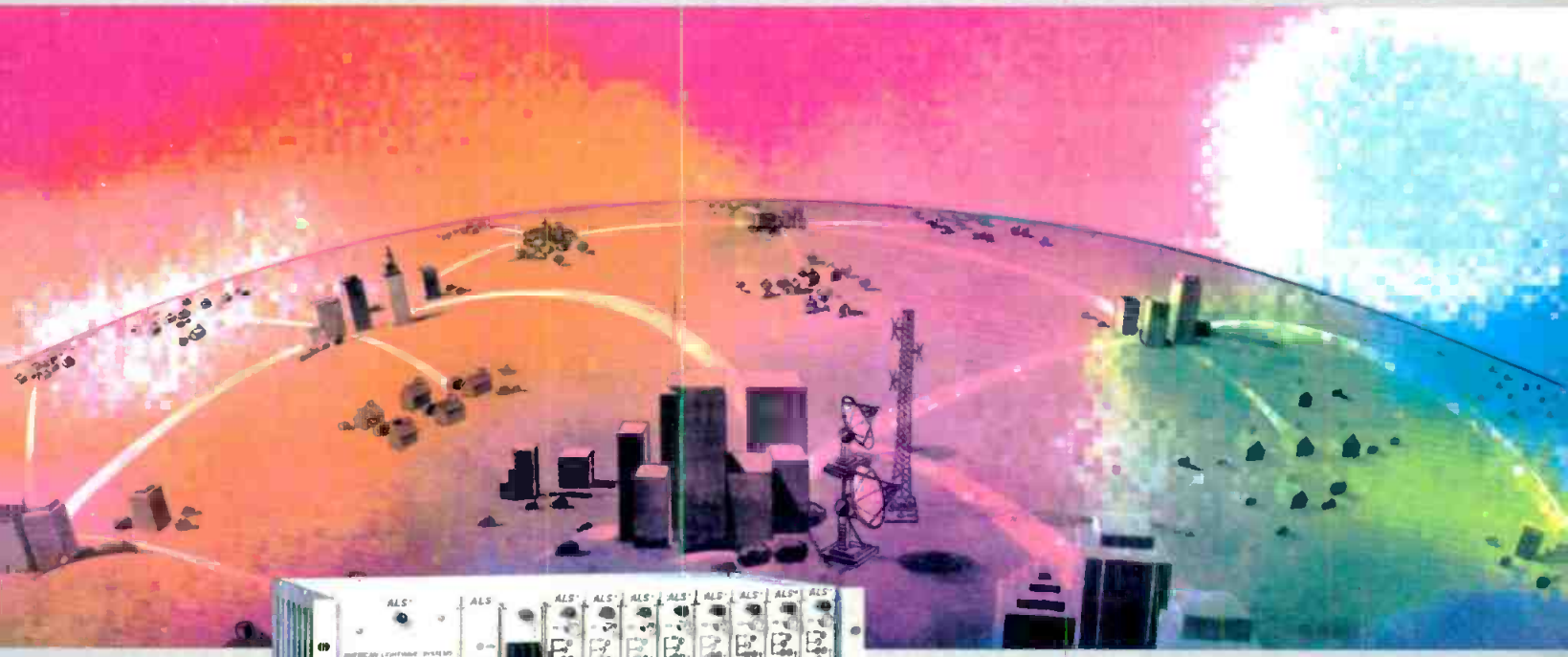

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Technology News

Memory ramaclature

By Curtis Chan

Manufacturing companies designing everything from multimedia graphics cards to video file servers are pushing memory technology to the limit. Current and future broadcast, communications and production systems are requiring faster, higher density and higher throughput solid-state storage requirements. Traditional stand-by (Dynamic) RAM is being nudged out in favor of newer application-specific types (Specialty DRAM). These new types of DRAM can be optimized for speed, density and/or cost efficiency. Although numerous types are under development, only seven show any current promise of making it into the mass market within the next couple of years. They are: Synchronous DRAM (SDRAM), Enhanced DRAM (EDRAM), Window RAM (WRAM), Synchronous-Graphics RAM (SGRAM), Rambus DRAM (RDRAM), Cache DRAM (CDRAM) and Extended-Data-Out RAM (EDORAM or EDO).

SDRAM

SDRAM is basically an asynchronous DRAM with an added clock plus burst addressing capability. Although it will not displace traditional DRAM or VRAM in the near term, future prospects look good for specific applications, such as graphic accelerators. For instance, conventional DRAM may be used for resolutions up to 800 x 600 at 16 bits/pixel. SDRAM is more suitable for resolutions of up to 1,600 x 1,280 at up to 32 bits/pixel with VRAM taking up the high-end applications.

These new types of DRAM can be optimized for speed, density and/or cost efficiency.

SDRAM's combination of high performance and low cost will allow a new generation of RISC-based systems using SDRAM to replace current high-priced workstations that use traditional SRAM cache and DRAM for main memory. As market demands increase, SDRAM may find itself in the enviable position of replacing DRAM. A side note is SROMs, although still in the R&D stage, could have enormous speed benefits to any device that requires fast access to stored data, such as computer operating systems, DVTRs, switchers and hand-held devices.

Chan is president of Chan and Associates, a marketing consulting service for audio, broadcast and post-production. Fullerton, CA.

EDRAM

EDRAM integrates a static memory buffer and cache controller with a fast DRAM to optimize timing. The benefit is the replacement of primary DRAM and secondary RAM cache for computers, thus saving valuable real estate, power and cost while increasing system performance. Computer motherboards are not the only applications for EDRAM. They have also found a home in virtual reality devices, graphics accelerators, multiprocessing DSPs, disk controllers and communications processors.

WRAM and SGRAM

Other manufacturers are betting on their own specialty memory for mid- to high-end graphics applications. In theory, the SGRAM is a single-port device with graphics features, such as block write and write-per-bit. WRAM is a dual-port device like VRAM, but has a smaller serial access memory, which translates to a smaller die size, making it easier to test. This makes it more cost effective to manufacture compared to VRAM, but has a performance impact on some types of applications, although it's still applicable for systems targeted at real-time video. A triple-port device also is targeted at the communications industry. For broadband ATM types of communications, triple-port RAM is fast and cost-effective because it can replace conventional FIFO types of DRAM currently in use.

RDRAM

One of the most revolutionary approaches to the new order of specialty memories is the RDRAM and the RamLink DRAM. This architecture adds a special controller cell to a standard DRAM design. The high-speed byte-wide paths transfer addresses and data between the DRAMs and the memory controller at extremely high speeds. In operation, the RDRAM removes the existing interface that supplies up to 30MB/s from an ordinary page-mode DRAM. What's left is the DRAM core where all of the data is stored. The core is then shifted to allow the insertion of the new interface. One of the major applications of these high throughput devices will be in graphics systems and accelerator cards.

Current and future systems are requiring faster, higher density and higher throughput solid-state storage requirements.

CDRAM and EDO

CDRAM chips integrate a static-memory cache with a standard DRAM and replace the traditional SRAM-DRAM 2-tier architecture. The devices are available in 4Mbit and 16Mbit and include 3.3V operation. The most common architecture will be the 256k x 16 version.

The last entrant to be discussed is EDO. These chips improve upon the Jedec-defined fast-page mode DRAM by removing some of the timing constraints to allow for up to 40MHz of bandwidth. A 4Mbit EDO version may be out this year, followed by a 16Mbit version next year. Apparently, EDO has taken on a strong following as well because some of the largest memory players are now manufacturing it or heavily evaluating its use.

The next half decade will see a plethora of "specialty" DRAMs coming to the market. System and product manufacturers are going to have a field day trying to pick the right one for the right job. It's possible that instead of risking everything on one type, many companies will use several types to minimize risk and maximize technology and manufacturing leverage. ■

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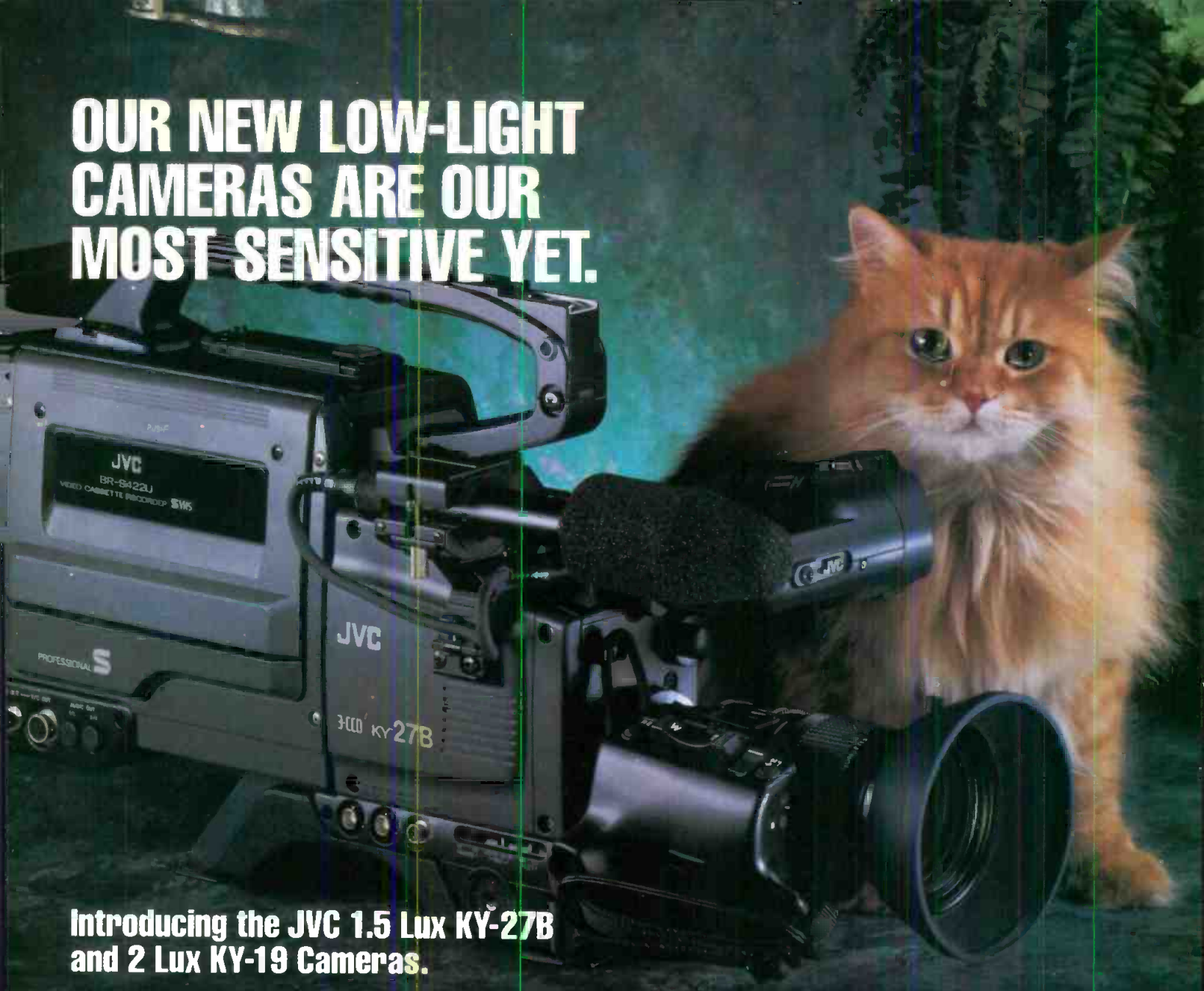

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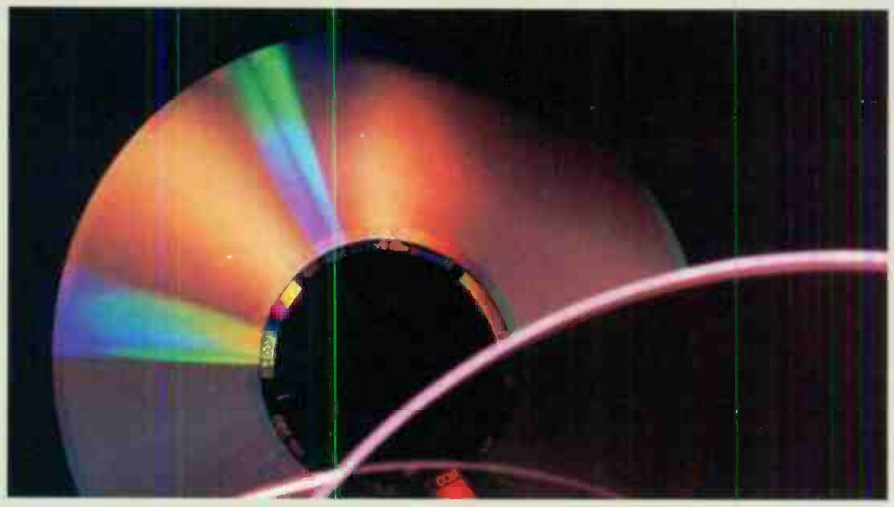
MANAGING TECHNOLOGY



When it comes to managing technology, engineers face a changing devil every day. One day you know where your facility's technology is going, the next day, some new development occurs, which requires you to change your plans. Sometimes, being a technology manager is kind of like holding a tiger by the tail. If you ever let it get loose, you'll never catch it again, and you may get bitten as a result.

Some of the keys to not getting bitten by these rapid changes in technology include: reading credible trade publications, like *Broadcast Engineering* and attending technical conferences.

In the latter vein, I just returned from the *Broadcast Engineering* and *HDTV Newsletter* Advanced Television Summit. The experience further ignited my enthusiasm about digital terrestrial transmission by broadcast stations.

At the summit, experts from equipment manufacturers, the NAB, EIA and the networks, revealed their view of tomorrow's television — and there was no lack of enthusiasm for the future of broadcasters. However, the promise of a successful future requires they invest in that future.

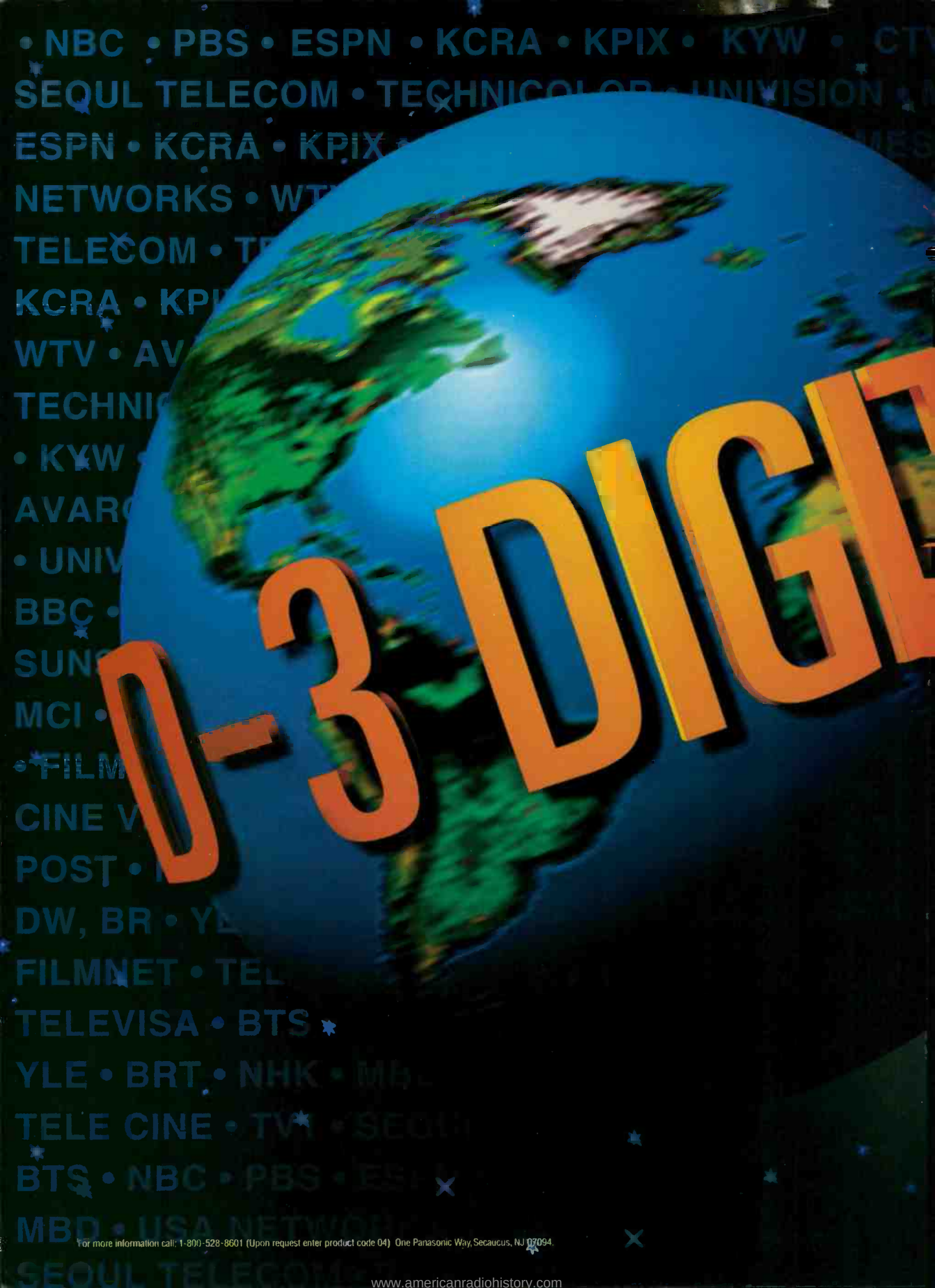
The modern equivalent of evangelist Elmer Gantry for digital terrestrial broadcasting, John Able, executive vice president/operations, NAB, almost danced when discussing the many new business opportunities for TV stations in the digital future. There are plenty of opportunities he said, broadcasters just need to redefine what broadcasting really means. It's much more than the simple delivery of one channel of programming to an audience. For him, HDTV is merely a subset of what broadcasters can do with a digital transmission medium. So, with major decisions on our digital future perhaps only a few months away, what should technology managers do?

For one thing, they need to first understand their business. Is that business only the transmission of video programming? Is it much more, perhaps including the delivery of text, data, interactive programming and a wide variety of yet-to-be-defined services?

Although the answers are not yet clear, there is little doubt that broadcast and production engineers and managers need to be future looking. They need to effectively use today's technology while building for tomorrow's future. In that challenge, *Broadcast Engineering* magazine promises to be your best ally as you lead your facility into the digital tomorrow.

Brad Dick

Brad Dick, editor



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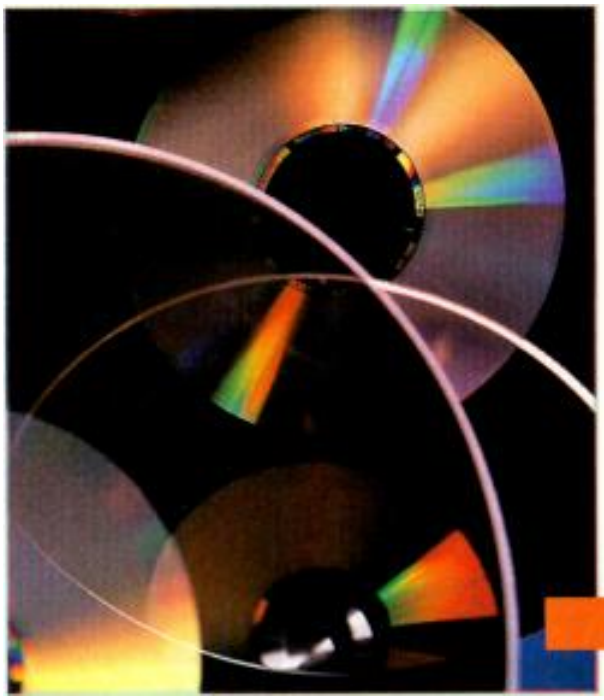

Contract engineering: A manager's guide

Replacing a staff engineer with a contractor requires some adjustment.

By Terry Baun

The Bottom Line

One effect of modern broadcast equipment's high reliability is a reduction in the need for constant engineering attention to keep a station on the air. Many stations have therefore elected to obtain their technical support on a more à la carte basis, using contractors rather than staff engineers. The process followed when implementing this change can greatly affect a station's resulting operations and profitability — for better or worse.

$

There was a time when every station had an engineer, and that engineer had an extremely broad-based job description. It included everything from specifying, building, and maintaining all the station technical gear, to servicing the phone system, computer network, and electrical/HVAC, to some occasional locksmithing and plumbing tasks, and even to changing the lightbulbs in the hallway.

That time is history. Today, many radio stations (and an increasing number of TV stations) choose not to employ a full-time engineer. The duties formerly handled by that employee are now distributed among other staffers and outside contractors. Driven by the necessity to maintain earnings performance in an increasingly competitive commercial environment, many broadcast managers have embraced the business principle known as *outsourcing*.

Outsourcing need not be a bad thing for either broadcast managers or engineers. It is simply a new kind of business relationship that may better suit the technologies and economies of broadcasting in the '90s. It allows managers to purchase only the level of services they feel are essential, and supports a broadcast contract engineering profession that is efficient at providing specific kinds of technical support to a wide range of client stations. Thus both sides can benefit.

A new management/engineering relationship

The station manager who pursues outsourcing by hiring contract technical help faces a number of issues, perhaps most important of which is the need for a change in attitude about the engineering functions of the station. No longer can engineering be a "catchall" for the repair and maintenance of every physical item at the station. Rather, only broadcast-related maintenance and repair will be performed by a contracted specialist. Other technical support functions of the station may be divided among other professionals, many of whom may *also* be outside contractors. For managers accustomed to assigning all those tasks to a single paid staff member, this will be a radical change.

Many broadcast managers have embraced the business principle known as outsourcing.

Moreover, because these support professionals will be called upon as needed, management and staff must also be prepared for a time lag between the support requests and the service delivery. For off-the-air situations, this is a critical element. The manager and service provider must have a clear understanding of expectations on typical emergency response times.

The positive side of this cost/benefit analysis will be seen in the trade-off between the money paid in salary and benefits to a full-time employee expected to handle a wide range of support functions vs. hiring non-employee specialists to fix

Baun is president, Criterion Broadcast Services, a contract engineering/technical support company in Milwaukee, WI, and vice president of the Society of Broadcast Engineers. Respond via the *BE* FAXback line at 913-967-1905.

Photos by Ben Weiss.

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specific problems as they arise. Managers should dust off their crystal balls to predict how much technical support their stations will require. Factors, such as the age and condition of the studio and transmitter equipment, the talent currently available among staff for minor technical tasks (equipment cleaning, filter changes, etc.) and the station's competitive

Management must be prepared for a time lag between support requests and service delivery.

situation in the marketplace will all play a part in estimating the depth of technical support required. In essence, this places some of the facility's engineering analysis squarely on the shoulders of station management, who will make the decisions about when and whom to call for technical support as circumstances dictate.

Although today's broadcast equipment is reliable and designed to operate with a minimum of maintenance, savvy broadcasters know that this does not render maintenance unnecessary. Transmitters, in particular, must have periodic checks of parameters, timely tube changes and touch-up tuning if the station is to operate reliably and at maximum efficiency. Many stations can continue to operate without a cart machine or two, or even without a main studio console. However, it is the rare station that can suffer the loss of a main transmitter without a concomitant rise in the blood pressure of the program director and the general manager. Situations like that require reliable and professional technical support from an outside contractor.

Questions to ask before negotiating a contract

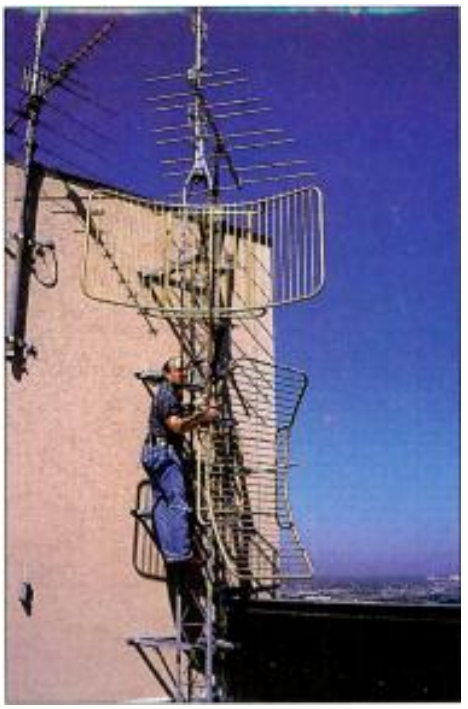
Once the decision to outsource engineering support is made, the next step is to determine just how much will be required. Managers should consider the following factors:

• *How much technical support could be supplied by existing employees?*

Most stations have a production person who is quite capable of cleaning tape heads and rollers, replacing lamps in consoles and source machines, and perhaps even swapping modules in consoles. As a first line of technical support, this person is invaluable. Another important area is setup and operation of remote broadcasts. Many contract engineers prefer not to handle these, but will usually agree to help train staff people to set up RPU and remote audio equipment. DJs, salespeople and promotion directors will probably have to get used to setting up remotes themselves.

• *Will you require chief operator services?*

Many contract engineering firms will not take on the official FCC responsibilities of the designated chief operator



Duopolies and other consolidations can keep a contract engineer busier for more hours at each client's facility.

(DCO). Find out if the contractor will work with an employee designated as the DCO to get him/her up to speed on the regulatory requirements of that position. Remember that according to current FCC rules, the DCO of an AM directional station or an AM non-DA operating at more than 10kW, or a TV station, must be an employee, not a contractor. Many contract engineers will not wish to jeopardize their IRS independent-contractor status by accepting part-time employment in such a situation. Nevertheless, there is nothing prohibiting an independent contractor from performing maintenance and repair work so long as it is understood that the DCO is the responsible party designated by the station licensee.

• *What is the age and condition of your technical facility?*

Even the best equipment will experience an increased failure rate as the years go by. Consoles, frequently in use around the clock, are particularly prone to contact/switch problems, which are difficult to work around. If you are still using magnetic tape as your primary source, cart machine downtime also becomes a critical issue for programming and sales.

• *How much backup capability do you have?*

Stations that have spent money to provide backup equipment will now begin to realize an additional benefit from those purchases, because properly trained staff members can often work around problems until the next scheduled maintenance visit. This also reduces the need for those expensive 2:00 a.m. calls to your contract engineer, many of whom charge a premium for demand services overnight or on weekends.

• *What kind of technical reliability is mandated by your competitive situation?*

Every station experiences technical difficulties at some time, but broadcast management must decide how much is tolerable. A typical uptime figure for a well-maintained and well-equipped station should be 99.9%, which still means approximately 10 hours per year off the air. Getting that last 0.1% of reliability might cost more in service fees and equipment expense than can be justified.

• *How conversant are you with FCC rules?*

Among the duties of most chief engineers is updating station management about FCC rules and assisting in maintenance of the public file. Contract technical support services may not provide this level of assistance. If this is important to you, be sure to include it in your negotiation list.

• *How comfortable will you be with outsourcing the other mechanical/telecommunications systems at your station?*

Even the best equipment will experience an increased failure rate as the years go by.

Remember, technical support for your HVAC, telephone, office computer or voicemail/PA systems may not necessarily be among the duties your contract engineer provides. It is best to get those responsibilities clearly defined from the start. You may prefer that your contract engineer serves as a resource center and provides names of other qualified support professionals for those systems, or you may wish to retain that responsibility yourself.

• *Who will purchase parts and supplies?*

Many contract engineering services do not sell parts, but will place orders on behalf of clients, either using existing client accounts or purchasing parts directly and requesting out-of-pocket reimbursement. Other contractors may choose to sell parts and supplies to their clients, usually adding a markup in the process. In any case, be sure that there is a clear understanding about purchase authority and payment procedures.

On a related issue, one additional advantage of outsourcing is the reduction or elimination of expenditures for station tools and test equipment, because contract engineers normally supply them while working at your facility.

• *Do you have corporate reporting responsibilities that need to be handled by your engineering services provider?*

If your corporate office demands monthly technical reports from its stations, you may want to be sure that your service provider will perform that task for you. Managers may also wish to request preparation of capital and operating budgets as part of the services to be contracted for. Some contractors will provide an hour or two of off-premises office time for this purpose each month, but it is best to have a clear understanding of this right from the start.

To avoid major failures occurring when no technical staff is on site, the contract engineer must watch for troublesome trends at each visit.

You're ready to talk

Once a station has decided upon the level of technical support it will need, it is time to actually sit down and talk with prospective technical support providers. Finding a competent contract engineering firm should be much like securing any other professional service. Ask your business associates for recommendations, check with other stations in the market, and check with former engineering employees for leads. Contract engineers are often sustaining members of state broadcast associations, so check with yours.

Finding a competent contract engineering firm should be much like securing any other professional service.

Most engineering services contracts contain business confidentiality clauses, and responsible engineers know they are to be respected. So there need not be undue concern about engineers working

for multiple stations in the same market. Engineering is engineering, whatever the competitive situation. The objective is to have a clean and reliable technical facility.

Working as an independent service provider is different from working as an employee.

Many managers are inclined to hire a former full-time employee as a contractor. This may offer a quick and easy conclusion to the selection process, but it often leads to misunderstandings and conflict because expectations formed by the old employer-employee relationship are difficult to change. Working as an independent service provider is different from working as an employee. To the extent those lines are blurred, difficulties are sure to result. Proceed with caution.

Questions to ask when negotiating a contract

Once a manager has located a prospective contract engineering firm, the next step is to ascertain whether that firm has the technical and financial resources to supply the services you require. Among the preliminary information you should be seeking are the following:

Taking pride in the quality of the air signal is an attitude that contractors should adopt for every station they service.

• *Ask for a rate card and client list.*
These are sales tools that any professional company should be eager to provide.

• *Ask about professional credentials (FCC licenses, SBE certification).*
If you are unsure of credentials, ask to see a résumé and be prepared to make a few phone calls.

• *Ask about quantity and quality of test equipment and tools.*
One sign of a thriving contract engineering company is its ability to invest in high-quality test equipment and supplies. Be sure that the firm has all equipment needed to perform a full audio proof of performance, and access to specialized tools, such as an RF spectrum analyzer and wattmeter.

• *Ask about 24-hour support and backup policy.*
Will emergency service be available 24 hours/365 days per year? Will backup support be available in case of illness or vacation?

• *Ask how the service provider intends to deal with parts and supply purchases.*

Will there be a set limit for out-of-pocket purchases each month?

• *Ask about the firm's policy on travel time and demand services during overnight hours or on weekends.*

Will it cost the station more if your transmitter goes down at 2 a.m. rather than 2 p.m.?

How services are billed

Most contract engineers operate on a *billable hours* basis. Because there is a finite number of hours in a month, there is a limit on the services that one person can provide. If you have determined that your station requires five hours of technical support time per week, be certain that the service provider is capable of providing that time. Contract engineers provide services to several stations, each with its own unique maintenance requirements, so it usually will be impossible for a service provider to maintain a consistent schedule week-to-week at any station. It is not unreasonable, however, to request a detailed time log each month as part of the billing process, so that both you and the contractor have a clear record of the number of service hours provided.

You may also find some companies willing to offer you a *flat fee* service contract, wherein they will handle all your technical requirements for a fixed sum each month. This arrangement is attractive to contract engineers just launching a business, because it guarantees a certain cash flow each month. The downside is that it tends to perpetuate an employer/employee type of relationship instead of the more realistic one of an outside service provider.

One sign of a thriving contract engineering company is its ability to invest in high-quality test equipment.

A third type of service offering is a hybrid of the two plans previously mentioned. It is essentially a guarantee of *x* hours of services at a flat cost of *x* dollars per month, with any additional hours required often billed at a discounted rate or applied to the next month's billable hours if requested. This allows both parties the advantage of a predictable amount of expense or cash flow. It also provides a law-of-averages cushion for those months when everything seems to go wrong.

No matter how the services are billed, a written contract should be employed when hiring a contract engineering company. The Society of Broadcast Engineers (SBE) has provided a sample contract to its members that has proven suitable for most situations. Like any contract, you should read it carefully to be certain that all your concerns are addressed.

The decision to outsource broadcast technical support functions is like any other business decision — it should be made only after careful consideration of alternatives and a thorough review of proposals. It *does* fundamentally change the way in which management and engineering work together, however. Whether that change is for better or worse will depend on the wisdom and business sense of both parties involved. ■

Managing technical resources with computers

Proper use of computers can help chart your operation's course for success.

By George Krug

The Bottom Line

A basic tenet of good management is feedback. The right kind of feedback lets employees know if their efforts are achieving the desired results. Fortunately, the nature of a broadcast operation allows the quality of its end-product to be observed in tangible and measurable ways. Attaching a computer database to this observation process can greatly enhance its accuracy and comprehensiveness, without necessarily adding much complexity or labor intensity.

Your facility probably already has a daily discrepancy report of some kind. Although this report gives a handy snapshot of the problems that occurred on a given day, it doesn't give the reader the long-term "big picture." You may have a gut feeling for the type and volume of problems that have been occurring, but long-term trends can only be accurately evaluated by methodically tracking performance statistics.

A database can help staff and management alike see beyond the daily discrepancy report. By compiling the right data, and using that information to generate regular performance reports, management gains a powerful tool. The report can be used to build team spirit, reward individual accomplishment, justify a budget, fine-tune procedures and ensure that everyone learns from everyone's mistakes.

Krug is director of technical operations at Lifetime Television, Astoria, NY. Respond via the *BE* FAXback line at 913-967-1905.

Planning your database

The first step is planning. The best way to develop a database is to begin by turning your computer off. As with any project, decide what your goals are first, then let those goals guide you in deciding what aspect(s) of performance you want to measure. For example, you may want to track the number of discrepancies caused by operator error, or you may prefer to log and document equipment failures, network interruptions and other facility problems. Keeping the categories to a salient few will prevent overwhelming the reader at report time. It also will help get the important points across. Categories can be fine-tuned as required by your facility's configuration and the number of discrepancies that occur.

Quantifying events requires you to make some more decisions: Do you want to show a simple count of equipment failures, head clogs and operator errors, or do you want to show the amount of downtime due to each kind of event? If you use a downtime approach, do you want to show the quantity of downtime in minutes, or express it in percentage terms? Other considerations: Which perspective best express-

A simple, user-friendly screen makes data entry chores easier, and improves the likelihood that they will be done in a timely and accurate fashion.

es the intended message? Will one depiction reflect better on your operation (or you) than another?

Although a written summary may suffice on its own, the impact of a visual representation, such as graphs and charts, cannot be overstated. Even if your readers don't have the patience or time to read through the text of a written summary, they will likely give a graph or chart at least a glance.

Before forging ahead, solicit the thoughts of staff and supervisors to ensure that the items tracked, the trends illustrated, and the graphs you plan on using, will be meaningful. Ask yourself and your potential readers whether the information tracked will serve as a guide to better performance, or will these lists of numbers amount to little more than interesting trivia? Also consider the software you'll use. It will have an impact on both the structure of the database and the kind of reports you can generate. Time invested in planning could save you a false start and unnecessary expense.

A database can help staff and management alike see beyond the daily discrepancy report.

On the subject of software, chances are you already have a spreadsheet and/or database that will allow you to compile the data, create some custom (but simple) reports, and use the data to create graphs and charts to help indicate trends. The latest versions of these programs make it easy for even the casual computer user to put a tracking system together, so the average engineer will have little difficulty with this phase of the project.

A key factor in creating and using such a database is to make the entire process, from entry to reporting, as easy and streamlined as possible. The steps needed to keep the information flowing should be integrated into daily procedures so that keeping the database up to date becomes second nature. Some database experience can be a big help here, especially when it comes to creating a user-friendly entry screen that can reduce the required number of keystrokes and speed the data-entry process. Daily data entry also means that up-to-the-minute information is available at virtually all times.

If data entry is handled by administrative staff, it may be helpful to offer some guidance from operations staff to verify proper categorization, terminology and abbreviations. This uniformity is essential to maintaining database integrity, and will ease report generation later on.

Turning data into knowledge

When producing reports, it is helpful to include analytical text as a guide for the accompanying graphs. Although graphs should be relatively self-explanatory, simple statistics are subject to interpretation. The analysis helps to put the charted figures into perspective, and highlights events and factors that cannot be shown graphically. All errors are not created equal, and the character of the mistakes, contributing factors, and unusual circumstances, all merit some mention. Resulting changes in procedures should also be noted and reinforced in the analytical text.

The process of writing this analysis can be enlightening to the author(s), as well. Sifting through the statistics, digesting the facts and reviewing the measures that were taken forces the manager to revisit the reasons behind the failures (and successes) before sharing that information with his or her readers. It's a good time to ask yourself: "Have I done all that I can to ensure that this doesn't (or does) happen again?"

Figure 1 is an example of using bar and line graphs to show the quantity of operator errors that occurred during the most

recent reporting period. Comparing this data for the 12 preceding months provides a good point of reference. To help smooth out the inevitable highs and lows, and to help the reader look beyond an anomalistically good or bad month, a "trend line" is overlaid that plots a rolling 12-month average.

The right kind of feedback about your mistakes can move you to change.

Figure 2 reveals which kinds of discrepancies occurred most frequently relative to others. Such a chart can help identify consistently problematic areas. The written analysis that accompanies this graph should explain what factors contributed to the number of errors and list what the errors were.

Consider carefully how personnel matters are dealt with in these reports. To avoid turning the report into a blame sheet, you may want to exclude individual names in generally circulated reports. On the other hand, using the report as a vehicle for occasional kudos to staff members who have performed exceptionally well can help reinforce the reporting process as a positive experience. Managers seldom get the chance to give an employee a public pat-on-the-back.

A multipurpose tool

Although the monthly graphs and analyses show how an operation is performing as a whole, the same database can provide empirical data on how each operator, procedure, system and piece of gear is performing.

For example, while a database won't tell you that VTR-5 needs to be rebuilt, it will show you that head clogs and other playback woes are trending upward throughout the facility, and that VTR-5 was indicated in more than half the instances. Such information can help gauge the effectiveness of maintenance cycles and procedures.

The database can also provide valuable support to managers at performance review time. The type and number of errors a technician makes during a review period can be quickly and easily summarized, giving a ready indication of the person's strengths and weaknesses. When compared with data from previous performance reviews, the manager can quickly see if there have been significant changes in the person's work from year to year (or day to day).

Comparing that person's record to his/her co-workers ensures that you are measuring everyone's performance with the same yardstick. This avoids the use of gut feelings and general impressions, which can be unreliable guides. Nevertheless, this data must be applied with care, and should be viewed in the context of other, less empirical factors involved, such as team spirit and general work habits. Don't expect to be able to create an instant review with a few keystrokes.

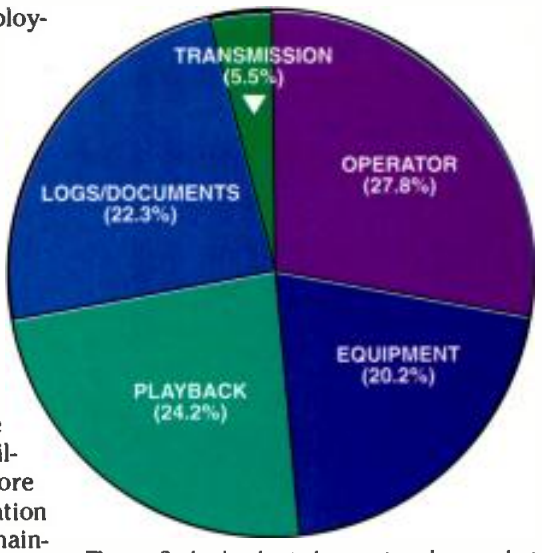


Figure 2. A pie chart shows at a glance what area is causing the most discrepancies.

This kind of feedback can be an effective motivational tool. To best take advantage of such properties, use a balanced approach that is part carrot and part stick in your written analysis. Draw attention to the items that take priority. If performance has been good, call it good. If an inordinate number of discrepancies have occurred in any area, use the report to relay expectations of improvement and long-term goals. For a staff to buy into and benefit from the program, getting feedback should be a positive experience, but not necessarily a painless one.

Virtually everyone wants to do a good job. The right kind of feedback about your mistakes can move you to change. Feedback about your successes promotes confidence in your ability to achieve. It's the manager's job to let staff members know if they are meeting expectations. It's also management's job to know if the measures taken and the changes made have been effective. A mechanism for tracking and reporting performance lets everyone know where they stand. ■

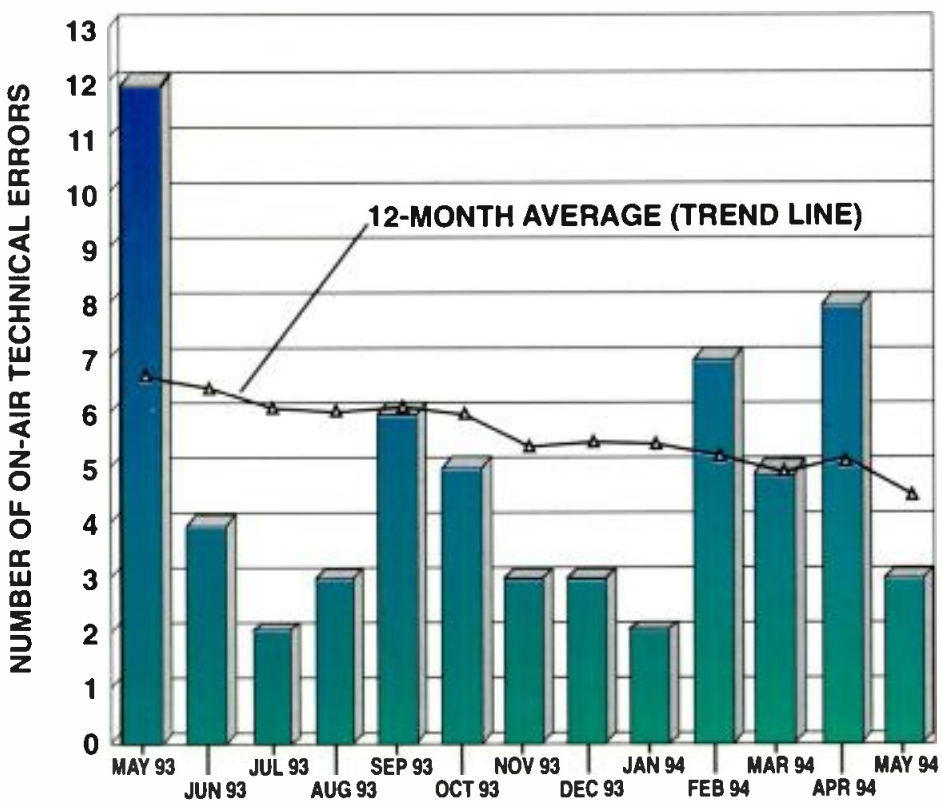


Figure 1. Bar graph shows each month's performance, while trend line shows a running 12-month average. In this example, despite the peaks that occurred in February, March and April, the trend line shows that the average number of errors is moving downward.

➡ *For more information on facility management software, circle (304) on Reply Card. See also "Business Automation," "Computers & Peripherals" and "Engineering Software," p. 71 of the BE Buyers Guide.*

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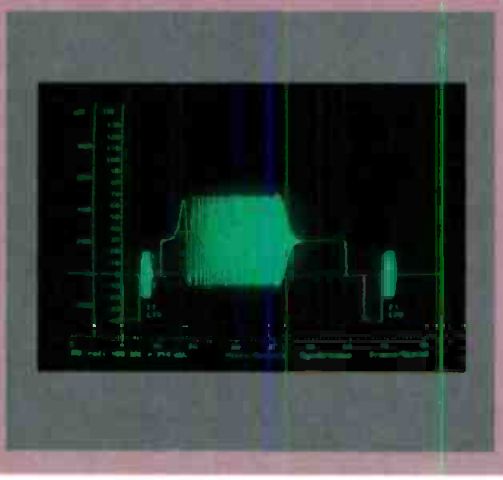

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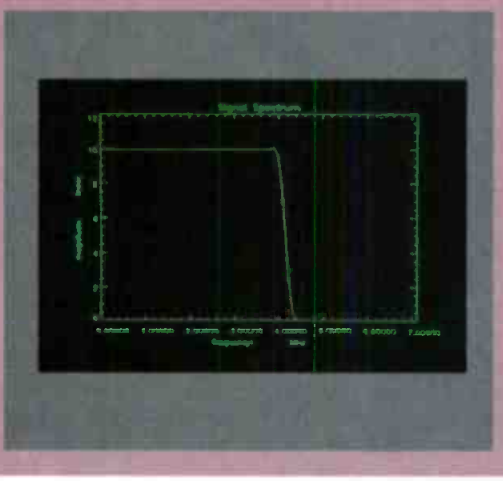

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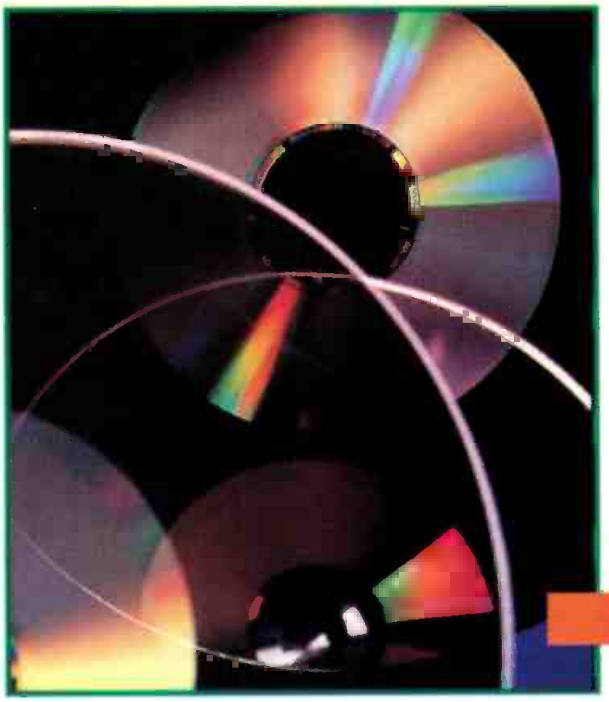


Cable/telco/ broadcasting: Convergence or confusion?

Where will broadcasters be when the dust settles?

By Michael Feazel

The Bottom Line

The techno-envy that has telecommunications giants poised to pick each other's pockets will undoubtedly affect broadcasters' future. Yet the changes ahead may be simply turns in the broadcasters' road, not the end of it. TV networks and stations exclusively possess key assets that are more valuable than any distribution system. Properly leveraging these strengths in the multichannel environment ahead may bring broadcasters unexpected new prosperity.

The question no longer is whether the "Baby Bells" will enter the TV business, or whether cable will enter telephony. The only unresolved issues remaining are: 1) When? 2) Who will benefit the most? and 3) What will the role for broadcasters be in a digital, wired world? Whatever the answers, the eventual result will create the bulk of the information superhighway.

Some hard data pertaining to these questions is already in. For example, the "when" answer is "almost immediately." The courts, Congress and the FCC are in a heated 3-way race to see who can open the doors to competition fastest. U.S. District Courts in Seattle, WA, and Alexandria, VA, have said that telcos in their jurisdictions can enter the cable business almost without restriction. The U.S. Appeals Court recently ruled that telcos don't even need a local cable franchise.

Meanwhile, Congress is finalizing work on legislation that, if passed, would remove virtually all restrictions against telcos and cable getting into each other's business. The FCC has begun approving telco applications for commercial video dial tone (VDT) systems, which have all of the video aspects of cable systems, plus interactivity and other new bells and whistles.

Cable companies are starting to operate their own competitors to local telephone companies, such as Teleport Communications Group, which provides alternative access to long distance lines. Cable operators are also obtaining FCC licenses for new services, such as *personal communications services* (PCS), and they are well ahead of the telcos in providing broadband transport of high-speed data, including access to the Internet and commercial on-line services.

Feazel is senior editor of Television Digest and associate managing editor of Communications Daily. Respond via the *BE* FAXback line at 913-967-1905.

Competitive strategies

It's immediately clear why each industry wants into the other's business. Telephone companies see an opportunity to pry away a major chunk of cable's $20 billion annual revenue.

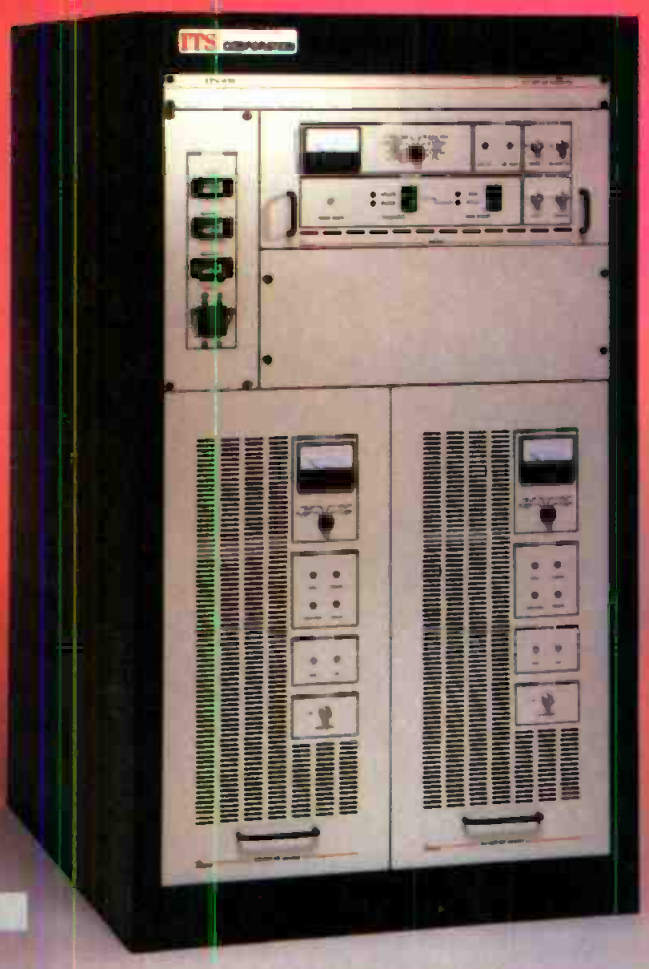
But the telephone companies may have even more to lose than cable, assuming that the telco entrance into the TV business leaves the door open for cable companies expanding into telephony. Cable operators hope to tap into the estimated $150 billion of revenue that telephone companies and other providers of telecommunications services generate yearly.

Both the telephone companies and cable are hoping that the convergence of their industries will allow them to tap third parties' markets, as well. For example, so-called *full-service networks* that combine video with interactivity and data services could give service providers access to the $160 billion annual market in catalog retail sales and financial services, or to the $35 billion market for other information services, or to the $28 billion entertainment market (movies and video rentals).

Building the highway

The total size of the market for converged telephony and cable depends on how the information superhighway evolves. The basics are relatively simple to describe, although far less so to implement. They include a broadband, 2-way connection from every household to a central video/telephony switch and vid-

A New Generation Of Transmitter Technology



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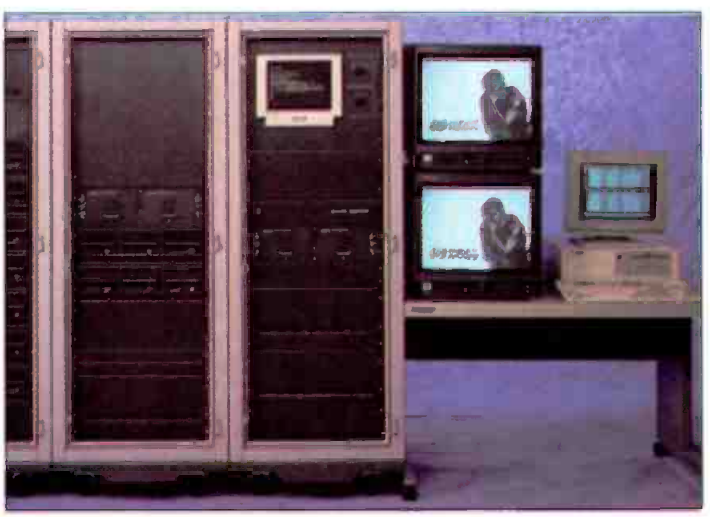
eo server. The fiber and coaxial networks already being built by both telcos and cable generally are fully capable of serving as the pipeline for the broadband digital datastreams.

The hard part may be figuring out what to do with the superhighway once it's built, and more importantly, how to generate enough revenue to support the hundreds of billions of dollars invested in it. Most lists of likely uses for the highway are relatively short: video-on-demand (VOD — like having a video rental store in your set-top box), much-improved catalog-like home shopping, Internet-like information services at high speeds, at-home banking, and the ability to play complex and visually exciting video games in direct competition with others elsewhere in the world. Beyond that, most video visionaries just say that it's impossible to predict what will be the "killer application," but they're convinced that if they build it, we will come.

Even though Time-Warner Cable's full-service network tests in Orlando, FL, have been delayed for several months because of technical glitches, hardware issues aren't likely to significantly delay the information superhighway. Virtually all of its major elements have been developed and are already in test, or in actual use.

The most challenging technology involves broadband digital switches and digital video servers, which will be located at the telco central office or cable head-end. Both are essentially large, specialized computers, though the video server will add massive tapeless digital storage capacity. Among the manufacturers are many familiar names. Hewlett-Packard's video server is being used in Time-Warner and Pacific Telesis tests. *Challenge* video servers from Silicon Graphics are on-line for other tests in Orlando. IBM has developed a massively parallel processing platform called *POWER SP-2*, as well as a separate system now under test that is based on an IBM System 390 mainframe. Another joint effort is under way between Thomson Consumer Electronics and Sun Microsystems. On the software side, Microsoft has released its *Tiger* video server software, while Oracle is making video-server software for several current test projects. (See "Disk-Based Video Storage," June 1994.)



The Hewlett-Packard video server system is currently in use at a number of cable and telco VOD tests.

Making the in-home decoder boxes is somewhat easier because these are much simpler computers, although most have at least the computing capacity of a 486-class computer. The challenge in this area is making the units cheaply enough to justify their installation in millions of homes by service providers. The manufacturers in the decoder market comprise another familiar litany: Scientific-Atlanta is building set-top boxes for US West's Omaha trial and Time Warner's Orlando network. Philips is making set-top decoders for Bell Atlan-

tic's full-service network trials in suburban Washington, DC. General Instrument, whose set-top converters have a major share of the cable market, is launching its *2200* family of interactive digital converters late this year. Zenith offers its *Multimedia-1* set-top box, and Pioneer is upgrading its set-top units for 2-way digital capability. Other players include Korean manufacturer Goldstar and Apple Computer (using a modified Macintosh for a decoder). Meanwhile, the ubiquitous Microsoft is said to be spending $100 million a year on telco-cable convergence development. Its full-service network project, code-named *Parrot*, is based on elements of Windows NT software.

A rocky road ahead

The telco and cable industries both have a long way to go before they can be fully competitive with each other. For example, cable companies are clearly inexperienced with high-speed digital switches and computerized video servers. Less obviously, they also lack telcos' facility to bill millions of customers for tens or hundreds of millions of individual transactions. On the marketing side, the cable industry also falls far short of telcos' reputation for reliability, customer service and good value. Telcos also have the edge on access to a seemingly unlimited pool of capital needed to establish new networks.

Yet the telcos' vaunted lead in switching may be somewhat overblown. TCI's CEO John Malone recently estimated that about 40% of current telephone customers don't have access to even the most rudimentary digital switches. Cable firms believe that it's relatively easy to buy digital switches that will plug into their existing fiber networks. Instead, they cite regulatory obstacles, such as those barring them from competing with the Baby Bells in many states.

Cable companies are far ahead of the telcos in installing broadband fiber. While telcos were bragging that they had installed long-range fiber land lines connecting most cities around the country, the cable companies, unfettered by state Public Utility Commissions, proceeded to extend fiber deep into their networks within individual cities. Getting fiber as close as possible to the end-user is critical to providing wide-bandwidth services, as well as the requisite reliability for digital telecommunications/video networks. Fiber connecting different markets is far less important in this regard. Because such installation is the toughest part of the job, cable companies appear to have a major edge in existing wide-bandwidth infrastructure.

One of cable's biggest advantages is that it may be much less expensive to upgrade video networks for telephony than it is to upgrade voice networks to video. TCI and its partners estimated that, in their United Kingdom cable systems, networks that combine voice with video cost only 18% more than video-only, and generated 40% incremental revenue. Voice-only networks may have to be substantially rebuilt to carry video.

Cable companies also have decades more experience than the telcos in producing, selecting and marketing TV programming. It's unclear whether that's more important than experience with billing and maintaining reliability. Of course, people with each skill are relatively easy to hire away from competitors. so human resource issues alone are not likely to determine which industry is most successful.

High stakes

Regardless of relative strengths and weaknesses, telephone companies have already announced plans to spend an estimated $75 billion on a variety of video projects, ranging from buying cable companies to building their own full-service networks in dozens of cities.

Cable companies, working under the umbrella of CableLabs, have issued a request for proposals for a reported $2 billion worth of equipment designed to add telephone capabilities to cable networks.

The networks being planned by telcos and cable look quite similar. Bell Atlan-

tic's hybrid fiber/coaxial network, for example, closely mirrors the hybrid cable structure that emerged in the cable industry after the discovery that taking fiber all the way to the home doesn't make economic sense.

Both telcos and cable also plan to provide virtually unlimited channel capacity on their networks. The initial claim is for 500 or more channels, but everyone believes that number will become meaningless as full interactivity arrives, because there will be essentially one channel for every subscriber, which can be programmed as desired by ordering programs from the video server.

Where do broadcasters fit in?

A critical question on many minds asks what this means for broadcasters, because every additional channel, no matter how small a niche it targets, siphons some viewers from broadcast television. So far, the average cable system's menu of about 50 channels, along with the arrival of Fox, has cut the traditional 3-network audience from more than 90% to near 60%. Such concerns, along with lagging revenues and profits, have helped drop the selling price of many TV stations, and the stock price of TV networks.

But recent interest in buying networks indicates that investors have suddenly realized that it will take years, possibly decades, and hundreds of billions of dollars for the information superhighway to reach all of America. They believe that at the very least, TV networks could make billions of dollars while the superhighway is under construction.

Furthermore, for the long term, investors believe big networks will continue to be important in a multichannel world for several reasons: 1) When there are too many TV choices, viewers will often revert to tried-and-true "brand names" of CBS, NBC and ABC; 2) Hundreds of niche channels, although they can deliver targeted audiences to advertisers, will never be as the major TV networks in delivering the large, broad-based audiences that many advertisers need; 3) Broadcasters, including local TV stations, have particular skills that any information highway operator will need. Among them are the ability to produce much high-quality, heavily demanded programming (especially news) every day for a relatively low cost, along with an almost-unparalleled ability to sell local advertising; 4) Local TV stations also have a local brand name that can be valuable in selling new services.

Far from becoming road-kill on the information superhighway, TV broadcasters could benefit, both directly and indirectly, from the technological and political developments that lead to the superhighway — assuming that stations realize their transmitter isn't the most important part of their business anymore. For example, in addition to developing programming and selling ads for cable and telcos, broadcasters could benefit from wider signal reach. Instead of getting virtually nothing for their signals under the must-carry/retransmission consent rules, broadcasters are likely to have telcos, cable and possibly others bidding against each other for the right to carry "broadcast" programming.

On another front, instead of using compression to transmit HDTV, broadcasters are hoping to have the option of using equipment developed by General Instrument, Scientific-Atlanta, Philips, Oak and others to transmit multiple NTSC signals, plus data and other services, on a single 6MHz digital TV channel.

Many radio and TV broadcasters already are generating some revenue from similar data services, some using the vertical blanking interval (VBI), and others using virtually invisible digital data interspersed in the regular TV lines. WavePhore, for example, says its equipment can deliver up to 384kb/s of data (soon to jump to 1.5Mb/s) on the existing TV lines without disrupting the picture. On the radio side, the Radio Broadcast Data Service (RBDS) is becoming established for text and other data transmission by FM stations. Radio may also benefit from enhanced services with future digital audio broadcasting (DAB) systems.

In the end, it appears that neither telcos nor cable has a clear head start on the information highway. The odds are that the winner will be the one that first finds both the "killer application" and the ability to make the highway easily accessible to and fun for consumers. Broadcasters may actually have it easier because any new delivery service will need the programming, sales talent and brand name that broadcasters alone can provide.

■

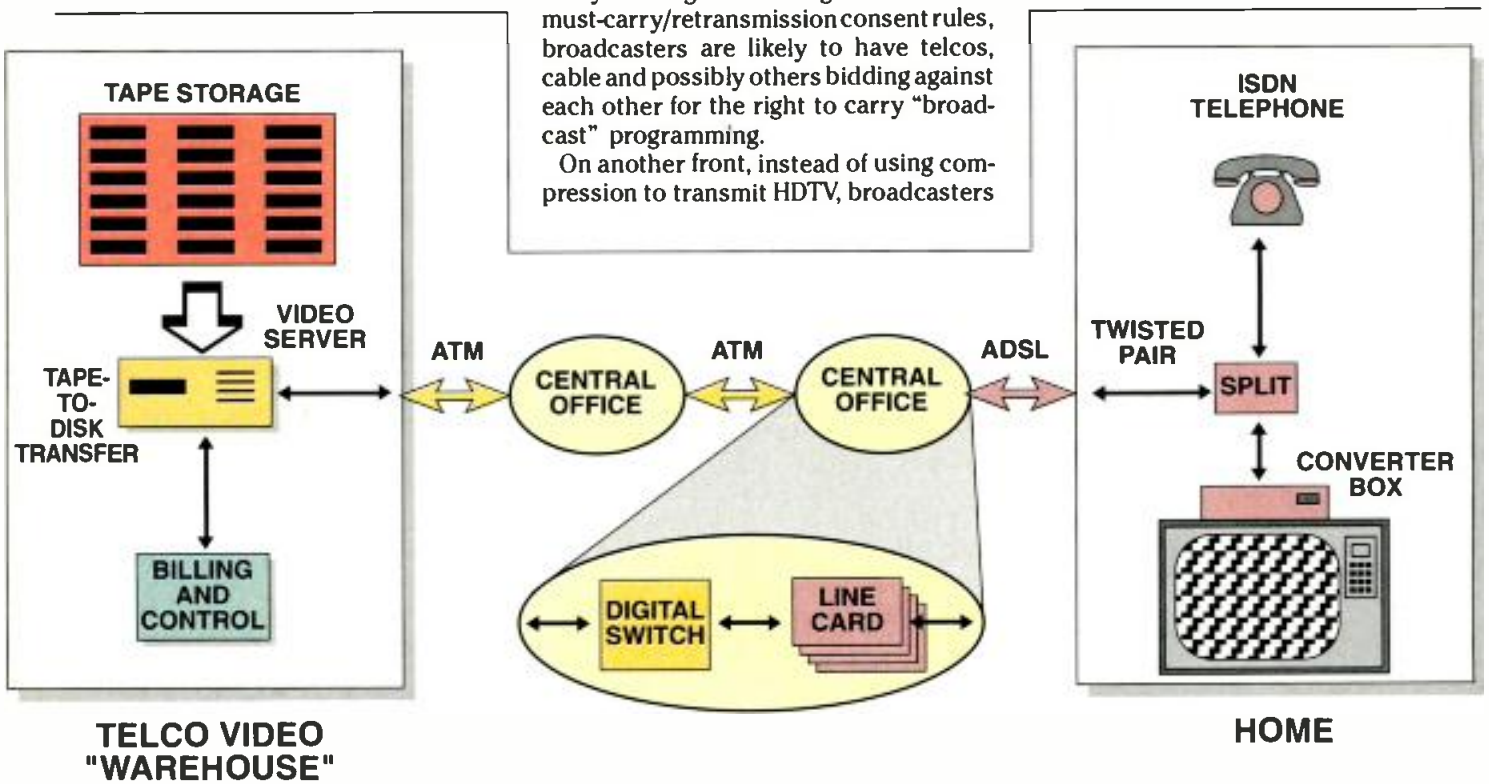


Figure 1. Basic plan for typical telco VOD system. Consumer orders programs from on-screen menu by phone (or hand-held remote). Programs not already on disk are high-speed transferred from tape archive. Compressed digital video is sent in wideband data bursts to RAM on consumer's line card. Consumer controls real-time video output of line card by remote control, which allows pause and rewind commands. (ATM = Asynchronous Transfer Mode; ADSL = Asymmetrical Digital Subscriber Link).

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14th annual salary survey

It's a slower climb, but salaries are still on the rise.

By Dawn Hightower, senior associate editor

The Bottom Line

Now, more than ever, stations require good, competent, and technically knowledgeable people. Stations interested in maintaining a profitable bottom line will invest in the right equipment – and the right people. Just as stations must adapt to the changing technologies, so to must those who work with it. But paying the right salary to the right people for the right job has never been easy, especially in an industry as diverse as ours. See how your salary stacks up in the BE 14th Annual Salary Survey.

This year, as in the past 13 years, it's time to get down to the nitty gritty on salaries and who makes what where in the broadcast industry.

Also, for the second year now, data is provided for our non-broadcast readers. In addition to the traditional broadcast salary results, the same data is provided for cable and post-production.

Tables explained

Engineering salaries are divided into four reports by job title: engineering management, chief engineers, staff engineers and operators.

This year's survey results are summarized in Tables 1A, 1B, 2A, 2B, 3 and 4. You will find information about each position by major category, job title, industry and, for broadcast titles, market size.

Salary breakdowns

Table 1A shows the results of engineering management salaries for television and radio. The estimated median salary in television is $60,625. Radio engineering managers earn about $22,000 less, with the estimated median salary for radio engineering management at $38,333.

Chief engineering salaries (Table 1B) did not change dramatically over last year. Salaries for the TV Top 50 category rose only about $1,500. Radio actually dropped slightly in the Top 50 category, with salaries at $42,500 compared to last year's salary of $43,333.

Table 2A summarizes staff engineer salaries, which increased in every category except for cable. The salaries for TV increased this year by more than 15%. Radio staff engineer salaries increased by a whopping 47%.

Table 2B summarizes operator salaries. Overall, there was a slight increase in pay in five of the six categories. TV salaries rose approximately $3,200 over last year. The below Top 50 radio operator salaries dropped by $110. The estimated median salary for television is $36,818; for radio it's $26,250.

Summary results for cable and production

For the second year in a row, the salary survey also includes tables on salaries paid in cable and production facilities. (See Table 3.)

This year's estimated median for executive/general managers increased by $10,000 to almost $55,000. Like last year, production salaries ran higher across the board than cable salaries. The salaries for broadcast executives and staff engineers ran slightly higher than for cable and production salaries when measured in the same category.

Does SBE make a difference?

SBE certification pays. And in some cases, it pays big. Table 4 compares the median salary betwen SBE-certified respondents with those respondents who are not SBE certified. In all but one category, SBE-certified respondents reported higher salaries, from $2,600 to $11,250 higher than their non-certified counterparts. Want a raise? Contact the SBE about becoming certified.

Tables begin on page 44.

Editor's note: The complete results of the 1994 Salary Survey are available in bound form of more than 100 pages. The data is displayed in tabular and graphical form for easy evaluation. Copies are available for $75 each. Call Chris Lotesto at 312-435-2357 for more information.

Details about the research methodology are available to any reader. Contact the *BE* FAXback line at 913-967-1905 for a copy.

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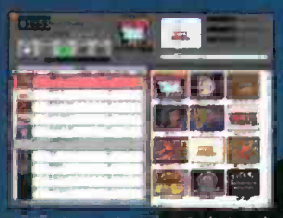

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TABLE 1A. ENGINEERING MANAGEMENT SALARIES

BASE = ALL RESPONDENTS	TOTAL TV	TOP 50 TV	BELOW TOP 50 TV	TOTAL RADIO	TOP 50 RADIO	BELOW TOP 50 RADIO
Less than $15,000	0.0%	0.0%	0.0%	8.5%	0.0%	15.9%
$15,000 to $24,999	1.0%	0.0%	2.2%	11.0%	2.6%	18.2%
$25,000 to $34,999	12.5%	7.8%	17.8%	26.8%	15.8%	36.4%
$35,000 to $49,999	21.9%	5.9%	40.0%	23.2%	21.1%	25.0%
$50,000 to $74,999	37.5%	43.1%	31.1%	18.3%	36.8%	2.3%
$75,000 or more	27.1%	43.1%	8.9%	12.2%	23.7%	2.3%
Estimated median	$60,625	$72,000	$47,500	$38,333	$54,167	$30,556

TABLE 1B. CHIEF ENGINEER SALARIES

TOTAL TV	TOP 50 TV	BELOW TOP 50 TV	TOTAL RADIO	TOP 50 RADIO	BELOW TOP 50 RADIO
0.0%	0.0%	0.0%	7.3%	4.0%	10.0%
4.5%	0.0%	8.5%	20.9%	4.0%	35.0%
18.2%	5.9%	28.8%	30.0%	22.0%	36.7%
40.9%	35.3%	45.8%	30.9%	46.0%	18.3%
32.7%	51.0%	16.9%	6.4%	14.0%	0.0%
3.6%	7.8%	0.0%	4.5%	10.0%	0.0%
$44,545	$52,500	$39,999	$32,500	$42,500	$26,538

TABLE 2A. STAFF ENGINEER SALARIES

BASE = ALL RESPONDENTS	TOTAL TV	TOP 50 TV	BELOW TOP 50 TV	TOTAL RAOIO	TOP 50 RADIO	BELOW TOP 50 RAOIO
Less than $15,000	2.7%	0.0%	7.7%	10.0%	0.0%	20.0%
$15,000 to $24,999	13.6%	7.0%	25.6%	20.0%	13.3%	26.7%
$25,000 to $34,999	21.8%	11.3%	41.0%	25.0%	20.0%	30.0%
$35,000 to $49,999	30.0%	35.2%	20.5%	26.7%	36.7%	16.7%
$50,000 to $74,999	26.4%	38.0%	5.1%	16.7%	26.7%	6.7%
$75,000 or more	5.5%	8.5%	0.0%	1.7%	3.3%	0.0%
Estimated median	$39.999	$48,889	$30,909	$33.750	$42,500	$27,500

TABLE 2B. OPERATOR SALARIES

TOTAL TV	TOP 50 TV	BELOW TOP 50 TV	TOTAL RAOIO	TOP 50 RAOIO	BELOW TOP 50 RAOIO
6.8%	1.9%	13.9%	18.8%	14.6%	22.7%
17.0%	11.5%	25.0%	28.2%	19.5%	36.4%
22.7%	11.5%	38.9%	32.9%	31.7%	34.1%
26.1%	34.6%	13.9%	8.2%	12.2%	4.5%
20.5%	28.8%	8.3%	10.6%	19.5%	2.3%
6.8%	11.5%	0.0%	1.2%	2.4%	0.0%
$36.818	$44,999	$29,999	$26,250	$31,250	$23,125

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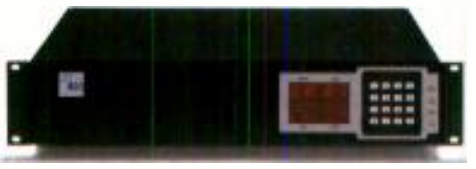
TABLE 3. CABLE AND PRODUCTION FACILITY SALARIES

BASE = NON-BROADCAST RESPONDENTS	EXECUTIVE/GENERAL MANAGER			VP/DIR. & CHIEF ENGINEERS			STAFF ENGINEER			OPERATIONS MANAGEMENT		
	SUB-TOTAL	CABLE	PROD.	SUB-TOTAL	CABLE	PROD.	SUB-TOTAL	CABLE	PROD.	SUB-TOTAL	CABLE	PROD.
Less than $15,000	3.2%	3.1%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	3.0%	0.0%
$15,000 to $24,999	4.8%	6.3%	3.2%	1.5%	0.0%	2.9%	14.5%	22.6%	6.5%	11.4%	18.2%	5.4%
$25,000 to $34,999	9.5%	9.4%	9.7%	9.2%	20.0%	0.0%	22.6%	32.3%	12.9%	30.0%	45.5%	16.2%
$35,000 to $49,999	20.6%	21.9%	19.4%	30.8%	26.7%	34.3%	41.9%	25.8%	58.1%	37.1%	21.2%	51.4%
$50,000 to $74,999	33.3%	37.5%	29.0%	33.8%	26.7%	40.0%	16.1%	12.9%	19.4%	8.6%	6.1%	10.8%
$75,000 or more	28.6%	21.9%	35.5%	24.6%	26.7%	22.9%	4.8%	6.5%	3.2%	11.4%	6.1%	16.2%
Estimated median	$54,999	$54,999	$61,667	$54,286	$53,333	$56,667	$39,091	$34,286	$42,500	$38,333	$31,875	$43,333

TABLE 4. TECHNICAL SALARIES: SBE-CERTIFIED VS. NON-CERTIFIED

JOB CATEGORY	ALL MARKETS			TV ONLY			RADIO ONLY		
	CERTIFIED	NON-CERTIFIED	SALARY DIFFERENCE	CERTIFIED	NON-CERTIFIED	SALARY DIFFERENCE	CERTIFIED	NON-CERTIFIED	SALARY DIFFERENCE
VIP/Dir. Engineering	$57,500	$46,250	$11,250	$67,500	$57,500	$10,000	$44,167	$33,636	$10,531
Chief Engineers	$41,923	$39,167	$2,756	$51,429	$42,813	$8,616	$35,714	$31,364	$4,350
Staff Engineers	$39,999	$37,333	$2,666	$39,999	$40,625	-$626	NA	$32,143	NA
All Engineers	$44,000	$39,595	$4,505	$52,500	$44,444	$8,056	$39,167	$32,069	$7,098



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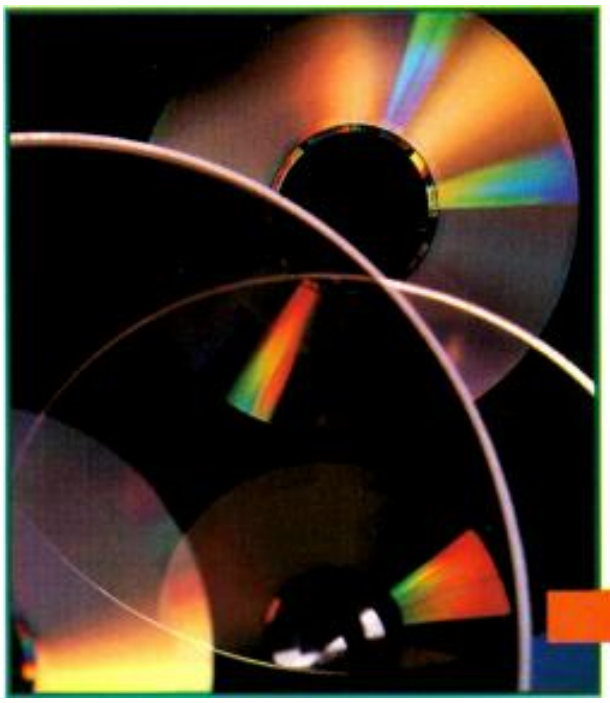


Camera lenses

Getting a clear picture isn't always easy.

By Steve Epstein, technical editor

The Bottom Line

High-quality studio and field cameras are expensive. Putting a lens on the front can add 50% or more to the camera's cost. Cheap lenses can reduce the image quality and camera usefulness. The sound of zoom servos in the background of quiet scenes can be distracting. Choosing the wrong lens can make a good camera look bad, choosing the right lens will make a good camera look even better.

$

For those responsible for choosing one, camera lenses can be a lot like transmitters — they are expensive and with a little maintenance they last a long time. Choosing the right one can mean years of trouble-free service, choosing the wrong one can be an ongoing headache. Quality lenses have several things in common. First and foremost, they provide the camera with high-quality images. Second, the mechanical components of the lens must be smooth and quiet. Third, construction of the lens must be precise and solid to prevent dirt and moisture from contaminating the internal parts. Finally, they must meet the needs of the application for which they are intended.

The first three of these points have been determined by the time the lens leaves the factory. For the fourth, however, the purchaser must decide the suitability of the lens to the task at hand. Several things must be considered including camera type, aspect ratio, whether the intended use is indoor or outdoor, and what type of handling the lens will receive throughout its lifetime. This article will look at the basics of zoom lenses and some things to consider when choosing a lens.

Lens basics

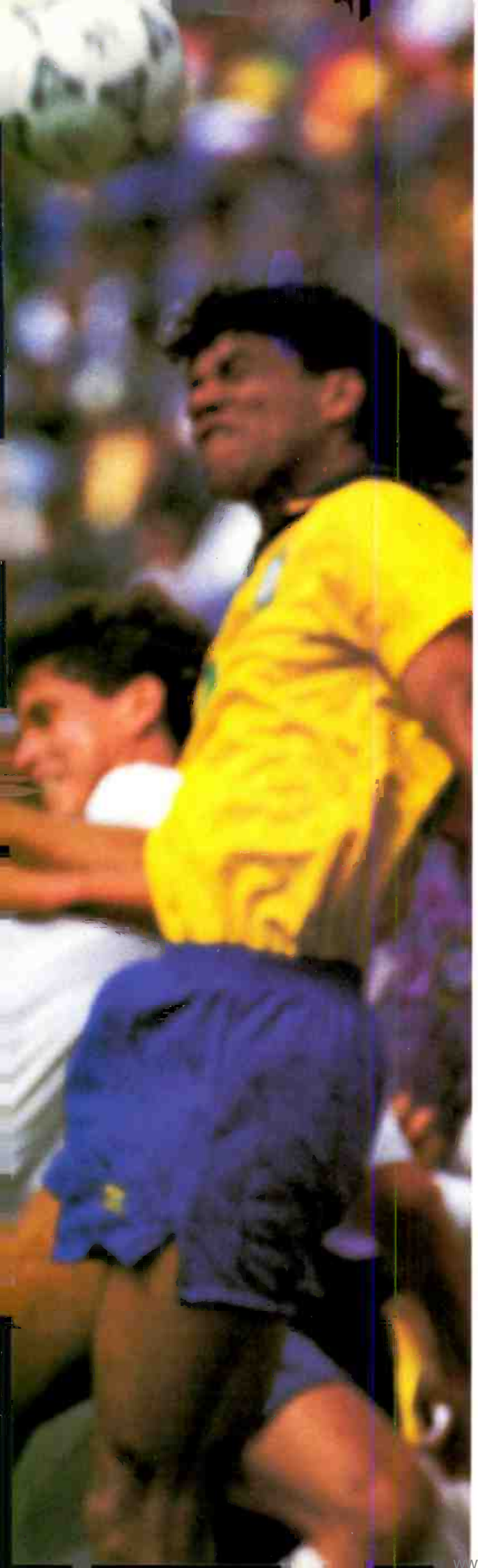
Zoom lenses were invented in the mid-'50s. Since then, they have found their way onto video cameras everywhere. The key to a zoom lens is its ability to change focal length continuously without losing focus. Accomplishing this requires moving multiple lens elements along precise paths. Today's zoom lenses can have more than 20 separate optical elements. Each is precision ground and optical grade, and each must be positioned precisely to focus images properly.

Rather than starting with the complexities of a zoom lens, let's focus on a single lens element. Spherical lenses come in two basic shapes, convex (converging) and concave (diverging). When parallel light rays pass through a double convex lens (a lens with convex surfaces on both sides), they converge. The point at which they converge is called the focal point. (See Figure 1.) Focal length is the distance from the center of the lens to the focal point. Lenses have two focal points, one on each side of the lens.

When parallel rays pass through a double concave lens, rather than converging, they diverge. The focal point of these lenses is determined by tracing the rays backward to a point where the rays appear to be emanating from. Because of this, these lenses have a negative focal length and are referred to as negative lenses. Using combinations of convex and concave lens surfaces makes it possible to control the light passing through the lenses in a precise manner.

F-number

The ability of the lens to pass light is extremely important. The F-number expresses the speed of the lens on the assumption that the lens transmits 100% of the incident light. The smaller the F-number, the brighter the image. The F-numbers on the stop ring give an indication of the brightness of the image. Each time the ring is turned one number up the F-scale, the image brightness is decreased by one half. Even though two lenses may have the same F-number, they may not produce images of the same brightness. This is because the lenses may have different transmittances. The F-number



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times 10, divided by the square root of the transmittance gives the T-number. Two lenses with the same T-number will always give the same image brightness.

If a zoom lens is operated at full aperture at the wide-angle end, and then zoomed to the telephoto end, the image brightness may decrease. This is common in many zoom lenses and is termed F-drop. In a zoom lens, the diameter of the entrance pupil changes as the focal length changes. As the lens is zoomed toward the telephoto end, the entrance pupil gradually increases. Depending on the diameter of the lens' front elements, they can limit entrance pupil diameter. When this happens, the apparent F-number changes. To eliminate F-drop requires large front elements that increase the size, weight and cost of the lens. For field use, the compromise of size and weight vs. F-drop leans toward reduced size and weight. However, for some studio and live sports applications, zero or a small F-drop is important.

Aberrations

Even high-quality lenses are not without problems. Visible light is composed of different wavelengths. Prisms split light into a range of colors corresponding to the various wavelengths. Lenses also act like prisms, bending different wavelengths differing amounts. This results in chromatic aberration. (See Figure 2.) When the colors focus at different points, the edges of the image become blurred, resulting in a loss of image detail. Solving this problem is difficult, and is accomplished by using coatings on the lenses as well as using several different materials in the construction of the individual lens elements. In tube cameras, this problem was not as critical, and could be addressed by adjusting the location of the tubes in their respective yokes. CCD cameras, however, don't allow for this type of adjustment and the problem must be corrected by the lens.

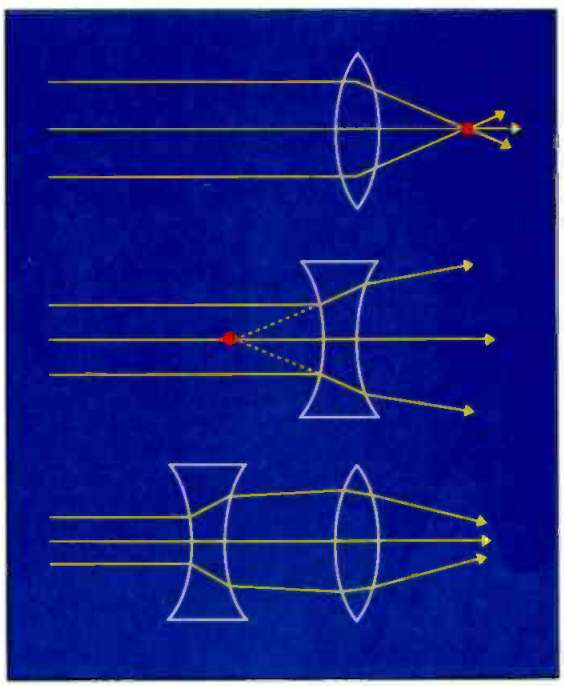

Figure 1. *The shape of a lens' surface affects the path of light rays going through it. A double convex lens (a) causes light rays to converge. Double concave lenses (b) cause light rays to diverge. Together (c), they can be used to vary magnification.*

Other types of lens aberrations include spherical aberration, coma, astigmatism, curvature of field and distortion. Spherical aberration results from the fact that all the light rays don't converge at precisely the same point. Again, multiple elements can be used to correct this. Another approach to correcting the problem is to use non-spherical lens elements that focus all the rays at a precise point. These elements are more difficult to manufacture, and can add to the lens cost. The added cost can be offset because fewer elements can be used in the lens, which can also reduce the lens' size and weight.

The tendency of off-axis light rays to develop a comet-like tail, rather than focusing at a precise point, is called coma. Astigmatism results from a lens' inability to focus a point off the optical axis into a point im-

Continued on page 53

IFplus A step forward for internal focus

By Ken Ito

The J15ax8B IRS IFplus lens from Canon features improved optics, an MOD of 0.65mm and a focal range of 8-120mm.

Canon, the pioneer of IF technology, has gone one step further with IFplus. IFplus improves upon IF technology through the use of ultralow dispersion glass. The HI-UD glass has a high refractive index. When combined with existing fluorite and low dispersion elements, it provides for reduced longitudinal and lateral chromatic aberrations. In addition, Modulation Transfer Function (MTF) of the lens has also been improved, allowing for MTFs corresponding to as high as 6MHz. With higher resolving power, these lenses can be used for production in 16:9.

To fully appreciate the advances made by Canon's IF technology and the new IFplus technology, a quick look at conventional lens construction is in order. In a fixed focal length lens there are two elements. The rear element is fixed and the front element is mounted on a threaded barrel allowing it to move relative to the rear element. In modern lenses, the front element is composed of a number of glass elements mounted together called the *focusing group*. The rear element can also be a number of elements working together and is called the *relay group*.

Today's fixed lenses, such as those used for 35mm cameras, require the camera to be moved toward the subject to achieve the desired field of view. The image can then be focused by moving the focusing group forward or backward in relationship to the relay group. Zoom lenses can change the size of the image and thus the field of view (without moving the camera physically) by changing the distance between some of the internal lens elements. To accomplish this, two more lens groups are added between the focusing group and the relay group.

The first group is the *variator*. When this group is moved the image size changes, however, image focus is lost. The second group is the *compensator*. It corrects (compensates) the focus for changes in image size. The two groups are precisely adjusted by a cam system within the lens. This lens system has been in operation for years and works satisfactorily. However, there are some problems because the largest and heaviest element is moved to focus the image and the required support structure is substantial. The lens hood has to be round to allow for rotation, and because the TV format is rectangular, the round lens hood allows ghosting and flaring problems that could be eliminated if the sun shade was closer in shape to the image format.

Another problem is in the use of filters. Many filters, such as polarizing and star filters, are position sensitive. Once the field of view is selected and focused, the photographer can adjust the effect of the filters. If the image is not ideal, the whole process must be repeated.

Because of these problems, the search was on for a better way. The solution is Internal Focus(IF) lens technology from Canon. To understand this breakthrough, recall that the front focusing group (in a conventional lens) consists of a number of convex and concave elements that move together. With conventional focus technology, the front or focus group is several lenses close together, which move as a unit when the focus ring is rotated. However, with Canon's IF system, the focusing group is separated into two or three subgroups allowing the front element to be fixed. The internal subgroups can then float within the whole focusing group. This new focusing subgroup is smaller and lighter than conventional focusing systems.

Changes brought about by CCD cameras have required lens manufacturers to rework their products. IF solved a number of problems and today's lenses are lighter and smaller, allowing for better balance between the camera body and lens. The fixed front element allows a square or format correct lens hood. Smaller focusing elements allow smaller motors and components with an additional reduction in weight. The problem of filter rotation vanishes because the camera operator can set the desired filter effect then zoom and focus as needed. Matte boxes can be attached directly to the lens barrel instead of complicated mounting systems to allow focus rotation.

IF technology, along with the improvements of IFplus, allows ease of use and provides better images to cameras designed for use today and in the future.

Ito is marketing manager for Canon Broadcast, Englewood, NJ.

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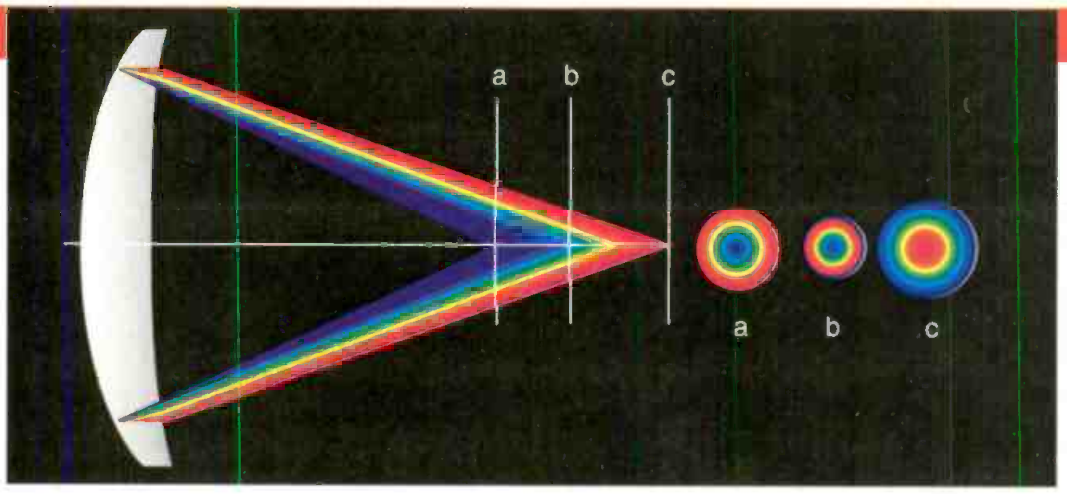

Figure 2. Chromatic aberration is caused by the lens acting like a prism. Depending on where the aberration is observed, it appears differently.

Continued from page 50

age. Distortion is just what it sounds like, a rectangular object viewed through a lens may appear barrel or pincushion shaped. Most zoom lenses will have some distortion of the image at both ends with little distortion in the middle.

Zoom lenses for video

Lens designations convey considerable information about the lens. The first character in the designation references image size. For video cameras, four image sizes are used: 1/2 inch, 2/3 inch, 1 inch and 1 1/4 inch. These sizes relate to the size of the pickup device in the camera. Lenses do not produce rectangular images, but rather produce round images onto rectangular pickup assemblies.

The next item found on lens designators is the zoom ratio. This is the ratio of the focal length of the lens at the telephoto end to the focal length at the wide-angle end. With a zoom ratio of 14, objects that occupy 420 lines of screen height at the telephoto end will occupy only 30 lines of screen height at the wide-angle end.

Next, (after the x) is the lens focal length (in millimeters) at the wide-angle end. In a zoom lens, the lens elements function as a single lens at any given point. The focal length at the telephoto end is found by multiplying the focal length at the wide-angle end by the zoom ratio. Knowing the focal length and the image size allows the field of view to be calculated. Field of view combined with an object's distance from the camera can indicate how a shot will look. Most people do not bother with these calculations as a general rule of thumb, but understanding them makes it much easier to plan events without leaving the office. Imagine having to rent cameras and lenses to shoot a sporting event in a distant city. Knowing the stadium dimensions and camera placements along with a few lens formulas will allow a good idea of what type of shots are available with which lenses.

Lens calculations

Calculating object size and angle of view can be done several different ways. The simplest are range calculating slide rules or computer software made specifically for the task. They are available from time to time as promotional giveaways from lens manufacturers. Another method is to determine the information from commonly published charts. If prepared material can't be located, a couple of formulas can supply the information.

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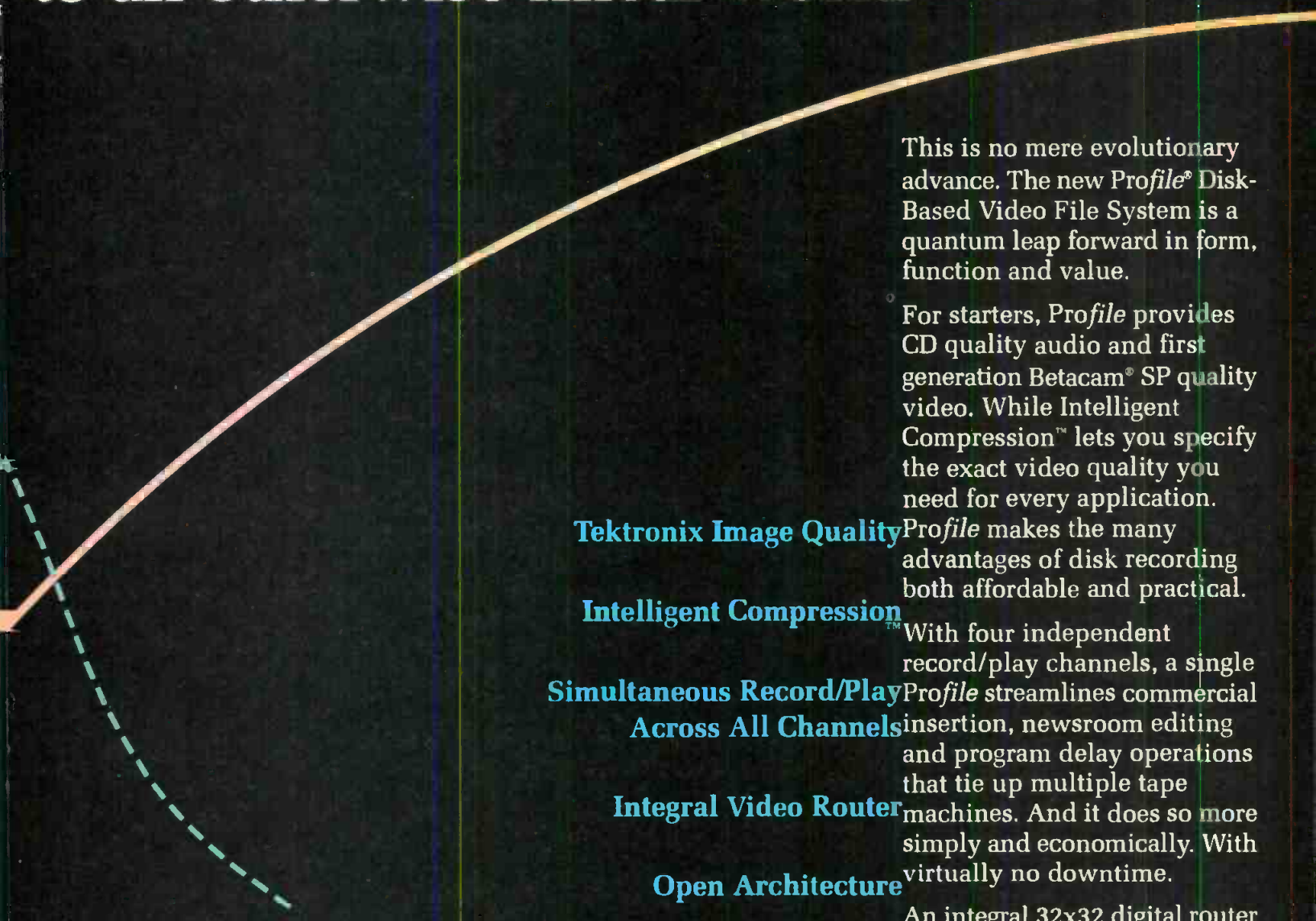

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Aspheric technology: A new weapon in the optical arsenal

By Dave Waddell

The zoom lens is a deceptively subtle contributor to the performance of a broadcast system, functioning as it does day after day, without a sound. However, beneath this tranquil exterior is a technology that is continuously being refined to increase optical prowess. One important recent lens improvement is called Aspheric Technology (AT). AT, in its simplest terms, defines a type of lens element that is not spherical, but rather one of several shapes, the exact dimensions depending on the requirements of the lens. The benefits AT provides in optical performance, specifically the efficient reduction of spherical aberration, have been known for decades. Small aspheric elements have been used in commercial products for nearly that long. However, they have not been used in TV zoom lenses because it was not possible to manufacture large AT lens elements in commercial quantities at an affordable price.

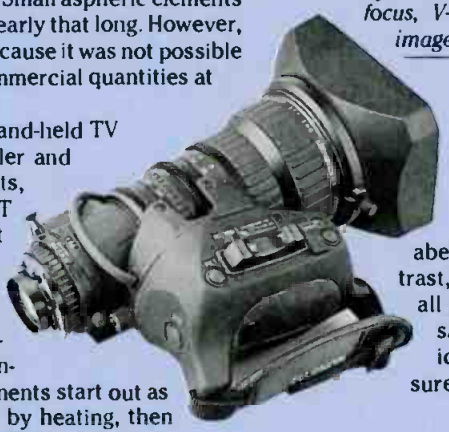
In mid-1993, Fujinon introduced the first hand-held TV zoom lenses using AT. The lenses are smaller and lighter than lenses using only spherical elements, and are no more expensive. In addition, AT allows the new lenses to achieve their light weight without resorting to the substitution of plastic for metal components.

This breakthrough was achieved by abandoning traditional lens manufacturing techniques — cutting, grinding and polishing. Instead, AT lens elements are molded. The elements start out as a preformed glass shape, which is softened by heating, then pressed and cooled in a proprietary system. The molding process eliminates most of the manufacturing steps associated with traditional lens manufacturing and is capable of producing AT elements in the volume required for commercial production.

What's in a shape?

To ensure that a TV zoom lens has the best possible optical characteristics, manufacturers optimize the desirable properties of light transmission while minimizing undesirable properties. Various techniques have been developed to accomplish this, including applying coatings to the lens elements that reduce flare and ghosting as well as using multiple lens elements (a lens group) to control spherical aberration.

An aberration is a deviance from the norm. In lens parlance, it refers to a family of conditions that cause light rays to depart from their normal path, degrading optical performance. Members of this family include spherical and chromatic aberration, coma, field curvature, and astigmatism. Spherical aberration results from the tendency of light passing through a lens to strike a focal plane behind it at different points. It's a characteristic common to all spherical lens elements.



The Fujinon A15X8EVM for 2/3-inch cameras uses AT along with inner focus, V-Grip, and adjustable zoom speed to provide quality images and ease of shooting in the field.

The level of spherical aberration can be substantially reduced by multiple corrective elements. However, these elements add weight to the lens, which is undesirable in models designed for hand-held environments. In addition, each lens element adds to the complexity of controlling ghosting, flare, chromatic aberration, and other undesirable characteristics. In contrast, light passes through an aspheric element similarly at all points along the element's surface, and focuses at the same point on the focal plane. Consequently, an aspheric element does not need substantial corrective measures to control spherical aberration.

Proof in the shooting

Fujinon has incorporated AT in virtually its entire line of premium hand-held TV zoom lenses, as well as two of its most popular economical hand-held lenses. The molding technique shows promise of allowing even larger AT optics to be manufactured, which may allow the benefits of AT to be exploited on other types of TV zoom lenses as well.

Coincidentally, the number of consumer 35mm still cameras using aspheric lens elements is increasing rapidly. At least two major lens and camera manufacturers are touting the benefits of their new aspheric elements. The benefits this technology holds for these products is equally obvious, as a visit to any camera store will quickly demonstrate; new lenses using aspheric elements are noticeably smaller and lighter. ■

Waddell is marketing manager, Broadcast and Communications Products Division, for Fujinon Inc., Carrollton, TX.

Angle of view = $2 \tan^{-1} y/2f$

y = image size (see chart)
f = focal length

When using this formula, the horizontal or vertical image size can be substituted for the diagonal measurement, and the formula will return the horizontal or vertical angle of view of the image.

To calculate the object size from the angle of view and object distance for an object that fills the screen:

Object dimension = $2l \tan (w/2)$

l = object distance
w = angle of view (degrees)

Substituting horizontal and vertical angles of view will return horizontal and vertical dimensions.

Pick-up format	H	V	Diagonal
Video			
1/2"	6.4mm	4.8mm	8.0mm
2/3"	8.8mm	6.6mm	11.0mm
1"	12.8mm	9.6mm	16.0mm
1 1/4"	17.1mm	12.8mm	21.4mm
Film			
16mm movie	10.3mm	7.5mm	12.7mm
35mm movie	22.05mm	16.03mm	27.26mm
35mm still	36mm	24mm	43.3mm

Image size dimensions for different formats. These can be used with angle-of-view calculations to determine object size.

Other considerations

In addition to what size lens is needed, consider the options available. In describing lens nomenclature we stopped after the focal length. Next in line are a series of letters and numbers that list lens-specific information including mount type, motorized controls and whether an extender is included. Extenders change the focal length, for example a 2x extender doubles the focal length. Other lens features can be determined by looking at manufacturers' literature. The question is which lens is needed, or maybe more to the point, which one is affordable?

When buying a lens, consider a lens with the following features: a high-quality extender, smooth and quiet servo motors, high-quality glass elements, and a lightweight, compact and rugged design. These items are all important and depend on the application. In any event, don't bother with features that are not needed, lens features are expensive. Instead, put the money into higher-quality optics.

Once a couple of lenses that meet the requirements have been found, compare them using the same camera. Things to look for include color purity, edge sharpness and resolution. When judging purity, shoot an object with vibrant colors then compare the real object with the monitor. A good lens will accurately reproduce the colors. For edge sharpness, check object edges carefully and make sure they are clearly defined. Set the camera up with a resolution chart and view the output on a high-quality monitor.

In the end, the lens will have a major impact on the quality of footage. Take the time to choose the best lens you can afford, it's worth it. ■

A related article, "Lens Converters," begins on page 58.

➡ *For more information on camera lenses, circle (301) on Reply Card. See also "Camera Lenses" on p. 60 of the BE Buyers Guide.*

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Lens converters

Getting a little extra from existing lenses.

By Evan Krachman

With the advent of digital acquisition formats, cinematographers are becoming attracted to video. In the past, they had been reluctant to give up the high quality of film for the convenience of videotape. Digital acquisition allows high-quality recordings to remain pristine throughout the editing process. Lens converters allow the high-quality lenses developed for film to be used on today's digital cameras. This not only provides cinematographers with a comfort factor of using familiar equipment, but also allows them access to the wide variety of film lenses in existence.

Nikon's FW-ENG converters provide wide-angle conversion and have both manual and servo driven iris controls.

Several things must be accomplished to properly convert a film-style lens for use with video cameras. The most obvious is the different mechanical lens mounts. Along with providing for the different mounts, the position of the exit pupil of the lens must be adjusted. Finally, the converter must compensate for the aberrations that exist in the camera as part of the trichromatic separation prism.

At least two types of converters for

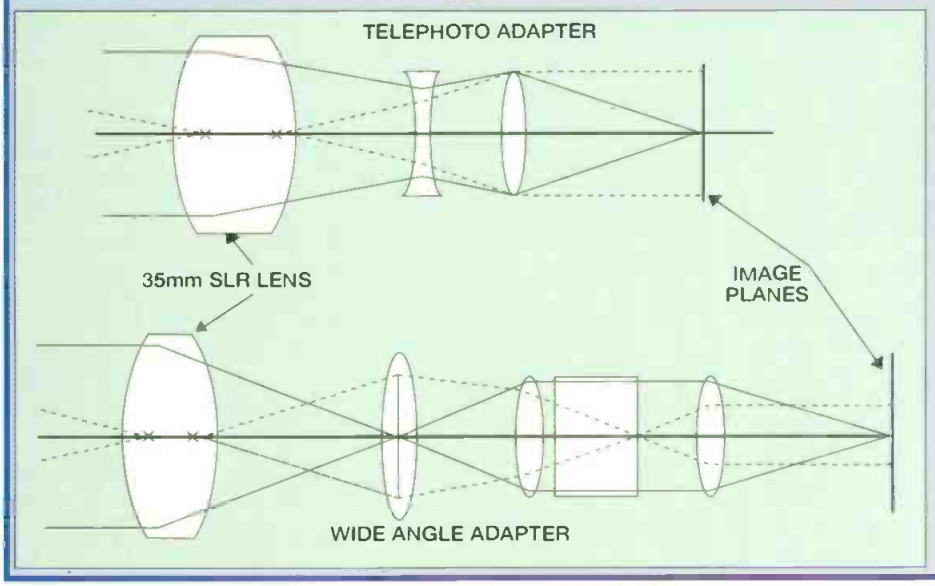

Figure 1. *Basic configuration of the elements used to convert 35mm film lenses for use with video cameras.*

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Lens Converters continued

35mm lenses exist. (See Figure 1.) One is mainly for telephoto-type lenses, the other is for wide-angle or fisheye lenses. Additional converters exist for adapting lenses to cameras for HDTV use. Converters used for telephoto lenses usually use a relay system consisting of several concave and convex elements. Because these lenses have a fixed focal length, the viewing angle is reduced to the ratio of the ⅔-inch video image plane to the 35mm image plane, which is 25%. As a result, the telephoto effects of the lens are emphasized. In the wide-angle converter, the viewing angle is not affected, but the image size is reduced to 25% of its original value. Also found in the wide-angle converter is a correction prism that prevents image reversal and an iris assembly that can be used for auto-irising.

To give an idea of the type of versatility this type of converter offers, a 6mm fisheye lens when combined with the wide angle converter becomes a 1.5mm video camera lens. At the other end of the scale, a 2,000mm lens with a 1.2° angle of view remains a 2,000mm lens but the angle of view changes to approximately 0.3°. For information on other focal lengths, see the chart.

The Nikon F-ENG converters provide conversion for telephoto lenses.

35mm lens spec Focal length	Angle of View	Video lens spec. Focal length	Angle of view
Wide-angle adapter			
6mm fisheye	220°	1.5mm	220°
16mm fisheye	180°	4mm	180°
13mm	118°	3.3mm	118°
24mm	84°	6mm	84°
35mm	62°	8.8mm	62°
Telephoto adapter			
200mm	12.3°	200mm	3.1°
300mm	8.2°	300mm	2.1°
600mm	4.2°	600mm	1.1°
1200mm	2.1°	1200mm	0.6°
2000mm	1.2°	2000mm	0.3°

These converters, along with a set of 35mm lenses, can be used by cinematographers and videographers to enhance productions. Acquiring field footage in the digital domain with today's cameras offers nearly unlimited possibilities. New digital cameras offer presets and adjustments on numerous parameters, and the new converters add a whole new set of lenses to the equation. It is unlikely that videotape will ever entirely replace film, however, shooters from both the video and film worlds have more choices than ever before.

Krachman is a sales specialist for Nikon Electronic Imaging, Melville, NY.

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New recording media: optical and magnetic

Advances in storage media are arriving not a moment too soon.

By Curtis Chan

The Bottom Line

The need for high-capacity, fast and cost-effective digital storage media continues to grow at a rapid pace, but developers are up to the challenge. Breakthroughs in both magnetic and optical media have managed to stay just ahead of the demand curve, and this trend looks as if it will continue. Broadcast and production applications can take advantage of these new digital recorder systems and tomorrow's server-based technology.

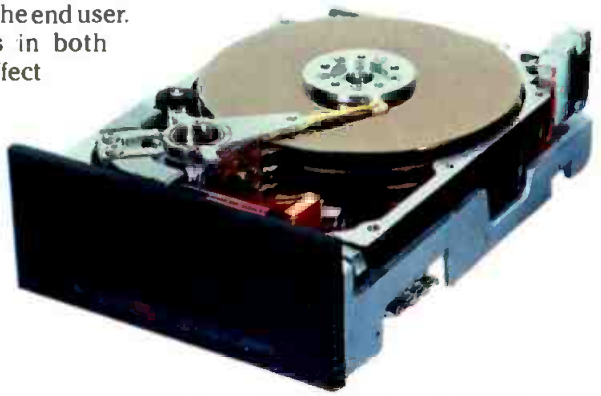
The evolution of image management, non-linear editing, video-on-demand, multimedia and data compression have brought about significant strides in data storage technology. In fact, anyone involved with the production or maintenance of video and audio programs will probably have developed a healthy respect for storage technology in addition to learning three critical axioms: There can never be too much storage; storage devices can never be too fast; and superfast storage is essential for real-time video operation.

Both hard disk and optical technologies have strengths and weaknesses, but when applied correctly, they each can offer tremendous benefits to the end user. Some recent developments in both forms of storage media will affect the performance of future products. This will be of particular interest to the broadcast and telecommunications industry as high-capacity/performance storage systems make their way into the *media servers* of tomorrow.

Hard disk storage

The broadcast and video post-production industries' continuing thirst for greater density and speed has been complemented by an equivalent need from the general computing industry. This has resulted in an annual increase in hard disk areal storage density of 60% in recent years. Such intense competition has encouraged hard disk manufacturers to seek several alternatives for boosting capacity and throughput. (See "Technology News," September 1994.)

Two of the most significant recent developments are the 2-head parallel processing drives by Seagate and twin high-density technology drives pioneered by IBM. The 2-head parallel processing drives, which use two heads and a buffer on a single platter to process data, work as a striped array. Striping is the process of splitting data between two drives to accomplish a doubling of data throughput. Under SCSI-2 fast/wide conditions, data can be output at close to 20MB/s.



The Seagate Elite 9 is a 5.25-inch, full height, 5,400rpm hard disk drive with 9.1GB capacity and an average seek time of 11ms. It can provide an average data transfer rate of 6.9MB/s. (Courtesy of Rorke Data)

The second breakthrough, high-density technology drives, exceed the performance of current ferrite or thin-film drives by packing 260MB onto a 1.8-inch platter. These devices combine two separate technologies: *magneto-resistive* (MR)

Chan is president of Chan and Associates, a marketing consulting company for audio, broadcast and post-production in Fullerton, CA. Respond via the *BE* FAXback line at 913-967-1905.

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heads and digital *partial response, maximum-likelihood* (PRML) read channels. The high-priced drives will first appear in workstations and media servers, a quickly growing market segment. (At NAB 1994, more than 100 manufacturers were moving video on and off hard drives.)

In the last three or four years, the hard disk industry has managed to increase areal density primarily by flying heads closer to the disk surface. But at the present 2.5 micro-inches, tolerance anomalies are starting to surface, and the possibility of a head crash has become more likely. Designers are now looking at different schemes like PRML and MR head technology, and getting away from the analog peak-detect chip technology that the majority of today's drives are based on. Of course, PRML and MR are not panaceas, and both will face start-up pains. In fact, there seem to be as many detractors as there are advocates of the technologies.

The two systems (PRML and MR) work in unison to provide greater than 40% increase in areal density. Additionally, PRML helps increase capacity while decreasing cost by keeping the parts count down. MR heads can pack flux transitions so tight on the disk that current peak-detectors may find it hard to read. To recover the pulses on a read pass, the PRML channel looks at samples from the waveform, not the peaks. In theory, PRML asks what sequence of bits would most likely have created the waveform it observed, and reconstructs the bitstream.

On the other hand, time-proven inductive thin-film heads are now capable of providing areal densities of around 500Mb/in2 and development is still ongoing. In addition, the manufacturing of the new MR heads and their optimization process is still challenging. PRML read channels are usually digital, and they involve far more software than analog channels. Unlike tweaking analog filter circuits for traditional peak detector channels, PRML uses customized DSP code requiring exotic DSP programming skills. PRML also depends upon a high sample rate, which forces the DSP core to run at high speed, thereby generating

Continuing developments in magnetic tape technology

By David Stafford

Since CBS first aired a videotape recording of *Douglas Edwards and the News* on Nov. 30, 1956, from Television City in Los Angeles, videotape recording technology has enjoyed a number of significant advancements. Most of these improvements would not have been possible had it not been for major advances in magnetic media and media coating technologies. As the early adopters of disk-based systems pronounce the end of magnetic tape, it is worth noting how the magnetic tape industry is responding to the challenge.

Recent trends in videotape formats, particularly those in the digital domain, have been characterized by narrower track and tape widths, higher packing densities, slower linear tape speeds, more compact cassettes and a demand for lower-cost media products. Media manufacturers project these trends will continue. Consequently, they are focusing their efforts in the areas of base film, tape formulation and tape coating developments.

Base film

Traditionally, magnetic media has been coated onto *polyethyleneterephthalate* (PET), or more simply, *polyester* base films. Over the years, PET has seen a number of technological advancements that have improved surface integrity. This translates directly to lower dropout counts and improved electrical performance. The physical demands made on base film are enormous, however, and it is clear that PET may eventually give way to *polyethylenenaphthalate* (PEN) films. PEN is considerably stronger and more durable than PET. It offers higher tolerance to changes in environmental conditions. As a result, magnetic media for newer formats can be thinner while being significantly stronger, while offering higher volumetric packing densities and better performance across a wider range of temperature and humidity.

After PEN, the next major advancement on the horizon is *polyaramide* films. At present, polyaramide and other newer generation films show significant promise for further improvements in base film technology.

Formulation elements

The next area of R&D involves magnetic particles and formulation chemicals. The recent trend toward metal particle media products has been driven by their higher coercivity and retentivity, which allow much higher recording densities. This attribute is particularly beneficial to digital formats.

The evolution of metal particle technology is certain to continue. Metal particles of 1,800Oe are now being coated in tape production environments, and many companies are experimenting with 2,200Oe particles. Due to their smaller and more uniform size, these particles will allow improvements that will easily satisfy the projected demands of future formats.

Functionalized binder systems are another recent chemical advancement. These provide a "glue" that is more efficient in cross-linking all the formulation ingredients, resulting in high surface durability and stability. The number of dispersants and solvents used during the manufacturing process also can be drastically reduced with these new binder systems, making formulations simpler and less susceptible to natural variations in inert chemicals.

Coating technologies

Since the early days of magnetic media, a continuing trend has been toward thinner coatings. *Knife coating*, therefore, has given way to *reverse roll and gravure coating*, as the demand for thinner products has increased — and still the industry demands more. Two recent improvements in coating technology are now in partial production. The first of these is *metal-evaporated tape*, which is coated in a vacuum chamber and produces a tape with a high-coercivity coating of pure metal. This type of magnetic media product is extremely efficient and consequently allows high packing densities. Due to the need to coat this type of product in a vacuum chamber, however, the technology does not lend itself easily to large-scale production volumes.

A much more practical coating method is that of *multiple-layer* coating. Presently, most of the professional videotape available on the market today is of the single-layer variety. A single layer must be optimized for use by the entire recording system — both short and long wavelength recordings must occur on the same coating. Consequently, a single-layer coating is necessarily a compromise. Multiple-layer coating allows each layer to be separately formulated for a specific purpose (e.g., one layer of chrominance signals, another for luminance). With the recent emphasis on component recording, the advantages of such technology are obvious. Multiple layer coating also allows for different layer thicknesses and even for non-magnetic layers. The possibilities for multiple layer technology are almost endless.

Will disk systems spell the end for tape?

The advances made in tape technology, and the results of research and development efforts into future requirements, ensure that the storage media industry has the capability of meeting the demands of future formats.

The advantages that tape offers are quite significant and are frequently overlooked. Magnetic tape offers the following:

- Extremely high packing densities for cost-effective storage
- Low cost per unit of recording time
- Flexible, inherently removable medium
- Highly reliable and consistent
- Wide-bandwidth and high-resolution recording capability
- Interchangeability due to standard formats and large installed machine base

On the other hand, there are some features of disk systems that tape cannot provide. Random access is a prime example. Each technology offers significant advantages and disadvantages, providing the end-user with a choice of whichever technology best suits the application. Ongoing development ensures the user of continuing improvements in performance and economy of *all* magnetic media — disk and tape formats alike.

Stafford is product manager, videotape products at Ampex Recording Media Corporation, Redwood City, CA. Respond via the *BE* FAXback line at 913-967-1905.

For more information on magnetic tape, circle (302) on Reply Card. See also "Recording Tape, Video," p. 64 and "Recording Tape, Audio," p. 56 of the BE Buyers Guide.

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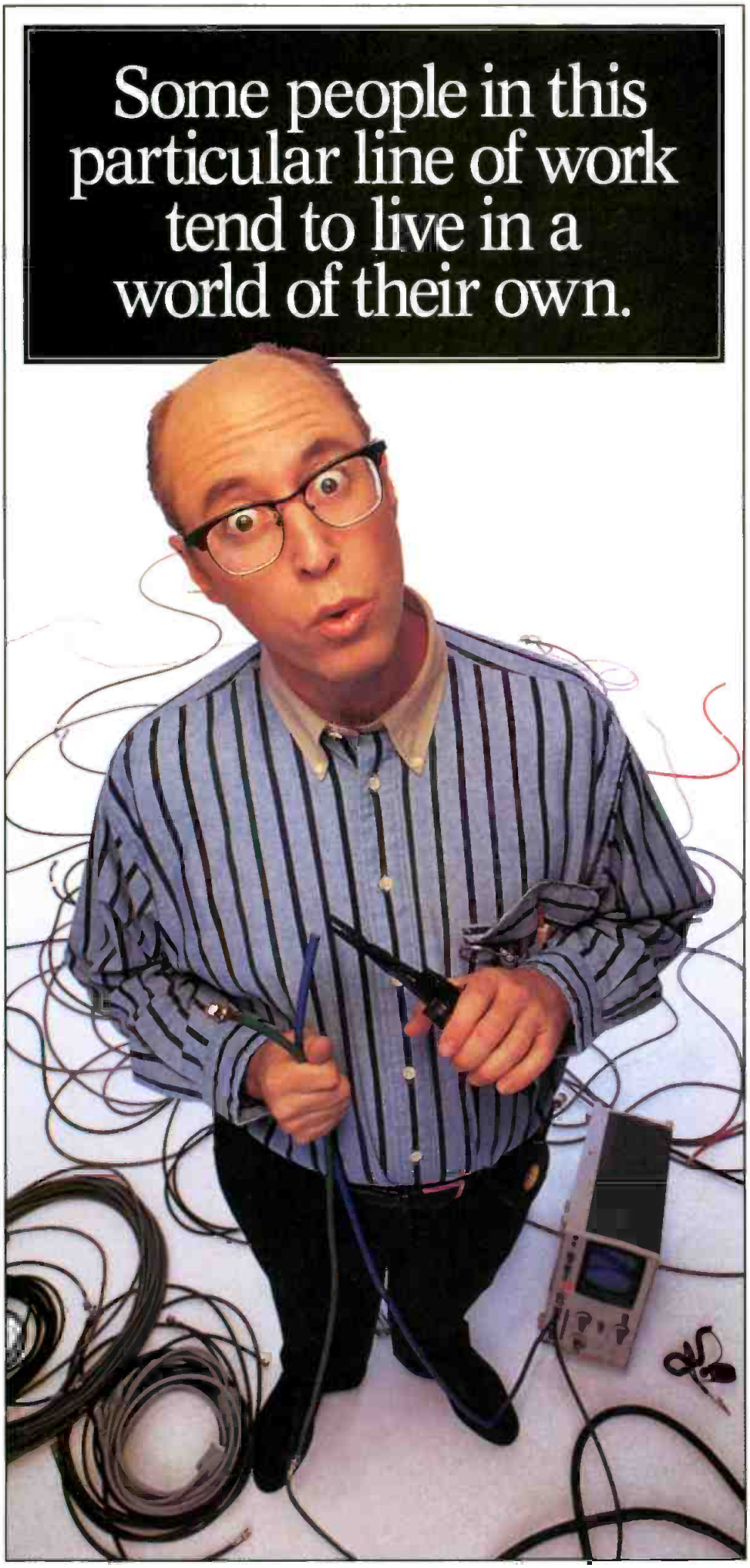

increased heat. This in turn results in greater noise and higher overall power consumption. Nonetheless, these obstacles are being addressed, and drive manufacturers have set their sights on some stringent goals: MTBF greater than 50 years non-stop and price declines of 4%-5% per quarter.

Hard drive prices will continue to fall while capacity increases, putting the cost below $0.50/MB soon. Today, 8" x 6" x 3.5", 14-platter, 9GB formatted drives, spinning at 5,400rpm are on the market for a list price of $4,500, with rumors of a doubling of this capacity to come soon. This is going to help make video servers and virtual studios a reality in the not too distant future.

Hard drive prices will continue to fall while capacity increases, putting the cost below $0.50/MB soon.

Optical advances

Equally impressive are advances in optical disc technology. The near future should produce some significant advances in WORM, CD-ROM and magneto-optical (MO) systems. Each of these technologies will certainly affect numerous industries.

On the WORM side, one company plans to introduce in late 1994 a CLV or CAV 12-inch disc that can run at four different capacity/throughput levels. These four increments are 136min/side at 5.2Mb/s, 130min/side at 9.4Mb/s, 68min/side at 10.5Mb/s and 65min/side at 18.9Mb/s. The same company is investigating the next generation of optical video storage, projecting video storage capacity of more than two hours on a CD-sized disc using a blue-laser recorder.

After a long, slow start, CD-ROM is finally poised for growth. Prices for this 650MB, 4.5-inch disc have dropped for hardware and media. Authoring studios, system developers and end users alike are moving to the format in increasing numbers, attracted by higher-speed players, writeable CD-ROM drives in the $3,000 range and disc manufacturing costs below $1.50. CD-ROM-based mass storage jukeboxes now can be found in capacities ranging from a few gigabytes to more than 180GB. An important issue in the CD-ROM environment involves the current battle for a new quadruple capacity standard currently raging among several competing manufacturers. One proponent is evaluating a quadruple density CD-ROM system capable of storing 2.2GB on a 4.7-inch disc and 540MB on a 2.5-

inch disc. Using MPEG compression to get transfer rates down to 4Mb/s and playing back at quad speed on the 4.7-inch disc, this format could provide an hour of real-time video.

The last, and probably most important, area in the near term for video is MO technology. For a start, 27 member companies in the Optical Storage Technology Association (OSTA) standardized an official migration path for MO this past July. The 3.5-inch MO disk moves from today's 230MB capacity to 2.6GB by the year 2000. Similarly, raw data rates will move from current 1.5-2.5MB/s to 5-10MB/s by 2000. (See Figure 1.) The 5.25-inch MO migration path begins with 1.3GB capacity today and goes to 10.4GB by 2000. Its data transfer rate moves from the present 2-4MB/s to 7.5-10MB/s by 2000.

Server technology

The real uses of the enabling technologies discussed here will become obvious as the markets for media-server and videodisc technology evolve into selected applications. Some of these applications are digital videodisc recorders (DVDRs), digital still-stores, broadcast media servers, (near-)video-on-demand (NVOD and VOD) and media servers for local and distributed delivery of information. Before discussing the role that media servers will play in these broad-based applications, a brief discussion of media server basics is in order.

The most basic requirements of media server technology are continuous retrieval of data and its management. This includes the storage medium and facilities for capture, retrieval, delivery and error correction of program data along with high reliability and fault tolerance.

An important issue in the CD-ROM environment involves the current battle for a new quadruple capacity standard.

Data compression is also involved. The amount of compression and its specific process can vary based on the needs of the storage and delivery system. Therefore, optimizing compression for a specific application is a key process. Early media servers will probably be based on JPEG or MPEG-1, followed later by MPEG-2. High-end media servers might not use compression at all and would depend heavily on huge capacity and extremely fast access speed.

In the broadcast facility, media servers

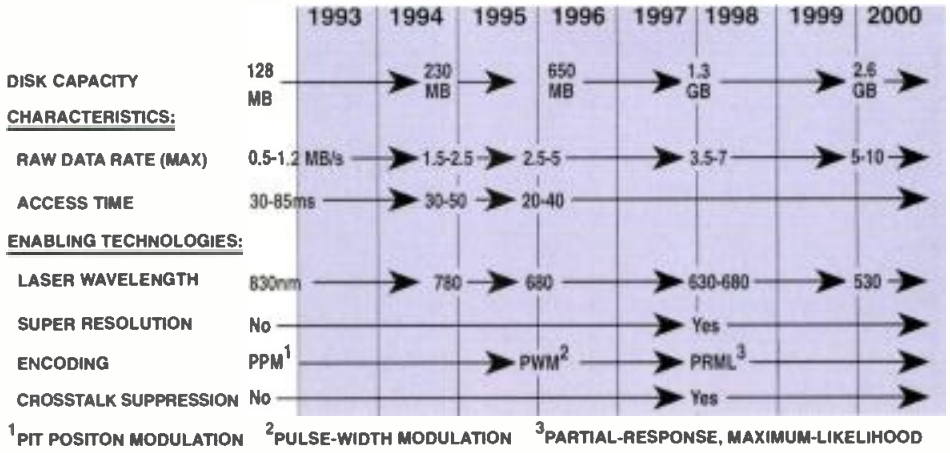

Figure 1. Migration path for storage capacity of 3.5-inch magneto-optical disks, as proposed by consortium of 27 manufacturers. (Source: Optical Storage Trade Association.)

might replace the decades-old electronic still-store. On the consumer side, if the future truly is interactive, media server technology will be forced to evolve. This can only be brought about by the development of disk-based stand-alones and server systems in all areas of industry. Ideally, the future will not just be tapeless, but open and scalable supporting a multiserver architecture.

Media servers will be capable of storing terabytes (10^{12} bytes) to exabytes (10^{18} bytes) of information.

In this new world, media servers will take on additional features because they will have to be more intelligent. For example, features like automatic load balancing and error correction, fault tolerant and transparent changeover and sophisticated self-healing repair diagnostics may become commonplace. In addition, video-based media servers will require a symmetrical architecture that must be able to read and write at the same time, have total random access and the ability to process multiple datastreams.

The last frontier is the integration of hard disk, optical and tape medias into application-specific media servers. (See the related article, "Continuing Developments in Magnetic Tape Technology" p. 64.) A typical media (video) server might include one or more processors, a large array of mass storage devices configured for throughput and data integrity, a solid-state memory buffer for real-time audio/video, and appropriate processing for compression and interfacing to the outside world. The server components may be linked by LAN/WAN, or established as dedicated systems. The LAN approach requires a common protocol standard, but would allow a flexible, multi-user environment. The dedicated direction may be more appropriate within the context of the information superhighway, where the establishment of local and remote media servers is a must. These media servers will be capable of storing terabytes (10^{12} bytes) to exabytes (10^{18} bytes) of information. Linked through a complex web of communications and control protocol, local and remote media server hubs will be able to provide vast amounts of information to the production, broadcast and end-user community. The prospect of video e-mail may not be too far from reality.

On the motion-picture and post-production/graphics side of the industry, imagine the possibility of having on-line access to vast amounts of digital imagery, stock footage, location scenery databases and on-line services. Even licensing and royalties could be taken care of in the background automatically.

With off-the-shelf hard disk and optical media increasing their reliability, capacity and cost-effectiveness, designers are turning to software to bring home the bacon. With proven hardware design, software then becomes the controlling agent for change, seeking an ultimate goal of hardware-infrastructure independence. As the industry moves onward, the media server (and its high-performance magnetic and/or optical storage components) will become another common tool. ■

Editor's note: The author wishes to thank Pioneer New Media Technologies, Sanyo and Syquest Technology for their assistance with this article.

➡ *For more information on magnetic or optical disc-based storage, circle (300) on Reply Card. See also "Computers & Peripherals," p. 71 of the BE Buyers Guide.*

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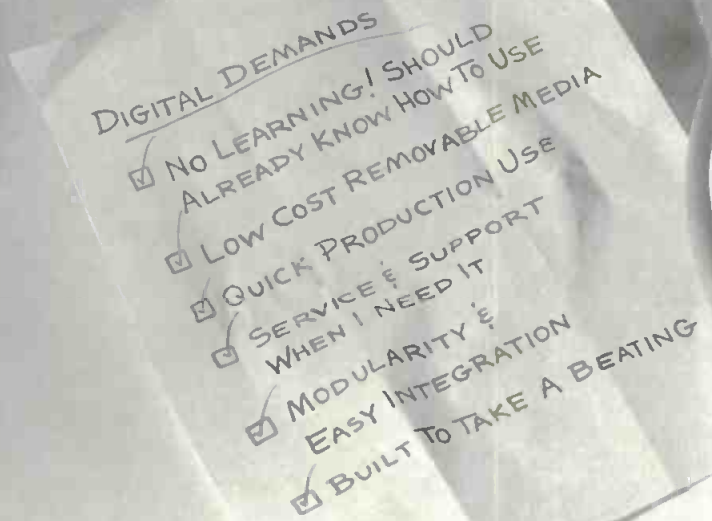

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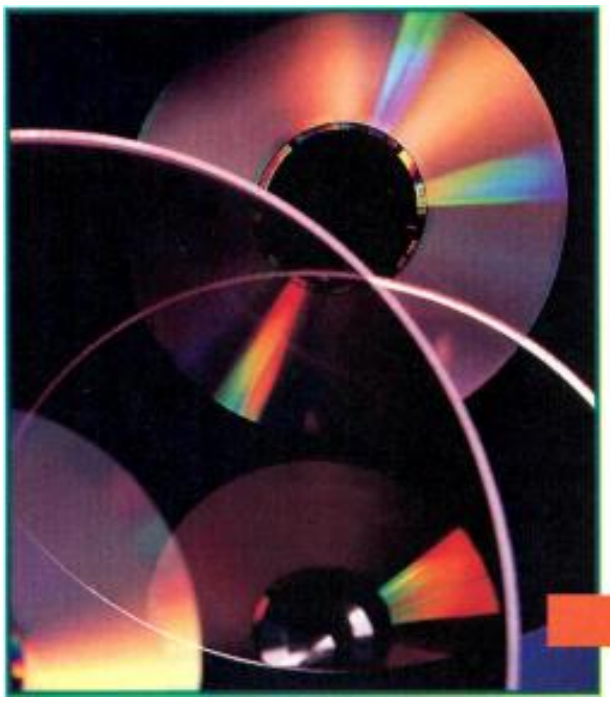


Moving to server-based production

First shown at NAB '94, servers are already causing quite a stir.

By Stevan Vigneaux

The Bottom Line

Tape-based production and automation have been a cornerstone of the broadcast and post-production industries for years. Despite their recent appearance, servers coupled with high-speed networks are opening up new possibilities for facilities throughout the industry.

The presence of video servers at NAB '94 was evidence of a technology turning point; disk-based editing and playback devices have evolved from stand-alone workstations to fully integrated production systems. Why is there so much excitement about servers? What are the benefits derived from server-centered production? Why are vendors and broadcasters turning to servers and networking? What distinguishes one server-centered product offering from another? This article will look at some answers to these questions as well as some of the reasons for a transition to server technology.

The server imperative

Several driving forces are behind the rapid spread of servers across the NAB floor, among them:

• *Media sharing:* Server-based systems allow multiple users to simultaneously record to, edit from and play out of a shared central library of audio, video and graphics. Media sharing also speeds editing because multiple users can work from the same material.

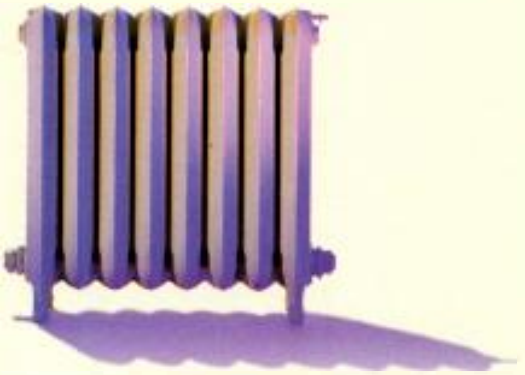
• *Production speed:* Editing from disk with a non-linear editor is faster and more flexible than the alternative. Once the footage is digitized, non-linear editing eliminates the shuttling, rewinding and cassette changes that can slow the linear editing process. With the footage on a server, multiple users can simultaneously access clips. Editing from a server also speeds the production process by eliminating the wait for a recording to finish. When properly implemented, server technology allows an editor to start using material from a feed even before the feed recording is completed. Another area where server-based production speeds the process is revisions. Rather than completely re-editing a news story, an editor can re-open the original version stored in the server, quickly add the updated material, and then place the new version in the server alongside the original.

• *Technical quality:* Many times news production can involve editing a story once and then recutting that version several times. Some stories are third- or even fourth-generation re-cuts of earlier stories. Production systems centered on a server and central library hold all the material in digital form so each re-cut remains the same quality as the original digitized footage.

With the footage on a server, multiple users can simultaneously access clips.

• *Production quality:* Word processing makes it fast and easy to revise and improve documents. This added flexibility allows for creative freedom that can result in documents that are better written. The same quality improvement from operating flexibility also comes with disk-based broadcast production, especially when practiced on a server. Instead of having to choose between getting a story done on time or getting it done right, disk-based editing makes it possible to

Vigneaux is senior product marketing manager, broadcast products, Avid Technology Inc., Tewksbury, MA.



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achieve both. The server's central library acts as a resource for images, graphics and sounds. Editors can quickly search the database for the right music or sound effect to enhance a story.

• *Efficiency:* Using a central library can eliminate running tapes throughout the building and can improve efficiency. Efficiency can also be improved when multiple versions of a story can be created with only slightly more work than a single version. Stories can be updated quickly and be ready for playback immediately.

• *Archiving:* Because the audio and video are digital, and the entire system is computer-controlled, high-powered databases can be used to archive or retrieve finished stories or raw stock. Mass storage jukebox systems provide near-line storage ranging from 10 hours to hundreds of hours with access times as low as 30 seconds.

With server technology, the operational flow of news production can be faster, smoother and less chaotic. The operational advantages just outlined are some of the significant benefits introduced by server-centered production systems.

Another benefit is the reduced maintenance needed on the disk-based systems when compared with tape machines. Sealed hard drives are virtually maintenance free, and when configured as part of a RAID system, drive replacement can be quick and easy.

Reliability is another area where disk-based systems can enhance the production process. News stories are less likely to be lost to operational problems. Commercial playback can benefit from server technology because make-goods caused by tape jams, dropouts, tape wrinkles and head clogs are eliminated.

Another advantage that is not always considered, and applies to server-based or stand-alone systems, is physical size. A disk-based edit system occupies perhaps one-quarter the space of a similarly equipped 3-machine edit suite with switcher, DVE and character generator. A playback system with storage for 1,500 spots can fit into a single 6-foot rack.

Server distinctions

The wealth of press coverage and manufacturers' announcements about servers often fails to make clear the important distinction between the various implementations and target applications. This also makes it difficult to distinguish current products from promises for the future. In addition, there is a difference between products designed for broadcast production systems and those targeted to the video-on-demand market. At present, there are three distinct server implementations:

1. *Video-on-demand servers:* Large capacity servers primarily intended for cable TV head-end playback to the home.

2. *Application servers:* Servers with sufficient hardware to allow the recording (digitizing), editing and playback software to run on the system.

3. *File servers:* Servers that function as central libraries networked to full-function external workstations.

Video-on-demand servers have received the bulk of the media's attention in coverage of the information superhighway. Although a critical development in video-for-the-home, they are not intended for or suited to broadcast production applications. These systems typically use MPEG compression and therefore editing cannot be done without first decompressing the images.

Application servers and file servers, also known as editing servers or production servers, are the server implementations suited for broadcast production

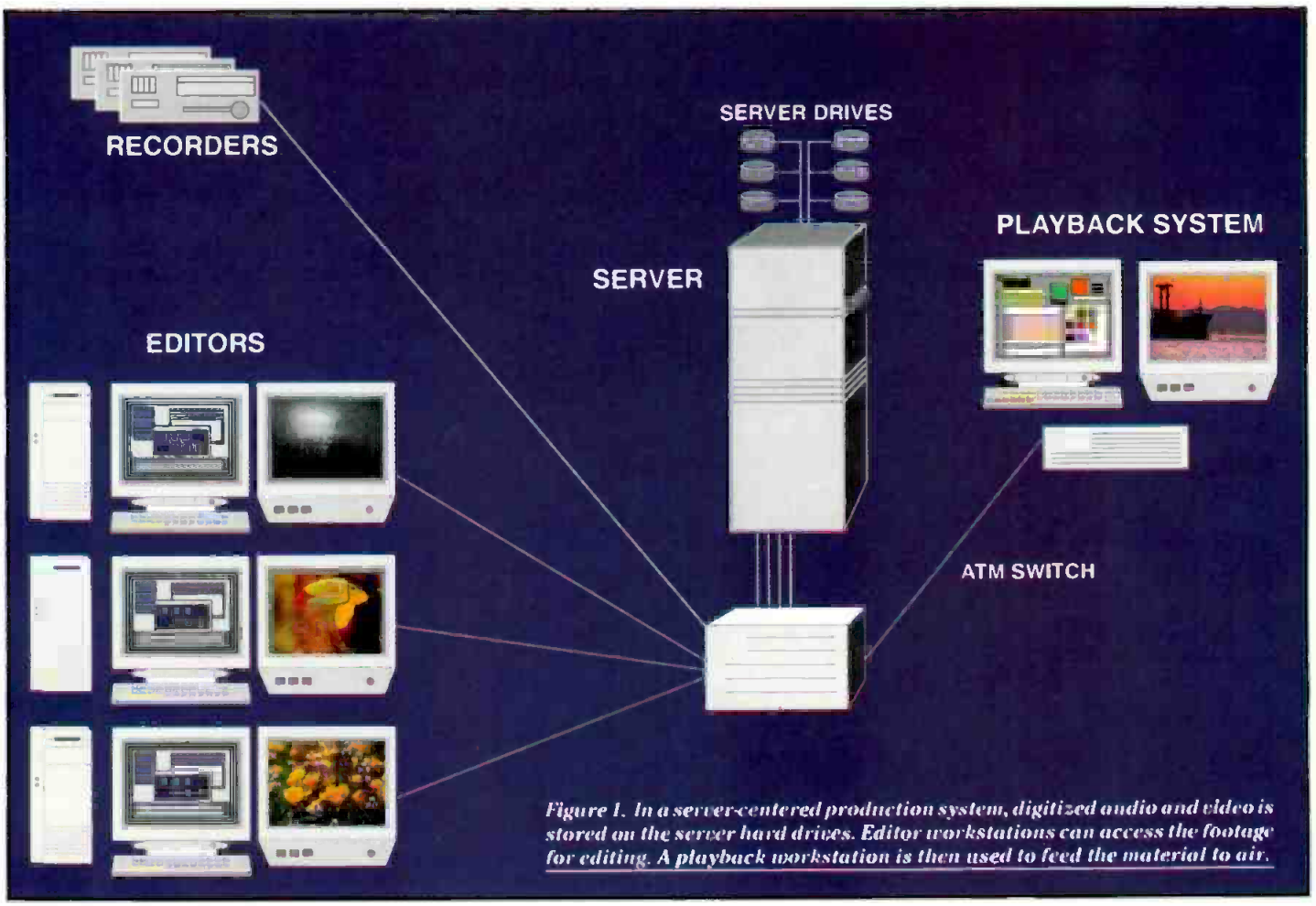
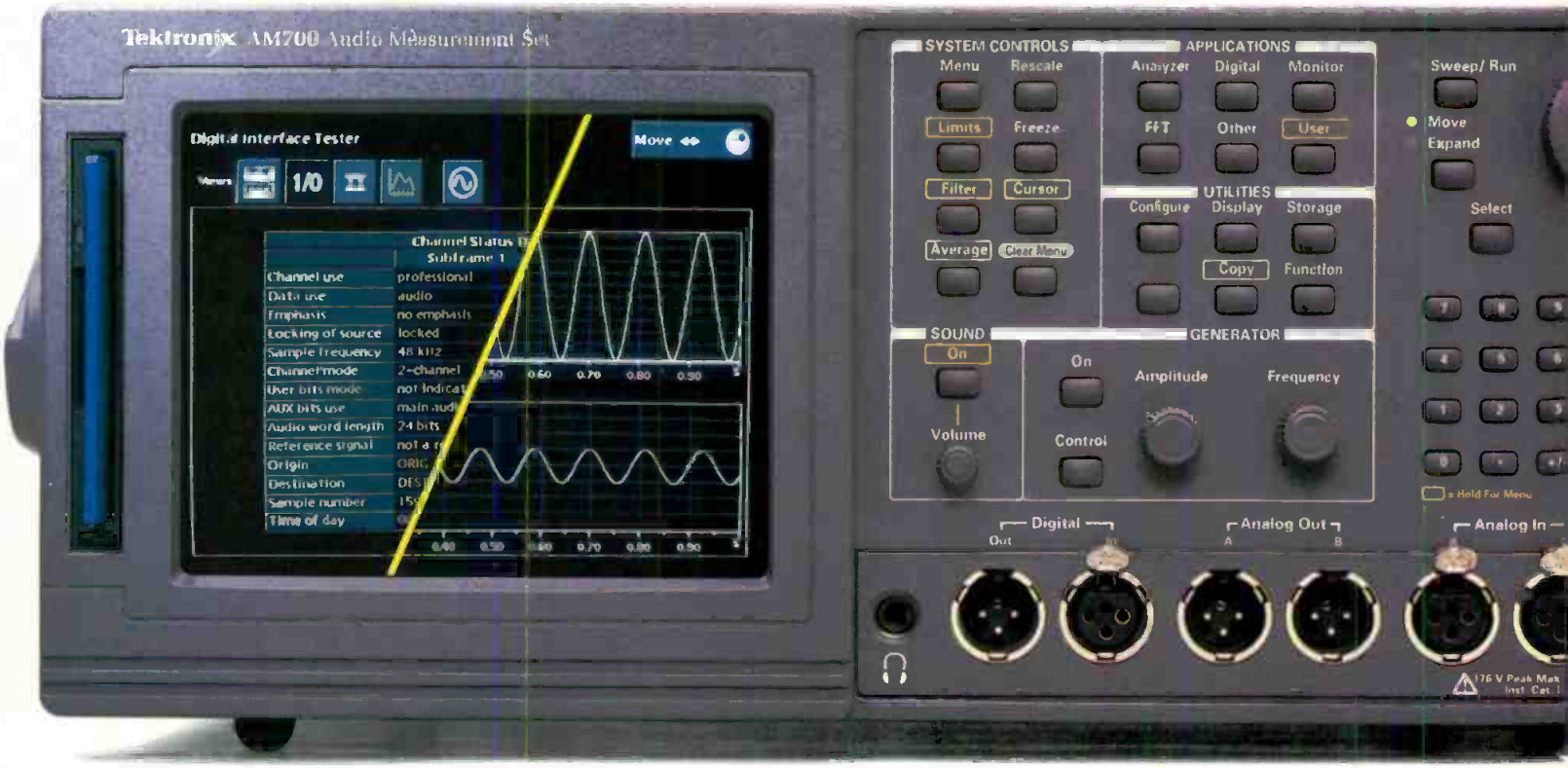


Figure 1. In a server-centered production system, digitized audio and video is stored on the server hard drives. Editor workstations can access the footage for editing. A playback workstation is then used to feed the material to air.

The one audio tester you can use in mixed company.



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Tektronix

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use. The file server architecture provides more flexibility and portability for workstation applications than application servers. File server architecture allows the workstation application software and hardware to be independent of the server. As more technologically advanced servers become available, only the server software needs to be ported to the new platform, while the application software and the workstation hardware remain untouched.

A disadvantage of application servers is the recording, editing and playback applications must be written specifically for the server. Furthermore, the server must be equipped with server-specific hardware for digitizing and playback. Changing to a new server can be a complex task.

Redundancy is another reason to select a file server implementation. In the event of a server failure, the external client workstations continue to function because they are independent of the server although direct access to media stored in the file server may not be possible. In an application server design, any failure of the server brings the entire system to a halt because all the hardware and software is in the server. In many ways, the distinction between application servers and file servers is much like the difference between mainframe computing with distributed terminals and contemporary client-server systems using desktop computer workstations.

The server's central library can also act as a resource for images, graphics and sounds.

Applications

Like any new technology, servers must be applied to the right tasks and projects. The best environments for server-based production are those where a team works together to produce a packaged whole. News production is a good example. A typical 30-minute newscast can be described as a group effort where a surplus of raw material is turned into 15 to 20 minutes of edited stories capsuling the day's news. Two or even three separate stories might be produced about major news events while other topics are covered with a single edited piece. Some of each day's stories reflect prior events. Access to a central archive can be used to enhance the edited product.

In a server-centered system, the workstations feed the incoming audio and video into the hard drives. Editing workstations can instantly access this material. It is possible for multiple users to access the same material simultaneously. This allows several stories to be cut from the same source material without copying or waiting. The playback workstation can access the edited pieces so there is no delay in going to air. Even last-minute stories are available for playback the moment they're completed. Finished pieces can then be digitally archived for quick recall.

Sports or magazine productions are other candidates for server-centered production. Sports programs and magazine-style programs resemble newscasts in many respects. As with news, these types of programs require that a variety of material be pulled together by a team of editors and producers working under deadline. Raw stock on the server may be shared by multiple editors, revised, and assembled into a final package. And, because every step uses the original digital data, each segment can easily be modified, even during final assembly, without losing a generation.

It seems clear that server technology is reaching a level that solves today's problems in a new and efficient manner. As server technology improves, it is apparent that disk-based systems with computer workstations linked by high-speed networks will play an important role in future broadcast production. ■

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Circle (48) on Reply Card

AM and FM transmitters

Quiet improvement has produced quieter transmitters — and quieted the pagers of many maintenance engineers.

By Skip Pizzi, technical editor

The Bottom Line

Many broadcasters wait to replace their transmitter until it is truly on its last legs, when further repair becomes prohibitively expensive. Moving up to the lower-maintenance world of current transmitter design sooner rather than later will free such a station from the financial burden of frequent transmitter problems that it faces. Savings from reduced maintenance and higher power efficiency of new transmitters can quickly amortize their costs.

The item that most notably distinguishes a radio station from any other audio facility is the broadcast transmitter. While an increasing amount of television viewing takes place via wired paths, radio remains a vital wireless medium, with no signs of this changing. The mobility of radio is a cardinal asset, and the lynch pin of its continued strength. The transmitter has been of singular importance to a radio broadcast operation from the earliest days of the medium, and this is no less true today.

The transmitter is also the broadcast facility's last transducer. It represents the broadcaster's final opportunity to influence the signal — beneficially or detrimentally — before launching it into the earth's atmosphere and topography.

The casual observer might think that not much has changed in this scenario since Marconi and Armstrong — AM and FM are still broadcast by high-power transmitters feeding appropriate antenna systems. Yet the incremental changes that have occurred would certainly be noticed if those pioneers were to visit any radio station (or listen to anyone's home/car/personal radio receiver) today.

The changes continue

Some broadcasters might be tempted to wait out any improvement or replacement of the transmitter until the next generation of radio arrives in the form of digital audio broadcasting (DAB). Others realize that there may be a need for interim improvements in traditional broadcast transmission equipment. Even if DAB is just around the corner (and that's no safe bet), existing AM and FM services will continue to coexist with DAB for many years thereafter. Broadcasters who don't take advantage of new developments for AM and FM transmission will lose ground to competitors who do.

Because the radio broadcast marketplace is essentially mature in the United States (i.e., few new stations are coming on line), transmitter manufacturers realize that domestic sales come almost exclusively from replacements and upgrades. Therefore, most transmitter designs are kept quite up-to-date.

What a new transmitter will provide

Most of today's transmitters stress high reliability above all else. Major components in this direction are ease of maintenance through modular design and increased internal redundancy.

Some new incremental features are also available, such as microprocessor control, on-board diagnostic display, reduced requirements for tuning, adaptive failure sense/switchover systems and frequency agility. The trend toward consolidated facilities and increased group ownership limits can make frequency agility a handy new feature, especially during emergency situations. A frequency-agile transmitter can offer a wider range of nearly immediate back-up service applications.

Qualitative improvements in AM and FM transmitters have focused primarily on reducing transmission noise floors. Among FM systems, lower AM synchronous noise has been a common theme (often provided by improved PA cavity design). Its benefits include reduced multipath noise and lower subcarrier interference. With the movement afoot in new subcarrier services, this attribute may become increasingly important for FM broadcasters.

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BEXT	L series	FM	4kW to 30kW	Single tube		307
	T2000	FM	2kW	Single tube	All models can be custom phase-locked to ext. reference	
	SF series	FM	150W to 2kW	Solid-state		
	TEX 100	FM	100W	Solid-state		
Broadcast Electronics	B series	FM	5kW to 35kW	Single tube	Optional video diagnostics	308
	FM series	FM	100W to 3kW	Solid-state	Combined or main/alt. available	
	AM series	AM	500W to 10kW	Solid-state	C-QUAM std.	
CCA Electronics	FM series	FM	700W to 50kW	Single tube	Solid-state IPA option avail. on units up to 13.5kW	309
	AM series	AM	10kW to 50kW	Single tube	Multifrequency capable	
Continental Electronics	814H	FM	250W to 1kW	Solid-state	Easily transportable	310
	814J	FM	3.8kW	Solid-state	Broadband design, no tuning	
	815B	FM	5kW	Single tube	Solid-state IPA	
	816 series	FM	11kW to 35kW	Single tube	Solid-state IPA	
	D816 series	FM	40kW to 70kW	Tube	Combined 816 configuration	
	314T, 315T, 316T	AM	1kW to 10kW	Solid-state	Interchangeable amps, no tuning	
	317D	AM	50kW	Solid-state	Interchangeable amps, redundancy	
DB Elettronica	PM/S series	FM	100W to 1kW	Solid-state	Freq. synth. exciter; easy pwr. adjust	311
	PM/T series	FM	1kW to 10kW	Single tube	Modular, redundant design	
Energy-Onix	SST series	FM	150W to 500W	Solid-state	Broadband design	312
	Legend series	FM	550W to 11kW	Solid-state	Built-in redundancy	
	ECO series	FM	1kW to 11kW	Single tube	Grounded-grid design	
	MK series	FM	1.7kW to 50kW	Tube	Grounded-grid design; full-featured	
	AM series	AM	1kW to 10kW	Tube	Lightning-resistant	
GEC Marconi	Marconi B6044	AM	600kW	Tube		313
	Eddystone B series	FM	300W to 10kW	Solid-state	Single-phase AC up to 2kW	
Harris Allied	Gates series	AM	1kW to 5kW	Solid-state	Polyphase PDM design	314
	DX series	AM	1kW to 2MW	Solid-state	Digital AM; >85% efficiency	
	Quest series	FM	100W to 1kW	Solid-state	All solid-state; 10W exciter included	
	Platinum series	FM	1kW to 11kW	Solid-state	All solid-state; FET RF amplifiers	
	HT 250, 500, 1FM	FM	<100W to 1050W	Solid-state	All solid-state, modular design	
	HT3.5 - 35FM	FM	800W to 37kW	Tetrode	Supplied with digital or analog exciter	
Itelco	T212, 242M, 282	FM	100W to 500W	Solid-state		315
	T213, 233, 273	FM	1kW to 4kW	Solid-state		
	T283, 214, 224, 234	FM	5kW to 20kW	Tube		
	T254	FM	30kW	Tube		
Larcan-TTC	FMS series	FM	100W to 16kW	Solid-state		316
LPB	AM-30P	AM	2W to 30W	Solid-state	All units; For PSSA/PSRA, synch or back-up use; single-phase 117 VAC; remote power-change option	317
	AM-60P	AM	6W to 60W	Solid-state		
	AM-100P	AM	25W to 100W	Solid-state		
Nautel	AMPFET FM series	FM	4kW to 10kW	Solid-state	Modular design; 65% efficiency	318
	AMPFET ND series	AM	1kW to 50kW	Solid-state	Modular design; 70-80% efficiency	
	AMPFET NA series	AM	100kW to 300kW	Solid-state	Frequency-agile; 85-88% efficiency	
QEI	675T series	FM	<100W to 600W	Solid-state	For low-power FM uses	319
	Quantum series	FM	300W to 6kW	Solid-state	Modular design; single or 3-phase	
	FMQ series	FM	1kW to 30kW	Single tube	Grounded grid; solid-state IPA	
RIZ Transmitters	OR 100 SD-1M	AM	100kW	Solid-state	Both units: All solid-state; >80% eff.; frequency-agile, 525-1605kHz	320
	OR 300 SD-1M	AM	300kW	Solid-state		
Thomcast	TMW Series 7	AM	100kW to 300kW	Solid-state	All solid-state	321
	TMW 2600, 2700	AM	600kW to 1MW	Single tube	Solid-state modulator	
	RAMSES I series	FM	500W to 2kW	Solid-state	All solid-state; modulator design	
	RAMSES II series	FM	100W to 5kW	Solid-state	All solid-state; redundant	
	FMT 10,000 S	FM	10kW	Tube	Microprocessor control	

Table 1. *A listing of major transmitter manufacturers and their current offerings. (FM transmitters, exciters and translators below 100W are not included.)*

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–Mike Britton, Production Director KODY/KXNP, North Platte, NE

"The DM-80 does more than DAWs costing twice as much. It's very rugged–you can set it up and forget about it. And it's easy to use."

–Tony Diggs, Chief Engineer WKHK Richmond, VA

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–Howard Silberberg, Sound Engineer United Nations Radio N.Y., NY

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–Tom Collins, Director International College of Broadcasting & Recording, Dayton

"The DM-80 is easy to learn, and once learned...it's fast, very fast! We also like its clean digital sound."

–Barry Witherspoon, Program Director WSTO-FM, Evansville, IN

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Solid-state takes over

A quick glance at Table 1 shows that the majority of current radio transmitter designs employ solid-state final amplifiers. Many manufacturers have moved away from tubes for all but their most powerful designs. The cost-effectiveness and reliability of solid-state systems have made this technology more attractive for most radio transmitter applications.

Besides higher reliability, many designs accommodate amplifier module changes while still on the air. Solid-state transmitters can also pay tangible dividends from their power efficiency. AC-input-to-RF-output efficiencies of 80% or more are now common in solid-state transmitters. Spare parts inventories may also be reduced due to many solid-state transmitters' use of interchangeable modules.The reduced requirements for tuning and other complex adjustments in many new transmitter designs are also a benefit of solid-state components.

Service extensions

Another issue of heightened interest recently (in some locations) involves stretching the boundaries of a station's existing service area. As cities grow and populations shift, a station's coverage may need to adapt. FM translators (and in some cases, boosters) and even synchronous AM systems can be employed to extend a station's service area, where allocations permit.

As a result, several manufacturers have increased their line of lower-powered transmitters and higher-powered exciters.

Digital systems

Although DAB is still some years away, digital RF technology has already begun to make its way into analog broadcasting. Digital AM transmitters have added even greater efficiency to solid-state systems, while digital FM exciters (introduced recently by a number of manufacturers) claim to improve the quality and consistency of the FM signal.

The digital AM transmitter uses many small amplifiers, which are switched and combined to build the modulated carrier wave. Lower distortion and noise plus increased efficiency are the result.

The digital FM exciter uses the *numerically controlled oscillator* (NCO) to create the FM signal. The NCO provides inputs for digital control signals that independently set the frequency, amplitude and phase of its output. Digital exciters include converters to create these digital control signals from analog audio and data inputs. Some units also offer AES/EBU digital inputs for main carrier audio, thus avoiding one conversion step. The NCO's accuracy and ability to handle extremely complex modulations is well-known among high-tech radio design engineers, and is available for FM broadcast applications.

The last link

If you find yourself saying, "Yes, but my main transmitter still has several good years left in it," consider the state of your *backup transmitter*. Can you say the same about it? If not, think about retiring your main transmitter to backup service while it's still in good condition. A new transmitter may soon amortize much of its cost through savings in maintenance and power consumption.

There is no "alternate path" (such as cable) for radio broadcasts to get to most of today's listeners. The RF link to radio audiences remains paramount. Keeping the reliability and the quality of the transmission facility as high as possible is a primary responsibility of every radio station owner, operator and engineer. The application of modern transmitter technology can go a long way toward fulfilling that goal.

➡ *For more information on transmitter products, circle numbers listed in Table 1 of this article on Reply Card. See also "AM Radio Transmitters," pp. 126-128 and "FM Radio Transmitters," pp. 128-132 of the BE Buyers Guide.*

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Re: Radio

Dealing with AM coverage problems

By John Battison, P.E.

Among the rewards of writing this column are the letters and comments I receive from readers. A recent one from Reid Brandon of Varian took me to task for not saying *why* filament "burn-in" is needed. (See "Re: Radio," August 1994). Actually, it was only for lack of space that this was omitted. Because Reid's comments are so concise I've excerpted the following from his letter:

"'Burn-in' usually describes the stabilization period during which a tube's filament voltage is set at the nominal (rated) value. A thermo-chemical reaction occurs within the filament: Metallic thorium migrates to the surface of wire, below the carbide layer. It is here that an electron flow starts in a mono-molecular layer. After about 200 hours the process stabilizes and filament temperature can be reduced without affecting proper electron emission. For long tube life, filament voltage reduction must follow 'burn-in.'"

(*Editor's note:* For more on this subject, Varian Power Grid Products offers a free booklet, "Extending Transmitter Tube Life.")

Coverage questions

Probably the topic most often brought up by AM station managers when talking to their engineers is *coverage*. Meanwhile, *loudness* is probably top on the program director's list. Management-engineering discussions generally lead off with, "Why aren't we as loud as W—?" or "Why are they louder than we are downtown?" Questions like these are the bane of most engineers' lives, because they generally don't lend themselves to easy answers.

In the case of stations with directional antennas, the engineer's answer is often, "The downtown area has moved, and it is now in one of our low radiation areas." Yet sometimes the major population area is still in the major lobe, but the signal is down. For both DA and non-DA stations, there are many reasons for low signals in previously strong areas. One that is happening more often than you may realize is simple "urbanization."

In one recent case, a station manager complained that his non-directional signal was much lower in the downtown shopping area than the original measured contour showed. New measurements confirmed this — signal strength was about half what the original proof measurements showed. The station was built around 1950. The city was much smaller then and the area between the transmitter site and the downtown shopping area was essentially open country.

Today's FCC seems more willing to accept unique and novel antenna systems.

In the past 30 years, this area has been built-up and is now covered more by concrete than by grass. What has happened to the conductivity? It measured 15mmhos 35 years ago. Running a couple of radials showed that it was now 6mmhos. No wonder the signal was down. In fact, the built-up area was now abutting onto the transmitter site, and the station engineer was privately having worries about environmental radiation problems.

In cases where previously good conductivity has dropped, there isn't much that can be done short of moving the transmitter downtown. Power increase is usually out of the question now that the interference rules have changed. What was originally an interference-free contour will now be producing, or receiving, theoretical interference that precludes any power increase. A co-channel synchronous station might be possible, but the interference zone might fall in a desired area.

Today's FCC seems more willing to accept unique and novel antenna systems, provided that operational proof of compliance with interference rules is achieved. Such things as antenna *directors* and *reflectors* dropped from guy wires to influence radiation in a given direction could be proposed with some possibility of approval, based on recent FCC precedents. These projects typically require costly engineering work, however.

More mundane fixes

Before resorting to such extreme measures when a coverage problem comes up, first make absolutely sure that the transmitter and antenna system are in first-class condition. Because the FCC no longer requires stations to have modulation monitors, many do not have usable ones. Beg, borrow or buy a scope, and observe your RF signal. Look for flat-topping and over-100% negative modulation. Check for maximum 125% positive modulation, and watch the scope to be sure that your limiters are really giving you the high *average* modulating level that your program requires.

If you are an all-talk station, consider buying one of the various available signal *inverters*. These devices invert the polarity of the audio signal such that the higher peaks in an asymmetric waveform are always sent in the positive direction. This will tend to increase positive modulation, thus raising the average RF level for a louder sound.

Be sure that the area at the base of the tower is clear of vegetation that could bridge the base insulator and change impedance and power developed. Check all ground connections for continuity and remake any hard-soldered joints that appear questionable. Clean all ATU connections, especially coils and clips.

Of course, base impedance should be measured. Also measure impedance of the transmission line leaving the transmitter and the input matching of the ATU. Over the years, standing waves often seem to develop, causing ATU matches to change.

In a properly adjusted RF system, the line current should be approximately the same at each end of the transmission line. If it isn't, it indicates a problem. If your RF ammeters are old, it's a good idea to check them against a known good one. Transmission systems — like people — can change a lot in 40 or 50 years. ■

Battison, *BE's* consultant on antennas and radiation, owns John H. Battison and Associates, a consulting engineering company in Loudonville, near Columbus, OH. Respond via the *BE* FAXback line at 913-967-1905.

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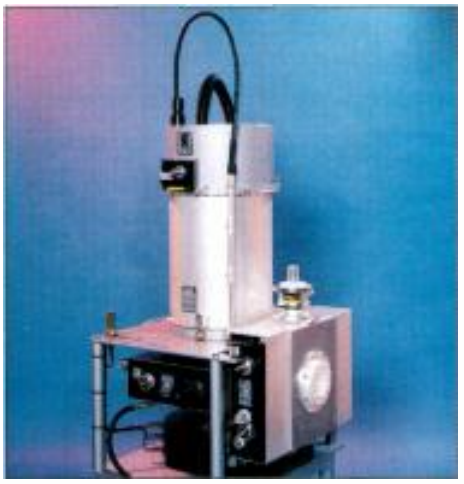
Pressurization fundamentals

By Lloyd A. Keyser



Operational transmission line is critical to broadcast operations, however, it is often overlooked or neglected until it is too late. Performance of air dielectric transmission lines can be greatly reduced when the lines are filled with ambient air, moisture in the air can condense on the inside of the transmission lines. To prevent electrical performance degradation transmission line should be maintained under dry gas pressure. Unfortunately, many of today's transmission lines are not pressurized.

Effects of moisture

Non-pressurized air-filled transmission lines allow moisture entry through the joints. Joint seals have a calculable leak rate, which increases with age. Ballistics penetration (through vandalism) allows copious amounts of water to enter unless the line can be maintained under pressure. Water in a line can cause problems of corrosion, voltage arcing and increased VSWR.

- *Corrosion:* Without positive dry air pressure, breathing allows moist air to enter. As the temperature drops, it will condense and cause corrosion, which increases attenuation.
- *Voltage arcing:* Dust-laden moisture deposited on the horizontal surface of an insulator builds a conductive path as the moisture evaporates. As the path arcs over, failure occurs.
- *Increased VSWR:* Water deposited on horizontal insulators and on the bottom surface of horizontal runs of waveguide causes increased reflected power. It degrades system performance (see Figure 1) and eventually results in transmitter shutdown.

Design considerations

Condensation in transmission lines depends on the amount of moisture in the contained air, expressed as dew point or relative humidity, and the outside ambient air temperature. *Dew point* is the temperature at which water droplets or ice crystals condense on a colder surface. In other words, when the partial pressure of the water vapor equals the saturation partial pressure of the water, moisture condenses. *Relative humidity* is the ratio of the actual vapor pressure to the saturated vapor pressure.

Dust-laden moisture forms a conductive path, as indicated by the burned Teflon. As the path arcs over, transmission line failure occurs.

Both dew point and relative humidity are affected by temperature and atmospheric pressure. Dehydrators remove specific amounts of water at a specified maximum relative humidity and temperature to provide air at a specific minimum dew point.

Outside ambient temperature changes require special consideration. The dry gas supply system must be sized to maintain transmission line pressure when the outside temperature drops at rates as high as 50°F per hour. Likewise, because the transmission line pressure increases when the ambient temperature and solar load on the transmission line increase faster than the leak rate, the transmission line must be protected with a high pressure relief valve.

Excessive pressure drop in feed lines and fittings can create unacceptable dehydrator operation. When the pressure drop of the fitting and/or the tubing approaches the on/off pressure switch differential, the dehydrator will build pressure to that point and shut off. The interval could be seconds, causing the dehydrator to short cycle until the line reaches the desired pressure setting. Short cycling could, over time, saturate the desiccant towers in a pressure swing dehydrator. This is the number one cause of field failure in pressure swing units.

The pressure drop in the feed line from the dehydrator to the transmission line depends on its length and diameter. All too often pressurization systems are installed using too small a feed tubing from the dehydrator to the manifold, or manifold to transmission lines. One-quarter-inch feed tubing is not recommended. Most systems can use up to 300 feet of 3/8-inch feed tubing. Large capacity broadcast systems can use up to 500 feet of 1/2-inch feed tubing without degradation.

The magnitude of a pressure drop in the system is directly related to equipment sizing and installation workmanship. Dehydrators are pressure tested at the factory to ensure leak-free operation. Improper or sloppy installation will result in kinks in the lines and compression fitting leaks. Protection of transmission line flanges while the lines are being installed in the towers and buildings is critical. The flanges should not have any nicks, gouges or raised burrs on the edge or surface of the flange. Check that gasket grooves are free of debris and flange seals are smooth with no nicks and cuts. Flange bolts must be evenly torqued to the prescribed values. High-quality installations are low maintenance installations.

Gas supply selection

The gas supply may be from a bottle or, as is usually the case, from a pressurization system. Bottled gases normally used for pressurization are Nitrogen (N_2) and Sulfur Hexaflouride (SF_6), which have dew points in the range of -70°F to -100°F. Air,

Keyser is the business unit manager, pressurization product line, Andrew Corporation, Orland Park, IL.

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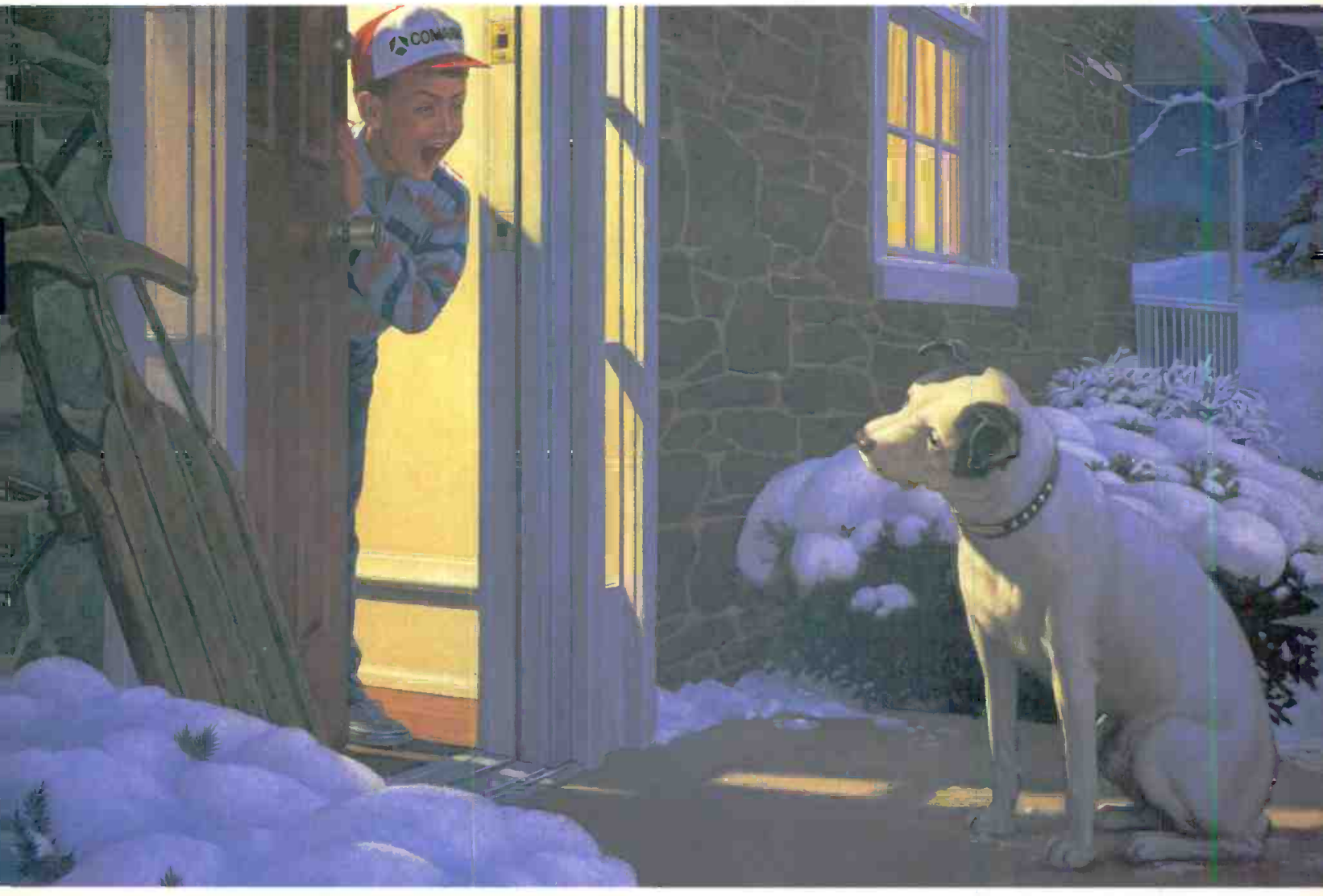

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which is the most economical gas, must be dehydrated to remove moisture to an acceptable dew point range of -36°F to -70°F. Pressurization systems can be classified as static or dynamic. In static systems, the transmission line is pressurized by a hand pump, or some other means, and the pressurization source is removed.

Transmission lines are not hermetically sealed and will eventually lose pressure in static systems. Therefore, they require periodic recharging. Hand pumps are used on small tight systems and can supply up to 135scf (standard cubic feet) of dry air under the ambient conditions of 40% RH and 70°F (21°C) before regeneration is required. Advantages include portability and simplicity. Disadvantages include requiring manual regeneration of the desiccant, and low purge and low system volume.

Dynamic systems incorporate a pressurizing source that provides dry gas on demand. The source may be nitrogen tanks with a regulator or an automatic dehydrator. The source is permanently connected to the transmission line system and recharges it as required.

Nitrogen tanks are mainly used on small tight systems and where mains power is not available. Advantages include a dew point lower than dehydrated air, no power requirements, no moving parts and inexpensive gas. However, there are hidden costs including monitoring tank pressure, ordering additional tanks, bad weather delivery problems, low purge volume, limited capacity (only minutes) in the case of vandalism, and a potentially complex piping installation.

Desiccant-type dehydrators are classified as manual, heat or pressure swing regenerative. Manually regenerative dehydrators require frequent inspection and periodic replacement or regeneration of the desiccant. Manual units can supply up to 270scf (7,646 liters) of dry air under the ambient conditions of 40% R.H. and 70°F (21°C) before regeneration is required. Their advantages include automatic drying, low power requirements, a 10 to 15 year life expectancy, economy of operation and simple installation. The disadvantages include manual regeneration of the desiccant, power, moving parts, low purge and system volume, and the compressor units generate some noise. However, maintenance is generally more economical than changing nitrogen bottles. Desiccant may be replaced during monthly or quarterly inspections. Saturated desiccant can either be reactivated by baking it for four hours in an ordinary oven at 350°F (180°C) during dehydrator down time, or replaced.

Heat regenerative units are used on low volume, low pressure systems only. They are not economical on larger systems due to the complex plumbing, electrical circuitry, and number of components. A heat regenerative unit operates by using two absorbing desiccant containers. Air is passed through one of these containers in which the moisture is absorbed. When the moisture in the desiccant reaches a specified value, the incoming air is switched to the second container. The moisture in the first container is driven

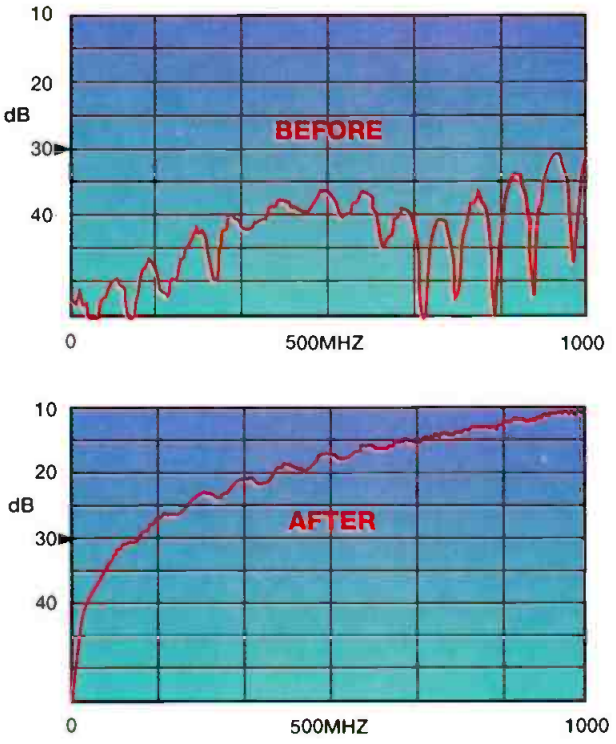


Figure 1. Return loss of a length of 3-inch air dielectric cable before and after the introduction of as little as 3ccs to 4ccs of water. The water collects at the bottom connector and causes severe performance degradation.

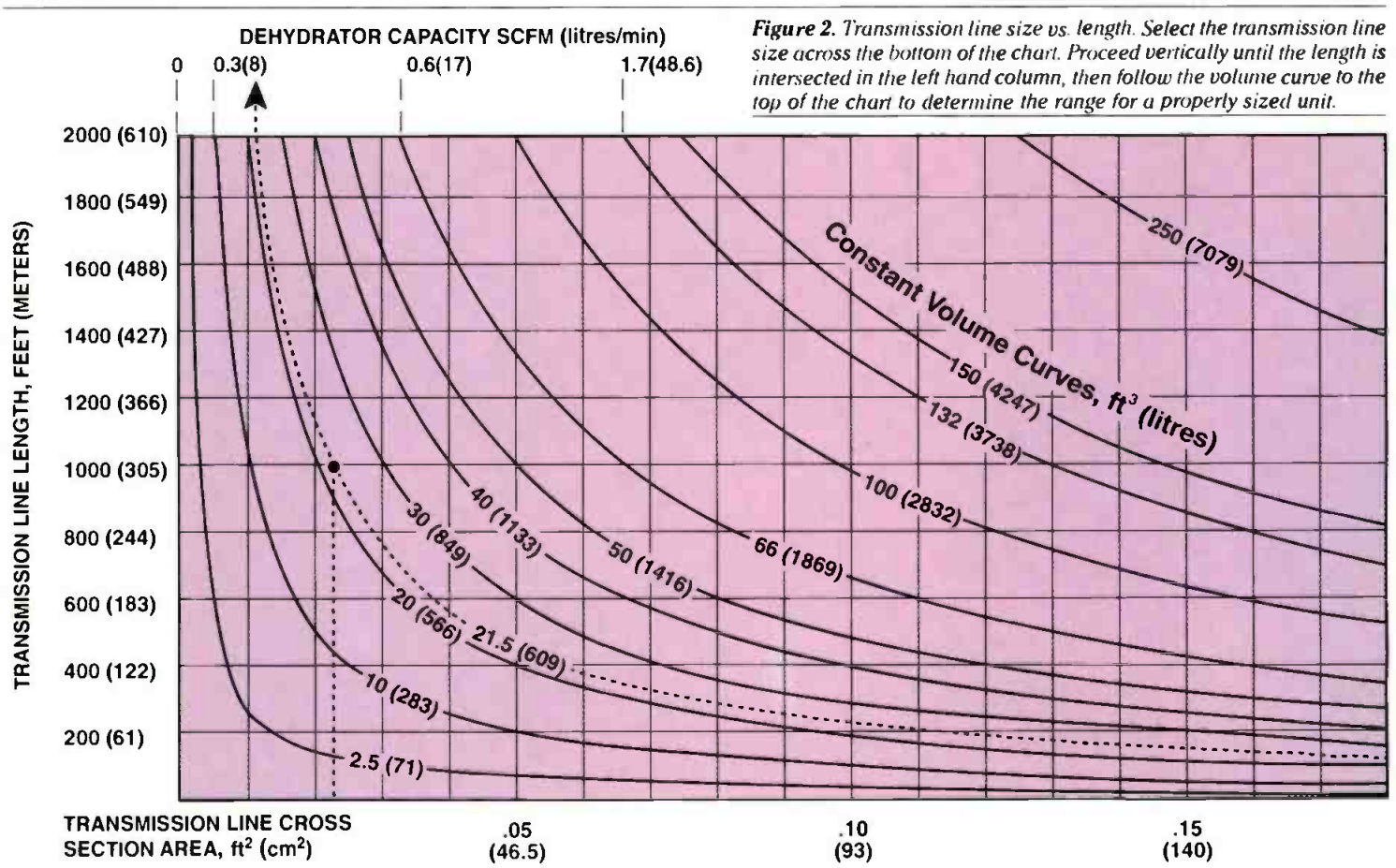
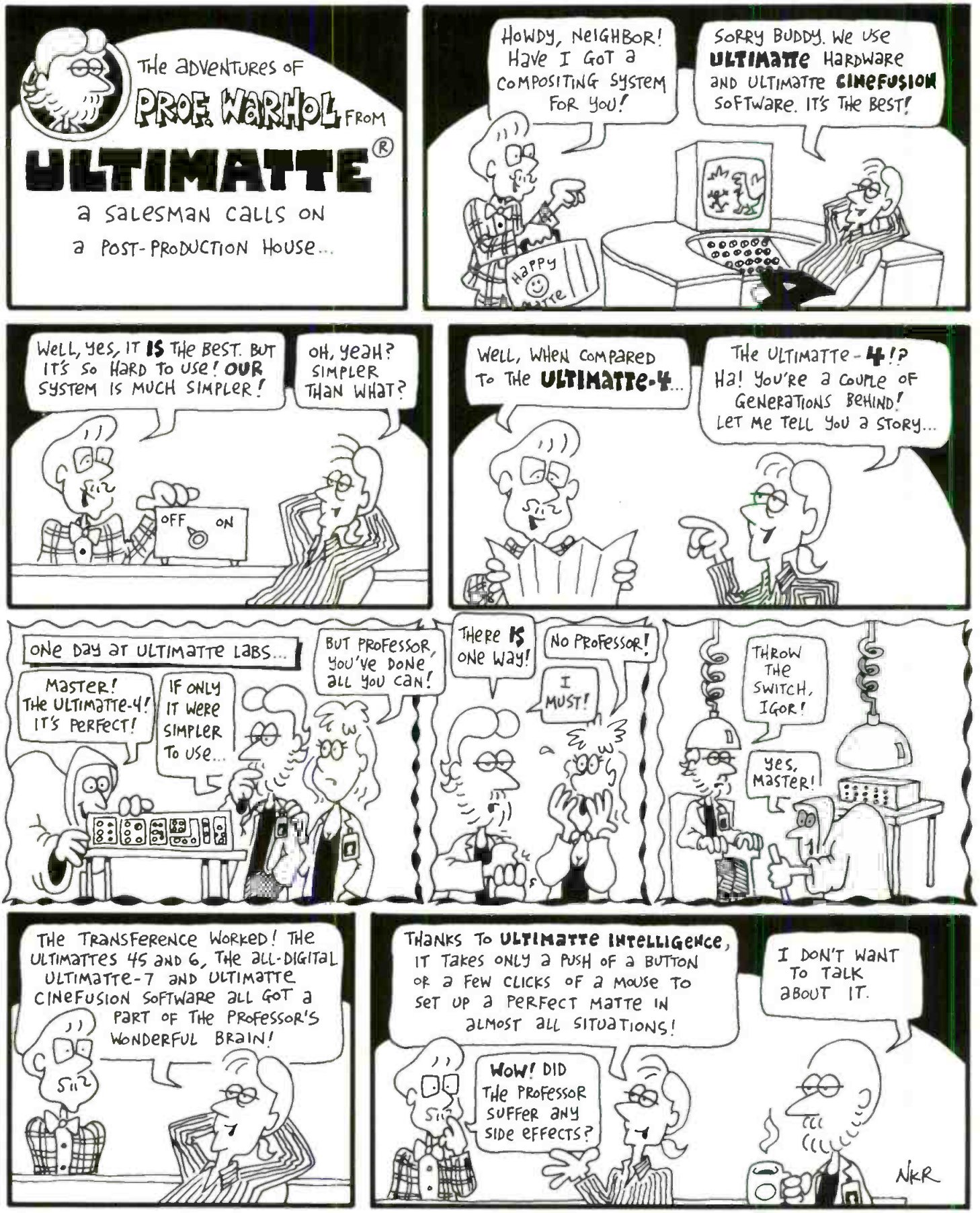


Figure 2. Transmission line size vs. length. Select the transmission line size across the bottom of the chart. Proceed vertically until the length is intersected in the left hand column, then follow the volume curve to the top of the chart to determine the range for a properly sized unit.



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out by heat and the process reverses as required.

The advantages of these units include being light weight and rack-mountable. They also generate less noise and vibration because a small low pressure compressor is used, there is automatic regeneration of the desiccant and relatively low power requirements. Disadvantages include higher total power consumption compared to pressure swing regeneration, a greater number of components for the plumbing and electrical circuitry, and they cannot support a high pressure, high volume system. To overcome system leaks, the unit must be capable of continuous operation.

Moisture in a transmission line can result in corrosion that increases attenuation and degrades system performance.

Pressure swing dehydrators incorporate the principle of moisture separation by desiccant absorption. The units consist of a high pressure compressor and two cylindrical absorption drying chambers switched by a timer control and solenoid-operated valve. The drying chambers are used alternately every 30 seconds. A molecular sieve desiccant is normally used. When the tower alternates, the solenoid valve at the base of the tower opens, allowing 65psi dry air from the drying side to blow the water molecules from the crystalline structure into the atmosphere from the wet side. Approximately two-thirds of the compressed dry air is used to regenerate the tower and the remaining one-third is sent to the system.

The advantages of the pressure swing units include automatic regeneration, a 10 to 15 year life expectancy, economy of operation, dew points in excess of -40°F, high purge volume, high system volume and simple installation. For small systems, a bypass kit can eliminate short cycling. The disadvantages of these units are the need for power, moving parts and a tendency to create noise.

Membrane dryers are new to the industry and offer exceptional reliability and dew points in excess of -50 F. A patented feedback system generates system dew points in excess of -65°F. Moisture separation is by the permeation process through an inert maintenance-free fiber material. The advantages of using membrane dryers are increased MTBF calculations due to fewer parts, longer warranty, higher capacity per compressor size with proportionately lower power consumption, and quieter operation. A noise-reduction option is also available. Disadvantages are the need for power, moving parts and some compressor noise.

Proper sizing and installation

Proper sizing of the dehydrator is important to its reliability and ability to provide dry air. A dehydrator that is too small will operate at a high duty cycle and require compressor overhaul in less calendar time. For the manually regenerative units, a desiccant change is needed more frequently, thus increasing costs. A dehydrator that is too large will, in the case of the pressure swing system, short cycle, saturating the towers. Manual and heat regenerative units are unaffected by a smaller system. Properly sized, a dehydrator should operate on a duty cycle of 5% to 10%. This provides maintenance-free operation for up to 10 years without a compressor overhaul.

Improper installation can degrade system performance. Feed line tubing should be neatly dressed and free from kinks. Fittings should be airtight. Transmission line must be purged of any moist air. When pressurized cable is supplied for the installation, the pressure should not be released until installation is finalized. If this is done, only a small amount of purging will be necessary.

During purging, the pressurization unit is connected to one end of the line, while the other end of the system is opened. The unit has to operate long enough to allow at least three air volume changes to take place. An alternate method is to pressurize to 8lb/in²(55 kPa) and let the air escape after one hour. Repeat this procedure several times, allowing an hour each time for the air to mix.

When choosing a pressurization system supplier, assure yourself of a highly reliable system by obtaining the benefits of program management, a dedicated pressurization engineering department, an environmental laboratory and personnel with a knowledge of the telecommunications requirements. The supplier should also be able to supply a 24-hour loaner dehydrator for an emergency. Remember, a properly selected dehydrator and pressurization system will provide years of trouble-free operation and quality air time. ■

➡*For more information on pressurization equipment, circle (303) on Reply Card. See also "Pressurization Equipment" on p. 68 of the BE Buyers Guide.*

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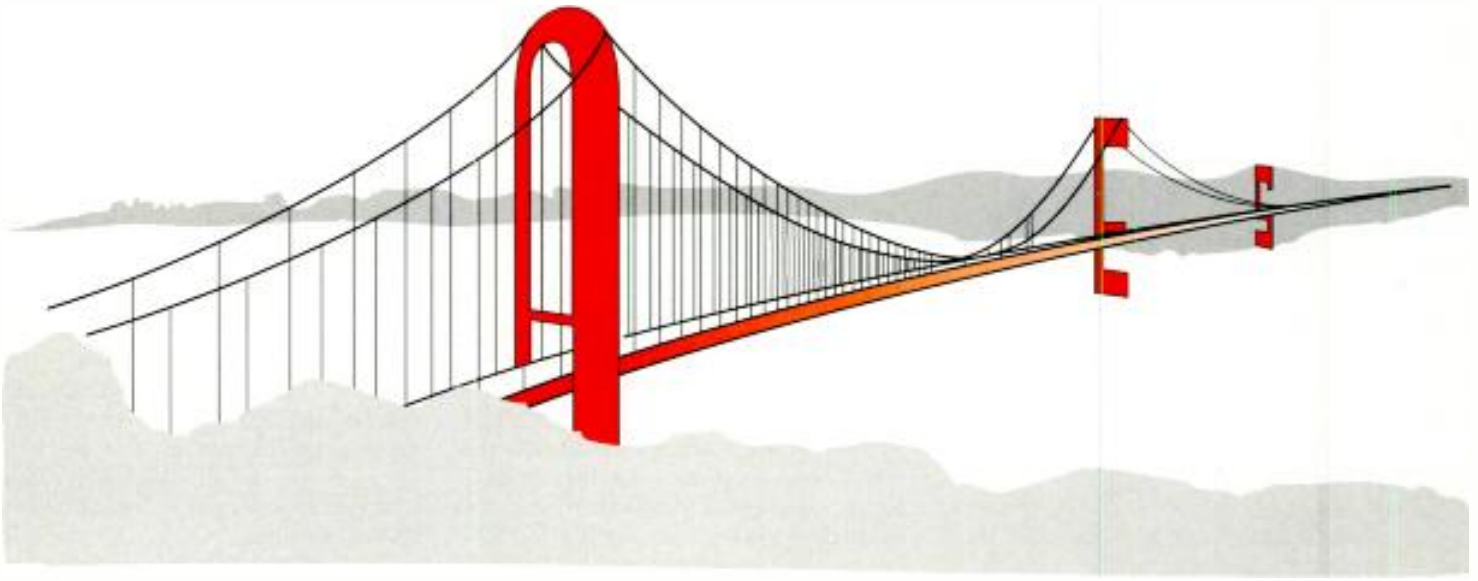

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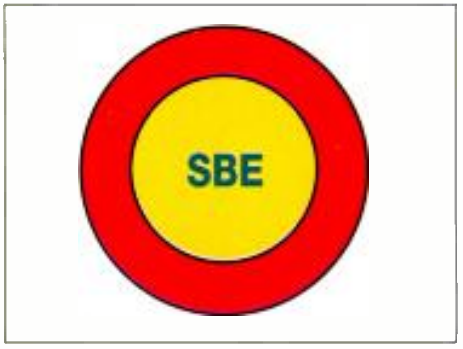
SBE Update

Electronic communications



By Jim Bernier

"Information superhighway" is the catch phrase of the '90s. When it becomes a reality, the public will be connected to a universe of services from home, car or wherever they may be. This "superhighway" is similar to another superhighway vision of a generation ago — the federal interstate highway system.

The parallels to these two visions are of interest to us today. In the case of the interstate highway system, the I-roads were generally built alongside existing, but narrower and slower, highways or along abandoned railroad right of ways. Many were built on old trails and stagecoach roads. The interstate highway used existing transportation routes to bring forth a system with greater capacity and speed. In broadcast engineering parlance, it's called increasing the system bandwidth and frequency.

The forthcoming information superhighway will most certainly be built atop existing communication channels, and with significantly increased bandwidth and speed. But that's the future. What about today? What are the narrower and slower highways this will be built upon?

In the realm of computer communications, that existing highway consists of analog and digital telephone lines. Broadcast engineers need to be involved in these networks, to understand their operation, and to become as comfortable with them as exciters, PAs and diplexers. To ignore this evolution is not in the best interests of the broadcast industry.

Networking systems

Many computer networking systems are available today. About a year ago, the SBE dedicated some of its resources to participating in those networking systems. The SBE HQ BBS, located at the SBE national office in Indianapolis, is the primary vehicle for this task. The SBE HQ BBS is an electronic bulletin board system administered by system operators, or Sysops.

The SBE HQ BBS has three principal areas:

1. The Main Area contains weekly bulletins and updates to the SBE Job Line, electronic versions of the "Short Circuits" newsletter, and information on certification exam dates and application deadlines.
2. The File Area is subdivided into specialty areas, such as engineering, chapter newsletters, and a special file area available to active members of the SBE.
3. The Message Area is divided into topical areas called conferences. It provides a means of direct communications with the national office. In the message area are two networked conferences: The SBE Conference, which is networked to more than 50 other BBS systems across the country, and the BROADCAST Conference, which is carried on a BBS network called FidoNet and is available to more than 30,000 BBS systems worldwide.

The SBE Conference is where discussions of SBE activities take place, upcoming Ennes Conferences are announced and people from around the country can request information from (and make comments to) the national office. This conference is delivered to individuals through Internet, and is available worldwide.

As indicated, the SBE and BROADCAST Conferences are networked to many different BBS systems across the country. That is to say that a message written on a BBS in Phoenix will also appear on systems in Indianapolis, Syracuse, Milwaukee, Houston, Tidewater, Seattle and more. This allows people to participate in national discussions electronically with just a local phone call.

Following the loop

The message networking is reminiscent of the way programming was networked in radio and television many years ago. Back then it was called *bicycling*, but the principle is the same. Let's follow a message originating on the SBE HQ BBS in Indianapolis: One Monday, Linda Godby, SBE's certification secretary, enters a message in the SBE Conference regarding the upcoming certification exams. Later that night, when long distance rates are at their lowest, the SBE HQ BBS automatically shuts down to call its hub site in Syracuse. The SBE HQ BBS makes copies of the new messages entered since the previous night's phone call and sends them to the Syracuse hub. With the same phone call, the Syracuse hub will send to the SBE HQ BBS any new messages that were received from other systems. The Syracuse hub is a regional hub that serves individual BBSs and also sends messages to the main hub.

The Syracuse BBS is operated by SBE Chapter 22. It will hold a copy of Godby's message for four other BBSs that connect with it (Milwaukee, Houston, Moscow, Idaho and West Palm Beach), and also send a copy of it to the broadcaster's BBS in Phoenix, which serves as the main hub.

The Phoenix main hub will make copies for the 15 or so systems that connect with it, some of which are also regional hubs that serve other systems. One of those systems copies Godby's message into the Internet. The process of moving a message from one type of network into another is called *gating*. Other systems that provide gating services are the Tidewater SBE BBS in Norfolk, VA, and the SPPE BBS in Chattanooga, TN.

These exchanges are made overnight with phone calls between the systems. Depending on the sequence of calls, the message will be seen on more than 50 BBSs within a few days. Responses to the message would follow the same paths but in reverse.

The SBE Conference BBS participants use a variety of networking software with names like FidoNet compatible, PCRELAY and QWK compatible enabling virtually any type of BBS to interconnect with the SBE Conference.

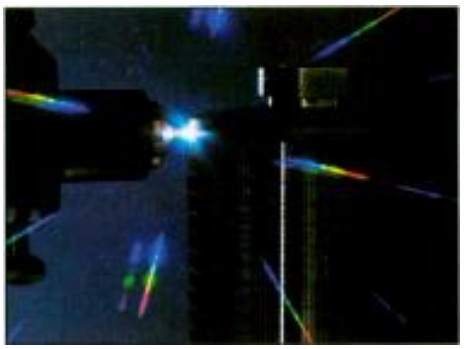
In the near future, the speed of the distribution system should increase once it begins to travel on the information superhighway. But until then, the tried and true networks continue to provide the SBE and its members with timely information and help.

The SBE Headquarter's BBS can be reached at 317-253-7555 and supports modem speeds up to 14,400bps. All members are invited to call and sample the entrance ramp to the information highway provided by the SBE HQ BBS. ■

Bernier, CBT, is the director of station operations for WTVH, Syracuse, NY, and chairman of the SBE's Electronic Communications Task Force. He is the past chairman of SBE Chapter 22 in Syracuse, and is one of the sysops for the SBE HQ BBS.

Interfacility fiber-optic links for satellite communications

By Dave Julin



In a few short years, fiber-optic technology has become a powerful force in the communications world. Applications are spreading rapidly. Among the more significant of these are benefits to satellite interfacility connectivity, where fiber optics can bring better solutions to interface links and flexible earth station design.

Until now, these links have been accomplished by other methods — mostly waveguide and coax. The user has learned to live with the shortcomings, restrictions and cost of these systems. Using a new technology called *Microwaves on Fiber* from Ortel Corporation, all signals and frequencies can be transmitted via fiber. This frees users from restrictions on distance as well as reducing installation and equipment complexities. This new approach offers wider design and operational flexibility while also saving time and money.

Advantages of fiber

Fiber-optic links provide a bidirectional, non-metallic transmission path over long distances. They can be applied between a satellite antenna site and its control center for any type of signal — analog or digital — from 70MHz to 14.5GHz. Transmission linking is simple, requiring only a fiber-optic transmitter/receiver for each signal and an optical fiber between sites. A fiber-optic cable of 0.5-inch diameter can contain up to 36 individual fibers at a cost of only five cents/fiber/foot. Satellite earth station operators are discovering the advantages of connecting antennas with control buildings via a cable that can take any convenient route rather than having to go in a direct line (like waveguide must). Signal loss through fiber is extremely low — between 0.3dB/km and 0.5dB/km — which is significantly better than waveguide losses in any band.

In addition, fiber inherently provides electrical isolation between sites, immunity to lightning strikes and EMI, low weight, compact size and freedom from some installation complexities. Fiber brings the added advantage of being more secure: Any interruption or degradation

Julin is North American sales manager at Ortel Corporation, Alhambra, CA. Respond via the *BE* FAXback line at 913-967-1905.

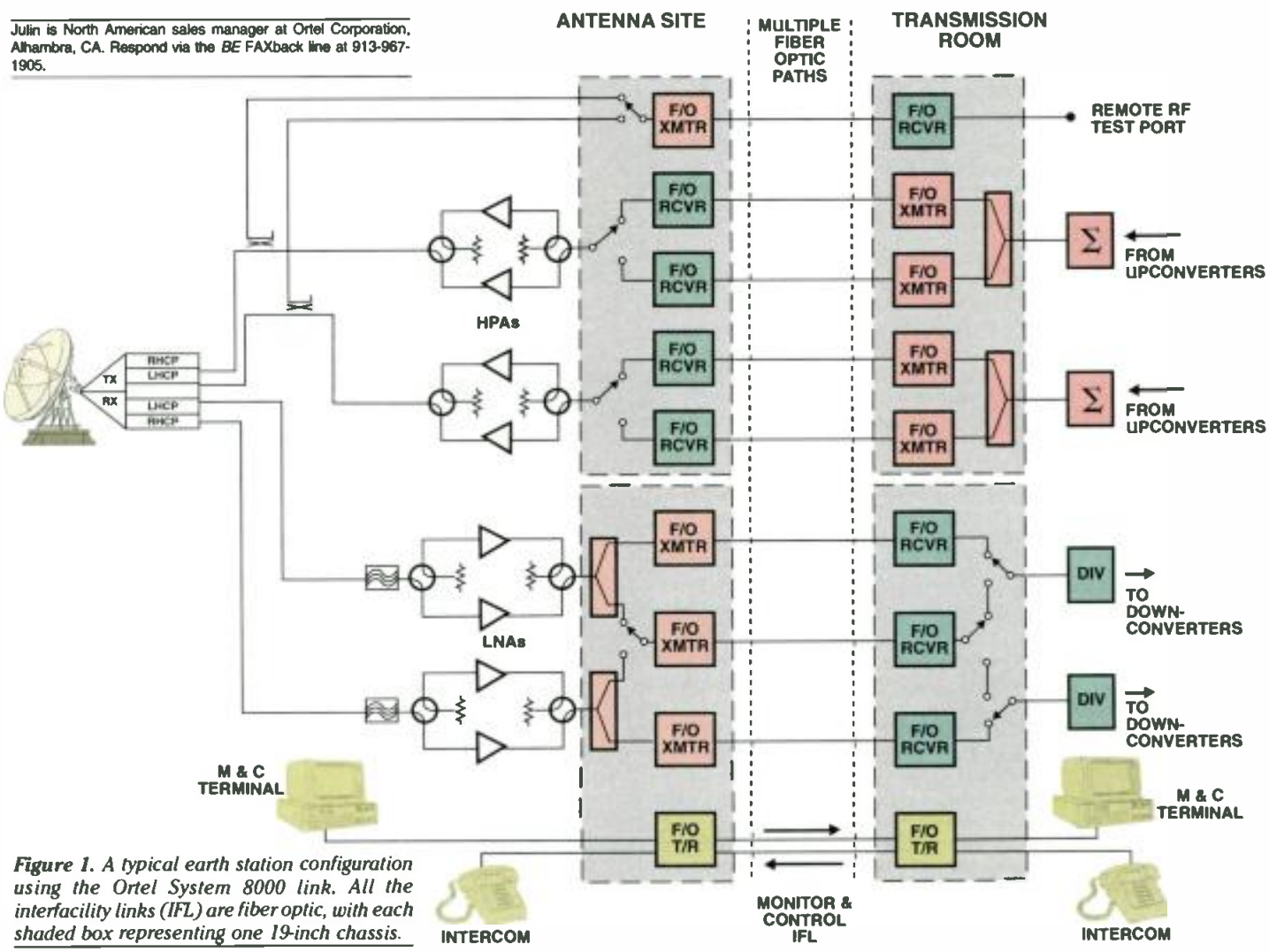


Figure 1. A typical earth station configuration using the Ortel System 8000 link. All the interfacility links (IFL) are fiber optic, with each shaded box representing one 19-inch chassis.

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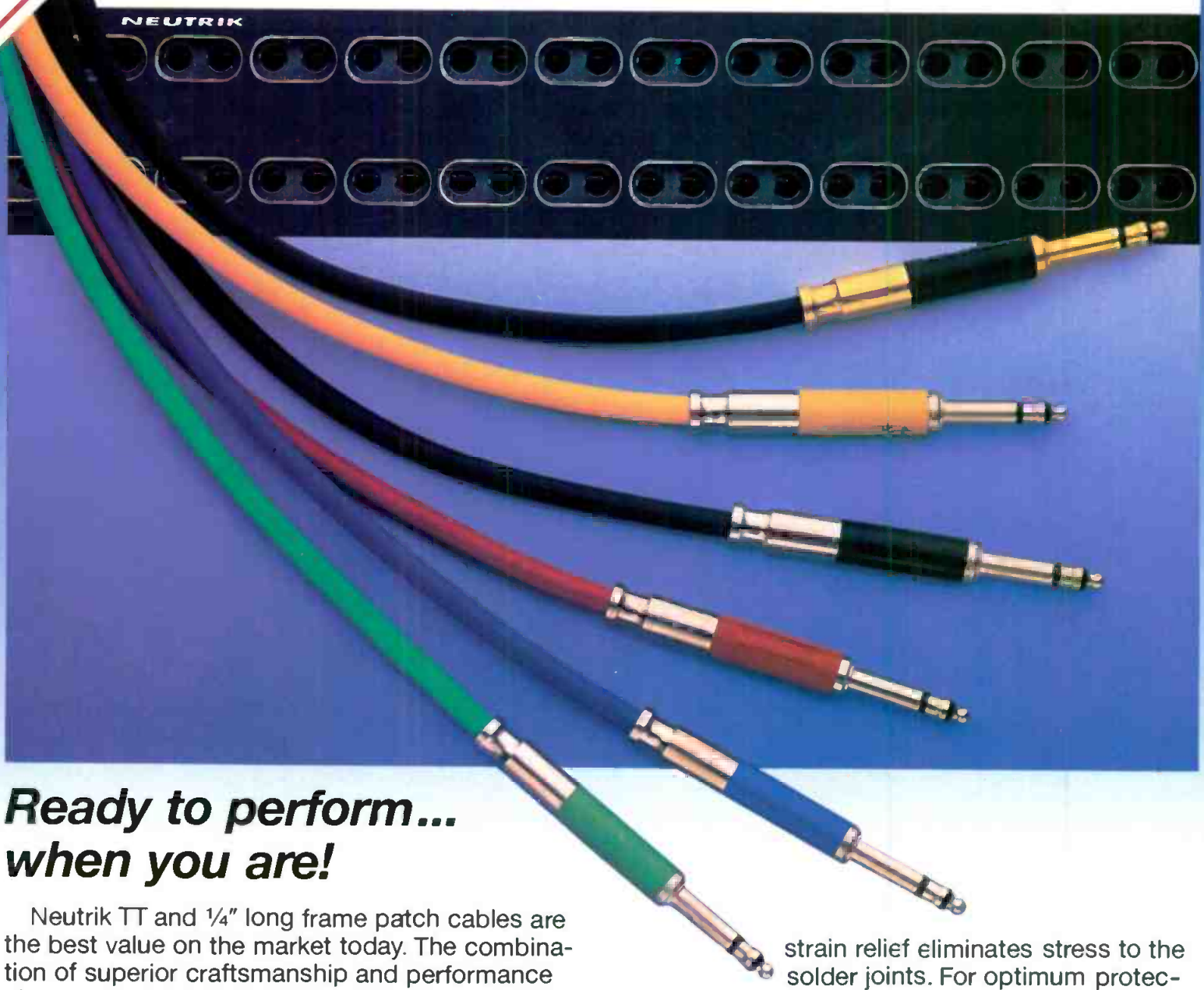

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of the signal is easily detected because the system monitors transmission levels and indicates if there is a break.

Where there is a need for diversity, multiple earth station sites can be economically interconnected with fiber. Links using IF signals can run up to 65km without repeaters, and Ku-band paths can do likewise on paths up to 15km.

This capability offers significant flexibility in selecting antenna site location. Sites can be selected solely on considerations of minimum interference, best view of the satellite and real estate costs. Uplink transmission signals also can be brought directly to the control facilities, giving the operator real-time monitoring of the transmission to the satellite.

The Ortel System 8000 uses a 19-inch rack housing to accommodate plug-in modules for custom configuration of fiber-optic interfacility earth station links.

System design

Because of the innate flexibility of this technology, Ortel has introduced a modular design, the System 8000, which gives the user a customized system configuration to deliver the performance that a particular installation requires. The system can easily be configured to accommodate future expansion. By installing a standard multiple-fiber cable, future expansion can be handled by the addition of plug-in modules in the terminal equipment. No additional cable need ever be installed between the two sites. This can result in savings on hardware at each antenna location.

This new approach offers wider design and operational flexibility while also saving time and money.

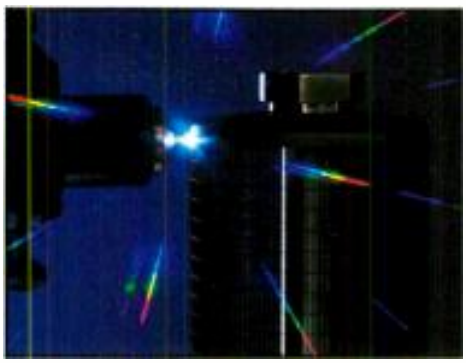
The combination of highly reliable system hardware plus fully redundant transmission paths with automatic switching provides high reliability. Redundant plug-ins can be replaced without turning the system off, so no downtime has to be scheduled for maintenance or a module change. Switching also can be initiated through an external computer command or can be changed over by a local technician for a system check.

Standard fiber-optic interfacility links (IFLs) are available for IF signals (70MHz or 140MHz), L-band, C-band and Ku-band frequencies (both uplink and downlink). Each fiber path's plug-in transmitter and receiver are mounted in a 19-inch rack-chassis with redundant power supplies. The performance at each fiber-optic link is optimized over a particular frequency band. Uplinks can pass a composite RF signal of 12 saturated transponders and still satisfy Intelsat requirements.

A typical earth station configuration is shown in Figure 1. The transmit IFLs include two 1:1 redundant paths and a return path that serves as a remote RF uplink signal monitor. The link is commanded by the monitor and control computer system to select either right-hand or left-hand circular polarization for monitoring. The receive interfacility link includes a 1:2 redundant path and a full duplex for the monitor and control system. Each fiber-optic transmitter and receiver shown is a chassis plug-in. For short distances, an optical attenuator must be used in each path to prevent optically overloading the photodiode. This means that link performance is the same whether the distance is 100m or 15km.

Continued on page 107

Applied Technology



Digital TV exciter and receiver for DSNG

By Keith Dunford

The move toward digital transmission of TV signals presents new opportunities and advantages to broadcasters when compared with today's analog links. This is particularly evident in the transmission of TV signals by satellite where the application of digital technology will have a positive impact through greater use of transponder resources, lower operating cost and improved link performance.

Recognizing that compressed digital transmission of the 525/60 and 625/50 standard signals might precede digital HDTV standards by a few years, Satellite Transmission Systems (STS) looked at areas of satellite TV operations where the introduction of new and innovative digital equipment could benefit the TV broadcaster. These include digital satellite news gathering (DSNG), remote broadcast production, network program distribution and satellite program delivery.

Dunford is director of product marketing at Satellite Transmission Systems, Hauppauge, NY. Respond via the *BE* FAXback line at 913-967-1905.

Digital TV exciter from Satellite Transmission Systems.

An immediate need was recognized in the DSNG area for affordable, high-performance, compact and rugged equipment suitable for small vehicles and fly-away terminals.

Design considerations

Several important issues were considered in the design of an innovative DSNG exciter and studio-grade receiver. Among the most important were the following:

- Technical performance
- Architecture
- Operational features
- Size, weight, robustness
- Affordability

Technical performance criteria have been established for the system to meet the MPEG-2 standard (with "I," "P" and "B" frames) for compressed digital TV signals. It has also been designed to meet the CCIR 601 standard for broadcast-quality signals, while at the same time providing flexibility to operate at several selectable lower data rates. This provides access to a wider range of domestic and international satellite transponder resources, and meets the growing needs of news gathering networks for acceptable quality (CCIR 3) under difficult conditions.

Operator-selectable data rates of the DSNG exciter are 2Mb/s, 3Mb/s, 4Mb/s, 6Mb/s and 8Mb/s. Video resolution of 720 x 480 (NTSC) and 720 x 576 (PAL) is maintained at any of the selected data rates. The perceived video and audio quality at the various rates will vary as the result of program content and signal processing differences. This has been considered acceptable in the DSNG environment to match the resources to that of the intended program material and SNG operational requirements.

It is widely recognized that judgment of picture quality in compressed digital video is subjective, and that no direct relationship exists between the operating data rate and perceived quality. Such important aspects of perceived quality in-

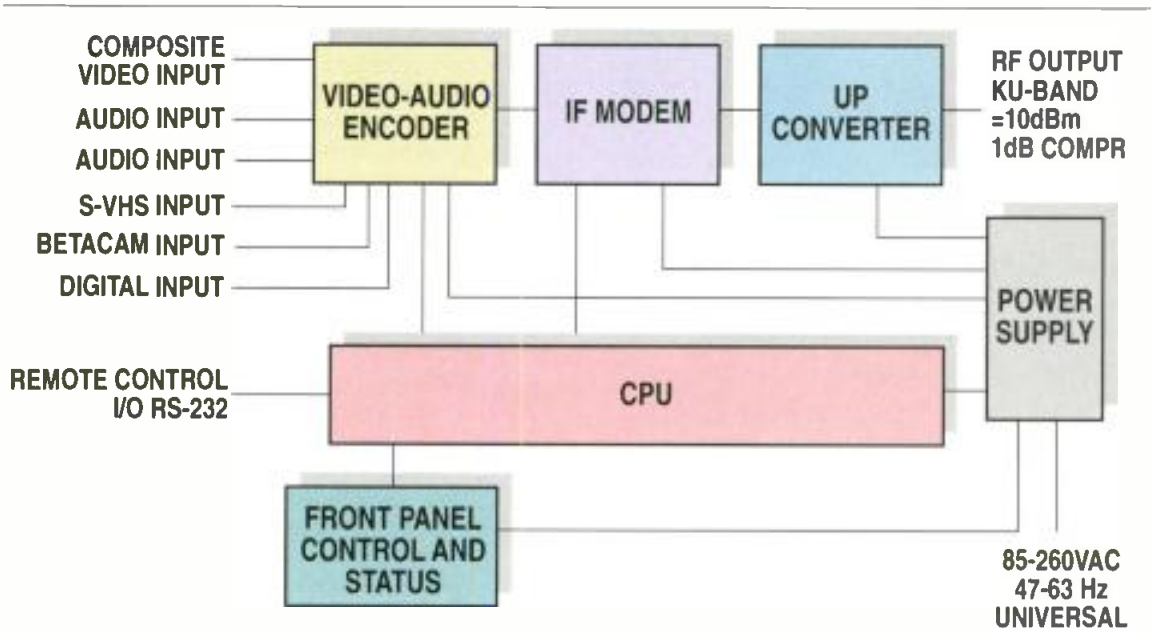


Figure 1. Basic block diagram of DSNG exciter.

cluding motion compensation, picture stability and signal robustness have been given special consideration, however.

Particular attention has been paid to robustness of the digital signal from analog to digital conversion, encoding and modulation. This was considered essential to ensure the digital video and audio information is free from errors that can result in disturbing aberrations resulting from multiple signal processing operations that are regularly encountered in broadcast news operations.

Superior motion compensation has been achieved through enhancements to the basic discrete cosine transform (DCT) algorithm. Latency has been reduced to less than 200ms at 8Mb/s through efficient DSP technology of the advanced-technology encoder.

Architecture

The design architecture for the DSNG exciter and studio-grade receiver was selected after lengthy discussion with a cross section of SNG operations. It integrates three previously separate equipment items into a single unit operated under the command of an on-board control and monitoring processor.

The DSNG exciter provides the following elements within a single 6U chassis. (See Figure 1.)

- MPEG-2 encoder
- QPSK modulator
- Frequency upconverter
- Control and monitoring CPU
- Universal power supply

The adoption of a single integrated product architecture provides DSNG operations with size, weight, cost and operational advantages. This is compared with alternative solutions that require multiple chassis configurations to provide encoding, modulation and frequency conversion elements.

In addition to the provision of various analog or digital video/audio inputs to the DSNG exciter, a 64kb/s auxiliary channel is also provided. It can be used for many applications including non-sync voice-grade channel, data link or low-rate video link, if required. An external mux or data concentrator can be used with this channel to provide various utility operations.

The integrated architecture adopted for the DSNG exciter was largely driven by three perceived operational needs: 1) an efficient, compact, lightweight unit; 2) a modular and flexible design; 3) a simple user interface.

The resulting system design provided several important benefits. For example, the use of common CPU, power supply, control panel and cooling arrangements for purposes of integration also served to lower cost. The modular design can accommodate the changing needs of the DSNG market by allowing replacement of

existing modules with newer technologies or higher performance/features as they become available and desirable. (For example, the Ku-band frequency converter can be simply replaced by a C-band converter, or the 8Mb/s modulator can be replaced by a 16Mb/s unit.) The system's integrated architecture also enables individual components to be harmonized under the control of a single CPU, thus simplifying operator involvement by automating many setup procedures.

Affordability

The rising cost of TV broadcast operations and the transition to digital technology are a burden. In order to make the transition to DSNG affordable and attractive for the news gathering industry, the STS system attempts to provide the lowest-cost design that will meet requirements of broadcast users.

STS's analysis has determined that the overall costs of a new analog or a digital satellite news gathering vehicle (or flyaway terminal) will be about the same. The digital exciter has a somewhat higher cost than the equivalent analog modulator/frequency converter combination. However, less cost will apply to the digital system's HPA support infrastructure (transport cases, AC power and air conditioning). In some cases, a smaller antenna also may be used for DSNG links.

The added cost of transition to digital operation by current analog users can also be made attractive and affordable through greater utilization or availability of transponder resources and the lower cost associated with partial transponder operation.

Conclusion

Digital technology and innovation have come together to make possible the transition to digital transmission of TV signals with potential long-term benefit in DSNG operations worldwide. There is little doubt that technology will continue to improve the performance, features and application of digital video compression and transmission.

STS believes that the DSNG exciter described in this article indicates the start of this trend toward digital transmission of TV signals for single-channel DSNG, network program distribution and multichannel applications. ■

➡ *For more information on the Satellite Transmission Systems DSNG exciter and studio-grade receiver, circle (306) on Reply Card.*

New Products

RFD counter
By Hewlett Packard

• **HP 53181A RFD counter:** features enhanced, intuitive user interface designed to simplify and speed frequency measurements; provides 10 digits of resolution per second; features digit-blanking function, built-in statistics and math functions; single-channel counter features 225MHz (optional second channel provide high-frequency measurements up to 1.5GHz and 3GHz).

Circle (350) on Reply Card

Triaxial video cables
By Nemal Electronics International

• **Flexible video triaxial cables:** line of cable for indoor and outdoor use; available in 3/8-inch (.360 OD) and 1/2-inch (.520 OD) sizes and a wide variety of colors; offered in bulk reels or fully terminated and tested; cables are suitable for use in temperatures as low -60 degrees C and are resistant to oils, chemicals, and ultraviolet light.

Circle (351) on Reply Card

Digital component videocassettes
By Fuji Photo Film U.S.A.

• **ADC001:** 19mm digital metal videocassettes designed for use with the Ampex DCT digital recording system; cassettes utilize Super-Fine Metallix magnetic particles; offers a proprietary binder formulation and tough backcoating.

Circle (352) on Reply Card

Genlock video Ic
By Elantec

• **EL4584:** combines key features of high-performance phase-locked loop systems with the most frequently used divider values for NTSC and PAL video applications; generates a master clock phase-locked to an external horizontal sync reference; fully programmable; can be used independently or with other Elantec video Ics.

Circle (353) on Reply Card

Text and image archiving software
By Imagine Products

• **Executive Librarian:** Windows-based application for text and image archives; features multi-user merging and full text searches of shot logs, EDLs, notes and more; other features include password control for administrative functions, automatic backup reminder, and browse results; version 1.0 is Microsoft Windows compatible and allows up to three levels of interrelated, user-definable fields.

Circle (354) on Reply Card

LPTV/NTSC couplers
By Pesa-MCi

• **LPTV/NTSC couplers:** allow signals from separate VHF and UHF transmitters to be carried on a single common transmission line up the tower and then split at the top and fed to two different antennas; the two signals remain independent of each other.

Circle (355) on Reply Card

Recorder/player
By Thomson Broadcast

• **Digital Betacam:** records 10-bit digital component video and digital on 1/2-inch metal cassettes; provides up to 124mn of recording time; features advance replay video and audio heads, confidence replay, pre-read facility, automatic replay equalization, dynamic tracking from -1 to +3, automatic tracking; also has multi- generation capability and 2-machine edit facility; other features include noise-free fade and freeze frame.

Circle (356) on Reply Card

Weather data system
By Alden Electronics

• **WeatherWorks 2000:** runs on IBM-compatible technology; designed to operate independently in groups or in unison with other applications; system uses UNIX operating system with the X-Windows/Motif graphical user interface.

Circle (357) on Reply Card

Switcher
By AVS Broadcast

• **Integra:** digital switcher and digital effects device with its own key channel in one unit; provides digital processing for analog or digital formats; features multi-format interfaces and digital 4:2:2:4 processing throughout.

Circle (358) on Reply Card

Video switcher
By Link Electronics

• **Model VSW-826 16x1 RS-232:** vertical interval video switcher; 1-rack unit mounts in a standard EIA 19-inch rack assembly; 4-digit LED readout shows input video and input audio signal selected; features bandwidth of 40MHz; VSW-826 video inputs are high impedance, 100KΩ, loop-through allowing multiple units to be stacked for desired number of destination outputs.

Circle (359) on Reply Card

LED selection guide
By Lumex Opto/Components

• **Guide No. 84-3:** features 35 Mega-brite Lites; high intensity red, green, and yellow LEDs in six sizes; includes full electro-optical specifications plus detailed dimensional drawings and radiation pattern graphs

Circle (360) on Reply Card

Software
By TimeLine Vista

• **Version V700-10:** software for the Lynx-2 time-code module; features locking of serial transports to serial time code only, film transports park to the Perf., 10 user-programmable transport settings, and sample rate selection for digital tape transports; detects and automatically loads transport parameters.

Circle (361) on Reply

New Products

TBC remote control
By Boltek Video

• **TBR-440:** controls up to four VTR TBCs; provides four memories for each VTR; memories can be used to store TBC setups of different tapes or scenes within one tape; memory can be recalled by pressing an illuminated pushbutton.

Circle (362) on Reply Card

File conversion software
By The Synclavier Company

• **S/Link 2.0:** offers compatibility with a wide variety of standards used in professional and multimedia audio production; now supports .WAV (Windows PC), VOC (SoundBlaster), MOD and IFF/SVX (Amiga), .SND/ .AU (NeXT and Sun UNIX), plus SoundEdit and Macintosh Sound Resource formats; also supports AIFF/AIFC, Open Media Framework Interchange, PostPro, QuickTime, Sound Designer I and II, and Synclavier; transfers sound directly from CD-ROM or CD-Audio.

Circle (363) on Reply Card

SATCOM uplink amplifier
By Varian Associates

• **350/400W SATCOM uplink amplifier series:** user-friendly, compact medium-powered SATCOM uplink amplifiers; provide direct communication with PC/digital interface or interface via an analog interface; feature high efficiency, dual-depressed collector traveling-wave tube; options include electronically controlled RF power level via a pin diode attenuator, improved intermodulation performance, peak power metering for TDMA operation and mimic remote-control panel duplicating local functions.

Circle (364) on Reply Card

Digital edit suite audio mixer
By Graham-Patten Systems

• **D/ESAM 820:** derived from D/ESAM 800; features new master processing board, audio output module and optional digital input card with integral sample-rate converter; master processor board offers more than 800 register locations and many register storage management tools; audio output module provides 20/24-bit resolution throughout D/ESAM chassis with 18-bit digital-to-analog conversion using crystal semiconductor chips.

Circle (365) on Reply Card

Dual coax video cables
By Belden Wire

• **Brilliance SVHS dual 30 AWG 75Ω coax cables:** designed for use in SVHS or Y/C applications; provide for separate transmission of video signal for better picture resolution and less noise; highly flexible cables feature a foam high-density polyethylene insulation; accepts 4- and 7-pin mini DIN connectors.

Circle (366) on Reply Card

New Products

Wireless mic system
By Williams Sound

• **Liberator One:** now features a handheld microphone; the T25 transmitter features a high-quality, directional, condenser mic element; adjustable mic sensitivity accommodates louder of softer voices; operates approximately 25 hours on a 9V alkaline battery and five hours on a 7-cell Nicad rechargeable battery.

Circle (367) on Reply Card

Digital mastering cassettes
By 3M

• **AHD audio Hi8 digital audio mastering cassette:** designed with ultrafine metal particles; provides 113 minutes of record time; features advanced binder system with polyester backing; protected by warp-resistant plastic shells.

• **ASD audio S-VHS digital mastering cassette:** designed for digital audio multitrack applications; ASD 40+ provides up to 42 minutes of record time at the 48kHz sampling rate; features binder system with stabilized polyester backing.

Circle (368) on Reply Card

Desktop video products for PC platforms
By Knox Video

• **PC40:** a real-time character generator; requires no additional software and runs completely in the background; it resides at a specific address and uses the existing power supply and keyboard but does not interact with the computer; compatible with any PC, AT or XT; features fully programmable bulletin board functions, multiple fonts and colors, rolls, crawls, and titles; can display serial/parallel input data.

• **PC-event controller:** a real- or elapsed-time VCR/event controller; controls any RS-232 or RS-422 serial control device such as routing or production switchers, character generators, and video sources.

• **PC-still-store:** a VGA-to-NTSC video still-store and frame grabber; full-color, high-resolution still images can be stored as pcx files and generated from live video, original art, or most graphics packages.

• **PC-sync:** an ultrastable gen-lock and blackburst generator; gen-locks instantly to almost any NTSC video input including off-the-air and non-time base corrected signals.

Circle (369) on Reply Card

Mounting kit
By Merlin Eng.

• **Two-Shoe Kit:** a compact, 10-piece kit allows a light and a microphone to be mounted on a single piece of equipment; includes a base bar with two female shoes and an array of mounting adapters; fits all video cameras.

Circle (370) on Reply Card

Standards conversion
By AVS Broadcast

• **Cyrus:** motion vector conversion for smooth, seamless, judder-free pictures; interfaces to all main I/O formats; features 4-field 4-line linear conversion processor; all formats available at the output simultaneously; post field-store test DAC allows output test generator patterns to be looped to the input while observing the decoded/inverted component signals.

Circle (371) on Reply Card

Time domain reflector/cable fault locator

By Riser-Bond Instruments

• **Model 1220:** locates and identifies cable faults and conditions in all types of metallic cable; features Super-Store waveform storage; standard features include four waveform storage bins (option of 16 total bins), high sensitivity and multiple pulse widths package, and on-board printer.

Circle (372) on Reply Card

Consoles

By The Winsted Corporation

• **Corner mini consoles:** wrap-around design for easy access to all electronic equipment; edit and VCR shelves adjust up and down in 1-inch increments; top shelf is 18 inches deep; base section features lift-off rear panels; dual wire raceway on back of modesty panel allows separation of AC and coax cables.

Circle (373) on Reply Card

Digital audio processing suite

By NVision

• **NV1055:** 4-channel digital audio mix/minus and routing module; allows four channels of AES-format I/O to be intermixed and phase inverted; allows user to rearrange channels, correct inverted channels, perform stereo mix-downs, quad mix-downs and voice and M&E overs.

• **NV1050:** 4-channel sample rate converter; accepts any AES/EBU format signal at sample rates between 28 and 54kHz; input sample rates are separately extracted from each input.

• **NV1060:** 4-channel digital audio delay compensator module; provides up to 20 video fields of delay on two AES-format signals.

• **NV1308A:** AES/EBU-format digital audio routers; handles a total of eight digital inputs cross-matrixed to eight digital outputs.

• **NV9301:** X/Y router control panel for the NV1308 digital audio routers; generates takes for any destination/source pairs with numeric addresses or mnemonic titles.

• **NV9055:** remote controller for the NV1055 mix/minus and routing module; provides remote control and status display of input channel gain and phase; four independent layers of 4-channel linear mixing; output gain and channel assignment

Circle (374) on Reply Card

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Industry Briefs

BUSINESS SCENE

Continental Electronics Corporation, Dallas, has been awarded a multimillion dollar contract by the Ministry of Film, Radio and Television of the Peoples Republic of China. The contract is for joint production of broadcast transmitting equipment.

CBS Radio has introduced the use of Personal Audio Computer Editing (PACE) units in its Washington, DC, bureau.

Scitex, Herzlia, Israel, has purchased ImMIX, Grass Valley, CA, from Carlton Communications Plc. for $21 million.

Anderson Group, Bloomfield, CT, has reached an agreement with the Grass Valley Group to acquire its Graphics Systems Division located in Paramus, NJ.

Pinnacle, Sunnyvale, CA, has announced an OEM agreement with Matrox's Video Products Group to develop a tailored version of Alladin, designed and configured to work with Matrox's system.

Devlin Design Group, San Diego, has been awarded the set projects for KCTV-TV, Kansas City, and WOOD-TV, Grand Rapids, MI.

Play, Sacramento, CA, has been formed by the merger of Digital Creations, Progressive Technology, and a group of eight senior staff members who left NewTek.

Avid Technology, Tewksbury, MA, has finalized the acquisitions of the news division of BASYS Automation Systems, Langley, UK, and Maryland-based SofTECH Systems.

Avid has sold the AirPlay digital playback system to FOX-affiliate KMVU-TV, Medford, OR.

Hewlett Packard, Palo Alto, CA, plans to install a broadcast video server at CBS-owned WCIX-TV, Miami.

BTS, Simi Valley, CA, has named the ABC Television Network and Public Broadcasting System as the first Media Pool beta sites. ABC will test Media Pool in its New York facilities; PBS will conduct its tests in Alexandria, VA.

Quantel, Darien, CT, has delivered Paintbox V series to ABC, Washington, DC; WLVI, Boston; and WITI, Milwaukee. KSAZ, Phoenix, has installed the Harriet graphics system. Quantel has also placed multiple installations at WTVT, Tampa, FL; Henninger Capitol; and KABC, Hollywood.

Utah Scientific, Salt Lake City, a member of the **Dynatech Video Group**, has supplied equipment to Orbit Satellite Television and Radio Network. The equipment included the Total Automation System, four DYN 1.28 digital routers and 13 DMC-601 digital master control systems for on-air channels.

United Media, Anaheim, CA, celebrated its 18th anniversary on Sept. 2, 1994.

Trident, Nashville, has sold a second Vector broadcast console to Unitel Video/Kingworld Studios, New York.

ENCO Systems, **Orban**, and **Harris Allied** exhibits at this year's World Media Expo were linked via an Ethernet local area network to demonstrate the interconnection possibilities between the ENCO DAD486x digital audio delivery system and Orban DSE 7000 digital audio workstation.

PEOPLE

Joyce Lieberman has been named supervising engineer for WHYY-FM, Philadelphia.

Andrew Sukawaty has been appointed chief executive at NTL, England.

Adam Schadle has been named vice president of marketing at Viewgraphics, Mountain View, CA.

Chris Schilling has been appointed as sales manager for M.I. Products at Otari, Foster City, CA.

Jan Hebel has been appointed northeastern regional sales manager at Otari, Foster City, CA.

Robert Traub has joined the design team at Russ Berger Design Group in Dallas.

■

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NEW! Super Radio III with selectivity modification and fixed frequency SCA. Advanced broadcast technology using no crystal or DIP switches. $85. 800-944-0630.

STUDIO EQUIPMENT FOR SALE: Two complete broadcast facilities now in operation. Available early fall. Pacific Recorders turn-key studios with all equipment. Bill Massey, WKHX/WYAY, Atlanta, GA. 404-955-0101.

MATROX STUDIO, loaded, incl. 2 Titania 30 DVE cards. Also, Panasonic TQ-3031F Optical Disc Drive and TQ-3032 Optical Disc Player. Best Offer. Call days 913-749-3436.

FOR SALE: Panasonic - Sharp - EiKi - Maxell - Ramsa - Tascam - Technics - Bogen: Professional/Industrial/Security Video & Audio Equipment. Wholesale Prices! Factory New Warranty! Sales = 800-233-2430, Support = 607-687-0545.

FOR SALE: Betacam SP Equipment. Sony BVW-570is Camcorder with new optical block, $25,500; Ampex (Sony) BVW-507P PAL Camcorder with Fuji 9x14, $23,000; Sony BVW-35 Betacam SP VTR, $8,000; 3 Sony DXC 537 cameras, $6,000 each. Harris, 415-456-7900.

UHF transmitter, good condition	$129,000
VA890 Klystrons low hours	$7,950
Klystrons WB, MSDC, IOT & Others	from $9,995
MEC XQ3427 set new & others	from $6,995
Anton Bauer/Cine 60s rebuilt	$165

VHF/UHF transmitters bought & sold
CALL JIM COMELLA
BT&T Company 708-204-5637

HELP WANTED

BROADCAST ENGINEER: Home Shopping Network, Inc., located on Florida's West Coast, is seeking an individual to perform analog and digital component-level troubleshooting, with a systems concept focus. Minimum 3-5 years of post-production experience and an AA/AS degree or equivalent work experience required. FCC general class license or SBE certification preferred. Competitive salary/benefits package offered. Please send a resume to HSN, Human Resources Department, Job Code BE1094, P.O. Box 9090, Clearwater, FL 34618-9090. EOE.

ASST. TV ENGINEERING MGR. in top 100 market. Familiar with scheduling, installation, maintenance, and operations of all types of studio and RF equipment, including Betacam, computers and transmitter. Must be a self starter and possess strong management skills and good interpersonal relations. Will assist in capital budgeting. General Class license required, SBE Certification desired. EOE. No phone calls. Send salary and resume requirements to Engineering Manager, WKBN TV, PO Box 59, Youngstown, OH 44501.

CHIEF ENGINEER/CHIEF OPERATOR: WNUV TV 54, Baltimore has excellent opportunities for a hands-on broadcast engineer. The position demands an extensive background in maintenance of transmitter and studio systems. Applicant must possess specific knowledge of computers, digital electronics, 1/2 inch broadcast VCR's, UHF transmitters and the duties of Chief Operator. An FCC license and the ability to be "on call" are prerequisites for this position. A part-time engineering position which includes many of the same qualifications also exists at WBFF-TV in Baltimore. The position offers a competitive benefits and compensation package. Send resume and salary history to: Del Parks, Director of Engineering and Operations, 2000 W. 41st. Street, Baltimore, MD 21211. No phone calls please. EOE.

MAINTENANCE ENGINEER: Southeast, top 50 market affiliate seeking a broadcast maintenance engineer. Four years of broadcast experience preferred. Experience with Ampex & GVG switchers, Chyron CG's and studio cameras a must. PC and computer related experience a big plus. Send resume to: Dept. 748, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66282-2901.

TELEVISION ENGINEERS: WTXL-TV, ABC in Tallahassee, Florida, has openings for Assistant Chief Engineer and a maintenance technician. Salary based upon experience and technical skills. Send resume to: General Manager, WTXL-TV, 8927 Thomasville Road, Tallahassee, Florida 32312.

MIDWEST UHF TV STATION located in God's Country is seeking a Maintenance Engineer. Television maintenance and operation experience is required. UHF transmitter experience is preferred. Please send resume and cover letter to WXOW-TV, PO Box C-4019, LaCrosse, WI 54602, ATTN: Chief Engineer. EOE.

MAINTENANCE ENGINEER: Immediate opening for a maintenance engineer for mobile operation in the mid south region. Five years minimum experience in related field. Looking for responsible individual capable of installation, maintenance and technical expertise in all areas of remote video production. Must be able to deal effectively with clients and crew. Excellent benefits. Apply to: Director of Finance, WYES-TV/Channel 12, P.O. Box 24026, New Orleans, LA 70184-4026. WYES-TV is an Equal Opportunity Employer.

TELEVISION MAINTENANCE ENGINEER: T.V. Station UHF transmitter and studio exp. Maintain 24-hour on-air station. Assist with camera maintenance, transmitter, microwave and Sony Beta Cam SP/Sony LMS. Burbank. Send resume to Broadcast Engineering, Dept. 749, P.O. Box 12901, Overland Park, KS66282-2901.

CHIEF ENGINEER needed to take hold & move a top 75 market station into the future. Applicant will need impeccable communications & capital budgeting skills. Applicant must have 3-5 years managerial or assistant managerial experience including full knowledge of station operations with a strong news emphasis. Candidate should be fully computer literate & slip right into a high level of station automation including newsroom computer, robotics, master control systems and an automated G-Line transmitter & very soon, digital. Engineering degree preferred. EOE. Candidates meeting the above requirements, send resumes to: WOWT/Human Resources, 3501 Farnam Street, Omaha, NE 68131-3356.

TELEVISION MAINTENANCE TECHNICIAN: The George Washington University offers an immediate opportunity for an experienced, people-oriented technician for operations and routine maintenance of A/V equipment. The ideal candidate will have experience with audio and video studio and field production, editing and lighting. A minimum of two years of experience is required. Toaster experience and familiarity with purchasing are desirable. We offer a Comprehensive Compensation Package to include health insurance, excellent tuition benefits (for eligible spouse and dependent children too) and an onsite wellness facility. To apply either Fax or mail a resume to: Enok Dancil, Campus Recruitment, The George Washington University, 2125 G Street, N.W., Washington, D.C. 20052. (202) 994-4498 Fax, (202) 994-3640 TDD. GW is an Equal Opportunity Employer.

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HELP WANTED

SUPPORT ENGINEER - BROADCAST AUDIO & VIDEO: RE AMERICA, INC. is the United States sales and distribution arm within the RE group of international companies. Our key products are digital audio and video codecs. We are looking for a Customer Support Engineer who has experience with audio and video products which are used in the Broadcast, Studio, and Telecommunications environments. This position is based out of our Westlake, Ohio office and will require some travel. 3-5 years experience in the industry is required and an engineering degree will be a plus. Send resume and salary requirements to RE AMERICA, INC., 31029 Center Ridge Rd., Westlake, OH 44145, Attn: Andy Bosworth.

ASSISTANT CHIEF ENGINEER: Group owned Fox affiliate in Northwest seeks an energetic, self starting, technically capable individual to join our engineering staff. This is a career opportunity for the right individual familiar with 1", betacam, 3/4" and general studio equipment and hands on experience with microwave and UHF transmitter technology. If you meet these qualifications and desire to succeed with a strong team please send resume and salary history to Lee Carpenter, Corporate Chief Engineer, Pegasus Broadcast Television, P.O. Box 10888, Jackson, Mississippi 39289. No phone calls. EOE.

SERVICES

EQUIPMENT WANTED

WANTED: TEKTRONIX 1440 VIR VIDEO CORRECTOR for transmitter closed loop operation. Please contact Mike Simon, WTAE-TV, Pittsburgh (412) 244-4437.

WANTED: USED VIDEO EQUIPMENT. Systems or components. PRO VIDEO & FILM EQUIPMENT GROUP: the largest USED equipment dealer in the U.S.A. (214) 869-0011.

TRAINING

FCC GENERAL CLASS LICENSE. Cassette recorded lessons for home study. Our 30th year preparing radio technicians for the license. Bob Johnson Telecommunications. Phone (310) 379-4461.

SITUATIONS WANTED

STUDIO/MOBILE EIC VIDEO/TRANSMITTER ENGINEER: 20 years broadcast experience including major television network and nationwide mobile production facilities. FCC licensed/SBE Senior Television Certified. For resume and information: (908) 494-9443.

Continued from page 96

Fiber-optic IFLs in developing regions

Most current and near-future growth in satellite communications infrastructure is occurring in the developing regions of Africa, Latin America, Eastern Europe and Asia. Four major factors make fiber optics the preferred choice for RF earth station IFLs in these regions: terrain, weather, cost and reliability.

Earth station design and location always tries to provide the best views of satellites' arc while minimizing terrestrial interference and installation/maintenance costs. Simultaneously, accessibility to land-based networks is also a factor. Satisfying all these requirements is particularly difficult in some developing areas, and earth stations may end up having to be built in many demanding environments. Cables often must be run under, across or over places as diverse as the Rub al Khali, Seward Peninsula and Hong Kong Harbor. Optical fiber cable, with its immunity to moisture, temperature extremes and EMI, is the logical choice for such interconnections. Equally important is the small weight and size of optical fiber. One 0.5-inch diameter fiber-optic cable can carry up to 36 fibers, which can be routed to many different locations at each end. This becomes particularly important when the cable must be laid across a mountain, a desert, over a bridge or under a harbor. The cable is flexible and easy to install, and the optical path is extremely low loss, free from multipath problems and electrically isolating for each site.

The ability to run RF IFLs over long distances reliably and without significant signal degradation becomes even more important in the design of diversity earth stations. With more Ku-band transponders becoming available in tropical and subtropical regions, there is more need for diversity earth station designs to protect against loss of signal due to rain fade.

All links handle the appropriate analog frequency, with no need for up/downconverters or equalization.

By using Ku-band, L-band and IF fiber-optic IFLs, all transmit and receive signals can be routed to/from a diverse antenna site with a minimum amount of hardware and cable required. It is this capability that has led Singapore Telecom to the decision to back up each of its earth stations by interconnecting them with a network of fiber-optic IFLs. Until this technology became available, such a network would have been cost-prohibitive using any other technology in a reliable fashion.

A new solution

In summary, fiber-optic links can provide system interconnections in both directions for uplinks and downlinks using Ku-band, C-band, L-band or IF 70/140MHz interfaces. This unique capability provides a new application for fiber-optic links.

All links handle transmissions at the appropriate analog frequency, with no need for upconverters or downconverters, nor is there need for equalization circuits. Plug-ins can be included for remote RF signal monitoring or for full duplex interfacility communication for the computer system. This modular design provides substantial flexibility, redundancy and growth capability.

For those with a need for remote earth station operation, the Ortel System 8000 is a significant breakthrough. ■

➡ *For more information on the Ortel System 8000, circle (305) on Reply Card.*

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Cipher Digital, Inc.	106	101	800-331-9066
Clear-Com Intercom Systems	27	18	510-527-6666
Comark Communications, Inc.	85	61	215-822-0777
Continental Electronics	20	13	214-381-7161
Dielectric	74	46	207-655-4555
Dynatech Video Group	99	66	800-453-8782
Electro-Voice	98	64	616-695-6831
ESE	103	72	310-322-2136
Fujinon, Inc.	32A-D	39	201-633-5600
Graham-Patten Systems, Inc.	50,51	25	800-422-6662
Grass Valley Group	66,67	42	800-343-1300
Grass Valley Group	29,30,31	10,11	800-343-1300
Harris Allied	1	4	606-282-4800
Henry Engineering	96	57	818-355-3656
Hewlett Packard	38,39	30	800-452-4844
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ITS Corp.	37	1	412-941-1500
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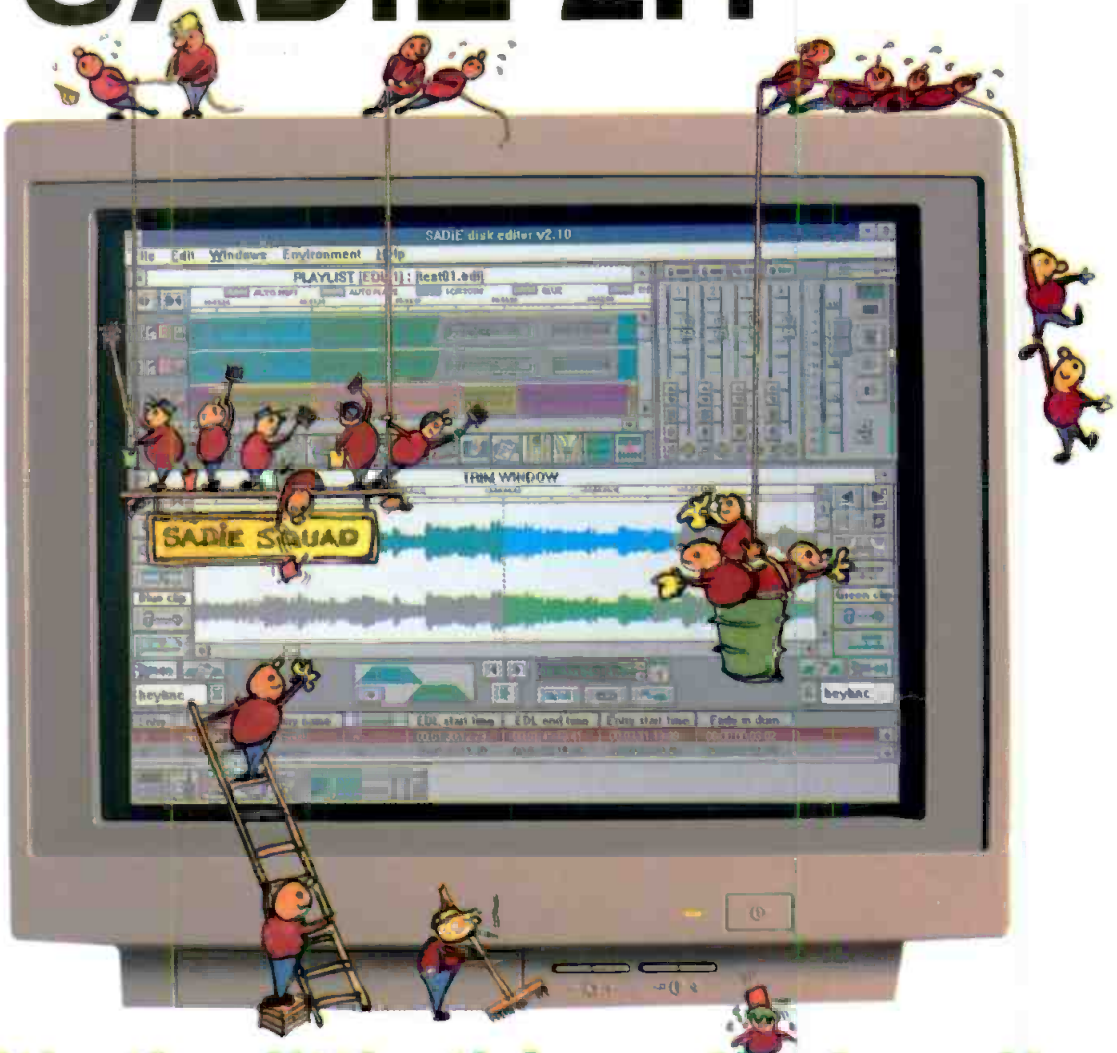

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