BROADCAST engineering

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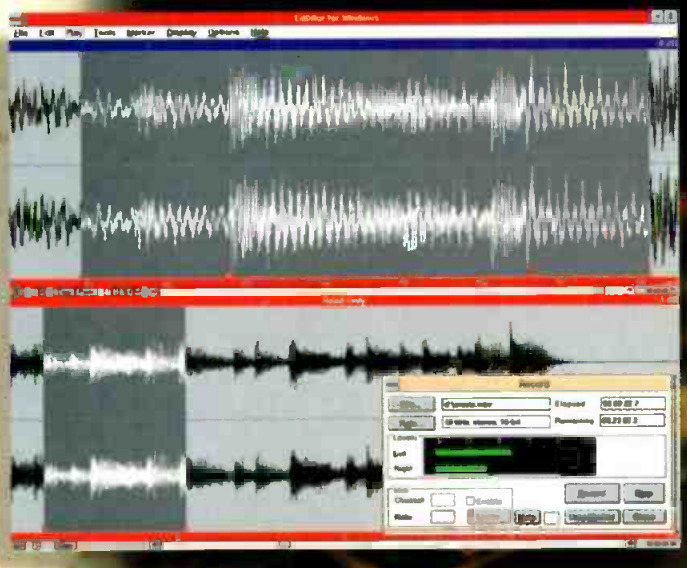

Audio Production Systems

- Digital audio workstations
- Audio processing
- DAT recorders
- Intercom systems

Also featured: Building serial digital facilities

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AUDIO PRODUCTION SYSTEMS:
Today's digital editing systems make razor blade editing as obsolete as 78rpm records. Audio technology also is more affordable and feature laden than ever before. This issue looks at some of the exciting developments in audio systems.

DEPARTMENTS:

COLUMNS:

THIS MONTH...

ON THE COVER:
Cover design by Christopher Irwin, Dolby Laboratories.

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News

By Dawn Hightower,
senior associate editor

Broadcasters warn that delays could doom infopike legislation

Broadcasters have urged lawmakers to pass Senate legislation that would set the rules of the road for the nation's information superhighway. Congressional inaction could hurt consumers and stymie development of a competitive national information infrastructure.

Edward O. Fritts, NAB president and CEO, pledged broadcasters will work with lawmakers to pass legislation and set a framework for future information services.

Fritts praised the Hollings-Danforth legislation for recognizing the role broadcasting must play in the future information marketplace. He singled out for praise provisions calling for a review of broadcast structural rules and for authorizing flexible use of broadcast spectrum that will allow broadcasters to provide competitive digital services.

On the issue of telephone company/cable cross-ownership, Fritts said broadcasters support the bill's safeguards, including those designed to prevent telcos from using their large rate payer base to subsidize unregulated video and other infopike services.

Fritts stressed the only way to prevent the substitution of one monopoly with an even larger monopoly is a flat prohibition preventing phone companies from buying up cable systems in their phone service area. Allowing such mergers would mean less competition, not more.

Broadcasters believe the bill could be improved by requiring telcos that transport video to offer non-discriminatory access to that capacity under common carrier principles.

Alliance forms to develop advanced wireless cable delivery

Six companies in the wireless cable industry have announced a research and development alliance to develop digital technologies for the over-the-air delivery of hundreds of channels of digital video programming and other services.

The alliance plans to develop wireless digital technologies that will enable consumers to receive from 150 to 300 channels, including near video-on-demand pay-per-view movie offerings. Efforts will also be directed toward wireless telephone services and interactive-based services.

The Wireless Cable Digital Alliance is expected to make wireless cable systems more competitive with traditional wired cable and telephone systems launching digital video networks. Members of the alliance are American Telecasting Inc., Colorado Springs, CO; Andrew Corporation, Orland Park, IL; California Amplifier, Carmel, CA; EMCEE Broadcast Products, White Haven, PA; Microwave Filter Company, Syracuse, NY; and Zenith Electronics Corporation, Glenview, IL. The alliance may be expanded depending on the needs of the group.

Hundt to speak at NAB Radio Show

FCC Chairman Reed Hundt will be a featured speaker during the NAB Radio Show, Oct. 12-15 in Los Angeles.

Hundt will address the radio broadcasters Thursday, Oct. 13 at 2 p.m. at the Los Angeles Convention Center.

Also during the show on Oct. 14, national radio talk show hosts G. Gordon Liddy and Jim Hightower will debate some of the most topical national and broadcast issues during a NAB Radio Show session called "The Right and Left of Talk Radio: Liddy vs. Hightower."

For complete details about the NAB Radio Show, use NAB's free fax-on-demand service at 301-216-1847.

SCTE issues call for papers

The Society of Cable Television Engineers (SCTE) is seeking abstracts for technical papers to be presented at its 1995 Conference on Emerging Technologies, to be held Jan. 4-6, in Orlando, FL.

Those wanting to present papers should send submissions by Sept. 1 to Bill Riker c/o SCTE, 669 Exton Commons, Exton, PA 19341. For more information call SCTE at 610-363-6888 or fax to 610-363-5898.

Should energy-saving standards apply to TV sets?

The NAB has urged the Department of Energy (DOE) not to impose energy conservation standards on TV sets, because televisions only require as much energy as a lightbulb.

The energy conservation standard also might deter TV manufacturers from introducing features preferred by consumers, and could deter introduction of HDTV and interactive television. ■

BROADCAST engineering

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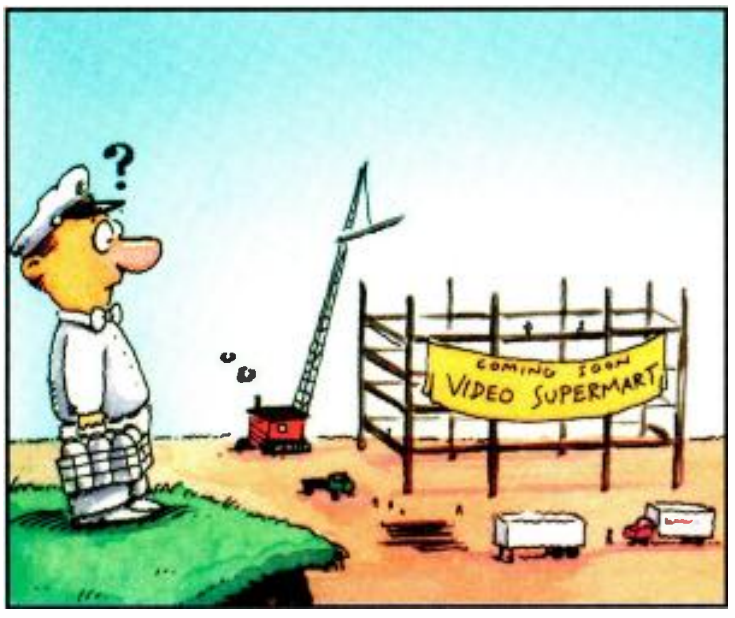
Editorial

The one-product dilemma



Imagine the dilemma of yesterday's milkman. Here was a guy (an entire industry) who built a successful business delivering milk products to the consumer. He didn't generate the product, he simply delivered it. The milkman was the pipeline that connected the product's producer (cows) to product consumers (milk drinkers). It was a successful venture. Then came the supermarkets.

Now consumers, who had to shop anyway, could just as easily get their milk at the grocery store. And the grocery store offered thousands of other products. Why should consumers continue using the milkman who offered only one product, when the supermarket had a variety of products on their shelves.

It was the result of marketplace changes that forced the milkman out of business. It simply became unprofitable to be the pipeline for a single product.

TV broadcasters are facing a similar paradox. Like the milkman, they deliver one product, one channel of programming, to the consumer. Although they do a great job, they are limited to only one product (channel).

On the other hand, cable has become the equivalent of a video supermarket, with 20 to 100 times more products (programs) available for the clicking. It's not hard to see why more than 63% of TV households are connected to cable. Viewers want options.

Will it be possible for the local TV station to effectively compete for the TV viewer? Or are broadcasters doomed to go the way of the milkman?

Regulators could learn a lesson from real world industries. Henry Ford once said you could have any color car you wanted as long as it was black. He was wrong and if Ford hadn't changed to meet the consumer's demand, the company wouldn't be around today. Would a TV station that refused to convert to color be around today? I think not.

The hallmark of TV broadcasting has always been free, over-the-air transmission of programming. That will remain the case. But stations also need the flexibility to offer more than one product. This means the ability to produce and transmit additional channels of programs, not just HDTV.

Forcing broadcasters to only transmit HDTV places them in the same dilemma as the milkman, being the pipeline for a single product. In today's world, a one-product company cannot succeed in a market that demands many options. We don't need the video equivalent of the now obsolete milkman. This is why future regulations must allow TV stations enough flexibility to meet the needs of their own viewers, whether that means multicasting and/or HDTV.

Brad Dick

By Brad Dick, editor

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See spot run.

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aggravating the entire audience because it's

too damn loud.

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FCC Update

Regulatory fee update

By Harry C. Martin and Andrew S. Kersting

The FCC recently issued an order regarding the assessment and collection of annual regulatory fees. See the table for FCC's established regulatory fee payment due dates.

FEE CATEGORY	PAYMENT DUE DATE
TV stations (VHF: $5,000-$18,000) (UHF: $4,000-$14,400) 2nd installment due Aug. 26 if fee exceeds $12,000	July 26-29
Low-power TV, TV translators and boosters ($135)	July 26-29
Commercial FM stations ($600-$900)	Aug. 8-10
Commercial AM stations ($250-$900)	Aug. 29 - Sept. 2
International (HF) broadcast stations ($200)	Aug. 29 - Sept. 2
Public fixed radio stations ($55 per call sign)	Aug. 1-5
Cable TV devices ($220 per license) ($0.37 per subscriber) 2nd installment due Sept. 9 if fee exceeds $18,500	Aug. 10-12
Space stations ($65,000-$90,000) 2nd installment due date Sept. 16	Aug. 17-19
Earth stations ($0.06 per antenna per call sign ($6.00 minimum))	Aug. 17-19
Cellular and public mobile licensees ($0.06 per subscriber)	Aug. 22-26

* If an entity is paying for more than one category of regulatory fees with a single payment instrument, the latter due date applies.

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

FCC modifies freeze on ITFS and wireless cable applications

The FCC modified the freeze on the filing of major change applications in the Instructional TV Fixed Service (ITFS). Accordingly, the commission will begin accepting applications for major changes to existing facilities and applications that are mutually exclusive with proposals on file.

The FCC also announced its intention to adopt a window filing system to increase the efficiency of processing ITFS applications, and is seeking comment on the following proposals intended to increase the efficiency and curtail potential abuse of the window filing application process by:

- requiring educators and wireless cable lessees to demonstrate their financial ability to construct the proposed facilities;
- limiting the number of applications that an ITFS or wireless cable entity can file or be associated with during a window;
- clearly defining an "area of operation" for the purpose of the 4-channel rule;
- making the protected service area for wireless cable lessees effective only with regard to applications filed after the protection request;
- expanding the definition of major changes to include certain changes, classified as minor, that would significantly impact existing or proposed facilities; and
- further ensuring that receive sites are accredited.

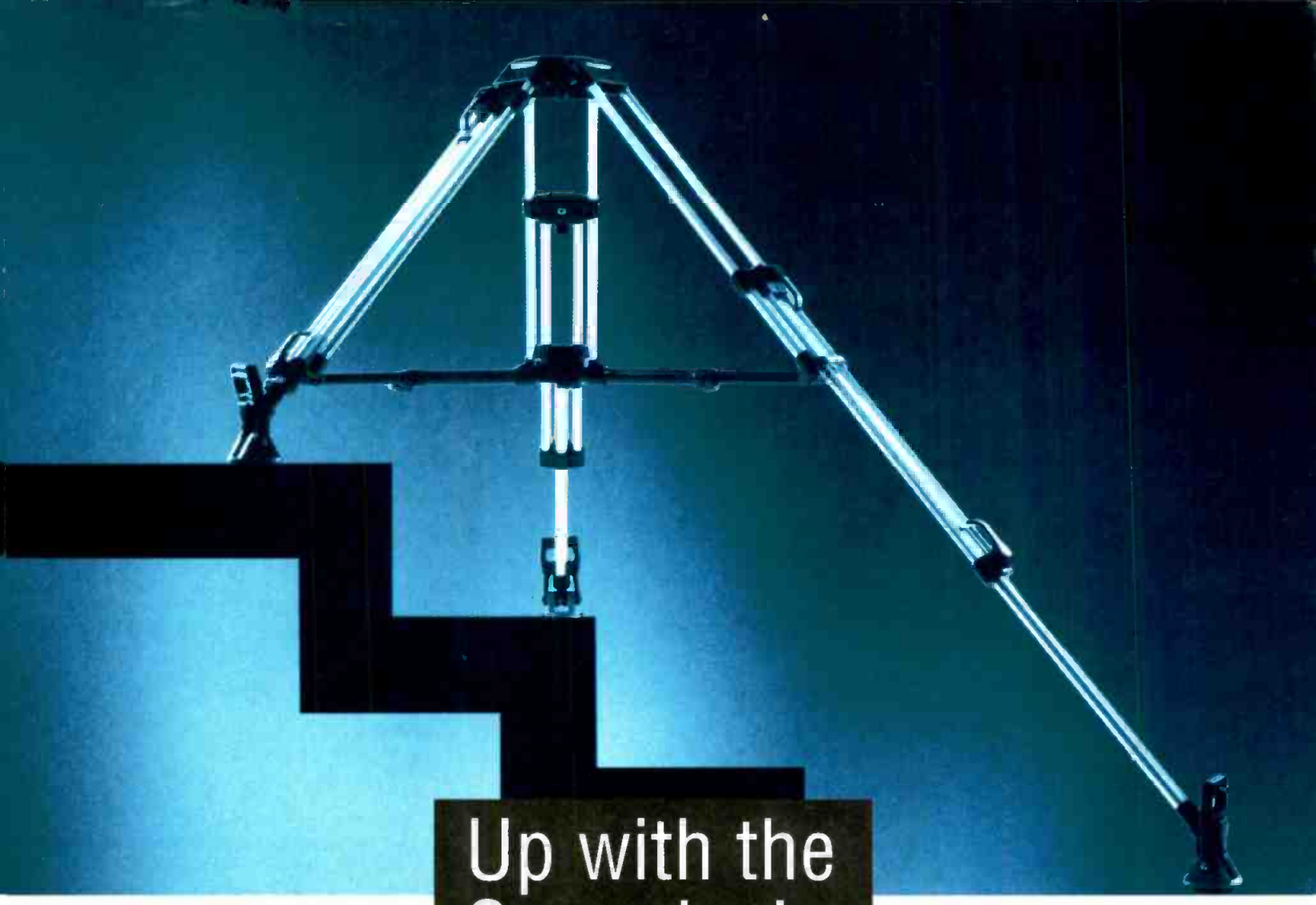
Forfeiture guidelines established for EEO violations

The FCC has adopted guidelines for assessing forfeitures for violations of the broadcast EEO rules. The agency has reestablished the base fine amount for EEO violations at $12,500. A base fine will be assessed where a licensee fails to attract an "adequate pool" of minority/female applicants or hires (i.e., at least one minority in each applicant pool) for at least 66% of all hiring opportunities during the license term. The FCC stated that evidence of a violation will include inadequate record-keeping and/or self-assessment throughout the license term.

- *Upward and downward adjustments.* The new guidelines also contain criteria for upward and downward adjustments to the base fine based on factors such as (i) the actual number of minority/female applicants or hires during the license term; (ii) the number of hiring opportunities; (iii) the number of minorities/females in the local labor force; (iv) the licensee's employment profile; (v) the licensee's use and productivity of general and minority recruitment sources; and (vi) the licensee's self-assessment of its EEO program.
- *Other sanctions.* Short-term renewals will be issued under a variety of circumstances. Moreover, where a licensee has been found to have a deficient EEO program, it may receive remedies or sanctions ranging from: (a) reporting conditions, a base fine plus a 90% upward adjustment (in addition to any other upward adjustments that may be imposed), and a short-term renewal; to (b) ' ıving its renewal application designat d for hearing and being subject to a possible fine of $250,000 if the licensee previously received a short-term renewal.
- *Retroactive application.* The FCC applied its new guidelines retroactively in several renewal proceedings and imposed fines ranging from $18,750 to $37,500. In the $37,500 case, the licensee failed to recruit for 51 of its 67 full-time hires, and did not contact any minority recruitment sources. As a result, the licensee attracted only one minority applicant for 67 overall and 61 upper-level vacancies.
- *Flexible approach.* The FCC emphasized, however, that its new forfeiture criteria are not intended to limit its flexibility in assessing fines for EEO violations. ■

Date line

On Oct. 1, commercial radio and TV stations in the following states and territories must file their annual ownership reports or ownership report certifications: Alaska, Florida, Guam, Hawaii, Iowa, Missouri, Oregon, Puerto Rico, Samoa, Virgin Islands and Washington. On or before Oct. 10, all radio and TV stations must place in their public files listings of issues and responsive programming for the quarter ending Sept. 30.



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Part 1

Strictly TV

A look at 8-VSB

Transmission

By Curtis Chan

Last February, the Technical Subgroup of the Special Panel approved Zenith's 8-VSB (8-vestigial sideband) transmission system recommended by the Grand Alliance. It was the last unapproved subsystem. The selection of the 8-VSB transmission system was the result of testing the proposed 32-QAM and 8-VSB system for terrestrial broadcast and the 256-QAM and 16-VSB for cable applications. Although the test results were close in many categories, VSB was the decisive winner in channel allotment issues, such as the ability to accommodate all stations while minimizing co-channel and adjacent channel interference.

8-VSB

The VSB transmission system architecture is designed around a pulse amplitude modulation (PAM) scheme for both terrestrial and cable applications. The PAM-based format uses eight (8-VSB) discrete levels for broadcast and 16 (16-VSB) for cable. The PAM stream remains at a constant level for a 92.9ns interval called the symbol period. This translates to roughly 10.76 million symbols per second. This symbol rate was chosen to have a 684xf_H relationship to the NTSC line rate, which allows for receiver processing to reduce NTSC co-channel interference. Because eight is 2^3 and 16 is 2^4, each symbol is represented by three bits in 8-VSB and four bits in 16-VSB. This translates to a raw data rate of 32.28Mb/s for the 8-VSB system and 43.05Mb/s for the 16-VSB.

The net data throughput of the final 8-VSB system is roughly 19.3Mb/s.

The VSB transmitter is composed of eight sequential subblocks: 1) a data randomizer; 2) an R-S encoder; 3) a data interleaver; 4) a trellis encoder; 5) a multiplexer; 6) a pilot inserter; 7) a VSB modulator and 8) an RF upconverter.

First, the randomizer is used to randomize the input data. This is done to ensure that the data being transmitted appears random even when the input to the system is constant. Random data is important for signal reception. After being randomized, the data is sent to the Reed-Solomon (R-S) encoder.

Interleaving is used to improve a signal's robustness by taking related data and spreading it out in a defined sequence.

Data format structure

The datastream sent to the modulator is divided into segments of 832 symbols each. Four symbols with a fixed sequence are added to each segment for synchronization. Each segment is 77.7µs. A group of 313 segments becomes a field, with one segment devoted to field sync. Each field is 24.3ms with two fields per frame. In the newer proposals, alternate field sync signals are inverted to avoid a DC imbalance from the fixed sequence.

For terrestrial broadcast, the 832 symbol segments break down as follows. The MPEG-2 transport stream packet length is 188 bytes. Another 20 bytes of ECC (error correction coding) using an R-S technique are added for a total of 208 bytes. These 208 bytes consist of eight bits each for a total of 1,664 bits. Then, another level of ECC is applied through a $^2/_3$ rate trellis coding. These extra error correction codes are the forward error correction (FEC). This coding scheme reduces the number of payload databits but improves the signal's robustness tremendously. The trellis coding increases the number of bits to 2,496. These bits are interleaved and then broken down into 832 symbols of three bits each. Interleaving is used to improve a signal's robustness by taking related data and spreading it out in a defined sequence. The result is a reduction in adjacent symbol errors, which would impact the effectiveness of the error correction process.

Sync signals are multiplexed with the data after it has been forward error correction encoded. Because of this, the sync signals are transmitted without FEC. Because the symbols used for sync are the only symbols that repeat at regular intervals, it is relatively easy for the receiver to lock onto them. The net data throughput of the final 8-VSB system is roughly 19.3Mb/s after accounting for the sync signals plus the Reed-Solomon and trellis encoding overhead.

After the sync pulses are multiplexed into the datastream, the pilot is inserted. To be relatively rugged, the receiver system must be able to acquire the signal and maintain a lock in the presence of noise and interference. A small pilot added to the suppressed carrier RF data signal allows robust carrier recovery in the receiver during these conditions. A small DC level is added to every symbol of the digital baseband data signal. This has the effect of adding a small in-phase pilot to the data signal, which provides a highly stable and accurate pilot.

System architecture is designed around a pulse amplitude modulation (PAM) scheme.

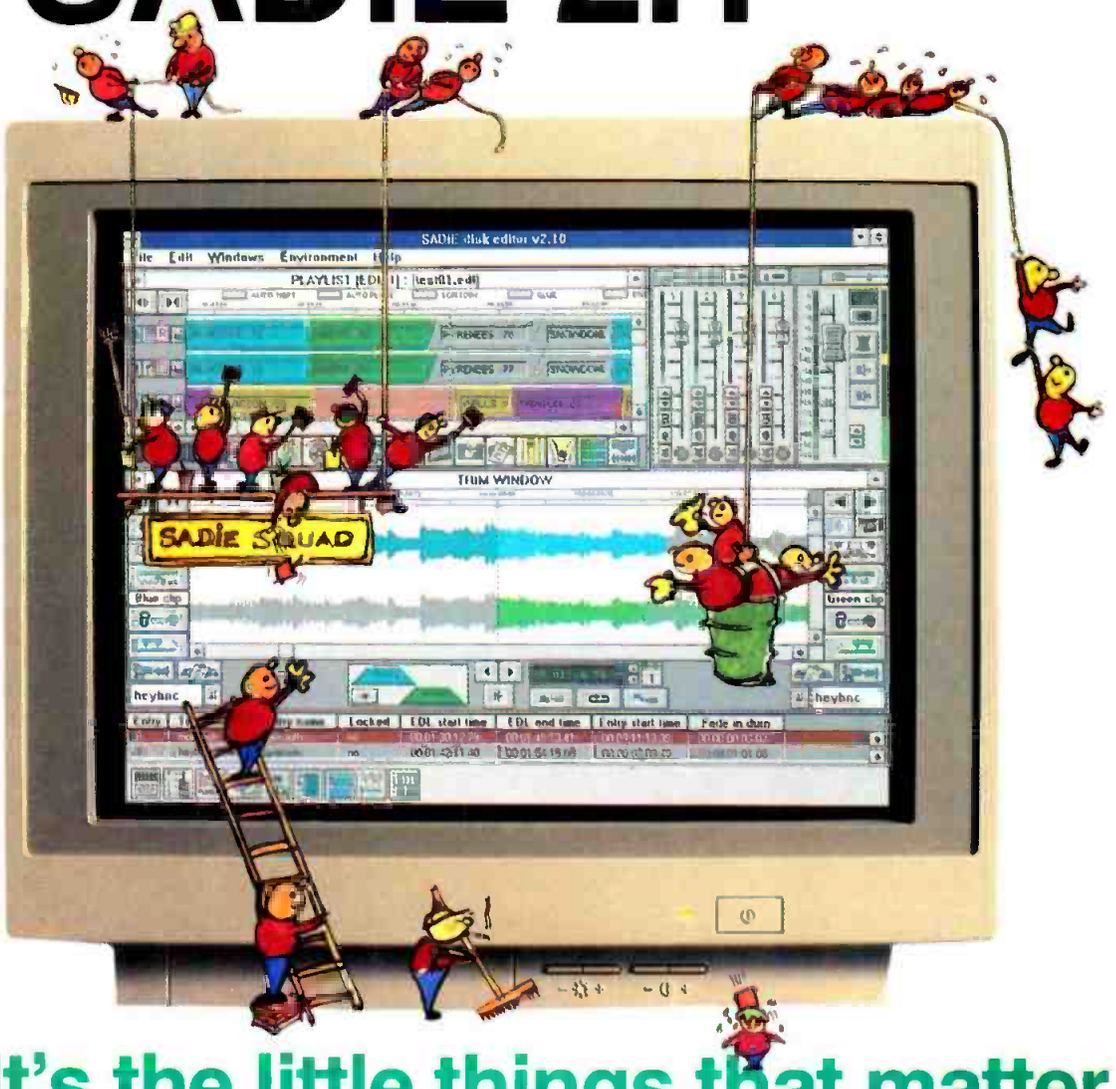
After the pilot is inserted, the datastream goes through a pre-equalizer filter and then to the VSB modulator.

Next month we'll continue our discussion of the VSB transmission system and will wrap up with a discussion on the inner workings of the receiver end.

■

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

SADiE 2.1



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Part 2

Management

Equipment acquisition

Equipment acquisition and employee productivity

By Rick Morris

As the chief engineer began to review her 5-year equipment acquisition plan, she noticed some important trends. Most of the equipment had been purchased many years ago and although the station had made emergency replacements during the last few years, the economy did not permit any equipment initiatives. This had been bad news, but now there were opportunities to achieve a more efficient engineering department and station. By carefully planning equipment purchases, the CE realized that she could maximize the use of her staff and reduce costs.

Productivity

Productivity, simply defined, is the output per worker. Productivity can be measured in many ways, but we'll consider productivity as output per hour worked, or an aggregate of the total labor costs that reflects the labor input.

There are two ways to produce more profit. The first is by increasing revenue (principally done by sales) and second by decreasing expenses. The engineering department can usually make the greatest contribution to the station's profitability by controlling expenses. One of the largest cost centers for engineering is labor. In order to decrease labor costs, you can decrease the total number of tasks performed, or increase the efficiency with which each task is performed. Broadcast and production tasks are dependent on technology and machines, so equipment is one key to increased productivity. The second area of productivity increases comes from R&D. Combine the concept of improving processes with the third area of improvement of the quality of the work force and you have reached the keys to productivity improvement: A productive work force is one where the workers are well trained and using good equipment. This is a simple statement, but how often do engineering managers forget to implement it when they deploy departmental resources?

Research and development in broadcast equipment has led to increases in labor efficiencies.

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.

Equipment replacement to increase productivity

Research and development in broadcast equipment has led to increases in labor efficiencies. Not long ago, it was all one operator could do to monitor a few VTRs. Now, with automation assist, reliable equipment, and automatic failure switching, one operator can be in charge of all on-air tape equipment, master control switching, transmitter remote monitoring and satellite recordings.

In television, post-production is undergoing such a metamorphosis with one operator able to control all video, audio, effects, tapes and text generation. The next wave of post-production efficiency is also visible with non-linear editing.

Many broadcast equipment manufacturers are sensitive to the issue of productivity of the end-users. They will usually provide information and informal assistance if the potential purchaser needs to know what it takes to operate the equipment.

Projections of savings

First, begin with the acquisition cost of equipment including interest expense if the money is borrowed. The acquisition of some equipment is purchased through cash-on-hand or current revenues, other equipment purchases may require borrowing. Equipment costs will enter the corporate balance sheet at a number of places (depreciation, ordinary expense, interest expense) and affect the bottom line.

Planning for equipment purchases that are premised on labor efficiencies will require the cooperation of the accounting department and engineering. You will be calculating a rate of return and time to pay back. Your accounting department will be able to do the bulk of the calculations, but will depend on you for crucial input on man hours saved, changes in the use of your staff, and saved and increased expenses. Manufacturers of major pieces of broadcast equipment can be helpful in assisting with projections on such things as maintenance costs.

When purchasing new equipment, buy necessary spares.

As facilities move to higher levels of efficiency, personnel and training become important. First, in order to operate complex equipment, you will need to enhance your commitment to training. Second, when purchasing new equipment, buy necessary spares, because you will be dependent on equipment up time. Also, make sure your manufacturers have substantial service support. Finally, plan on additional training for maintenance engineers. Although the savings of operational effort should outweigh possible additional maintenance costs, do not fail to account and budget for them.

What to do with the labor savings

Anything that affects manpower is fraught with controversy because of the specter of layoffs, but it need not be so. Planning for major operational changes can take years and staff attrition can be used to minimize direct impact on job positions. Opportunities arise to start new programs or newscasts with the same number of staff, raising the possibility of having more local time to sell. Technology can also allow you to release people from repetitive tasks for more creative work. Finally, you may reduce overtime, saving costs and helping your staff to achieve a better quality of life. ■

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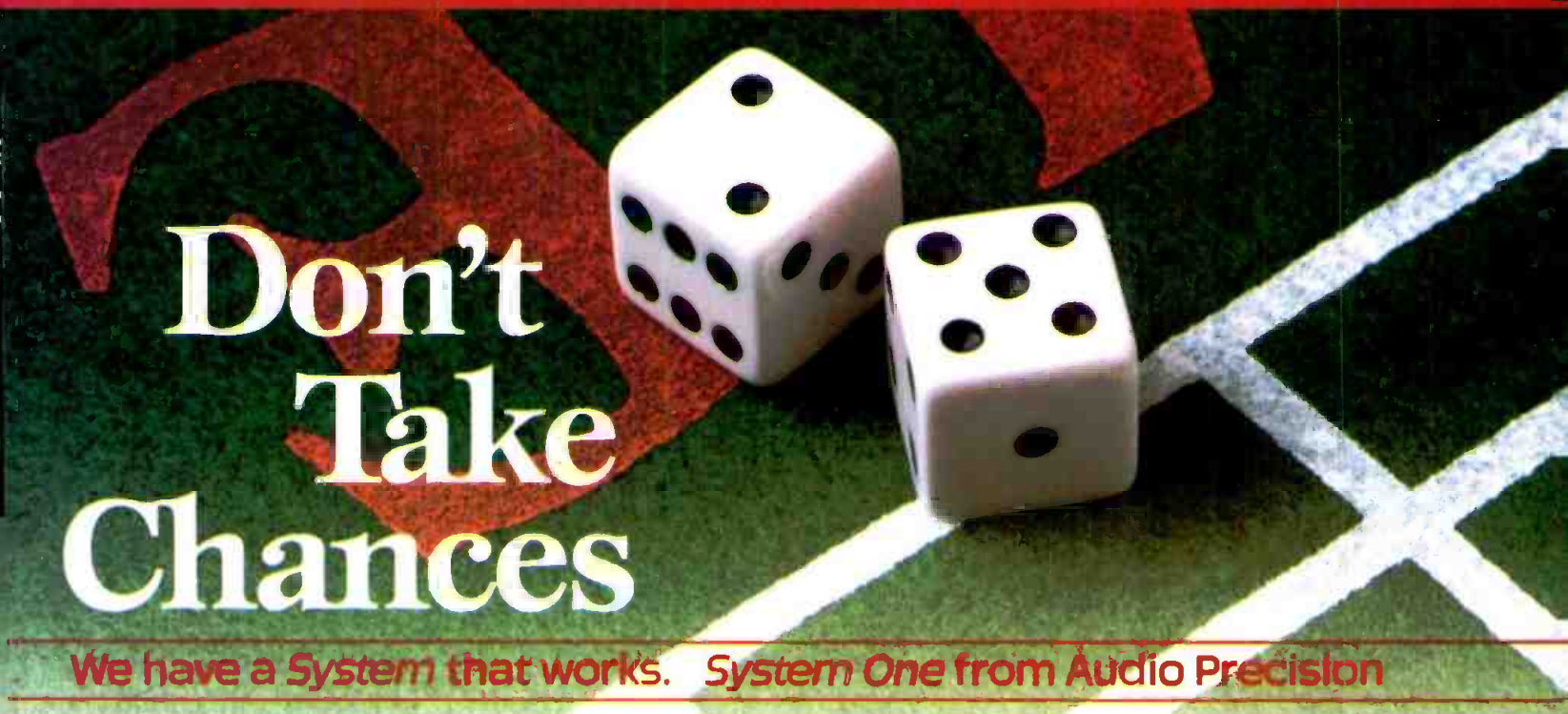

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Part 1

Production

Production test equipment

Hand-held solutions

By Jeff Noah

If you've ever had a problem at the end of a long string of video and audio cables that are strung out across a golf course, race track or stadium, you can appreciate the value of portable test equipment. Without it, cameras and microphones end up as the signal sources during setup, which makes for a marginal installation arrangement at best, but often, it's the only option.

Remote trucks are often booked so tightly there's hardly time to shut the engine off before the feed begins. This leaves little, if any, time for troubleshooting the inevitable problems. Even in the best of circumstances, the only video quality checks that production gear can provide are subjective: you eyeball the picture and try to spot any anomalies.

Quick - which connector is bad? The perfect time to have hand-held test equipment. (Photo courtesy of Ken Hunold.)

There's no substitute for the assurance provided by a test signal displayed on a waveform or vector monitor. Once the site is wired and the production equipment is in place, questions of equipment performance are answered only by punching up standard video test signals, routing them through the suspected device or link and looking at the other end with a waveform monitor and vectorscope.

A better way

In the past, having portable test gear on hand for remote productions was viewed as a luxury rather than a necessity. This perception stemmed from the expense of the equipment and a lack of understanding of the benefits the equipment could deliver (although production crews fortunate enough to have a good set of portable TV test tools will tell you they can't live without them). However, the perception is changing with the latest generation of test equipment designed for field use.

With portable test gear, crews can install and easily identify and label wiring well in advance. Signals can be sent through cables to verify performance. If problems surface, the tools are on hand to identify them, hopefully with adequate time to make repairs.

The list of necessary gear is fairly short. A signal generator with text ID at one end of a cable, and a portable picture monitor at the other, simplifies the process of identifying cables. Add some standard video test signals and audio tones to the generator, pair it with a combination waveform/vector/picture monitor, and that's all that is needed to troubleshoot wiring problems.

Hand-held solutions

In recent years, several manufacturers have supplied products addressing the needs of remote production. The latest generation of test gear goes beyond yesterday's solution of a 20-pound half-rack combination waveform/vector monitor with a 10-pound battery brick attached to its underside. Many of today's solutions redefine the term portable. They run on generic-sized disposable batteries or their NiCad equivalents and fit in the palm of your hand. Signal generators offer capabilities ranging from bars-only to feature sets with many of the same features as full-sized studio equipment, including text ID, a large signal complement and several audio tones and levels.

Although the miniaturization of signal generators is impressive, the greatest advances have occurred in the signal monitoring arena. A recently introduced monitor combines the functionality of four monitoring devices, a color picture monitor, waveform monitor, vectorscope and audio monitor in a hand-held, battery-operated package.

The technological advances required to manufacture tools small enough to fit in your hand include the reduction of complete instruments to a single chip. This high degree of circuit integration can result in lower manufacturing costs and higher reliability through reduced parts counts.

Inside connections

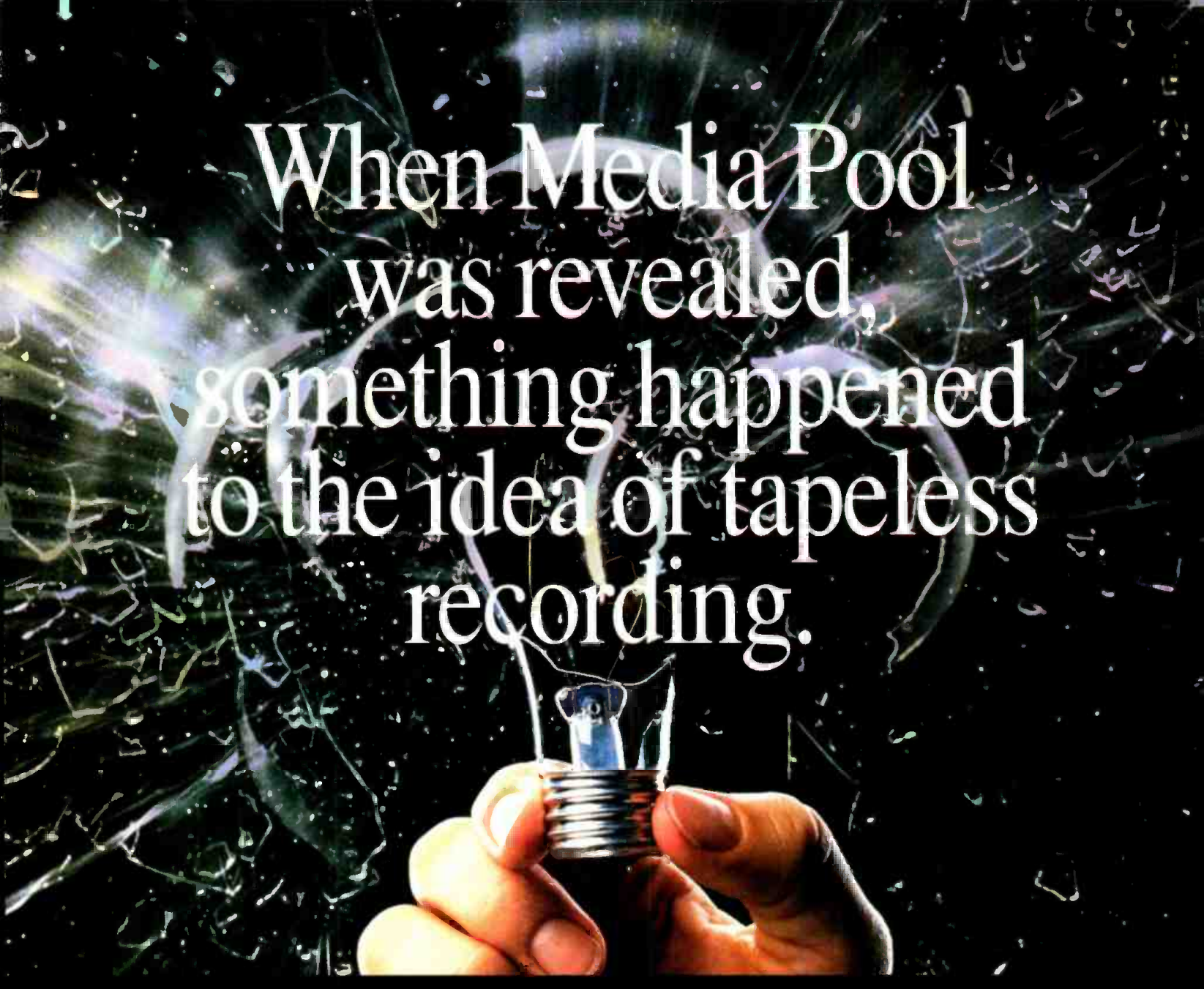
In-house productions are typically more stable than field productions, with fewer variables and, hopefully, no unknowns. However, problems still arise in studios with tried and true setups. Finding and fixing them as quickly as possible is essential. Having talent and crew standing around while you locate a bad BNC or cable can get expensive quickly.

The technological advances required to manufacture tools small enough to fit in your hand include the reduction of complete instruments to a single chip.

The latest technology in portable test gear permits engineers to simply open a tool box, grab a compact generator and/or monitor and head straight for the suspected problem source. There are no extra audio or video cables to run, no power and/or extension cords to locate and no heavy, bulky gear to maneuver behind a rack.

So whether you're working in the studio or lugging gear from the parking lot to the 13th green, today's hand-held equipment, combined with experience, ingenuity and planning, can make any production go more smoothly. ■

Noah is a technical writer for Tektronix Television Division, Beaverton, OR.



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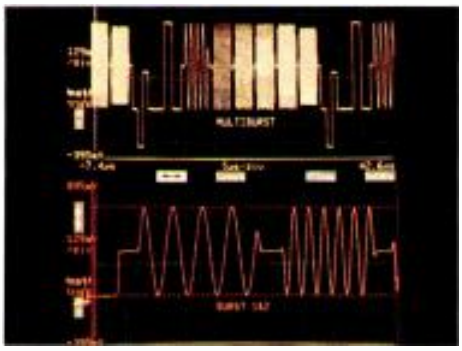
Part 2

Troubleshooting

Industrial computers

Selection and configuration



By Steve Newbegin

Selecting and configuring an industrial PC system doesn't have to be a daunting task. Despite all the possible configurations and vendors out there, you can minimize confusion and save money simply by being informed and organized. As described last month, the modular design of the industrial PC provides high adaptability to a variety of applications. Conversely, no single PC configuration will fit all needs perfectly.

Both motherboard CPUs and plug-in CPU cards are available for a variety of popular bus architectures, including Industry Standard Architecture (ISA), Extended ISA (EISA), Video Electronics Standards Association (VESA), Peripheral Components Interconnect (PCI) local bus and others. Onboard features of these CPUs usually include floppy disk and IDE or SCSI device controllers, cache RAM and other options. The motherboard is less expensive, but if your application is critical and a quick response to downtime is necessary, you may opt for the passive backplane unit with its 5-minute MTTR of all major system components including the CPU, drives and feature cards.

The most popular and space-efficient industrial PC is the 19-inch rack chassis, which provides from four to 20 full-length card slots, depending on the model. With onboard power supplies, passive backplane options supporting popular buses, and mounts for up to 11 disk drives of various types, these units provide a high degree of off-the-shelf system customizing for high-density I/O or memory-intensive applications. In order to increase operator access to the system chassis, 18-inch, 24-inch or 30-inch deep slide rails are also available for quick and easy removal and repair of hot-swappable or other components.

Drive options include floppies, floptricals, IDE hard disks, SCSI fixed disk drives, CD-ROMs and rewritable optical drives. All of these are available in full-height or half-height formats. IDE drives are reliable and cost less, but don't offer the speed, interface flexibility to different media and built-in expandability that SCSI controllers do. Most IDE controllers will handle only two drives per system vs. seven for each SCSI controller. At two controllers per PC, that's four IDE drives or 14 SCSI drives. Let the application determine the best solution.

Table 1 provides a list of the most important features and options that your system may require.

- **CPU:** passive backplane plug-in card or motherboard
- **Chassis:** 19-inch rack-mount with slide rails and enough expansion slots
- **Memory:** ROM BIOS, RAM (standard, expanded and extended), virtual drive(s)
- **Disk drives and controllers:** IDE or SCSI HDD, FDD(s), CD-ROM
- **Environmental:** power supply, cooling fan(s), vents and air filters
- **Display:** video/graphics adapters, monitor and rack-mounting slides
- **Data entry:** keyboard, mouse, touchscreen or custom user-interface
- **Data integrity:** RAID or tape backup
- **Maintenance:** extender (diagnostic) boards
- **Signal processing:** analog/digital I/O, DSP and application-specific cards
- **Network hardware:** LAN adapters, concentrators, hubs
- **Communications boards:** real-time clock, communications co-processors, etc.
- **Interfacing:** serial/parallel ports, termination boards, remote I/O
- **Modem:** high-speed POTS, Switched-56, ISDN or dedicated line
- **Software:** operating system/environment, networking, applications
- **Printer:** dot-matrix, ink-jet or laser; monochrome or color
- **Protection:** watchdog timer, security panels, locks, surge protector

Table 1. A list of features and options for an industrial PC.

Off-the-shelf vs. off-the-wall

Many so-called custom computer designs are simply variations on existing themes. They range from custom logos or color schemes on the metalwork, to added redundancy of key components, to special fabrication of a non-standard housing. For example, in many communication applications, deep cabinets won't fit, so specially made short-depth chassis are the answer.

Some manufacturers have their own quick-turnaround design engineering departments and metal-bending shops, so an unusual or difficult request may be within their capabilities.

Technical support and stability

Approximately 75% of PC sales in the broadcast market are made by value-added resellers (VARs) and system's integrators who supply their customers with fully integrated systems and a high degree of service and applications support. The other 25% of sales go to do-it-yourselfers who buy their system components from a variety of sources and configure the systems themselves.

If the latter describes you, remember that many vendors exhibit limited responsibility to the products they resell. When one of their products comes back under warranty, they often refer the customer to the original manufacturer. This can extend to virtually every major component in your computer. Generally, the closer to the source that the end-user is on the chain, the more responsive service and support is likely to be. Make sure you have a vendor's support before you make a commitment. As any veteran PC user knows, the need for technical support is not so much a question of if, but of when.

Note also that the board layout or BIOS may change without notice at any time in typical offshore designs, whereas American-made PC products tend to have greater longevity and consistency. For this reason, it's a good idea to specify that key components — such as the CPU, critical feature cards and chassis — are made domestically. The long-term advantages of this approach may outweigh the cheaper initial prices of offshore components.

Next month this column will consider how to maximize PC system performance.

■

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

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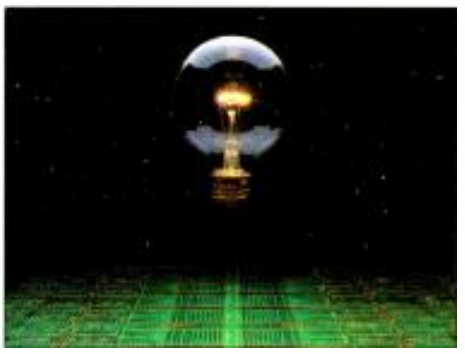

By Curtis Chan

As computers have become faster and more powerful, there has been considerable movement toward the convergence of computer and post-production technologies. It seems everyone is scrambling for on-line broadcast-quality random access. Although this goal has been approached by numerous manufacturers, many of the current solutions are still limited. In another area, HDTV developers typically run software simulations of new algorithms and proposed hardware. Until recently, the ability to interactively analyze high-resolution imagery to the smallest detail was usually an expensive proposition. Finally, there's the detail of finding a way to retrieve and backup these huge amounts of data in or near real time.

To many, an ideal solution would have a transparent interface, high compute speeds and high-volume, and random access while also being cost-effective. It also would have the ability to view full-motion imagery, interactively, at progressive and scalable scan resolutions and input and output real-time digital video (including translated computer data) at D-1 or better resolution. Viewgraphics Inc., located in Silicon Valley, has solutions focusing on two of the major roadblocks: 1) the ability to quickly access and analyze image media, and 2) the ability to off-load massive amounts of image data in real time. The two products, the Viewstore 6000 Image Media Manager and the Dataview D-1 serial digital adapter, will be a boon to multiple markets.

Who will benefit?

Both products will directly impact the broadcasting, film and video post-production markets. With Viewstore, broadcasters, cable companies and HDTV developers testing new compression algorithms, can store and interactively analyze (stop to real-time full-motion playback with 8x zoom and pan of up to 10Kx10K images) any resolution RGB or 4:2:2 format digital imagery. Video output is programmable to any resolution up to a 360MHz pixel rate (which includes 2Kx2K, 60Hz, non-interlace).

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

The unit also acts as a recorder/player with frame-accurate timing in response to commands from a V-LAN controller. The graphical interface provides icons emulating a VTR, such as looping, forward and reverse jog, field/frame still and variable speed playback modes. Stored sequence duration is increased by keeping the data in compact YUV (4:2:2) format and converting to RGB on the fly. The resulting sequences of images can then be stored directly to a D-1 DVTR or SMPTE 260M compliant recorder. Similarly, the resolution-independent Dataview adapter will add another layer of ECC to the CCIR 601 compliant output signal and turn D-1 recorders into pseudo real-time data backup units. The result is a removable medium (tape) at a fraction of the cost of present disk storage, with 100GB storage capacity per tape.

Combined with computer graphic servers and on-line storage facilities, the integration of this type of media manager allows high-resolution electronic screening of work in progress, which reduces the production cycle. Because the scene or image information is stored in RAM, users can zoom, scroll, perform windowing and analyze images for artifacts and flaws that might otherwise be overlooked. A Dataview can be connected to the computer's output, resulting in an additional layer of data integrity for real-time backups of image or visual data.

Image media management made simple

Digital imaging techniques also bring with them issues of data management and real-time visualization. These products are designed to accelerate access to image media and addressing the critical time element of backups. Viewstore comprises either a stand-alone system or a multiboard set that can be operated via a stand-alone processor option or connected to a workstation via a VME bus adapter. It consists of a data transfer controller board, up to six memory boards, an analog output board and an optional digital I/O board.

Each memory board can have four memory banks of 128MB or 512MB for a total of 512MB or 2GB of storage. The data transfer controller card controls all memory access from the host via the VME bus as well as the data transfers between memory and the video I/O board via a 500MB/s generic digital interface. Optional modules provide up to 360MHz video output at 8-bits/component or 250MHz at 10-bits/component. Also, a programmable, real-time color space conversion matrix is included to enable users to store 4:2:2 formatted YUV (or YCrCb) in the frame buffer and to convert this data to RGB upon output.

Aside from the normal interactive menu and display functions, an overlay option integrates advanced display functionality with on-screen control and annotation features. The gen-lockable digital I/O provides specialized data interfaces and compliant D-1 (SMPTE 125M) and SMPTE 260M digital video interfaces.

Taking the byte out of backup

The soon-to-be-released Dataview serial digital adapter will address the issues of computer data backup/archival, high-resolution image archival and real-time D-1 video I/O, all from one box. The 6U device uses a VME host interface on the front end, a sophisticated memory and controller system, an ECC codec, serial digital I/O, timing and gen-lock circuits and an RS-422 controller.

The user gets an interface product that allows existing D-1 (version D-2 is on the drawing boards) recorders to double as a true data peripheral, connecting directly to high-end graphics computers for real-time image retrievals and transfers. The secondary ECC circuitry plus read-after-write option ensures high data integrity for backup and restore operations. The D-1 recorder offers 120GB of storage at a fraction of the time and cost. The bottom line is new opportunities for D-1 manufacturers along with productivity benefits and cost savings for the end user. ■

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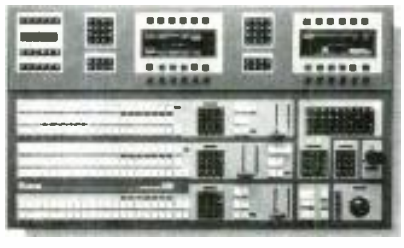

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Circle (9) on Reply Card

Selecting a DAW

Searching for the perfect DAW requires a special discipline.

By Dave Harris

The Bottom Line

The world of digital audio workstations (DAWs) continues to develop at a rapid pace. New systems are increasing ease of use, lowering the cost of entry and expanding capabilities. Naturally, these ever-widening horizons make a prospective purchaser's work even harder. It is therefore an appropriate time to review the criteria of choice for digital audio workstations in the broadcast environment.

There was a time when the mere fact that there were digital audio workstations was a wonder. This ability to capture and manipulate sound in a computer was at once exciting and intimidating to people in the audio community. The systems that existed were all integrated hardware/software packages. Prices were high and operation often quirky. As the technology improved, users began to understand that there were trade-offs when choosing one system over another.

Many of these issues concern the user interface, which translates all instructions for the computer and displays status and control functions to the user.

A good interface should be intuitive, which means it should actually do what it looks like it does. A well-designed interface should present information in a clear and uncluttered manner. A digital audio workstation interface also should require the minimum of mouse clicks or keystrokes to accomplish its various tasks.

Although feature sets are important, your exploration of a system's operation must proceed further. Certainly, the lack of some features will rule out some systems for use in a broadcast production environment. Yet, when two or more systems under consideration each cover the basic functions required, make your final choice based on ease of use.

Lower entry-level costs

The prices for computer capability and storage space have fallen quickly in the last two years. Computers are now using CPUs that either contain DSP chips on the motherboard or are so powerful that audio can be manipulated without them. With the addition of approximately $400 worth of software, these machines can provide the same or greater level of performance out of the box as did the previous generation of computers requiring up to $3,000 of additional DSP hardware. Some of the newer systems may still require a few hundred dollars worth of additional hardware if digital I/O is required, however.

The need for a digital input and output is actually a lower priority than you might at first think. In the digital world there is less need to plan ahead for the inevitable noise and distortion because of the generational losses and console circuitry in analog production. The mixing and track-bouncing process is so clean in DAWs that an analog transfer at the beginning and end of the process still provides an acceptable broadcast-quality product.

AKG's DSE 7000 workstation is DOS-based and designed primarily for radio production.

Harris is a consultant based in Woodacre, CA. Respond via the *BE* FAXback line at 913-967-1905.

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The Roland DM-80 is a cost-effective DAW using a proprietary platform for 8-track operation. Optional Mac-based control software allows up to 32-track operations.

Application-specific designs

As more DAW systems are introduced, another recent trend has focused on a particular usage area, such as video post or radio news production. This allows a narrowing of functionality, which provides the advantage of easier (and perhaps faster) use and a shorter learning curve. In some cases, this has also led to the development of specific hardware or interfaces, such as random access video linked to audio files, which is now available on a number of DAW systems.

If your intended use of a DAW is limited to a particular type or style of production, remember this when considering which systems may be appropriate.

Expanding system capabilities

A frequently asked question when exploring DAWs involves how many channels the system can record or playback simultaneously. The answer is not always obvious even after inspecting the hardware and the software manual.

Consider one popular system where the hardware that comes with the system has four input and output connectors. An observation might lead you to conclude that four audio signals can be recorded or played out at once. After reading the software manual, however, you will find that only two of the inputs or outputs can be used at one time.

Now you may feel that you have discovered that this is a 2-channel system, yet you may need to look further. The unused capacity of this system's DSP board has been activated by a third-party software developer whose inexpensive product converts the original 2-channel system to a 4-channel system. In addition to the channel expansion, other high-value features, such as mixing and track slipping are added by this optional piece of software. This illustrates the need for thoroughness in your evaluation of today's DAW marketplace.

Another area where additional functionality has been added involves multimedia and interactive information presentation/retrieval. Some broadcasters may be able to reuse their archives and develop new products for the interactive market.

For productions that will require the synchronization of audio to Quicktime or other video formats, it is paramount that the selected DAW have that ability. Adding such capability to an existing system can be as painless as buying and installing additional software, or it can be impossible, depending on the DAW. Often, a system originally purchased with audio-only applications in mind falls into the latter category. In such cases, adding synchronization capabilities requires that a new system be purchased.

SADiE from Studio Audio and Video is a Windows-based system featuring fast, user-friendly editing and mixing of up to eight tracks.

Audio processing is another area of DAW functionality that is developing nicely in numerous manufacturers' systems. One new idea bears some notice. It borrows from a software concept that has been used in computer graphics applications for some time — the *plug-in*. A plug-in is a specialized piece of software that provides limited but high-quality functions. Until now, this approach has not become popular in audio production software. Where they have existed, plug-ins have been restricted to use with a single company's system. Such functions have included noise reduction, multiband parametric equalization, dynamics processing (limiting, compression, expansion), effects (echo, reverb, flanging) and resolution conversion (16-bit to 8-bit, for example).

Now, however, a standard has been proposed to allow one plug-in to work with any number of DAW systems. This could allow a user to put together a minimal

A buyer's guide to DAWs

By Dave Harris and Skip Pizzi, technical editor

In preparation for a DAW demo or an exhibit visit, ask yourself the following questions:

- How many signals do I need to record onto the hard disk or play out of the system at one time?
- How many tracks do I need to mix together at any one time? (Remember that nearly infinite track bouncing is possible.)
- Do I need digital audio I/O?
- Will I need to play back tracks at the same time I am recording?
- Will I need to sync the audio to time code?
- What plug-in functions will I need? Do third-party applications exist for this system?
- Do I need a system that requires an add-on DSP card? DSP-card systems usually have several I/O options (S/PDIF, AES/EBU, +4dBm balanced analog), while systems without a card are limited to -10dBV unbalanced analog stereo in and out.
- Will I be networking this DAW with other computer-based systems?
- Do I require any integrated machine-control functions for external devices (VTRs, ATRs, external processors)?
- What backup format options are available, and exactly what data is stored? How long does the backup procedure take?

Once you have a clear picture of your requirements, ask the person selling the system if it has what you're looking for. If so, you have covered the specifications and it's time to try out the system. You may be able to arrange for a system to be loaned to you or your facility so you can get the feel of the interface for an extended period under real working conditions.

If you can't get an extended demo with the product, you will have to rely on your first impressions of the interface. Note the number of times you must click or keystroke to accomplish common production tasks. Does the program require you to move your mouse hand from the mouse to the keyboard and back or can you leave one hand on the mouse and the other on the keys? Is it possible to move a piece of audio forward or backward in time?

Ask for a list of users in your area that you could contact. This list will probably be selected by the vendor to give the best impression of the product, but get in touch with them anyway. Ask them how the product performs when the going gets tough.

To help with your search, Table 1 (right) notes each DAW's *primary* application area. Keep in mind that many systems may be configured for equally useful application in other areas.

MFR	SYSTEM MODELS	PLATFORM (Min. level)	PRIMARY APPLICATIONS					
			Audio for video	Radio Prod.	News Prod.	Music Prod.	Gen'l Audio	Reply Card #
Akai	• DD1000	Prop	X				X	312
	• DR4d	Prop					X	313
AKG	• DSE 7000	386		X				314
AMS Neve	• AudioFile	Prop	X					315
Audion Labs	• VoxPro	Mac			X			316
Augan	• 408 OMX	Prop					X	317
Avid Technology	• AudioVision	Mac Quadra	X					318
Basys	• D-CART	Prop			X			319
CEDAR Audio	• CEDAR Prod. System	386					X	320
Digidesign	• Audio-media II	Mac II	X					321
	• Pro Tools 2.0	Mac				X	X	322
	• Session 8	386SX or Mac				X		323
	• Sound Tools II	Mac II					X	324
Digital Audio Labs	• The CardD	386		X			X	325
Digital Audio Research	• Sabre	Prop					X	326
	• SoundStation	Prop	X					327
Doremi Labs	• DAWN II	Mac II w/Sys 7				X	X	328
Fairlight ESP	• Fairlight MFX 2	Prop	X				X	329
Fostex	• Foundation 2000	Prop					X	330
Innovative Quality Software	• Software Audio Workshop	386 w/sound Card		X			X	331
Korg	• SoundLink	Prop				X		332
Lexicon	• Opus	Prop	X				X	333
Micro Technology Unlimited	• MicroSound	386		X			X	334
OSC Media Products	• DECK II	Mac IIx[1] Mac AV or PowerPC		X			X	335
Otari	• ProDisk PD-464	Mac II				X	X	336
Pacific Recorders & Engineering	• ADX	Mac II		X			X	337
Roland	• DM-80	Prop		X			X	338
SADiE	• SADiE Disk Editor	486		X			X	339
Sonic Solutions	• Sonic Quattro	Mac II	X			X		340
	• Sonic Station II	Mac II	X				X	341
Spectral Synthesis	• Audio Engine	486/33				X	X	342
SSL	• ScreeenSound	Prop	X				X	343
	• Scenaria	Prop	X					344
	• OmniMix	Prop	X					345
Studer Editech	• Dyaxis II	Mac IIci				X	X	346
Sunrize Industries	• Studio 16/ AD516	Amiga 2000	X					347
Synclavier Company	• Synclavier Tapeless Studio	Mac II				X	X	348
Turtle Beach Systems	• 56k Digital Rec. System	286/12		X			X	349

Note: [1]On Mac II platforms, DECK II requires System 7.1 or higher plus DAW hardware and software from DigiDesign, RasterOps or Spectral Synthesis.

Pacific Recorders and Engineering has recently introduced ADX BASIC, a cost-effective, self-contained version of the ADX WorkStation.

system and later add or upgrade as needed, and as software becomes available.

A final technology to watch is that of data compression and data reduction as applied to finished audio files in a DAW. This promises to have a profound influence on the way digital audio production is done in the future. It is well-known that uncompressed digital audio files can become quite large. The general rule of 5MB per track-minute typically produces raw original files that can range into multiple gigabytes.

DAW users must deal with memory management during production and while planning distribution of the final product.

Therefore, DAW users must deal with memory management during production and while planning distribution of the final product. It is a rare production that has access to all of the storage capacity it could ever need.

Although data reduction via perceptual coding has been possible for some time, available systems generally have relied on dedicated hardware to code and decode the audio. Now, a growing trend has emerged for manipulating file size with these algorithms through software. This has become another software plug-in possibility, allowing the means to decode reduced audio files to be contained in inexpensive playback software or even stored along with the audio file itself. This technology is in its infancy and bears watching.

Digital audio workstations are maturing. If you can't budget for a world-class production system now, take advantage of the many useful and less-expensive systems that are available. They will provide you with some real digital production experience and improve your facility's audio programming. ■

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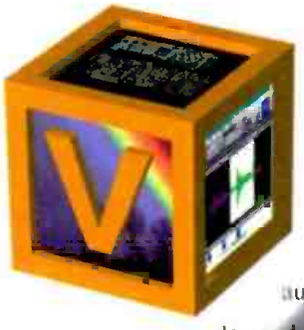

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Circle (21) on Reply Card

Audio processing for broadcast production

Audio processing in the production studio has come a long way lately.

By Curtis Chan

The Bottom Line

Broadcasters are always looking for a competitive edge to sell their services and airtime. On the hardware side, that edge may come in the form of devices that give a station a unique aural presence. Gaining such capability continues to become more affordable as the systems themselves become more powerful. Digital signal processing (DSP) and a resurgence in analog processing are the keys to this synergy.

$

Not only are today's audio processing systems cheaper than their predecessors, but they offer higher sonic quality and more powerful features, as well. Broadcasters should examine analog and digital processors for their production suites within three major categories: 1) compressors, limiters and gates; 2) equalizers and spectral enhancers; and 3) effects devices.

These production processing systems are generally in a separate class from the on-air audio processor used by broadcast stations to control and tailor their signal as it goes to the transmitter. (See the related article, "Dynamic Range Processing and Intelligibility," p. 32). Production systems require a wider palette of capabilities coupled with significant ease of operation, so they can be properly used in the heat of a session or a live broadcast. Cost is also an issue because in many cases, multiple units of a particular production processor will be required by a facility.

Compressors, limiters and gates: Current trends

Compressor/limiters and noise gates are critical in controlling the dynamic range of audio program material, for live on-air and recorded programs. They are especially helpful on voice (vocalists and announcers), percussion and bass instruments. Because there may be multiple channels in need of individually controlled compression, these types of units can be obtained in single, dual or multi-channel configurations, which in many cases can be linked.

Some newer units use FET technology to emulate the sound of tubes. Tube or synthesized tube designs favor even-order harmonics over odd-order harmonics, resulting in a subjectively smoother sound (to some ears) across a heavy compression curve.

Production processing systems are in a separate class from the on-air audio processor.

Because noise gates and compressor/limiters usually work hand-in-hand, many companies combine such functions in one box for more integrated control over the signal. When properly adjusted, this combination allows significant dynamic range reduction to take place without a concurrent rise in the noise floor during passages where the instrument or voice is silent.

The term "properly adjusted" is critical. It is possible for a misadjusted audio processor to do more harm than good. Therefore, the designers' primary goal should be to allow the user to produce the desired effect with a minimum of adjustment. Interaction of controls, while impossible to fully eliminate, should also be minimized. Last, virtually any competent compressor can sound natural if it doesn't work hard. The trick is getting a unit to process heavily *and* naturally.

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

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Another design attribute that affects sonic quality is the use of either discrete, hybrid or VLSI circuitry. Many compressor/limiters use a voltage-controlled amplifier (VCA) for their central gain block. The distortion that can be caused by VCAs is well-known. The distortion generally manifests itself as additional unwanted spectral components, such as harmonic or IM distortion. In addition, deficiencies in traditional control circuitry often produce unnatural modulations of the signal, often referred to as "pumping," "hole-punching" and "shivering."

Controlling a compressor/limiter and noise gate is relatively easy, and manufacturers have had a long time to fine-tune this technology. Specifically, control usually centers on five major functions (with occasional enhancements to each section): threshold, compression, attack, release and gain. By combining added functionality to these primary functions, frequency-selective gating or compression and other variations are possible.

More advanced compressor/limiter designs allow two separate threshold and ratio settings, one for compression and one for limiting. This allows mild compression (low ratio, low threshold) to be combined with protective peak limiting (high ratio, high threshold), for example, offering cost-effectiveness by combining two necessary functions in a single device. On higher-priced units, the release shape is selectable and may have normal, linear and exponential release time characteristics. The resulting output can therefore have either a "soft-knee" or "cliff-effect"

Production processors require a wide palette of capabilities coupled with significant ease of operation.

Advantages (and disadvantages) of digital I/O

By Robert Orban

Since dinosaurs ruled the earth, audio professionals have used analog connections between their gear. The advantage of an analog connection is that it is universal. Other than level differences and balanced vs. unbalanced, there is little that can prevent some sort of signal transfer between the originating and receiving devices.

Analog connections have their well-known weaknesses, however. They are prone to hum and noise pickup, and long connections can easily cause unacceptable high-frequency loss. Furthermore, in a complex facility with active devices in the signal path, levels must be carefully aligned to prevent amplifiers in the signal path from clipping.

In a stereo or multichannel facility, cable lengths and types must be matched to prevent relative polarity shifts from appearing between channels. It is all too easy to accidentally swap left and right channels, mirroring the stereo image. Worse yet, reversing polarity of one channel causes cancellation of the monophonic sum signal. And for those who worry about absolute polarity, it is even easier to invert absolute polarity so that speakers pull when they should be pushing.

Digital I/O solves most of these problems. In the common AES/EBU and S/PDIF standards, one cable carries two channels of audio. There can be no problems with relative polarity shift between channels, channel imbalances, absolute polarity inversion or gain shifts to cause clipping. If you use AES/EBU properly, status bits tell you whether the signal is stereo or mono, whether it is pre-emphasized and what its sample rate is. If you choose your cable carefully (110Ω balanced cable is required), you can run AES/EBU several hundred feet with no signal loss. Using a balanced-to-unbalanced adapter with 75Ω coax and BNC connectors can extend that distance to several thousand feet. If you go too far, you'll know it — the receiver will simply fail to decode the signal. Subtle problems are quite unlikely.

Jitter

One subtle problem that can arise in AES/EBU transmission is jitter in the clock recovered by the receiver. Jitter means that the period of each recovered clock cycle is not quite identical to the period of the cycle preceding and following it. If such an unstable clock is used to synchronize a digital-to-analog converter (DAC), the resulting frequency — or phase-modulation sidebands around the clock frequency and its harmonics result in what amounts to modulation noise in the recovered audio. *One-bit* DACs (like the MASH converter and its cousins) tend to be more sensitive to this than the more traditional multibit designs.

To a modest extent, the AES/EBU standard itself tends to cause jitter because it is a *self-synchronizing* system — the receiver must recover the clock from the bitstream, which is not entirely uniform when it is modulated by a digital audio signal. However, if a low-pass filter is interposed between the AES/EBU transmitter and receiver, this can cause the position of the bit transitions to become much more uncertain, greatly increasing the probability that the receiver will recover a jittered clock. The TOSLINK optical connections provided on consumer CD players are particularly prone to this behavior, but any long cable will roll off the higher frequencies (the AES/EBU signal has significant energy up to 5MHz) and cause similar problems.

Orban is chief engineer for Orban, a Harman International Company, San Leandro, CA. Respond via the *BE* FAXback line at 913-967-1905.

Mixing digital signals

Another important issue regarding digital signals in the studio environment is how to mix them. With analog, there was no problem — a couple of resistors would do quite nicely. However, digital audio is not nearly as forgiving because mixing must be synchronous. (This also implies that the signals to be mixed must have identical sampling frequencies.) The situation is similar to video, where mixing two video signals requires that they be timed identically. In digital audio, requirements are not quite as stringent because a DSP mixer will accumulate the serial input bitstreams in a buffer memory until all of the bits in a given digital word are available. Only then are they added, so the video requirement of exact phase matching between inputs does not exist in the world of digital interconnect.

Nevertheless, if the digital words are appearing at the inputs at different rates, then the buffer memory will quickly overflow as it tries to line up the words from the different inputs. So identical sample rates are a must.

New technology to the rescue

Fortunately, the last year has provided solutions to the jitter and sample-rate problems with the advent of low-cost, integrated asynchronous sample-rate-converter (SRC) chips from Analog Devices and Philips. Within a wide range, these chips will emit a bitstream that is synchronous to the system clock that drives the chips regardless of the sample rate at their inputs. Fortuitously, they simultaneously remove jitter at their inputs, and the jitter at their outputs is essentially as low as the jitter of the system clock driving the chips. By placing an SRC at each input of a digital mixer (or any other device where jitter removal is required), interconnecting a digital studio becomes a plus-and-play operation. No house sync is required to ensure that various digital sources emit identical sample rates. An input can accommodate any digital signal meeting the standard for which the receiver is designed (such as AES/EBU).

Experience with the Analog Devices chip shows that there is only one serious potential problem. Internally, asynchronous SRCs require large FIR filters to do their job. At a 32kHz output sample rate, the filter used in the Analog Devices chip is down approximately 0.5dB at 15kHz. (It's essentially flat to about 14.5kHz.) So multiple passes through SRCs outputting 32kHz may result in significant loss of frequency response at 15kHz. However, because 32kHz is generally only used in STLs, this should not be a significant problem. For the common studio sample rates of 48kHz and 44.1kHz, the new SRC chips are essentially transparent and will usher in a new generation of high-performance, easy-to-connect digital studio equipment.

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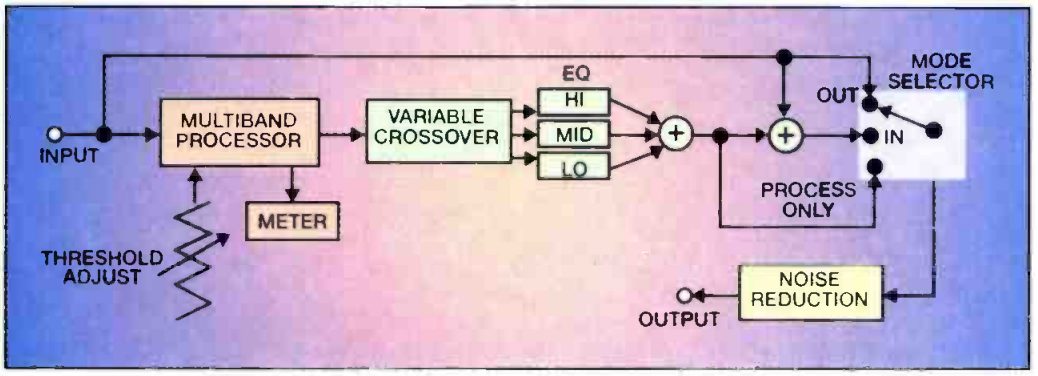

Figure 1. *Block diagram of the Dolby 740 spectral processor, an example of the latest directions in equalization, using a combination of fixed and adaptive processing.*

characteristic, providing a single unit with enough flexibility to operate as a single channel vocal compressor or an overall program hard-limiter.

Most of the gain reduction devices that perform these tasks are analog systems, but a growing number of recent designs use digital technology, at least for control, if not for actual audio processing. Among the latter, digital inputs and outputs are sometimes offered. (See the related article, "Advantages [and disadvantages] of Digital I/O," p. 28). Digital interconnection capability will grow more useful as the equipment surrounding an audio processor in the production studio becomes increasingly digitized.

Spectral enhancers

Another signal processing device that has become popular recently in broadcast circles is the *spectral enhancer*. These devices fall somewhere between equalizers, multi-effects units and noise reducers. Spectral enhancers typically use a combination of static and dynamic EQ and noise reduction to provide user-selectable low- and high-frequency detailing of audio sources. (See Figure 1.)

The end result is a quieter yet brighter signal — two attributes that are often mutually exclusive when using a standard equalizer.

Such technologies from the professional audio recording community are making their way into broadcast production equipment. The end result of this migration is a new breed of highly cost-effective, fully featured and sonically pure peripheral devices that will enhance today's and tomorrow's broadcasts. ■

➡ *For more information on audio processing for broadcast production, circle (309) on Reply Card. See also "Dynamics Processors," "Effects Processors" and "Equalizers," p. 54 of the BE Buyers Guide.*

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Dynamic range processing and intelligibility

By Marvin Caesar

The arguments for dynamic range control are strong, obvious and well-known to broadcasters. If a program has too wide a dynamic range, listeners/viewers will have to ride gain in order to bring up low-level dialog and turn down high-level effects. When commercials — often compressed to high average levels — come on too loud relative to the program material, the disparity is magnified. Often, when the viewer/listener reaches to make such an adjustment, the channel gets muted or switched, and a negative image may be formed about the advertiser. The dramatic difference in levels between program and commercials is the number one complaint about TV audio. Another major cause of complaints, especially on channel-populous cable systems, is the difference in audio levels between channels.

If too wide a dynamic range creates problems for TV audio, dynamic range that is too constricted is equally undesirable. It is clearly inappropriate for TV facilities to use the kind of aggressive processing employed by many radio stations to create and maintain maximum loudness at all times. Aesthetic considerations aside, this aggressive type of processing is inappropriate for TV audio because it reduces intelligibility.

Caesar is president of Aphex Systems, Sun Valley, CA. Respond via the *BE* FAXback line at 913-967-1905

Intelligibility can suffer

Speech intelligibility, especially for the English language, depends on consonant recognition. Consonants are typically characterized by transients with fast rise times that are rich in harmonics and high frequencies. If the integrity of consonant waveforms is diminished, either by dynamic or frequency-response changes, the intelligibility of those words will be reduced.

An extreme example of this type of loss of intelligibility is the soundtracks for movies played on airplanes. It seems that no matter what level you set, or how far you push the ear buds into your ears, you still lose a great amount of the dialog. The dynamic range is certainly controlled (footsteps can be as loud as gunfire) but at an unacceptable cost. Thankfully, the problem is rarely so extreme with TV audio. However, the 75µs pre-emphasis curve employed in TV (and FM) transmission can exacerbate intelligibility problems because it often results in the attenuation or distortion of high frequencies.

Advice to broadcasters

In controlling dynamic range and audio modulation levels, the tasks of a broadcaster are to define the parameters of acceptable dynamic range, choose the appropriate equipment for each function, and operate it properly. Power or loudness is a function of *average* levels and these should be monitored using a VU meter rather than a peak-reading unit. The average levels should not vary more than 6dB to 8dB from low program material levels (other than quiet ambience) to highest level effects. This range will allow dramatic impact and syllabic emphasis without letting the low levels fall too far down. Compressors and levelers should be used to control average levels in this manner. It's important to select devices that are designed to recognize the relative densities of different signals (unprocessed, "open" audio such as live broadcasts vs. heavily processed audio such as commercials.)

Modulation is defined by *peak* levels, which are best measured by a modulation monitor. In order to maintain the highest possible peak levels without overmodulation, a peak limiter should be used. For point-to-point links with flat response (no pre-emphasis) a flat limiter should be used. For TV broadcast transmission, the pre-emphasis curve must be taken into account. This means the peak limiter should be multiband with the pre-emphasis curve at the input. The peak output ceiling should be set to generate 100% modulation in the transmitter. The total amount of peak limiting should not be greater than 8dB to 10dB. More than that amount can result in unnatural, overprocessed audio.

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Advances in DAT recorders

New DAT features make the format even more attractive to broadcasters.

By Curtis Chan

The Bottom Line

Digital audiotape (DAT) recorders have come a long way since their introduction in the mid-1980s. Today, DAT recorders' portability, long recording time and digital nature make them ideal for on-location recording and post-production work. The more recent advent of time-code-equipped DAT machines have further reinforced the format's usefulness as a replacement technology and extended its livelihood as a viable acquisition and production format.

The usefulness of the DAT format has been greatly enhanced for broadcasters with the recent addition of a standardized, non-longitudinal SMPTE time-code format and a number of other useful features. To begin an examination of this new DAT generation, a review of the format's basics is in order.

With the exception of one DAT deck that allows recording of each track individually, the basic DAT format is stereo — both tracks are recorded simultaneously. Three types of signals are necessary for the correct operation of a DAT system: 1) PCM audio, 2) subcode data, and 3) the *Automatic Track Finding* (ATF) signal.

The PCM audio is usually a 16-bit linear, 44.1kHz- or 48kHz-sampled signal with substantial error correction. Subcode data can include *Absolute Time* (or *A-Time*, which counts real time in hours, minutes and seconds from the head of the tape), several forms of ID markers, and SMPTE/EBU time code (sometimes referred to as *R-time*). The ATF signal ensures accurate tracking during playback on any DAT unit, similar to those used by various video formats.

Although DAT is a tightly specified standard format, some broadcasters have learned the hard way that not all DAT recorders are created equal. Particularly vexing are the differences between consumer and professional DAT units. Consumer models are generally limited to a 48kHz sampling rate when recording from the analog inputs. This becomes problematic if the material is to be used for CD production later at 44.1kHz.

Also confronting the consumer-DAT user is the *Serial Copy Management System* (SCMS). Designed to inhibit digital copying of copyrighted material, SCMS will not allow users to make a digital dub of a DAT that is itself a digital copy of "protected" audio. In other words, when using consumer DAT equipment, it is possible to make a digital DAT dub from a published CD, but a second-generation digital DAT dub cannot be made of the first DAT. (SCMS is sometimes described as "allowing digital children but not grandchildren.") Although SCMS has no effect on recordings made via *analog* inputs, the best solution for broadcasters is avoidance of SCMS-equipped devices. This implies the exclusive use of professional DAT equipment.

Another potential flaw among consumer DATs (or even low-priced pro-DATs) is the poor quality of the mic pre-amps and/or the lack of phantom power for condenser mics.

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

The Panasonic SV-4100 is designed for on-air use, with a 5-point autolocator and instant-start RAM buffer. It can also be externally synchronized to a variety of sources.

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Portable DATs

Portable DAT recorders are nothing new, but the latest models offer a number of features that may be welcomed by broadcasters. Several of these new units offer transport-control and other buttons that each have unique tactile characteristics, allowing the experienced operator to manipulate the controls without visual inspection.

To minimize dust and moisture in the cassette well, a tight gasket is often found surrounding the compartment. High-end units sport four motors that eliminate the need for complex linkage and belts, resulting in a longer life expectancy and smoother tape operation.

Otari DTR-90 has detachable front panel/remote control and offers time code, instant-start memory buffer and edit-preview RAM buffer/interface.

Some units also have a built-in head warmer that allows operation through wide temperature and humidity variations. Not surprisingly, most portable DATs designed for professional use are built with a rugged, road-worthy chassis. Some consumer-type portables are even smaller and lighter, but are far less robust and reliable.

Most professional portable DATs offer AES/EBU and IEC958 (consumer) digital audio I/O, allowing signals to remain in the digital domain from acquisition to mastering. Emulating the analog Nagra recorders that they aim to replace, high-end portable DATs offer a variety of mic-powering, filtering and attenuation features along with limiting and polarity reversal. On some machines, the settings of these controls can be stored in memory for easy recall.

Most portable DATs offer multiple monitoring modes that allow the broadcaster to listen via headphone in stereo, mono-sum or one-channel-only modes. A built-in speaker is also provided in most cases. Some models offer a stereo MS decoder in the monitor section, while others offer a predefined shuttle speed for fast listening or cuing.

Some DAT field recorders use 4-head drums, allowing off-tape confidence monitoring and punch in/out capability. Time-code display may also be offered for monitoring in the field. Because a portable DAT may be used in conjunction with film or video production equipment, newer units allow multiple power options, including Betacam power adapters, NP-1B-type cells, GEL cells, power straps or, of course, AC power supplies.

In addition to slate mic and tone-generating functions, most portable DATs also come with full subcode address capability, such as start IDs, end IDs, program numbers, blank search and error IDs that are useful for marking and cataloging sections of a tape. Because a few subcoding details were left unspecified in the DAT standard, however, some subcode data recorded on one DAT machine will not be recognized upon playback on another model or brand. Some units also carry a unique ID system that monitors all operating areas. The user determines the setup parameters and if any discrepancy occurs, the deck will send a mark to the tape for review later. Alerts can come in the form of blinking LEDs, screen icons

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or audible alert tones in the headphone output.

Production DAT recorders

With the new breed of cost-effective modular digital multitrack recorders using S-VHS and 8mm tape, DAT manufacturers are in a creative frenzy to integrate more bang for the buck. New models of professional production DAT recorders are a testament to this. Many of these decks are more expensive than their predecessors, with prices for the most fully featured units ranging to $12,000 and beyond. Other models are quite reasonably priced, however. Most DAT manufacturers try to accommodate users by offering a modular design, allowing decks to be configured for audio mastering, post-production editing, broadcast playback or sound library applications.

The Fostex D-30 features a super twist display like those found on some laptop computers. It includes many advanced features, such as time code, off-tape monitoring, scrubbing, edit previewing, auto-cuing to first audio, instant start and RS-422 control.

These high-end decks are rack-mountable and rugged. Designed for heavy studio and edit suite use, the units are surrounded by a thick sheet metal outer layer with shock mounting on the transport. In many cases, high-quality stamped metal parts are used instead of the plastic items used on lower-priced models.

Other new features include varispeed controls (usually around ±12.5%), enhanced autolocation and improved editing. In the latter area, implementation of jog/shuttle knobs, memory buffers and EDL-type editing control have made intensive editing on DAT a practical reality. This allows a production to use the same recording format from acquisition to air, and stay within the digital domain as much as possible. Editing on these systems gives the user precise control based on SMPTE/EBU time-code or film/video frame rates. Crossfades are available across a wide range (up to three seconds duration, definable in 1ms increments), and crossfade curves are selectable for log or linear ramps, with separate time settings for fade-in and fade-out.

Because the DAT subcode can be accessed independently from the audio data, SMPTE time code can be pre-striped, post-striped or recorded simultaneously with audio. One time-code rate or type can even translate to another during playback. Like VTR editors, auto-edit, rehearse and review modes provide automatic punch-in/out and review of the edit at preselected points. Cue-point storage and edit-history recall are also offered. Jog-wheel manipulation of audio stored in a RAM buffer makes precise cuing a simple and "analog-like" process.

Memory buffers are also finding use for instant-start DAT playback, making the format more suitable for on-air use. A similar RAM feature can be applied to pull-up and pull-down functions for film/video transfers.

Taking a page from the VTR manufacturer's book, some newer DAT decks incorporate control panels that can be detached for use as a remote-control and status-indicator. A variety of more traditional wired and wireless remote controls are also available on many models.

Regarding converters, current DAT recorders typically offer either 16-bit linear or 64x oversampling ADCs with 18-bit 8x oversampling DACs. Sampling rates differ among models, but expect to find at

Advanced wireless intercom system

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- **Designed specifically for broadcast and production**
- **Directly compatible with all standard wired intercoms**
- **Many advanced circuit and system design features**

In the studio or on the set, Vega's wireless intercom systems are the choice of professionals who demand ruggedness, reliability, broadcast-quality audio, and a full set of professional features. Designed from the ground up for broadcast and production work, the Q600 UHF/VHF system provides all the functions and technical capabilities required for these demanding applications.

The Q600 system provides continuous, full-duplex, hands-off communications between up to six people plus an unlimited number of "listen-only" users.

The QTR-600 beltpack remotes are extremely easy to use and provide operation similar to that of hard-wired intercom beltpacks. They are compatible with popular dynamic or electret headsets, such as Beyer, Clear-Com, and Telex. The cases are welded aircraft aluminum alloy with a high-impact, molded Cycolac (ABS) control panel that will withstand the roughest use.

One QX-600 master station supports up to six QTR-600 remotes with "hands-free" two-way communications, and an unlimited number of PL-2 receivers for listen-only users. Circuitry is provided to interface external line audio with the system or to link two QX-600s into a 12-user system. The master station is directly compatible with all standard wired intercom systems such as Clear-Com, RTS, ROH, Telex, and many others via internal programming switches. A local headset position and extensive control, adjustment, and monitoring provisions are also included.

The PL-2 VHF mini-receiver provides a high-performance, low-cost solution to providing one-way "listen-only" communications. Very often, individuals need to receive instructions but are not required to speak. Using PL-2 receivers for this application avoids the expense of additional full two-way remotes and can significantly lower the cost of a typical system. The PL-2 is fully compatible with the Q600 system and is designed to provide reliable communications in the most demanding RF environments.

When the job demands hands-free, full-duplex operations in the most demanding environment, go with the Vega Q600, the system recommended by professionals worldwide.

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least 48kHz, 44.1kHz and 32kHz. Some units also offer a -0.1% mode for 47.952kHz and 44.056kHz. AES/EBU and S/PDIF (electrical or optical) digital I/Os are standard. For control, many decks provide (as either standard or optional equipment) RS-422, RS-232C and TTL-compatible parallel I/Os. This can allow DAT decks to be integrated into broadcast automation systems as a cost-effective and high-quality long-form storage medium. External word sync and video sync are also offered on many decks, which allow synchronization with incoming digital audio or analog video signals.

SMPTE time-code generator/readers are available for an increasing number of DAT machines, either as standard or optional features. This not only gives the deck a capability to stripe tapes with time code, but also to chase-lock and synchronize to incoming code. Sync offset time is adjustable, and the offset time can be captured instantly for later recall. Available frame rates typically are 24, 25, 29.97 (DF/NDF) and 30fps. Jam synching is commonly available, and some DAT decks offer the ability to record and display time-code user-bit information. Time-code generators can usually run either continuously or in a time-of-day mode.

The Sony PCM-E7700 is a portable, 2-deck DAT editor that offers time-code-based EDL and auto-assemble operations, a graphical editing display, off-tape monitoring, a real-time jog/scrub wheel and double-speed edit assembly or dubbing.

A few non-time-code decks can provide a time and date stamp with every start ID, which can be handy for cataloging. Additionally, some decks can read A-time from a non-time-code recorder and translate it into a SMPTE/EBU time-code emulation, allowing the audio to be easily integrated into a time-code-based production environment without post-striping the tape.

The latest generation of DAT hardware has helped establish a solid niche for the format among the professional community. The price of a DAT cassette is about one-third of equivalent-length reel-to-reel tape, with the additional benefit of space savings for hardware and storage of tape. Recent enhancements, such as RAM buffers and time code add significant utility for broadcast applications. Combining these advantages with DAT's inherently high audio quality should keep the format popular among broadcasters for years to come. ■

➡ *For more information on professional DAT recorders, circle the following numbers on Reply Card:*

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Intercoms

Today's high-tech systems are computer-based.

By Bob Cohen

The Bottom Line

Modern technology has caught up with broadcast intercoms, and the results are powerful, flexible and easy-to-use communications systems. Many times, facility intercom systems are taken for granted or thrown together at the last minute. Either of these situations can spell disaster when the system goes down. Having a functional intercom system that complements a facility's communications needs can mean the difference between getting a hot story on the air or losing it completely.

Talented engineers can equip facilities with the latest state-of-the-art equipment and make it all work. However, wise engineers remember that high-tech boxes aren't worth anything if the people operating them can't communicate with each other. It's the staff's skill, creativity and teamwork that keeps viewers interested and keeps shows on the air. The intercom system ties those people together and allows them to work in a harmonious, coordinated way.

Today's intercoms give facilities reliable, easy-to-use communications systems that surpass anything available. Most facilities use the latest in party-line (PL) systems, which usually do the job. Many facilities, however, are turning to the latest computer-based systems for the ultimate in flexibility and communications power.

Let's party

For decades, party-line intercom systems were the standard in North America. The party-line concept has grown by quantum leaps since early poor-quality, low-level, carbon microphone-based systems were built into camera CCUs in the 1950s. Those systems have evolved into sophisticated multichannel systems based on distributed amplifier, line-bridging architecture capable of interfacing to external communication systems and devices.

Modern PL systems provide low-noise, high-level, full-bandwidth audio quality that reduces listening fatigue over long listening periods. The distributed amplifier, line-bridging concept makes it possible to add and subtract users (stations) from a channel without affecting audio level or quality. Additionally, advanced headset construction has resulted in a wide range of units that fill many headset needs, from ultralightweight to high-noise environment to general purpose, all with great audio and exceptional comfort. Those who have used Telco 52BW-type headsets understand how important comfortable headsets are.

Single-channel PL systems serve well when key personnel must relay instructions to numerous support staff. For example, directors must be able to talk to people who run cameras, graphics, prompters, CGs, engineering and others all at the same time.

As long as the director is the only person talking, this system works fine. But when other communications need to happen, a single party-line soon turns to confusion as people's voices step on each other. The problem can be solved with multiple party-line channels, each used by groups of individuals who need to speak to each other. Each group is put on their own party-line. Individuals who need to can break into any group using master multichannel intercom stations.

But even with the advances, party-line systems alone often don't serve the needs of a modern radio or TV facility. As production capabilities become more sophisticated, so do intercom system requirements. More equipment is being controlled by more operators, which requires more communication capability to coordinate activities. Intercom installations can require 25-pair cable wired throughout, and once installed, it is difficult to change.

Then there is the problem of interfacing, cameras, IFBs, 2-way radios and telephone circuits often sounding like mush, thanks to conversions from their 4-wire audio circuitry to the standard 2-wire

Cohen is president of Clear-Com, Berkeley, CA.

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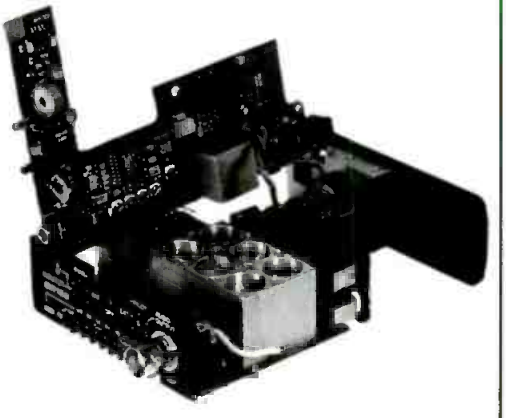

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intercom system. But because there was no better solution, broadcasters put up with these systems for decades.

Modern miracles

The advent of computer-controlled switching matrices allowed broadcast facilities to replace huge audio and video patch panels with routing switchers. These modern miracles permit any source to be sent to any destination with the push of a button or two.

It didn't take the intercom business long to catch on, applying switching matrix technology to broadcast communications systems. Matrix-based intercom networks provide flexible, powerful voice communications throughout facilities and interface to the outside world. In these systems individual intercom stations, telephone lines, talent IFBs and 2-way radios, are connected to a computer-controlled central switching network or matrix. Then, through software assignments, any one person can be connected to any other person or group of people with no patching or wiring required. (See Figure 1.) Advanced systems seamlessly integrate the matrix with party-line technology for the best of both worlds: point-to-point communications, as well as plug-in party-line technology.

Manufacturers are making matrix intercom systems as small as 2x2 and as large as 450x450. The needs of most facilities can be met with a system less than 100x100. KABC-TV in Los Angeles, has gone on-line with a new matrix-based system after outgrowing its 15-year-old party-line system. The system will allow up to 100 ports, however, current needs require only 72, leaving plenty of room for expansion. Future plans call for interfacing the intercom with the station's computerized automation system.

Flexibility to bend over backward

Whether it's large or small, a matrix-based system can be configured for almost any intercom application imaginable, and can be reconfigured instantly. Stations can be programmed to communicate with each other as party-line or point-to-point consoles. Different individuals can be grouped together for single-button communications, and clear LCD or LED electronic labels over every key let users know exactly who they can speak with at any time.

For example, newscasts might come from Studio A, except for the 5 p.m. show, which is live from the newsroom. In the afternoons, a studio talk show in Studio B is taped, and on Saturday afternoons it's a kiddy show. On Sunday mornings, the public affairs show has different requirements, and don't forget annual elections, parades and marathons. With a computer-controlled matrix intercom, system configuration files are created with a PC, stored to hard disk, and then loaded into the intercom system as needed.

News happens

Of course, not every situation is scheduled. Breaking news, sports and other live events tax any intercom system, and personnel who don't normally communicate may find a need to during a crisis. With a matrix system, panels can be reprogrammed in seconds without interrupting ongoing operation, which is a feature important to many news operations. With numerous crews in the field, sometimes the director needs to cue one group while the assistant director is readying another.

With the intercom control panel at the user's fingertips, the change to computer-based communications becomes immediately apparent. Electronic LCD or LED labels located over each key are easy to read and change instantly when the panel is reconfigured. This simplifies operation because the intercom station needs to be configured with only the communications capabilities that the op-

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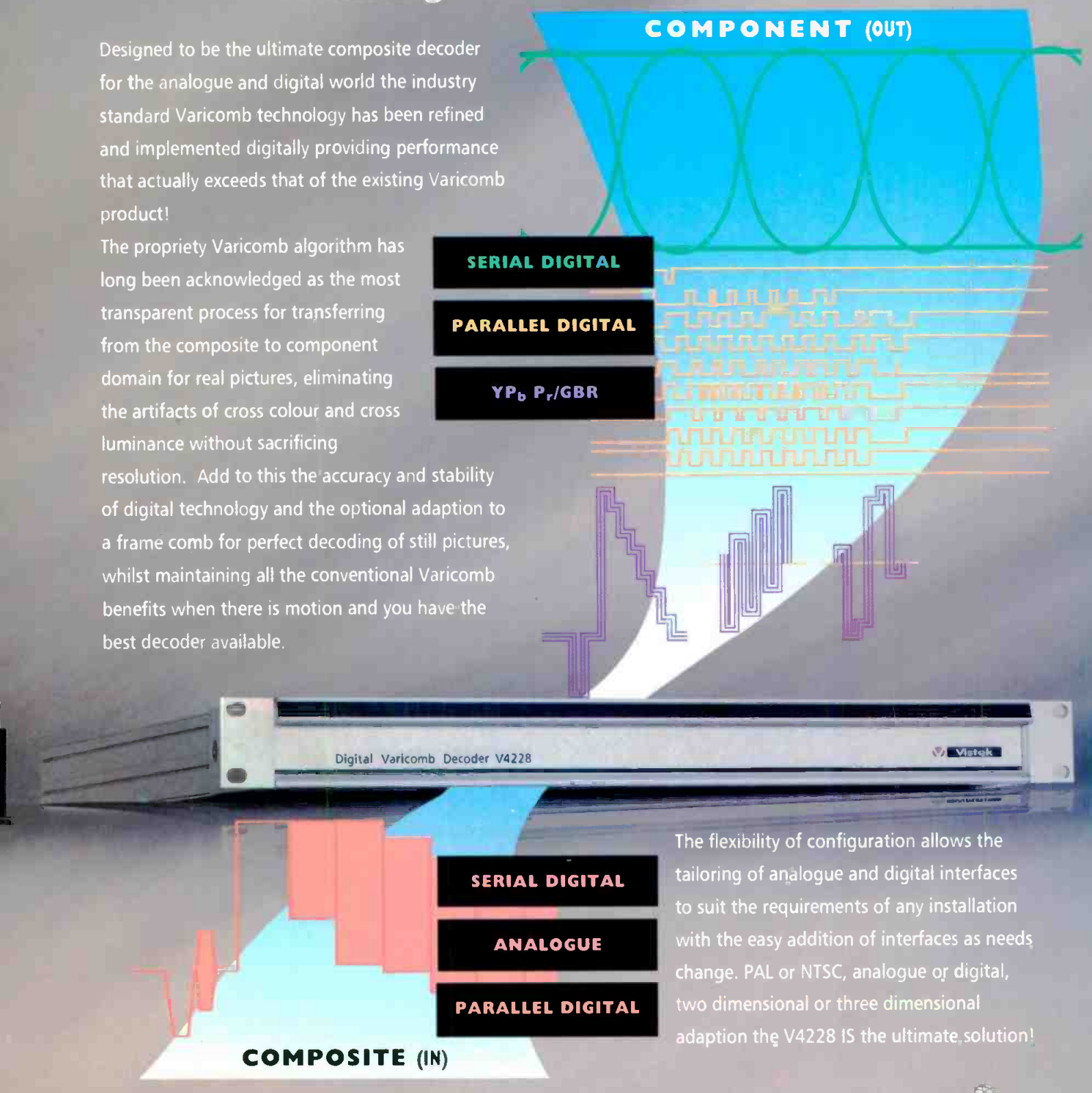

The flexibility of configuration allows the tailoring of analogue and digital interfaces to suit the requirements of any installation with the easy addition of interfaces as needs change. PAL or NTSC, analogue or digital, two dimensional or three dimensional adaption the V4228 IS the ultimate solution!

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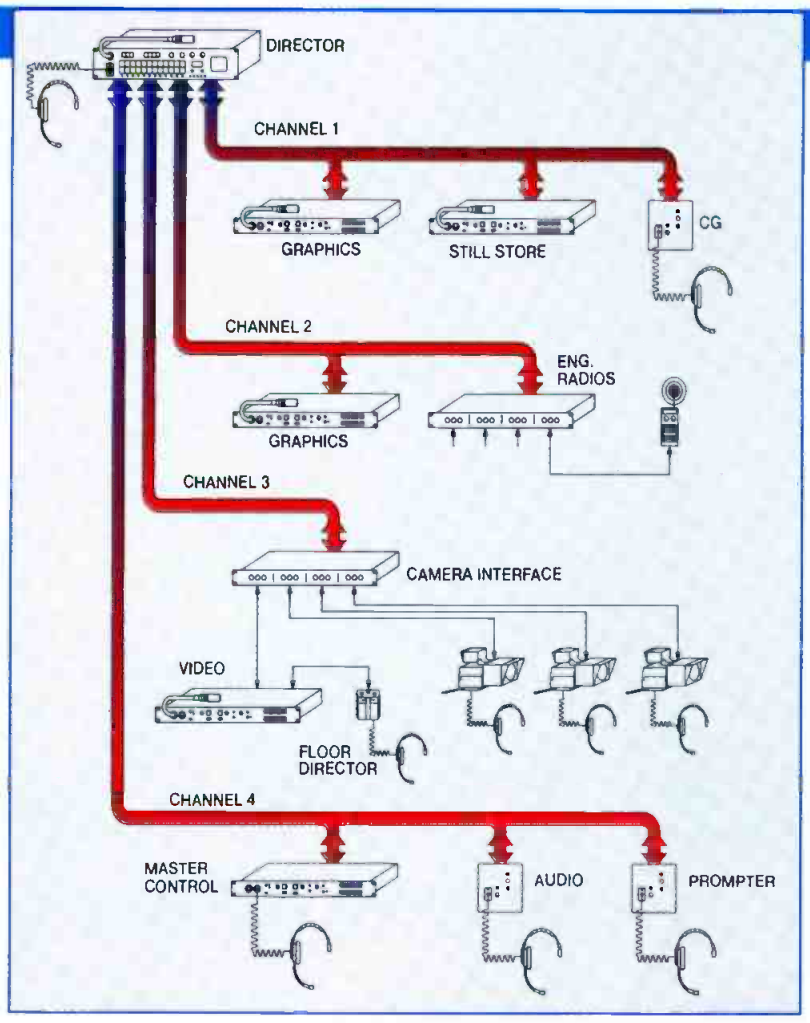

erator needs. Extra or confusing key labels are a thing of the past.

Some systems offer master panels that allow sophisticated users to make a myriad of routing changes through a keypad and an extended display screen. With these powerful panels an operator can instantly route different IFB sources to talent receivers or connect the director to a camera operator on the roof shooting an incoming storm.

Telephone interfaces are built into many matrix-based intercom systems. For outward access, a built-in speed dialer can automatically dial and connect users to remote locations. And with direct inward access, outside crews can dial in and use their touch-tone keypad to connect to any station, group or IFB circuit in the system.

A tangled web we no longer weave

The extensive wiring and thick cables necessary for multichannel party-line intercoms are a thing of the past with modern matrix systems. Stations are wired back to the central computer frame with three pair of wires — two pair for audio and one for RS-422 data. Some systems make it even easier, whereby digitizing the audio and the data stations can be wired back to the central matrix using only a single twisted pair or piece of coax. This is especially useful for long runs. Some digital station interfaces have been successfully tested with runs of up to four miles. For example, in Atlanta last January, a system was used to coordinate

Figure 1. *Simplified block diagram of a matrix-based system and possible interface requirements.*

the Super Bowl half time show. The system hooked together a team of 76 technical specialists including lighting, sound and floor personnel.

Sometimes, direct wiring isn't possible, but with the latest matrix-based systems, a full-function intercom station can be placed anywhere in the world that has access to a standard 4-wire audio path and 4-wire RS-422 data path. Links to intercom stations from a facility can be made via standard microwave, satellite, fiber optic or over a T-1 multiplex circuit, giving anyone anywhere full access to the entire intercom matrix.

The main production control room at KING-TV, Seattle, with newly installed intercom panels in the foreground.

Future shock

Many matrix systems incorporate GPI relays to trigger external devices. There are installations where intercom keys are used to unlock the door to the control room or light up an "Applause" sign. If GPI-style control isn't enough, many matrix-type intercom systems are equipped with serial ports so they are ready to join the automation revolution. Currently, few if any automation companies include "hooks" to intercom systems, but it is possible and markets and applications are being investigated.

How would you automate an intercom system? Weekend intercom setups could load automatically after the Friday late news. Loading the Emergency Broadcast cart could open all relevant mikes for instant communications or automatically dial up the transmitter site. Disabling camera robotics could add paths from the director to the camera operators — the possibilities are endless.

Talk is cheap

One of the most surprising things people encounter when learning about matrix-based systems is that they are affordable, especially when compared to multichannel party-line systems requiring several full-function master stations. The upfront expenditure of the matrix system's central equipment can run from $4,000 to $15,000 depending on size and manufacturer. Full-function intercom panels (and the required interfaces) are less than $3,000 each. Compare that to 12-channel party-line stations costing from $3,500 to $7,000 each. With that in mind, and remembering that wiring for a matrix system is much cheaper and less time consuming than multichannel party-lines, it can be seen that matrix becomes cost effective once you go beyond an 8-station system.

Conclusion

Party-line-style intercoms have served broadcasters for generations. But like art cards, 3/4-inch videotape, and the BBC Color Girl, engineers need to take a long, hard look at their party-line systems to see if they are doing what's needed. In today's rapidly evolving world of broadcasting, the more comprehensive and flexible the communications system, the faster and easier the job can be accomplished. This, in turn, increases productivity and provides for better looking and more profitable programming. ■

➡ *For more information on intercom systems, circle (310) on Reply Card. See also "Intercoms" on p. 55 of the BE Buyers Guide.*

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Building serial digital facilities

The question is, how much trouble are we about to be in?

By John Luff

The Bottom Line

As analog facilities and equipment age, the need to upgrade increases. Remaining analog may not be wise or even possible. Upgrading to digital, however, means an entirely new set of problems to deal with. The integration of digital into analog facilities and the continued use of analog equipment in a digital facility can be accomplished without major problems as long as careful planning is part of the process.

The emergence of sufficient serial digital equipment to credibly build facilities has made many questions surrounding the technology much more urgent. The transition is much the same as the conversion from black-and-white television to color; many techniques will be the same conceptually, but the specifics will be entirely new and considerably more complex. The net result remains unchanged — an analog display of 525/625-line video — but the technology is new. Old monitoring techniques will not work and home-grown experience about what works with analog signals must be replaced by new knowledge that will be as hard to learn as we once thought NTSC was.

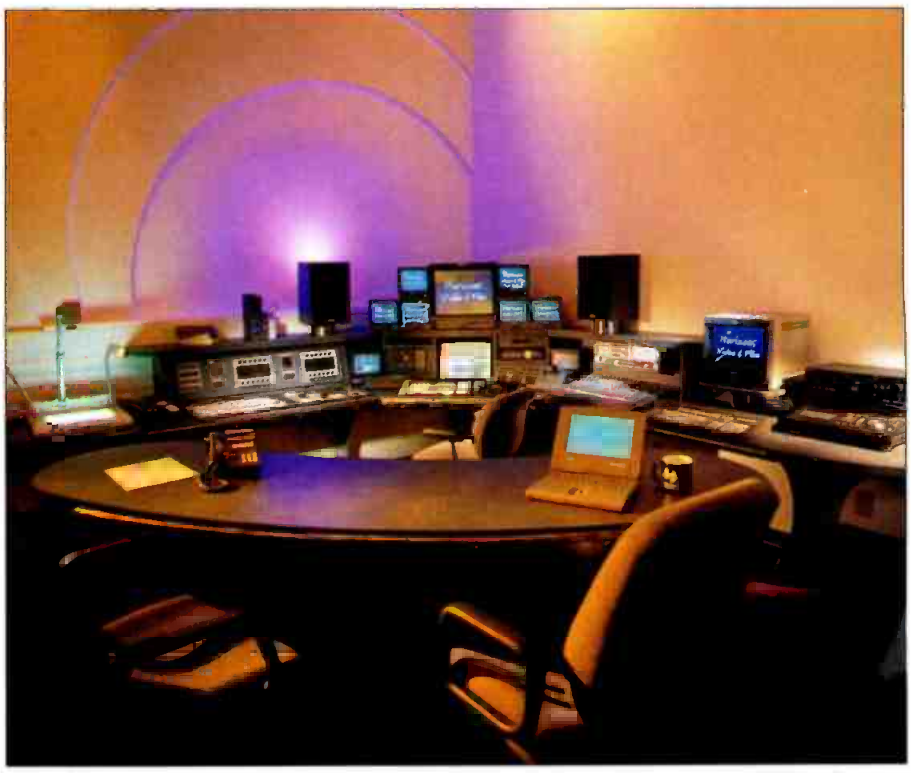
Transitioning from analog to digital

Most troublesome to many is the route from analog to serial digital. Wholesale system replacement is expensive and, in many cases, not practical. Can the best and most useful digital techniques be implemented while avoiding pitfalls? The answer is yes and no. No transition this profound can be as simple as we would like. We must re-train ourselves while executing designs and installations of often untried combinations of equipment.

The most robust part of the technology is the SMPTE 259 standard. It defines a flexible and reliable interconnection that can carry four channels of audio with component or composite video on one coaxial interconnection using familiar cable. It has built-in error detection capabilities and error detection and handling (EDH) that allows each piece in the transmission chain to test the signal and pass information on to the next link. SMPTE 259 is based on known digital transmis-

One of the newest facilities using serial digital technology is DirecTv, located in Castle Rock, CO. Several interconnected routing matrices provide serial digital signals throughout the facility. (Photo courtesy of Sony System Integration.)

Luff is president and owner of Synergistic Technologies, Pittsburgh, PA.



The advantages of component digital technology are crucial to high-end suites. This technology is shown here in a new suite at Horizons Video and Film, Columbus, OH.

sion techniques and benefits from significant knowledge about automatic equalization, signal reclocking and error propagation.

Some claims about conversion to serial digital may be myths, but they can have a big effect on decisions about implementing serial digital equipment.

• **Myth 1:** *All manufacturers' equipment is entirely compatible because it conforms to SMPTE 259.* The truth is the standard is more completely defined for composite digital than for component digital. For instance, the techniques for inserting audio into component serial digital are not fully approved by the SMPTE standardization process, and any implementation runs the risk of incompatibilities. Also, there are still surprises about the interweaving of AES/EBU audio into the video due to fuzzy definitions in how the differing data and framing rates correlate.

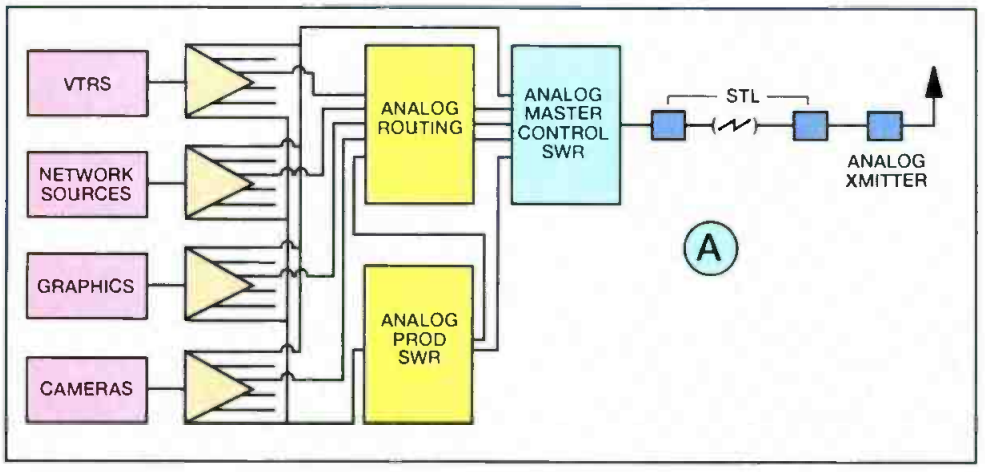
• **Myth 2:** *You can safely plan to use existing 75Ω cabling and patching when converting an existing facility to a serial digital environment.* Few facilities have new equipment that uses the same number of connections in the same places in the racks as a previous incarnation. Long runs can be pulled back, but cable stretchers have not been invented. Patching can be used provided it is truly 75Ω impedance. Anything else may work for short distances, but can be questionable.

• **Myth 3:** *Component digital is simpler; timing is not critical.* When all signals are component serial digital, the world seems right. But when any composite digital or composite analog is used, timing complexity increases. For instance, some digital decoders have internal delays that effectively move the active video relative to vertical sync. Keep a couple of sync generators with line advance and delay when cleaning up those last few missed details.

• **Myth 4:** *Serial digital facilities cost less than expected because only one level of routing is needed.* If you will never make a switch without splitting audio and video, you can buy this one without fear. But it's seldom that simple. Techniques exist for integrating "audio drop and add," which allows audio from one video bitstream to be shifted to another video bitstream.

Because it appears there could be negative factors along with the benefits, why bother? One simple answer: economics. It may be unfortunate, or just a natural process, but consider the amount of new equipment being designed for analog. Only three professional videotape formats (Betacam SP, M-II, 1-inch type C) using analog technology are in production. However, six videotape formats (D-1, D-2, D-3, DCT, Digital Betacam, and D-5) are in production that use digital recording and interfacing. Many other equipment categories are comparable.

If faced with a decision today, you may choose analog equipment to replace older analog equipment. But equipment purchased this year will certainly still be on the books when major manufacturers



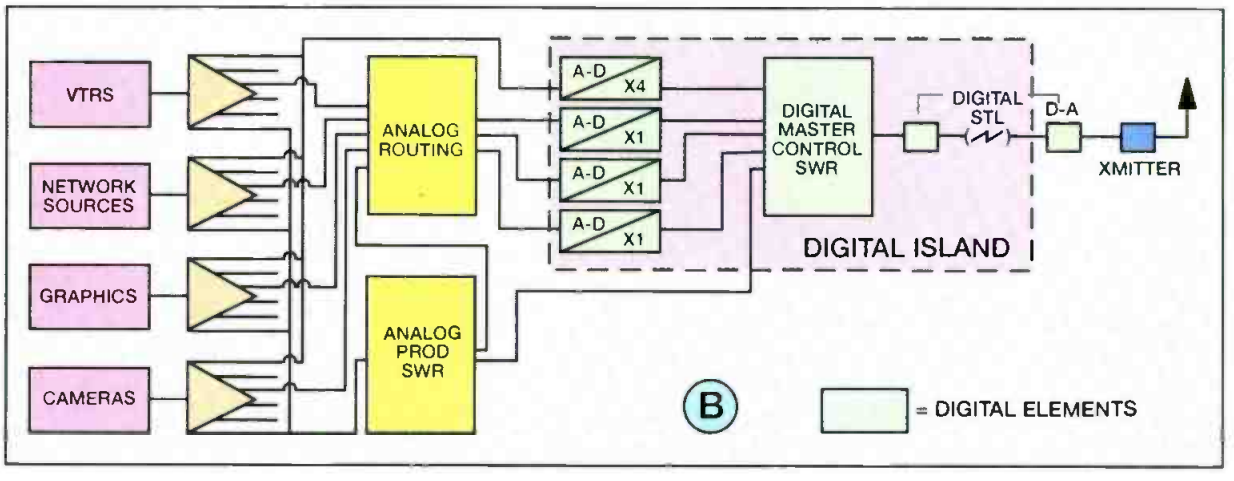


Figure 1. *Most facilities will have to transition by sections into the all-digital world. Shown in A is a typical facility with an analog master control switcher. A first step in the conversion process would be to create a digital island by replacing the analog switcher with a digital switcher, as in B.*

cease production of analog equipment for broadcast and high-end production. Looked at another way, will you be able to purchase additional equipment three years from now to interface with this year's analog purchase? It's hard to say yes, given the current rate of change.

It has been stated that digital is just too expensive. Analyses performed for production clients have yielded only a 10% to 15% premium for comparable digital systems. At the high end, digital equipment has taken over and provides benefits simply not available in analog systems at any price.

Serial benefits

Some benefits of a fully serial digital system are worth enumerating:

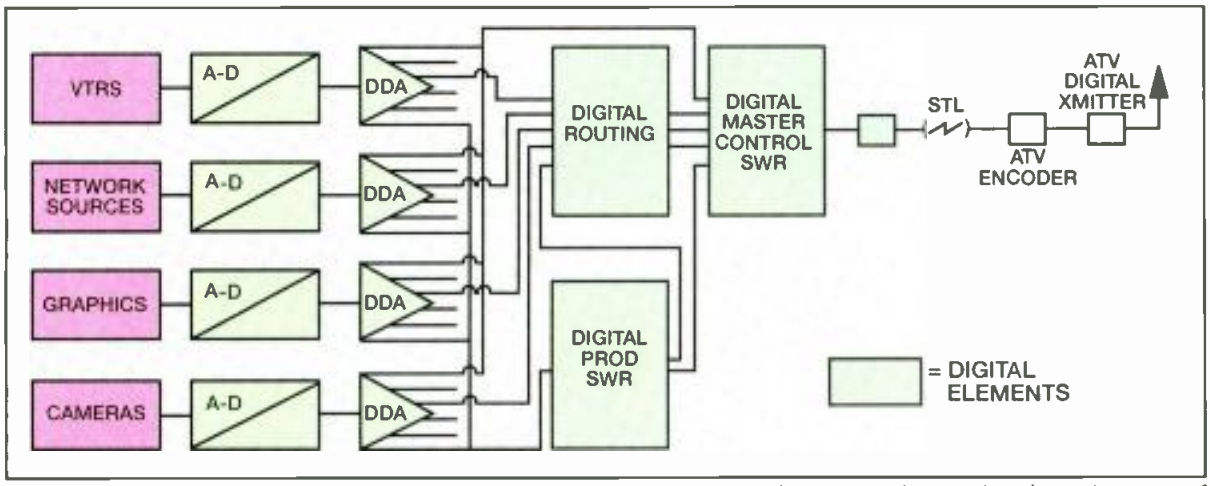


Figure 2. The final transition process in converting the master control area to digital operation requires the replacement of the routing and production switchers with digital equivalents. (DDA=Digital Distribution Amplifier.)

1. Simplified interconnections may be possible if embedded audio fits your needs.
2. Lower total power consumption (though higher power consumption per cubic foot of space).
3. Less drift because digital equipment requires far fewer adjustments.
4. In many cases, upgrades can be done with software.
5. Most digital equipment has built-in diagnostics that simplify maintenance. However, many boards can no longer be repaired without sophisticated instruments and training. The construction of some units makes field repairs nearly impossible.
6. Timing is greatly simplified with most serial digital systems. Cable lengths can almost be ignored. The through delays of individual processing units, however, must be carefully considered in the system design process.

Getting from here to there

The crux of the matter is the transition from a familiar analog facility to an unfamiliar serial digital facility. Two approaches seem evident: evolution and revolution. By replacing portions of a system in blocks, a facility can evolve into a largely digital facility without wholesale replacement at huge economic and operational cost. You might revamp an edit suite and choose to make it internally serial digital, or replace a master control switcher and the link to the transmitter site with a new digital design. (See Figure 1.) These islands internally have all the benefits of the new technology, but come with a cost to interface to the existing analog world on the outside. As the islands grow and become more numerous, these same interfaces can be moved from the I/O of one island to a later conversion target, saving some capital cost. Personnel can get familiar with the new technology in isolated islands without the risk to the total operation that a wholesale conversion would pose. Maintenance schooling is a must, and new test equipment will be necessary. SMPTE, NAB, and SBE conferences are a good place to get a firm grounding in the issues the staff must cope with. The increased emphasis on professional training at the combined SMPTE/SBE/RTNDA conferences will also be helpful.

Revolution is far more difficult, and today will have a higher price than analog systems. Recorders and monitoring systems are more expensive and training must be aggressively looked at before total conversion is considered. In an existing facility, the transition to a new system means space must be made available for the chess game of moving and replacing systems. In this technique, a piece of the new system is constructed on vacant floor space. When it is ready, it is cut over into the existing system, leaving an orphan that can be removed to make room for the next piece. Although this approach is not simple, it is a proven technique. Making the subsystems digital means that for the duration of the transition much interface equipment is needed. And for a time, some of the flexibility of the old analog facility must be given up in favor of purchasing fewer A/D and D/A interfaces. In the end, the completed serial digital system can be more functional than the old NTSC facility, but the transition period will require patience and cooperation from all concerned.

If the luxury, or fortunate mistake, of a new facility is available, the transition is much easier. In the purest example, you simply build the new facility across the street, and when finished, go to work in a shiny new world. But it is highly unlikely that you can abandon the analog world completely. After all, the commercials and promos you get from the outside world and existing library material are still likely to be

on analog tape. The accountant will push to have as much of the old equipment incorporated as possible. In the end, the day will dawn when the entire staff carries equipment across the street and bolts it into the racks. Hopefully, the equipment that moves will be a small portion of the final facility, but be prepared for the lingering footprint of NTSC for a long time.

Component or composite?

A serious concern is whether to choose component or composite digital. Although the answer may become clear quickly, it has cost implications and changes the complexity of interfacing issues when combining serial digital into an existing facility.

Serial composite digital is cheaper than serial component digital. But it is fundamentally NTSC- (or PAL-) coded for more robust transmission. All the old concerns for keeping SC/H phase consistent through multiple generations of reduced resolution composite systems still exist. It is easy to convert from composite digital to NTSC and back with little loss and at affordable costs. Finally, composite coding yields data rates only half that of component coding (143Mb/s for NTSC and 177Mb/s for PAL vs. 270Mb/s for 10-bit component digital and 360Mb/s, 18MHz sampling needed to keep resolution constant with 16:9 aspect ratio).

Serial component digital has all the benefits of analog component technology. It has immunity to the cross color/cross luminance artifacts of NTSC/PAL, better apparent chroma signal to noise performance when converted to analog, higher intrinsic resolution of color and luminance channels, and better multigenerational performance. Component analog edit suites are popular because they have fewer ways for most operational misadjustments to leave a picture unacceptable. Component serial digital has the same benefits with superior performance.

Another huge change lies ahead making component techniques far more important. The interplay between conventional video and computers and the looming transition to ATV must also be considered. ATV formats are inherently component with no composite techniques at any point in the transmission chain. Production techniques should, as my university physics professors used to say, "follow by symmetry arguments." Computers are also inherently component. Workstations and PC-based systems all are available with component digital and analog interfaces. They all require external devices to interface to composite systems of any type.

You can argue the likelihood of ATV being implemented in anything like the form under consideration. But all of the closed-loop compressed video systems under trial or in design use component techniques as well. It seems highly probable that all future systems will converge toward component digital. The CCIR-601-based serial digital systems have coding specifically for 525/625-line inputs, but it seems possible to create extensions to the current standards to include variants not yet planned, at bit rates perhaps far lower. If such extensions can be created, there will be few portions of the media world whose equipment cannot be connected using a single ubiquitous interface. Take this as either a plea to the manufacturers, or at least a fervent wish of one system designer for action by the industry to satisfy a growing need.

Serial is here. It works. It is complex, and its concepts are challenging. It will be critical for all video and broadcast technical personnel to understand techniques for implementation, testing, and use of serial digital signals. It is a fundamental shift away from our knowledge base, but one which holds great promise for our collective futures. ■

Radio in transition

Audio distribution

Digital audio distribution is far more complex than its analog equivalent.

By David Bytheway

The Bottom Line

An all-digital signal distribution system may not improve a facility's overall audio quality. In fact, if done incorrectly, it can actually degrade performance. Better signal-to-noise ratios, headroom, bandwidth, and even lower distortion may still be achieved with analog distribution methods. Because digital audio is clearly advantageous for storage and long-distance transmission, however, it makes sense to include proper digital pathways among a facility's interconnection systems. The key to success lies in careful implementation.

It is often said that digital audio solves a lot of problems. Although this may be true in theory, when it comes to a teleproduction or broadcast facility, a lot of baggage comes along with digital audio, making operations significantly more complex than with analog techniques.

Because AES/EBU digital audio is a sampled and quantized signal with a serialized bitstream, frames and subframes, it must be handled like video. Devices, such as sync generators, auto-framers, sample rate converters, and methods like impedance matching, cable equalization and reclocking are required. Much of this is foreign to many audio engineers, even those that have been working with digital recording for years. The following are some observations on the transition from analog to digital audio distribution.

A-to-D and D-to-A conversions

Make as few analog-to-digital and digital-to-analog conversions as possible. Significant degradations can occur in the conversion process. Select the best A-to-D converters possible because they will ultimately control signal quality. Monitoring stations and other non-critical locations can use inexpensive D-to-A converters, but for the main program signal path, only top-quality converters should be used. Look for such features as AES cable equalization, secondary phase-lock-loops (PLLs) to reduce jitter, and full compatibility with all AES/EBU modes (sample rates, pre-emphasis, etc.).

The AES/EBU standard supports up to 20 bits of resolution in standard mode, and up to 24 bits in extended mode. True 20-bit resolution is necessary to equal the performance of analog distribution equipment. Converters with real 20-bit performance (in terms of actual measured distortion and noise specs) are not yet widely available, but they will be soon.

Digital audio synchronization

It is not always necessary to run a fully-synchronous digital audio distribution system. Eliminating the small disturbance caused by a damaged sample due to a switch is not always worth the effort required to synchronize and time all sources or the switch point. Even when all sources are synchronized, and switches made on frame boundaries, there may still be audible effects. For example, if the outgoing sample is positive and the incoming sample is negative, a large signal transient will be generated that will sound like a click or pop.

It is not always necessary to run a fully synchronous digital audio distribution system.

In analog switchers, the turn-on and turn-off times are relatively slow and produce a sort of fade-down, fade-up effect that is "soft" sounding. Experience shows that synchronized and timed digital audio switches sound quiet only when the switch is done during silence or soft portions of the signal between programs. There is no simple way to avoid this

Bytheway is a principal engineer at Broadcast Television Systems (BTS) in Salt Lake City. Respond via the *BE* FAXback line at 913-967-1905.

The result— Foundation.

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switching noise. Some systems use a crossfade via digital signal processing (DSP) to achieve a quiet switch.

Broadcast systems have also incorporated sample rate converters (SRCs) so that sources with widely different sample rates can still be delivered on-air.

Sample rate conversion

Sample-rate conversion is not always a cure-all. Some advocate the use of sample-rate converters to solve certain synchronization problems. In fact, sample-rate conversion of asynchronous sources is quite likely to cause signal-degrading artifacts. Sampling rate conversion should be minimized.

Sample rate converters work best when the incoming and outgoing sample rates are locked together by some integer ratio. Higher distortion results when the two rates are close to the same frequency but not locked. This is what happens when sample rate converters are used for synchronization.

Even though it seems heretical, the use of high-quality D-to-A and A-to-D converters connected back-to-back may be the simplest way to solve some sample-rate or sync problems. This method has proven equal to the performance of digital sample rate converters

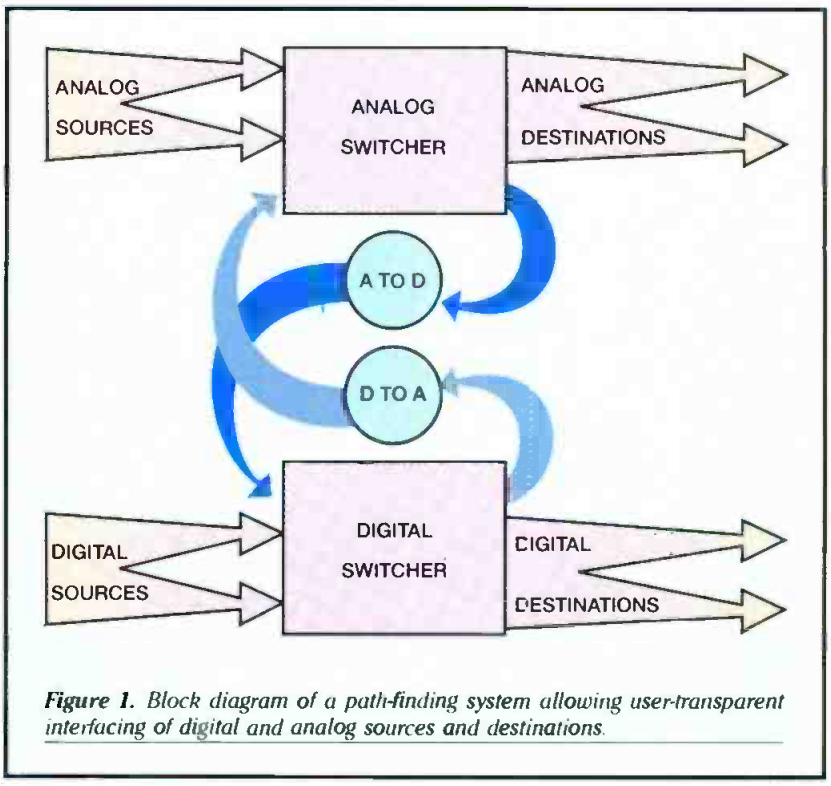

Figure 1. Block diagram of a path-finding system allowing user-transparent interfacing of digital and analog sources and destinations.

Make as few analog-to-digital and digital-to-analog conversions as possible.

when the highest quality converters are used, and it certainly costs less.

Routing digital and analog signals

An advantage of newer switcher control systems is the provision for *path finding*. Using this technique, tie lines with A-to-D and D-to-A converters in their paths are connected between separate analog and digital switchers. (See Figure 1.)

Some control systems can automatically route signals through these tie lines, providing full interchangeability between analog and digital devices. The exchange can be totally transparent — the user does not even have to know which sources are analog and which are digital. This technique, called *automatic path finding*, has been used successfully in several recent installations.

Equalization and AES/EBU digital audio signals

Experience has proven that distributing AES/EBU signals on twisted pair cable without some form of equalization may be impractical in many facilities. The signal losses in standard audio cable are simply too high. Newer, low-loss cables are now available that help with the problem, but for long runs, equalization is still required. (A new 75Ω coax standard for AES/EBU audio is under development in a joint subcommittee of SMPTE and AES. The lower loss of coax will allow much longer lengths before equalization is needed.)

Standard twisted pair cable can be used for only 150 feet or so for AES/EBU audio. With low-loss, data-type cable, lengths up to 500 feet work reliably. Using adaptive equalization, lengths up to 1,500 feet or more have been used with complete reliability. An added benefit of equalization is the resulting increase in rise-time of the AES edges. Some AES receiver circuitry is sensitive to the rise-time of the AES edges. If these edges are too slow, then the recovered clock signals that are derived may have greatly increased jitter. When these recovered clocks are used to drive sample-rate clocks in DACs, degraded distortion performance can result, even with short cable lengths.

Standard twisted pair cable can be used for only 150 feet or so for AES/EBU audio.

New receiver circuitry using secondary PLLs reduces jitter and improves conversion performance. Converters that use delta-sigma methods are much more sensitive to this error than standard ladder-type converters, and therefore should be checked carefully.

Although this discussion does not hope to explore all the pertinent issues in today's audio signal distribution, those mentioned are the most critical at present. Paying careful attention to these matters can make a significant difference in the performance and reliability of your facility's operations, both today and tomorrow. ■

➡ *For more information on audio distribution, circle (311) on Reply Card.*

See also "Routing Switchers," p. 56 of the BE Buyers Guide.

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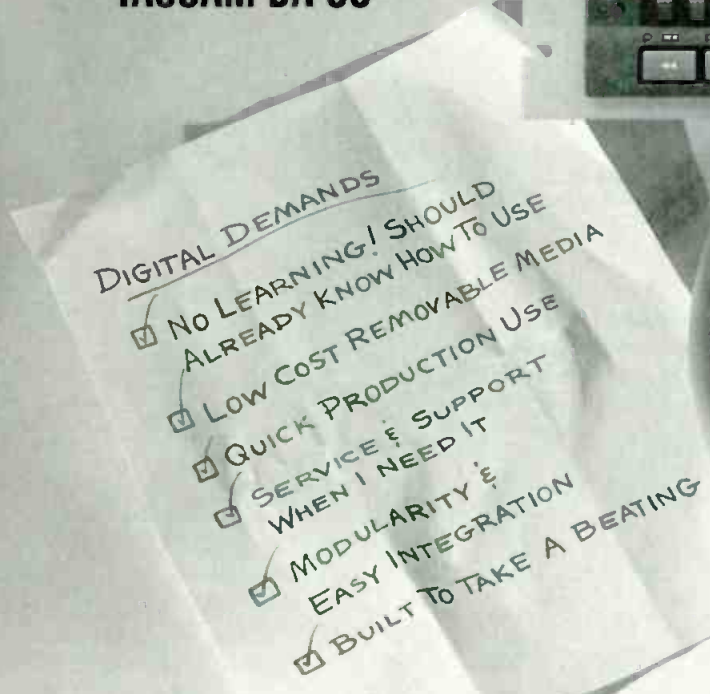

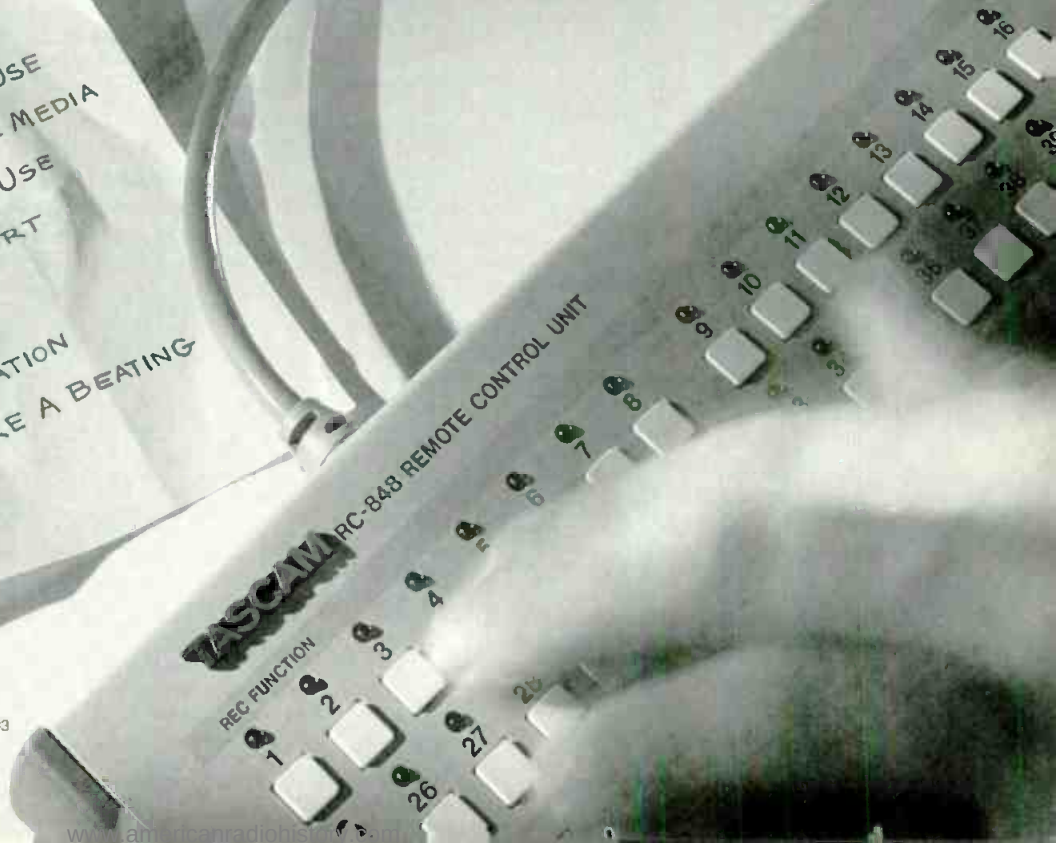

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Re: Radio

Tubes in review

By John Battison, P.E.

Few modern radio transmitters have more than one tube stage (if any) in their design. If there is a tube, it is always in the final output stage, and therefore, is part of the critical last link between a station and its listeners. Just as some older engineers had difficulty coping with transistors, so do many younger ones find tubes a little daunting.

For example, on a recent station visit I encountered a contract engineer who had the final tube running half a volt higher than specified because he was "burning it in." Although opinions differ concerning the proper treatment of tubes, I'd never heard anyone recommend running 0.5V above the rating *when new* for burn-in purposes. Perhaps a brief recap of tube theory and operation is in order.

Although tubes rely on heat for their operation, too much heat will shorten tube life.

Tube theory

Tubes require a source of electrons to operate. This source is a heated element. The element can be a direct part of the electron stream (as in a final power tube), or an indirectly heated part (as in a tube used in a receiver). Transmitting tubes are always of the directly heated cathode — or *filament* — type.

The size of the filament is determined by the power that the tube has to handle. For example, a popular type 811 tube requires 6.3V at 4A. A 4X500A, the type often used in the finals of small AM transmitters requires 10V at 10.2A. A type 5681 requires 12V at 220A! In order to provide the necessary volume of electrons to carry the power required, the filament has to be large and mechanically strong.

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.

Such high filament currents immediately bring to mind possible trouble sources, and an obvious one is filament contacts. In the case of larger transmitting tubes, connection is often by means of heavy, braided leads clamped to the power source. For tubes like the 4X250 and the 4X500A, pins on the base are used for plug-in connection. With many amps flowing, a dirty or poor filament connection can easily burn up a socket.

Paradoxically, *heat* is also one of the tube's greatest enemies. Although tubes rely on heat for their operation, too much heat will shorten tube life.

Filament design

A tube's filament design varies depending on the age of the tube, the power and the tube designer's own influence. Many tubes today use a *hairpin* style of filament. In this design, a ring of parallel filament wires in the shape of hairpins is built into a cylindrical shape. Springs compensate for heat expansion, and filament warm-up is not essential, although tuning can drift slightly during warm-up.

Older tubes usually have spiral-wound filaments, which can sag as they age and short out adjacent turns. There are also even older filaments using parallel wires running vertically.

Mesh filaments, like their name, consist of a cylinder of fine wire mesh with a center support that carries current to a top plate to which the mesh is welded. Current then flows down through the mesh and heats it as it flows. As the filament heats up, it tends to expand and change shape. In fact, filament-to-grid shorts can often occur, which occasionally clear themselves on cooling and prove hard to locate when the transmitter is off.

As we all know, vacuum tube principles were first discovered when early lightbulbs experienced a darkening of their glass envelopes. This led to the discovery that the hot filament emitted something. From this came the diode tube with a filament and a plate that allowed current to flow between the filament and plate when hot.

Simple hot wires proved to have inadequate electron emission, and as tubes developed, the rare metal thorium was added to the tungsten filaments. Today, a specific amount of carbon is burned into the thoriated filament as it is manufactured. This is called *carburizing*.

During operation, carbon level in the filament decreases and emission becomes too low to maintain power output. This is known as *decarburizing* and is directly connected with the filament temperature — the higher the operating temperature, the shorter the tube life.

Gassing

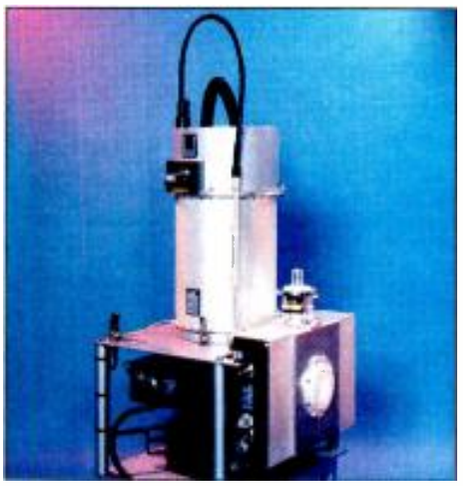
As a tube operates, a second problem arises. The residual gases also react with the heated filament and speed up the decarburizing process. Most tubes contain a *getter* — a small metal plate that is heated during manufacture to absorb or burn out any excess residual gases. In earlier days, tubes tended to become gassy over time, even when not in use. (This was indicated by a blue glow that danced with modulation.)

Most modern tubes made with ceramic and metallic envelopes can be stored without encountering such gas problems. Otherwise, it would be hard to maintain an adequately fresh spare tube stock. Veteran engineers will remember the need to rotate tubes to prevent "shelf gassing." The constant in and out maneuvers that this process required often damaged the sockets, fingers or pins of the tubes, thereby defeating the purpose of extending tube usefulness.

If you have a transmitter that uses older-style tubes with glass envelopes, it is best to store them in air/moisture-tight bags to prevent rusting of the Kovar metal-to-glass seal. This Kovar also has a tendency to introduce gas into the tube. Notwithstanding the problems just mentioned, such tubes *should* be placed in service every year or so.

Be careful not to overvolt a tube — unless it is old and worn out and the only way to maintain licensed power is by burning up its filament while waiting for a replacement to arrive! ■

Tower maintenance



By J. Cabot Goudy

Protecting structural steel from environmentally induced corrosion is a controversial topic, complicated by numerous products and treatments as well as their application. Most broadcast towers are protected using one of the following systems: painting, hot dip galvanizing, zinc spraying or some combination of these. Paint as the sole means of protection is considered the least effective. It relies upon the paint forming a protective barrier and sealing the steel from moisture and other corrosive agents. When the paint is chipped or scratched, the steel begins to corrode. Some paints contain zinc, which affords some additional cathodic protection, however, few structures built after 1960 use paint only.

Virtually all contemporary broadcast structures employ hot dip galvanizing, zinc spraying or a combination of one of these plus paint to protect the steel. Hot dip galvanizing is the most widely used method. It is the process of thoroughly cleaning the steel and then dipping it into an 850°F molten zinc bath. Upon removal, the remaining zinc forms a thick, tough, abrasion-resistant coating. This coating covers the entire unit and is metallurgically bonded to it.

The galvanized coating protects the base metal in three ways. First, it acts as an effective barrier against the penetration of water, salts and other corrosive agents. Second, the zinc sacrificially dissolves to provide cathodic protection to any exposed steel. Third, over a period of time, the zinc layer forms a film of zinc carbonate that seals over any voids or small damaged areas in the zinc coating.

It is the *cathodic* protection that primarily differentiates this coating system from the paint-only system. When painted steel is exposed, rust forms at the steel/paint interface. The rust occupies a volume several times that of the base steel and the resulting expansion leads to failure of the paint/steel bond. In addition, the rust is porous and attracts moisture and other reactants, which in turn create additional rust and lead to further failure of the paint system. (See Figure 1a.) Figure 1(b) illustrates a break in a hot dip galvanized coating. Here the zinc provides cathodic protection to the steel because the zinc is more anodic than the steel. Small scratches and cut edges do not rust because of the sacrificial nature of the zinc. An important feature of the hot dip galvanized coating is the bond to the base metal that ensures corrosion will not occur between the zinc and the base metal. Zinc is deposited on the base steel and forms several layers, ranging from 100% zinc at the surface, changing through various layers of iron/zinc alloy, to 100% steel at the base.

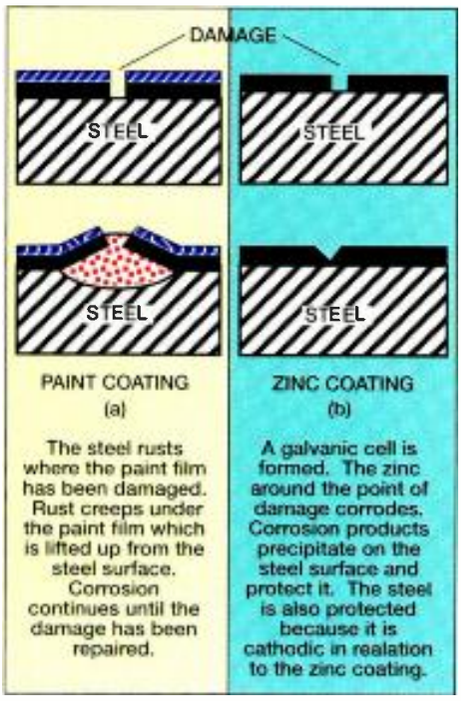


Figure 1. *Cross-section showing the effect of surface damage on different rust-preventive coatings.*

A third method of protection is a process called *zinc thermal spraying* or *flame spraying*. The zinc is applied by spraying a stream of molten zinc onto the base metal. The coating is mechanically bonded to the steel, but no iron/zinc alloy layers are formed. The adhesion is quite good if the base metal is properly prepared. The resultant coating is slightly porous compared to the hot dip galvanized coating. The zinc, however, affords the same "cathodic" protection and over time zinc corrosion products will form and act to seal the porous surface. The surface is also slightly rough and makes an excellent base for a top coat of paint.

The final method of protection is sometimes called a "duplex system," or the application of paint over hot dip galvanized or flame-sprayed steel. Applying paint over hot dip galvanized steel can be troublesome and frequently results in failure. Although, with proper surface preparations, hot dip galvanized steel can be successfully painted.

The zinc coating applied to hot dip galvanized steel undergoes certain evolutionary transformations that begin immediately upon removal from the molten zinc bath. First, the outer layer (100% zinc) begins to oxidize. The early stages of this oxidation will not lead to adhesion problems for some paints if applied within 48 hours. Beyond 48 hours, however, zinc oxides, zinc hydroxides and other various contaminants on the surface prevent proper paint adhesion. This condition can be present between 48 hours and two years after galvanizing.

The final stage of evolution in the galvanized coating occurs between eight months to two years after galvanizing, when the final film of zinc carbonates form on the surface. They are essentially inert and tightly adhered to the surface. Painting after the stable zinc carbonates are present can be done with little or no surface preparation.

Unfortunately, most hot dip galvanized

Goudy is a professional engineer in Great Falls, VA.

steel towers if they are going to be shop painted, are painted when the films of zinc oxides and hydroxides are present. Proper surface preparation is critical and can be achieved by lightly sandblasting the material to roughen the surface and remove the contaminated films. Sandblasting is costly and requires a skilled operator being careful not to remove too much zinc. Another alternative is a high-pressure washing followed by a metal conditioner or "wash primer."

Life expectancy of galvanized coatings

The ASTM A123 standard covers hot dip galvanizing of structural steels and requires an average minimum thickness of zinc applied during the process. The average minimum is between 2 and 2.3 oz./sq. feet of zinc or approximately 3.4 to 3.9 mils thickness. Research has shown the life expectancy of the coating is a function of the thickness applied and the structure's environmental exposure. (See Figure 2.) Similar results would be expected from zinc applied through a thermal spraying process if the two applications were compared on an equal thickness basis. In practice, zinc spraying is difficult to apply in corners and similar areas, making the thickness non-uniform. For this reason, and because the surface is considered porous, most zinc spraying applications also receive a top coat of paint.

The most significant advantage of the duplex system is the synergistic effect of paint over a galvanized coating. The combined effect adds a 50% life span extension to the simple addition of the protection provided by the zinc and paint separately. In other words, if a coating has a life expectancy of 20 years and paint has 10 years, then the duplex system can be expected to last 45 years. Some research indicates that the 50% increase is a conservative value.

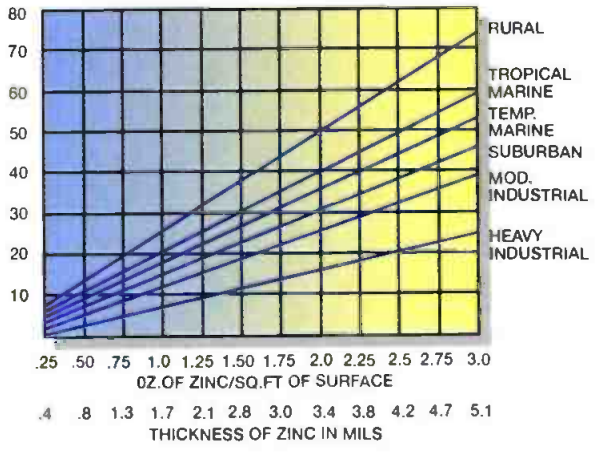


Figure 2. Service life of protective coatings vs. the zinc thickness and type of atmosphere.

Many non-painted hot dipped galvanized broadcast towers have been reported to be rusting after only a few years in service. In most cases the so-called rust is a yellow to orange-red discoloration and is not rusting of the base metal. This phenomenon is called *alloy layer staining*. In some cases the outer layer of pure zinc is expended quickly, thereby exposing the iron/zinc alloy layer. As the iron in the alloy layer is liberated and forms rust, the characteristic discoloration is evidenced. It should be noted that a significant amount of galvanic protection remains after the first appearance of this discoloration.

Remedial treatments for in-service structures

Corrosion protection for an in-service structure relies upon the quality and integrity of the originally applied system. Once it begins to fail it must be corrected or enhanced by a field-installed paint application, which falls into three basic categories.

The first protection system discussed was that of paint applied directly to steel. Although rarely used on contemporary structures, many older structures still exist with paint alone providing corrosion protection. The most important maintenance factor is routine inspection and correction of paint failure

and rusting. Rusted areas should be scraped clean to bare metal, painted with an organic zinc-rich primer and top coated.

The second category is the non-painted hot dip galvanized structure. Because of alloy layer staining, many towers have been painted prematurely. Once painting is decided upon, the weathered galvanized steel provides an excellent, stable base for the paint. The surface should be thoroughly rinsed with a high-pressure water blast, primed and top coated. Some paint manufacturers recommend the application of an inorganic zinc primer to severely weathered galvanized steel. However, many experts feel most quality paint, properly applied, will adhere well and provide the necessary protection assuming there is still some zinc remaining to provide cathodic protection to the base steel. Severely rusted areas must be cleaned to bare metal and primed with a zinc-rich paint.

Maintenance of the third category, paint over galvanizing, can range from minimal to extensive. As a minimum, touch-up paint will be required after erection. If the tower is not strobe lighted, a color coating must be applied on a routine basis to meet FAA requirements. The most common failure of the paint over galvanizing system is a lack of adhesion. A failure of this nature requires extensive surface preparation to remove all loose paint using either water or sandblasting. Severely rusted areas require heavy scraping to bare metal and priming with zinc-rich paint.

Removing rust to bare metal on a broadcast tower requires an application of a zinc-rich primer. (Photo courtesy of Broadcast Communications, New Glarus, WI.)

The real world

Finally, corrosion protection maintenance for in-service structures needs to be discussed. Recommendations must consider the realities and difficulties of working on a 2,000-foot tower. Following are some considerations:

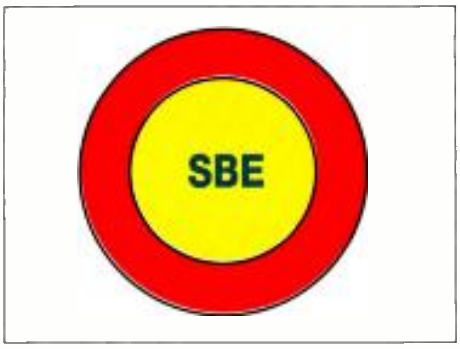
1. *Sandblasting may not be an option.* Many towers are located in urban environments, requiring complete recovery of the abrasive particles. Power tool scraping or waterblasting may be required as alternates.
2. *There is limited control of the environment; in particular, humidity.* Many paints are not recommended to be applied in high humidity. This can become a serious consideration in locations such as Jacksonville, Florida.
3. *Two-part epoxy paints or "hot" paints have a limited pot life.* These paints perform well in laboratory tests and when properly applied under controlled shop conditions. However, their use in the field is complicated by their limited pot life and temperature sensitivity.
4. *The quality of water-based acrylic paints has improved.* They are durable, easy to handle and easy to apply.

Conclusion

This is a guide to some of the problems and solutions associated with controlling corrosion on broadcast towers. If the problems are ignored, the consequences can be extremely costly. If the solutions are misdirected or misapplied, the consequences can be even more costly. Careful consideration of these issues will help ensure a long tower life. ■

SBE Update

SBE industry relations



By Terry Baun

"In the terminal years of this century, broadcasting will face a host of dramatic changes; our ability to meet and manage them will largely determine broadcasting's character and may mark its survival."
— Joseph Flaherty,
Senior VP/technology
CBS/Broadcast Group

Preparing our membership to meet the challenges of emerging communications technologies is the SBE's most vital goal. It's a challenge that's renewed with every announcement of progress on construction of the information superhighway.

If broadcast engineers are to survive as vital and active contributors to the technology stream of the 21st century, it is important that the SBE grow.

Because of the efforts of past president Richard Farquhar and the International Committee, SBE boasts active relationships with parallel broadcast organizations on several continents.

But just as the society reaches out to fellow broadcast engineers around the world, the SBE must also begin to relate in a fraternal way to organizations in this country who operate on parallel technical tracks. Visitors to a major technical gathering, such as the NAB or World Media Expo quickly see distinctions blurring among audio, video, broadcast, cable and satellite. It seems evident that we are all moving down the highway toward a PC-integrated digital universe. The idea of an integrated exposition such as this fall's World Media Expo, which involves SBE, NAB, RTNDA and SMPTE, would have been unthinkable 10 years ago; the fact that it is a reality in 1994 is a tribute to the vision of all four organizations.

The bottom line is this: SBE is committed to maintaining the art and science of broadcast engineering as a vital contributor to the forthcoming information age.

As the first step in that effort, the SBE is inviting the leaders of allied technical societies to be special guests at the annual convention at World Media Expo each year. The SBE wants our technical brethren to see what it is that makes the SBE distinctive and vital to the communications industry, and to have the opportunity to meet with our officers and board in an informal and relaxed setting. The SBE knows how much its membership has to offer — and it isn't shy about it.

The first group of industry associations to receive formal invitations to the fall convention will include a senior representative from the Audio Engineering Society, Society of Cable Television Engineers, The Association of FCC Consulting Engineers, and the Society of Satellite Professionals. It is the SBE's hope to develop a program to introduce these senior representatives to the SBE officers and board in Los Angeles and let them see what SBE is all about.

The SBE must expand its thinking about how we relate to our fellow engineers and technicians in telecommunications. It must begin to form strategic alliances to ensure the continuation of our identity as broadcast engineering professionals while acknowledging the expanding role of media engineering and our rightful place within it.

Those of you who attended the 1994 NAB Convention may have noticed a rather subtle, but significant, change in the badges this year. Instead of badges marked Radio Management, TV Management or Engineering, 1994 NAB conventioneers all wore badges that were the same color and bore the same marking: NAB '94. This allowed admission to any of the three convention programs, but more importantly, reflected a new and more realistic view of radio/TV managers and engineers as partners in the commonweal of broadcasting.

In addition to working with other technical societies, the SBE seeks to develop training and educational programs involving technologies that are vital to the future of our industry.

High on that list is the development of a certification endorsement emphasizing PC networks, local and wide-area. Just as broadcast management currently expects our membership to be comfortable with managing voice telephone systems, PC network management is a certain next step. A program that certifies that our members are comfortable with this new technology will be vital for continued professional growth in not only today's job market, but tomorrow's opportunities.

SBE Engineering Conference / WORLD MEDIA EXPO

Digital data communications and satellite systems are other specialized skills that will be investigated for possible certification endorsements. Undoubtedly other areas of interest will be forthcoming. We know it is vital that SBE members have access to the latest in telecommunications training, but we depend upon the membership to let the society know what new skills are required.

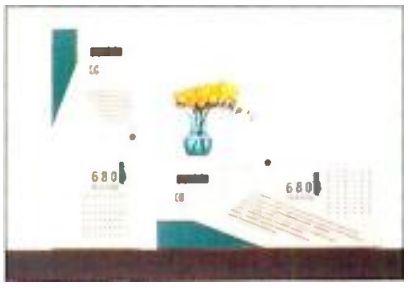
Just as SBE challenges members to expand their thinking of what their job description is, the SBE too must examine its relationship to other engineering and technical societies.

As Joseph Flaherty points out, our survival as an industry is at stake. We can stand by and watch the information superhighway being built, or we can grab the tools and help make it happen. What is absolutely certain is that we will be working alongside fellow engineers who can benefit from the expertise our broadcast training can provide. ■

Baun is vice president of the SBE, and chairman of the SBE Industry Relations Committee.

New Products

Real-time disk array
By Ciprico



• **6800:** provides sustained transfer rates of more than 19MB/s with Data-on-Demand performance features; compatible with the 6700/10 series of RAID disk arrays with the use of a 6800 controller; offered in 4GB, 8GB, 16GB and 40GB configurations; offered in Spectra or Rimfire packages.

Circle (350) on Reply Card

Cable telecommunications dictionary
By Jones International Ltd.

• **Jones Cable Television and Information Infrastructure Dictionary:** 4th edition includes 2,900 information superhighway definitions; 6x9 hardbound, 216 pages; available on 3.5 diskettes for Macintosh or IBM Windows platforms, and on CD-ROM; both formats feature 850 "Hot Links" highlighted terms to help seek out related entries; easy-to-use navigation and search tools.

Circle (351) on Reply Card

Video routing switcher
By Pesa

• **Lynx 200 RM2416V:** compact, wideband, high-performance video routing switching; supports 24 inputs and 16 outputs in one-rack unit; can also be configured as an 8x5 RGB 200MHz router; internal controller supports operation from a pushbutton or touchpad type control panel; supplied with an internal power supply; second backup power supply can be connected to external, rear-mounted connector.

Circle (352) on Reply Card

Hand-held multimeters
By Hewlett Packard

• **HP 971A, 972A, 973A and 974A:** feature manual- and auto-ranging modes as well as a safety shutter; 971A, 972A and 973 feature a 3½-digit display with accuracy ranging from 0.3% to 0.1%; the 974 features a 4½-digit display with basic accuracy of 0.05%

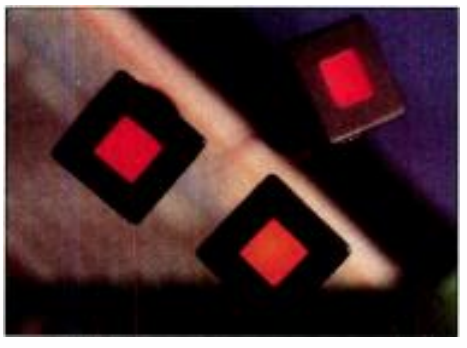
Circle (365) on Reply Card

Test accessories catalog
By ITT Pomona Electronics

• **1994 New Product Test Accessories Catalog:** introduces more than 100 new products in 36 full-color pages; highlights Pomona's logic scope probe, insulated scope probes, oscilloscope probes and DMM test lead kits, IEC1010 probe leads, fused probe kits, grabbers, cable assemblies and adapters; also features test clips and adapters for IC devices.

Circle (357) on Reply Card

LED indicators
By Lumex Opto/Components



• **SSI-LXH55 series:** fit into standard 11/32-inch round holes, outside dimensions are 5x5mm for the lighted area and 10x10mm for the surrounding black bezel; color choices are blue, green, yellow, amber and red with bi-colors available as specials; light intensity varies depending on color.

Circle (355) on Reply Card

Ceramic sleeve
By AMP Services

• **Solid ceramic capstan sleeve:** for Ampex VPR 6 and VPR 80 capstan motors; existing shaft is turned down and ceramic sleeve is mounted and ground in place to be concentric and flutter free; precisely finished surface texture optimizes tape contact; guaranteed for life against wear, scratching or chipping.

Circle (356) on Reply Card

Field-strength meter
By Z Technology

• **R-501P RF field-strength meter:** handheld, battery operated and fully synthesized; covers 3.0 to 1000MHz with frequency steps as fine as 2kHz; can measure input power levels from 0.32 uV to 320mV; input impedance is 50Ω; power measurement accuracy is guaranteed to within +/-2dB.

Circle (353) on Reply Card

Software
By ImMix

• **VideoCube 1.2:** provides new functions for PAL and NTSC; PAL version provides feature set and functionality available in NTSC version of the VideoCube workstation; offers variable speed playback of clips, selectable slow-motion and fast-motion, freeze frame in and out for clips, multiclip move for blocks of clips, support for Sony UVW-series Betacam SP VTRs and build to disk capabilities.

Circle (358) on Reply Card

New Products

Universal VTR controller
By DNF Industries

• **ST200:** universal VTR controller featuring numeric keypad for easy entry of "search to" locations, a 2-cue point memory, search to cue, preroll, and standby on/off functions; operator can control D-1, D-2, D-3, D-5, DCT, Betacam, MII, 1-inch, 3/4-inch, S-VHS and Hi-8 formats from Sony, Ampex, BTS, Panasonic, Hitachi and JVC via serial RS-422 using one controller; functions can be customized.

Circle (359) on Reply Card

Audio/video cable catalog
Belden Wire & Cable

• **Audio/video catalog:** 76-page, illustrated publication featuring line of Brilliance audio and video cabling products in addition to comprehensive application and technical information.

Circle (360) on Reply Card

High-resolution monitor
By Asaca/Shibasoku

• **CM14A:** 14-inch color monitor designed for monitoring NTSC or PAL color video signals; easily rack mountable in a VTR console or standard rack; composite and component signals are standard features with Y/C; operable with optional D-2 and D-3 digital signals; in-line dot CRT of 0.31mm dot pitch; horizontal resolution is 650 lines.

Circle (361) on Reply Card

Audio/video routing switchers
By Knox Video

• **RS16x16 and RS8x8:** these audio and video routers operate at 660Ω and handle the full range of balanced audio up to +4dBm; also feature professional quick-connect, self-locking, bare-wire connectors; balanced audio switchers route the full matrix from either front-panel control or RS-232 interface; also available are RS remote controllers, single rack-space units configured to control full matrix including breakaway audio or a single output and a Windows driver to control the router from a Windows format featuring a graphics interface; front-panel LED indicators display current routing pattern; remote video readout is also available.

Circle (362) on Reply Card

Continued on page 70

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B&H PHOTO-VIDEO

TASCAM

DA-88 Multi-Track Recorder

The first thing you notice about the eight channel DA-88 is the size of the cassette - it's a small Hi-8mm video cassette. You'll also notice the recording time - up to 120 minutes. These are just two of the advantages of the DA-88's innovative use of 8mm technology.

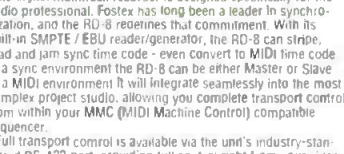
- Intrinsic to the 8mm video format is the Automatic Track Finding (ATF) control system. This approach records the tracking control information, along with the program material, using the helical scan (video) head. Competing S-VHS based system record the tracking data with a linear recording head, independent of the program data. The S-VHS tape must be run at a higher speed (thereby delivering shorter recording time) to deliver control track reliability, and requires some form of automatic or manual tracking adjustment. Synchronization and tracking must be adjusted, either automatically or manually (just like on your home vcr) as the machine ages, or if the tape is played back on another machine.
- On the other hand, the ATF system ensures that there will be no tracking errors or loss of synchronization. The DA-88 doesn't even have (or need) a tracking adjustment. All eight tracks of audio are perfectly synchronized. What's more, this system guarantees perfect tracking and synchronization between all audio tracks on all cascaded decks - whether you have one deck or sixteen (up to 128 tracks!).
- Incoming audio is digitized by the on-board 16-bit D/A at either 44.1 or 48KHz (user selectable). The frequency response is flat from 20Hz to 20KHz while the dynamic range exceeds 92dB. As you would expect from a CD-quality recorder, the wow and flutter is unmeasurable.
- One of the best features of the DA-88 is the ability to execute seamless Punch-ins and Punch- outs. This feature offers programmable digital crossfades, as well as the ability to insert new material accurately into tight spots. You can even delay individual tracks, whether you want to generate special effects or compensate for poor timing. All of this can be performed easily on a deck that is simple and intuitive to use.

OPTIONS

- RC-808 – Single Unit Remote Control
- RC-848 – System Remote Control
- MU-8824 – 24-Channel Meter Unit
- SY-88 – Complete SMPTE/EBU Chase Synchronizing and MIDI Machine Control interface

FOSTEX

RD-8 Multi-Track Recorder



This digital multitrack recorder is designed specifically for the audio professional. Fostex has long been a leader in synchronization, and the RD-8 redefines that commitment. With its built-in SMPTE / EBU reader/generator, the RD-8 can stripe, read and jam sync time code - even convert to MIDI time code. In a sync environment the RD-8 can be either Master or Slave. In a MIDI environment it will integrate seamlessly into the most complex project studio, allowing you complete transport control from within your MMC (MIDI Machine Control) compatible sequencer.

- Full transport control is available via the unit's industry-standard RS-422 port, providing full control right from your video bay. The RD-8 records at either 44.1 or 48KHz and will perform Pull-Up and Pull-Down functions for film/video transfers. The Track Slip feature helps maintain perfect sound-to-picture sync and the 8-Channel Optical Digital Interface keeps you in the digital domain.
- All of this contributes to the superb sound quality of the RD-8. The audio itself is processed by 16-bit digital-to-analog (D/A's) converters at either 44.1 or 48KHz (user selectable) sampling rates, with 64X oversampling. Playback is accomplished with 18 bit analog-to-digital (A/D's) and 64X oversampling, thus delivering CD-quality audio.
- The S-VHS transport in the RD-8 was selected because of its proven reliability, rugged construction and superb tape handling capabilities. Eight tracks on S-VHS tape allow much wider track widths than is possible on other digital tape recording formats.
- With its LCD and 10-digit display panel, the RD-8 is remarkably easy to control. You can readily access 100 locate points and cross-fade time is fully controllable in machine to machine editing. Table of Contents data can be recorded on tape. When the next session begins, whether on your RD-8 or another, you just load the set up information from your tape and begin working. Since the RD-8 is fully ADAT compliant, your machine can play tapes made on other compatible machines, and can be controlled by other manufacturers ADAT controllers. Your tapes will also be playable on any other ADAT deck.
- In addition to familiar transport controls, there are a number of logical, user friendly features. This is the only unit in its class with an on-board, back-lit variable contrast LCD display. It provides all of the information you'll need to keep track of offsets, punch points, generator functions and other pertinent data. Three function keys, combined with HOME, NEXT and UP/DOWN buttons, enable you to navigate the edit menus effortlessly. If you need to have access to the front panel controls, the optional model 8312 remote control gives you remote command of the most common functions.

SONY

EVW-300

Hi-8 3-CCD CAMCORDER

Features:

- Equipped with three high density 1/2" IT Hyper HAD image sensors. Has an excellent sensitivity of F8.0 at 2,000 lux, high S/N of 60 dB, and delivers over 700 lines of horizontal resolution.
- Provides high quality PCM digital stereo and single channel AFM Hi-Fi recording. Has XLR balanced audio connectors.
- Quick start 1.5" viewfinder with 550 lines of resolution plus Zebra pattern video level indicator and color bar generator.
- Built-in 8mm Time Code generator (non-drop frame or drop frame mode may be selected). Also incorporates a variety of time code features such as Time Code PRESET/RESET, REC RUN/FREE RUN and User Bits.
- A variety of automatic adjustment functions for different lighting conditions are incorporated into the EVW-300.
  - ATW (Auto Trace White Balance) – when ATW is turned on optimum white balance is always ensured during recording, even for changes in color temperature. Conventional white balance adjustment is still provided with the Auto White Balance.
  - AGC (Automatic Gain Control) – In addition to manual Gain Up AGC provides linear gain up in the range of 0 dB to 18 dB.
  - Intelligent Auto Iris – for situations where the lighting between subject and background is different (subject is underexposed) the Intelligent Auto Iris automatically examines the scene and adjusts the lens iris for proper exposure.
- Selectable Gain-up from 1 dB to 18 dB in 1 dB steps for Mid & High positions.
- Clear Scan function – provides a variety of selection of shutter speeds ranging from 60-200 Hz allowing recording of almost any computer display without flicker.
- Compact, lightweight (12 lbs with NP-1B) ergonomic design provides well balanced and extremely comfortable operation.

JVC GY-X2

3-CCD S-VHS CAMCORDER

- Three 1/2" CCD image sensor delivers 650 lines of horizontal resolution.
- New micro-lens technology provides exceptional sensitivity of F7.0 at 2000 lux and new LOLUX mode lets you shoot with almost no light! Shoot superb footage with excellent color balanced at a mere 3 lux illumination.
- Variable Scan View allows flicker-free shooting of a computer monitor.
- Quick Record Mode - when turned on the camera is set to the auto iris even if lens is set at manual. Also activated is (ALC) Automatic Level Control and EEI Extended Electronic Iris which provides both variable gain and variable shutter. Now you can shoot continuously from dark room to bright outdoors without having to adjust gain, iris or ND filter.
- Full Time Auto White circuit lets you move from incandescent to fluorescent to outdoor lighting without changing white balance or the filter wheel.
- Genlock input allow synchronization with other cameras.
- Dual output system allows camera output to be connected directly to an external recorder.

TOSHIBA

TSC-200

3-CCD Hi-8 Camcorder

- 3 ⅛" CCD chips mounted with spatial offset technology deliver resolution of 700 horizontal lines.
- Low noise design provides extreme sensitivity of F8.0 at 2000 lux. Min. illumination 7.5 lux with excellent color reproduction.
- New LNA (low noise amplifier) delivers a S/N (signal-to-noise) ratio of 62dB - the highest achieved for this type of camera.
- 26-pin connector outputs Y/C or component video signal allowing hook up to a portable S-VHS, MII or Betacam recorder and simultaneously record with Hi-8.
- Quick-start 1.5" viewfinder needs no warm up time so you never miss a shot. Zebra pattern in the viewfinder alerts operator to excessive video levels.
- Genlock capability allows synchronization with other cameras. Full calibration functions built-in as well as color bar generator.
- Variable high speed shutter from 1/60 to 1/2000 second.
- Built-in 8mm time code generator records an absolute address to every frame.
- High-performance back electret condenser mic records to all three audio tracks. Low cut filter eliminates wind noise.
- Very low power consumption. Draws only 16 watts per hour allowing 100 minutes of recording time with 1 NP-1B battery.
- Body made of magnesium alloy previously only on broadcast cameras. Still only 13 lbs. in standard configuration.

Panasonic®

AG-DP800 UPERCAM

S-VHS 3-CCD Digital Signal Processing Camcorder

- Three high-density 380,000 pixel CCDs with half-pitch pixel offset to achieve over 700 lines of horizontal resolution, a S/N ratio exceeding 60dB and remarkable sensitivity of f8 at 2000 lux result in simply extraordinary image quality. Additionally the Frame Interline Transfer (FIT) CCDs minimize vertical smear, so you maintain impressive picture quality even in very bright illumination.
- Advanced digital signal processing circuitry provides four valuable benefits:
  1) Consistently reliable up-to-spec performance.
  2) Fine adjustment of a wide range of parameters.
  3) Memory storage and instant recall of specific settings.
  4) More flexible and higher quality image processing, as well as easier maintenance.
- Some of the DSP circuits and their functions:
  - CHROMA DETAIL - This function compensates for poor resolution in the high chroma areas of the picture.
  - DARK DETAIL - Determines optimum degree of contour enhancement in dark areas to deliver crisp, natural-looking images.
  - HIGHLIGHT COMPRESSION - Expands the dynamic range of the highlighted areas and prevents halation. The highlight compression circuit allows a wide dynamic range producing detailed images even against bright backlight or daylight.
  - FLARE CORRECTION CIRCUIT - Compensates for unsteady black caused by light or by a subject's movements.
- Six Scene File modes. There are two user modes for custom digital parameter settings including Horizontal Detail, Vertical Detail, Chroma and Dark Detail, and Color Correction. The four preset modes are normal, fluorescent, special and sparkling.
- In addition to regular AGC (Automatic Gain Control), Supercam has a Super High Gain mode. At F1.4 this enables shooting under illumination as low as 2 lux while retaining detail and color balance.
- Synchro Scan function allows flicker-free shooting of computer monitors. Electronic shutter increments can be set variably from 1/61 seconds to 1/253 of a second.
- Built-in internal time code generator lets you record with SMPTE LTC/VITC (Longitudinal/Vertical Internal) time code.
- 26-pin connector for direct signal output from camera section for easy backups using 2nd VCR equipped with 26-pin connector.
- Two hi-fi stereo audio channels with a dynamic range of 80 dB, as well as two linear audio channels with Dolby NR. Normal/Hi-Fi recording is selectable. Uses XLR connectors to further ensure high-quality sound.
- Phantom power can be supplied to an optional microphone. Power can be switched off to prevent battery drain when not in use.

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FOR CAMCORDERS OR STAND ALONE CAMERAS

- Designed for working from the back of a van or the trunk of your car. The top loading case has a wide open fold back top that stays neatly out of the way. It's lighter and more compact than shipping cases, thus saving valuable storage space. With other equipment crowded around it the sturdy built-in frame provides added protection.
- Heavy duty shoulder strap & comfortable leather hand grip.
- Carry it in crowds – crush proof aluminum guard protects viewfinder.
- Fits into back seat and fastens securely with seat belt.
- Holds camera with on-board battery attached.
- Lid closes with Velcro for quick-opening or secure with full-length zippers.
- Two trim exterior pockets and clip board pocket.
- Dual purpose rear pouch is an expandable battery chamber or all-purpose pocket.

anton bauer

Logic Series DIGITAL Gold Mount Batteries

The Logic Series DIGITAL batteries are acknowledged to be the most advanced in the rechargeable battery industry. In addition to the comprehensive sensors integral to all Logic Series batteries, each DIGITAL battery has a built-in microprocessor that communicates directly with Anton/Bauer InterActive chargers, creating significant new benchmarks for reliability, performance, and life. They also complete the communications network between battery, charger and camera. With the network in place, DIGITAL batteries deliver the feature most requested by cameramen: a reliable and accurate indication of remaining battery power.

DIGITAL PRO PACS

The Digital Pro Pac is the ultimate professional video battery and is recommended for all applications. The premium heavy duty Pro Pac cell is designed to deliver long life and high performance even under high current loads and adverse conditions. The size and weight of the Digital Pro Pac creates perfect shoulder balance with all camcorders.

- **DIGITAL PRO PAC 14 LOGIC SERIES NICAD BATTERY**
  14.4v 60 Watt Hours. 5 1/8 lbs.
  Run time: 2 hours @ 27 watts, 3 hrs. @ 18 watts
- **DIGITAL PRO PAC 13 LOGIC SERIES NICAD BATTERY**
  13.2v 55 Watt Hours. 4 3/4 lbs.
  Run time: 2 hours @ 25 watts, 3 hours @ 17 watts

DIGITAL COMPAC MAGNUM

Extremely small and light weight (almost half the size and weight of a Digital Pro Pac), the powerful Digital Compac Magnum still has more effective energy than two NP style slide-in batteries. The high voltage design and Logic Series technology eliminate all the problems that cripple conventional 12 volt slide-in type batteries. The Digital Compac Magnum is the professional choice for applications drawing less than 24 watts. Not recommended when using an Ultralight.

- **DIGITAL COMPAC MAGNUM 14 LOGIC SERIES NICAD BATTERY**
  14.4 v 43 Watt Hours. 2 3/4 lbs.
  Run time: 2 hours @ 20 watts, 3 hours @ 13 watts.
- **DIGITAL COMPAC MAGNUM 13 LOGIC SERIES NICAD BATTERY**
  13.2v 40 Watt Hours. 2 1/2 lbs.
  Run time: 2 hours @ 18 watts, 3 hours @ 12 watts.

ALL VIDEO COMES WITH A SEVEN-DAY SATISFACTION MONEY-BACK GUARANTEE

Circle (51) on Reply Card

New Products

Continued from page 66

Poster/Satellite guide
By Keystone Communications

• **North American Satellite Guide Poster:** 22 inch by 28 inch full color poster featuring the North American communications satellite arc, C-Band and Ku-band frequency tables, Ku-band half transponder formulas as well as a Greenwich/military time conversion chart.
• **Asia Pacific Satellite Guide:** features up-to-date transponder loading information and coverage maps of Asia Pacific satellites that carry video traffic; spiral bound; published quarterly.

Circle (364) on Reply Card

Power platforms
By Sonic Solutions

• **Sonic Quattro:** a power platform for 4-track and larger configurations; can handle music editing, radio production, dialog and sound effects editing and sound for picture work; it supports four channels of digital I/O and can be expanded to 24 tracks.
• **Expanded Quattro:** permits direct serial control over a variety of 1-inch, 3/4-inch, and 1/2-inch decks as well as time-code DATs; also features TimeTwist and optional converters.

Circle (366) on Reply Card

Visual effects
By Discreet Logic

• **4:4:4 digital video signal I/O for Flame:** enables Flame special visual effects system to support full 4:4:4 component digital video signal input and output; doubles the quality of chrominance data available; Flame can capture the 4:4:4 signal in real time to its disk system direct from any 4:4:4 source.

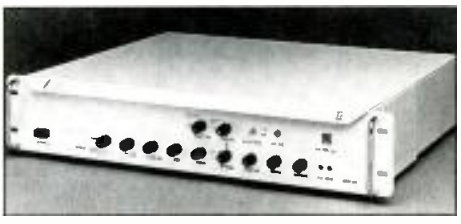
Circle (354) on Reply Card

Time base corrector
By Prime Image

• **5011 TBC/Freeze II:** expanded version available for NTSC, PAL or PAL-M standards; features AGC on/off, H-position, vertical color advance, horizontal chroma-to-luma adjust, three levels of detail enhancement; frame or field freeze, and variable rate strobe; provides transcoding of composite and component inputs to all outputs; accepts synchronous or non-synchronous inputs; provides composite and Y/C in and out and offers full proc amp controls.

Circle (363) on Reply Card

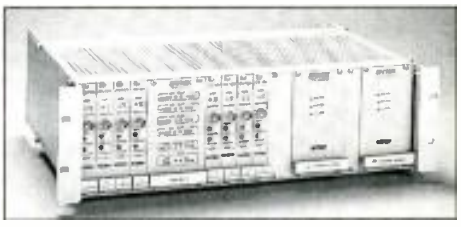
Multiformat TBC/ TBC synchronizers
By Prime Image



• **HR6001I series:** line of high-resolution TBCs featuring wide bandwidth signal handling at 7.5MHz and multiformat transcoding; provides for 3-way wideband (8MHz) digital adaptive comb filter and RGB 3- and 4-wire input/output; features include true component processing and composite, S-VHS, Y688, Y/R-Y/B-Y in/out.

Circle (368) on Reply Card

Digital video fiber optics
By Ipitek



• **Imtran system:** digitally encodes video and audio, transmits via fiber-optic cable; capable of digitizing multichannel analog video, audio, RS-232 unidirectional data and two 25Mb/s overhead channels over a single fiber covering more than 40 miles.

Circle (369) on Reply Card

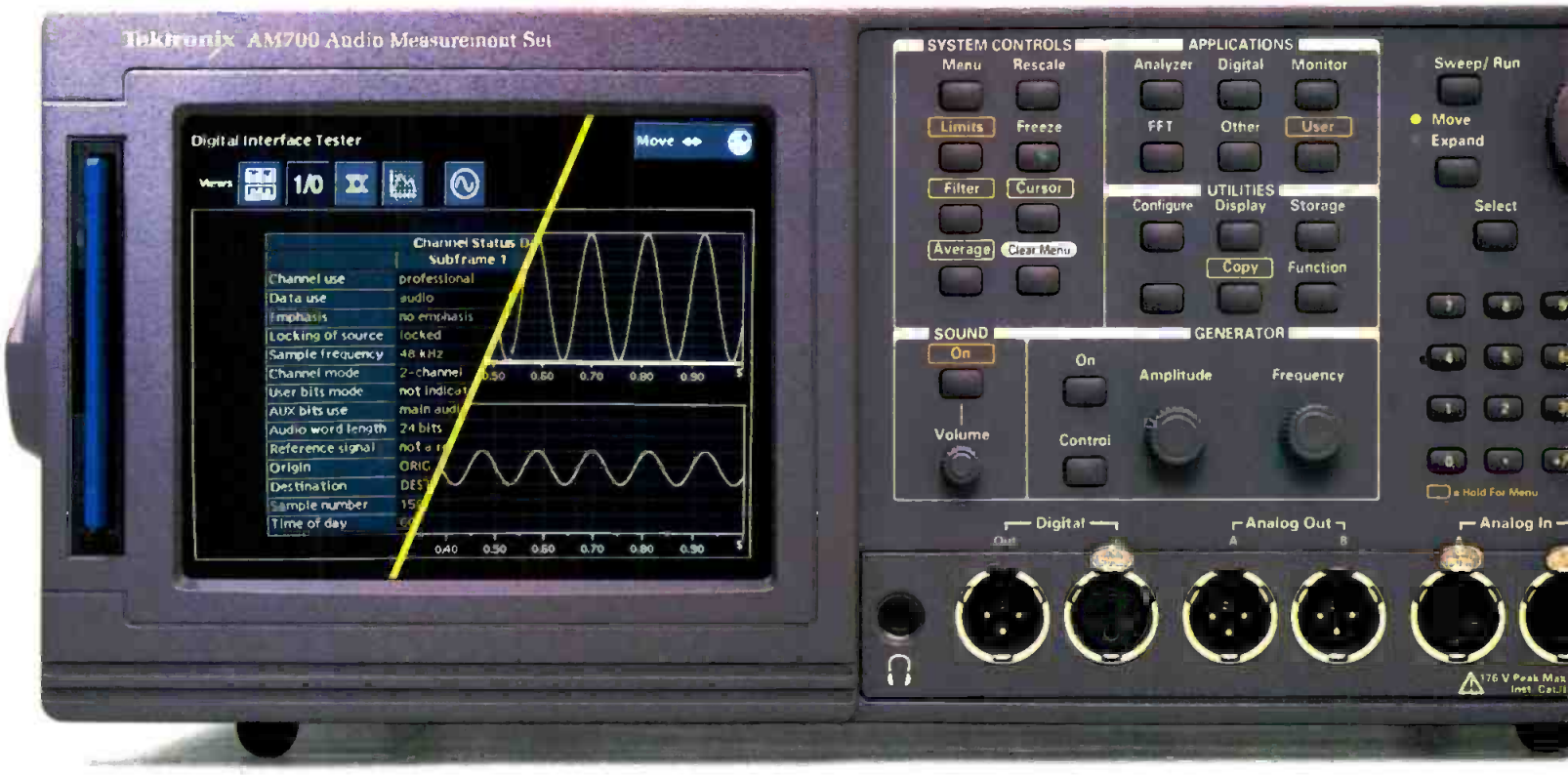
Database
By SoftWright

• **TAP database:** high-resolution database for use in the Terrain Analysis Package; based on the 7 1/2-inch quadrangles; uses a grid interval of 30 meters that provides an increase in grid density about nine times the data in a given area.

Circle (367) on Reply Card

Continued on page 75

The one audio tester you can use in mixed company.



THE TEKTRONIX AM700. THE HIGH PERFORMANCE MIXED SIGNAL AUDIO TESTER THAT'S VERSATILE AND EASY TO USE. ■ Meet a real crowd pleaser. ■ The AM700. It's designed for virtually any audio test application—analog or digital. Making it the perfect choice for testing car radios, recording equipment, radio and television audio broadcast systems, and more. ■ For starters, it's fast and easy to use. There are no complex commands to learn. Just a simple interface that guides you to any function you need. And a high performance processor that gets the job done pronto. ■ Plus, the AM700 lets you work any way you want. Automatically, semi-automatically, or manually. It's ideal for design engineers working at the bench level, test engineers on the production line, and everywhere in between. ■ And it's completely portable, too. Everything's included in one compact instrument. ■ No wonder it knows exactly what to do in mixed company. ■ Make an appointment for a demonstration by calling your local Tektronix sales office or call **1-800-TEK-WIDE ext.TV**

Input and output ports allow you to generate test signals for both analog and digital domains.

Tektronix

Circle (70) on Reply Card

IBC94 RADIO • TELEVISION • SATELLITE • CABLE • FILM

IBC show preview

By Dawn Hightower, senior associate editor

This year's show reflects the changing industry.

Amsterdam is the place to be this fall if you are involved in radio, television, satellite, cable or film. The IBC 94 International Broadcasting Convention and Exhibition will be held Sept. 16-20 at the RAI Convention Centre.

This year's technical program has been expanded to incorporate more traditional high-quality papers in addition to its workshops. This year's convention also will feature a new addition – panel sessions. These sessions will provide attendees the opportunity to question leading figures in the industry on a wide range of topics.

Something for everyone

Whether you are involved in station management, technical operations, equipment selection, system planning, equipment design or advanced research and development, the technical program has something for you.

Two parallel streams of papers sessions will cover the latest state-of-the-art technology, as well as a wide range of reviews of current developments. Sessions also will address future technology and the decisions that need to be made. Session presentations will include widescreen, audio for radio and TV, microwave video distribution, cable, direct-to-home satellite broadcasting, digital terrestrial TV, digital audio broadcasting, transmission coverage, digital coding of video signals, random access media and digital film processing and enhancements.

IBC workshops, which were introduced in 1992, have been extended to a full stream of tutorials for those new to the business, as well as old hands. The workshop sessions are free to convention registrants. However, attendance is limited and tickets will be available on a first come, first served basis.

The workshop sessions will include digital compression, film production, sound for pictures, non-linear editing, special effects for beginners, automation, multimedia and electronic effects.

For more information on the IBC event this fall, contact the IBC Secretariat at PO Box 193, Savoy Place, London WC2R 0BL; telephone +44(0)71 240 3839 or fax: +44(0)71 497 3633. ■

Panel sessions

- ***Friday, Sept. 16***
  A.M.: Cable/Satellite/Terrestrial and VOD
  P.M.: The Battle for World Standards
- ***Saturday, Sept. 17***
  A.M.: Tapeless Recording
  P.M.: Is MPEG-2 Future Proof?
- ***Sunday, Sept. 18***
  A.M.: DAB -- Technology Looking for a Market?
  P.M.: The Broadcast Engineer -- an Endangered Species?
- ***Monday, Sept. 19***
  A.M.: Using Tomorrow's Channel Capacity
  P.M.: Standards in Film and TV
- ***Tuesday, Sept. 20***
  A.M.: Do We Need an FCC in Europe?
  P.M.: Has Enhanced Analog TV Missed the Boat?

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(2) YAMAHA M406 RACK MIXERS, 6 x 2, +4, -10 sub in/out, stereo aux., phantom power, mint, massive headroom, zero noise floor. Call Dan - (216) 923-9856. $575 each.

FOR SALE: One inch Hitachi HR 200B machine. Operating hours 2581. Head only 700 hours!! Parallel interface to controllers. Jog/Shuttle feature. Best Offer. Call (408) 997-7679.

EMC PRIME-TIME, DIGITAL NON-LINEAR EDITOR: Off-Line, 486 complete turn-key system. Generates an EDL for On-Line final editing. Includes all hardware and software. Like new demo unit. $10,000. Call 407-696-4086 for specific details.

RADIO BROADCAST FACILITIES available November 1. Atlanta, Georgia. Broadcast equipment and office furniture. Reply to Broadcast Engineering, Dept. 747, P.O. Box 12901, Overland Park, KS 66282-2901.

EQUIPMENT WANTED

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.

HELP WANTED

ESPN HAS IMMEDIATE OPENING for an individual with 3-5 years in broadcast equipment maintenance. Digital experience and the ability to diagnose and troubleshoot to the component level is required. Computer literacy, FCC General License and satellite uplink experience are preferred. Send resume to Human Resources Department, ESPN, Inc., ESPN Plaza, Bristol, CT 06010. ESPN is an Equal Opportunity/Affirmative Action Employer.

ENJOY LIVING AND WORKING IN TULSA. Chief Engineer/Maintenance Engineer combination. UHF experience a must. KDOR TV 17, 2120 N. Yellowood, Broken Arrow, OK 74012. EOE.

CHIEF ENGINEER needed for West Central Nebraska NBC Affiliate, with maintenance skills, VHF transmitter, satellite facilities. Good with people. Good benefits and good salary. EEO employer. Send resume to General Manager, KNOP TV, PO Box 749, North Platte, Nebraska 69103.

CHIEF ENGINEER/BENCH TECHNICIAN: for Chicago post-production house. Minimum 5 years experience in general video and system maintenance with emphasis on Beta-Cam, 1" & D2. Operation knowledge of editing system desirable. Sony factory training desired. Must exhibit ability to teach and motivate. Send resume with salary history and requirements to: P.O. Box 1045, 734 N. LaSalle St., Chicago, IL 60610. Attn: Mr. Gongorki.

SONY PRODUCT SUPPORT ENGINEER. You'll provide national level technical support for assigned products. Must be knowledgeable in engineering and servicing of professional video recorder formats including 8mm, VHS and Betacam formats. BS in a technical field and 5+ years' related experience strongly preferred. Send resume to: Sony, Human Resources, Attn: Catherine Boarders, 3300 Zanker Road, San Jose, CA 95134-1940. We are proud to be an EEO/AA employer M/F/D/V. Women and minorities are encouraged to apply. Also, we maintain a drug free workplace and perform pre-employment substance abuse testing. SONY.

LANDMARK COMMUNICATIONS has an immediate opening for a broadcast maintenance engineer. Must have a minimum of two years electronics training or equivalent broadcast engineering experience. Candidates knowledgeable with P/C's, Betacam, Odetics, Quantel, Ampex, and Grass Valley equipment desired. Shift work required. Competitive salary and benefits package offered. Send resume to Landmark Communications, Engineering Department, 2600 Cumberland Pkwy., Atlanta, GA 30339. EOE.

TECHNICIAN: Experienced and entry level positions available. AA in electronics required. Work on broadcast MII video tape machines and cameras. Some transmitter work. Drug screen required. WHAG-TV is a small market NBC affiliate. We offer a comprehensive benefit package, including 401(k) and Section 125 plans. Send resume and salary requirements to Personnel, WHAG-TV, Dept. Z, 13 East Washington Street, Hagerstown, MD 21740. No Phone Calls. EOE.

PROMOTION MANAGER. Single station market, ABC Affiliate with FOX football, beautiful Shenandoah Valley of Virginia awaits the experienced promotion person. Must be able to write, edit and produce on air promos. Media planning and implementation credentials important. Send resume to Bob Ganzer, General Manager, WHSV-TV, P.O. Box TV 3, Harrisonburg, VA 22801. EOE.

CHIEF ENGINEER: Southeast Boston area combo seeks aggressive studio and R.F. engineer. Experience in networked digital hard drive audio a plus. Send resume to: Broadcast Engineering, Dept. 746, P.O. Box 12901, Overland Park, KS 66282-2901.

Classified

HELP WANTED

TAFT BROADCASTING COMPANY

Taft Broadcasting Company is growing.

We are seeking Engineers, Technicians, Operating and Production personnel with all levels of experience in the broadcast industry. Taft Broadcasting is an Audio/Visual Systems integrator involved in government contracting and business to business broadcasting providing sound systems, closed circuit cable microwave TV systems, multimedia, video and photographic image management systems. If you are interested in a progressive, growing company please send your resume with qualifications, education and salary requirements to:

Debbie Burks
Taft Broadcasting Company
16441 Space Center Blvd., Bldg. A
Houston, Texas 77508

No Phone Calls
Principals Only Please
EOE/AA

WRDW-TV has an opening for Maintenance Engineer with specific knowledge and formal training at level equivalent to two years college in Electronics Engineering Technology and two years experience repairing electronic broadcast equipment at component level. Must have working knowledge of computers. Transmitter experience or SBE certification a plus. Resumes to: Jim Myers, CE; WRDW-TV, P.O. Box 1212, Augusta, GA 30903-1212. EOE.

ENGINEERING SUPERVISOR: Technical Maintenance and operation of satellite truck involving travel and maintenance of broadcast tape and studio equipment. Also, ENG equipment and UHF translators. High school diploma and experience necessary. Send resumes to: Barry Erick, Chief Engineer, 62 South Franklin Street, Wilkes-Barre, PA 18773. Equal Opportunity Employer.

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New Products

Continued from page 70

Digital video disk recorders
By Recognition Concepts, Inc.

• **VDR 4000 and VDR 5000 series:** VDR 4000 component supports CCIR 601/SMPTE 125M with standard rate capacities of four minutes and seven minutes; VDR 5000 component/composite supports CCIR601/SMPTE 125M and SMPTE 244M and offers from four to seven minutes of rate partitioned component storage and 8.2 to 13.7 minutes of composite storage depending on the model.

Circle (371) on Reply Card

Video processing amplifier
By Link Electronics

• **PRC-960:** designed for any application where new processed sync and burst is required; the front panel has video level, chroma gain, pedestal, white clip, video AGC, threshold, horizontal phase and burst phase controls; the video AGC is incorporated into the brightness, contrast and chroma level circuitry and can be defeated; an auxiliary input is provided; the PRC-960 will output blackburst with the absence of an input signal.

Circle (372) on Reply Card

Consoles
By Otari

• **Status RP:** the first in a line of digitally controlled analog consoles with onboard automation and a complete set of computer-controlled features; each input module has two independent signal paths and a 4-band equalizer; the 12-track buses and 8-aux buses can be sourced from either signal path, while the stereo program bus may be sourced from all paths simultaneously.

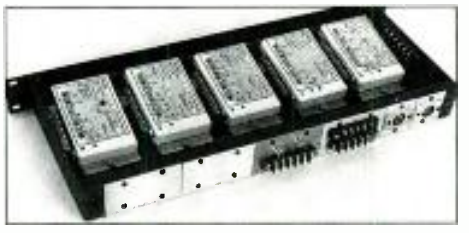
Circle (373) on Reply Card

Digital video editor
By TouchVision Systems

• **D/Vision - Pro version 2.2:** offers compositioning, motion control effects, autobatch digitizing with machine control, film cutting lists, importing and editing of AVI files, improved on-line EDLs and graphics quality; features professional on-line EDLs, 3-D text, graphics and animation, six channels of CD-rate digital audio, up to 100 hours of instantly accessible video and SuperRTV video compression quality.

Circle (374) on Reply Card

Rack system
By Ramko Research



• **P-R5 ProMod module rack system:** 1.75-inch x 19-inch rack tray houses up to five of the 42 available ProMod ultraminiature audio modules in a "face up" position; each rack comes with a UL approved, AC wall adapter; optional rear panel connector plates available for XLR, barrier strip, ¼-inch jacks, DIN, etc.

Circle (375) on Reply Card

Amplifiers
By R.L. Drake

• **DDA-1218 and DDA-1236 distribution amplifiers:** designed for applications in TV distribution systems; DDA-1218 offers 18dB of gain while DDA-1236 offers 36dB of gain; one-piece construction with built-in power supply and continuous frequency coverage from 40MHz to 1,000MHz.

Circle (376) on Reply Card

Playback card
By Digidesign

• **SampleCell II:** 16-bit stereo, 32-voice, 32 megabyte sample playback card available for Windows/PC platform; features dynamic digital filtering and eight polyphonic analog outputs; includes two CD-ROM sound library discs.

Circle (377) on Reply Card

Safe area generator
By Broadcast Video Systems

• **SA104 single board safe area generator:** capable of being plugged into a Grass Valley or Leitch distribution amplifier frame; locks to incoming video; digitally generated patterns are inserted by an onboard keyer and remote controlled; safe action and title area, center cross and blanking markers can be selected individually or simultaneously, or a positionable full-screen cross hair can be displayed; stand-alone version also available.

Circle (378) on Reply Card

■

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Anthro Co.	24		503-241-7113
ASC Audio Video Corporation	23	20	818-843-7004
Audio Precision	13	6	800-231-7350
Belar Electronics Laboratory	32	14	215-687-5550
Belden Wire & Cable	36	27	800-235-3364
B&H Photo - Video	67,68-69	50,51	800-221-5662
Broadcast Video Systems Ltd.	70	52	905-764-1584
BTS Broadcast TV Systems	15	7	800-962-4BTS
Canare Cable, Inc.	30	12	818-365-2446
Cipher Digital, Inc.	74	66	800-331-9066
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