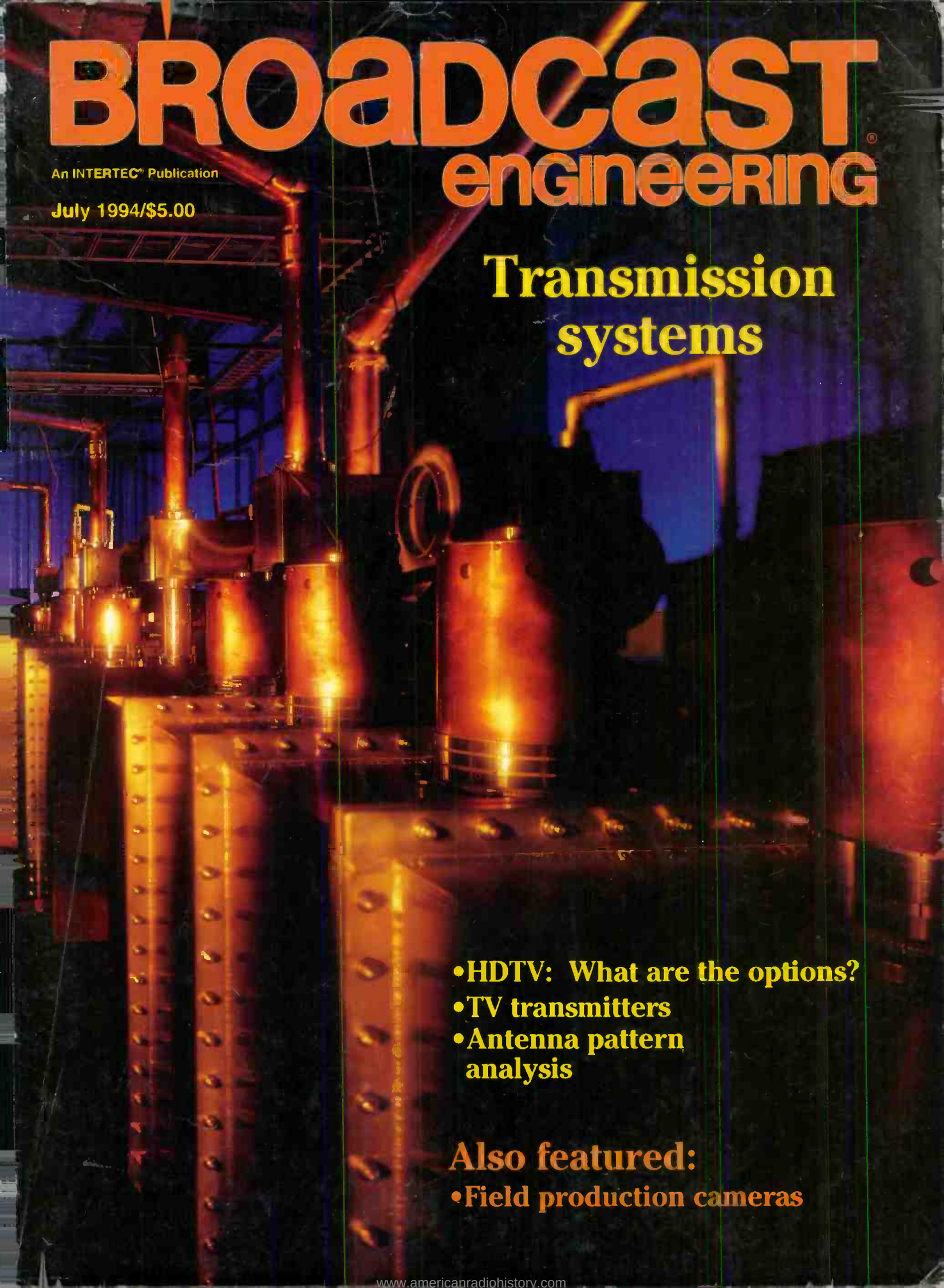

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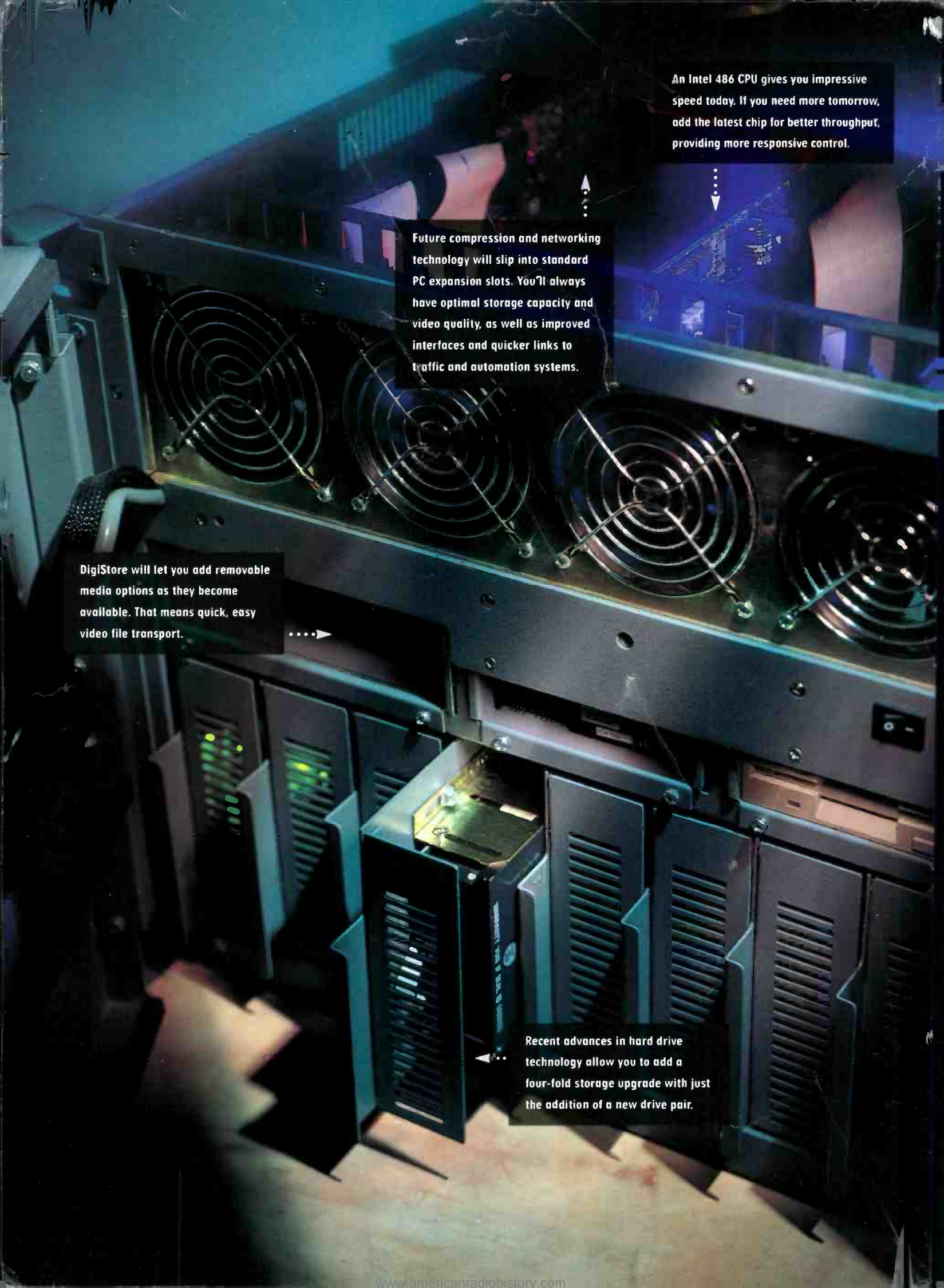
Transmission systems

- HDTV: What are the options?
- TV transmitters
- Antenna pattern analysis

Also featured:

- Field production cameras



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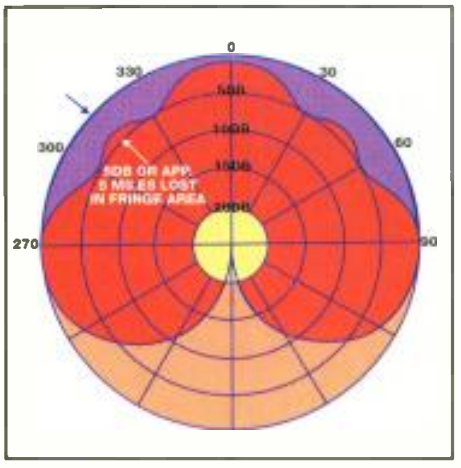

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TRANSMISSION SYSTEMS:
Broadcasters are increasingly concerned about the requirements of HDTV transmission. As the deadlines for making those decisions approach, managers and engineers need to plan now for the successful transition from NTSC to HDTV.

DEPARTMENTS:

COLUMNS:

THIS MONTH...

ON THE COVER:

Broadcasters are uniquely different from other entertainment deliverers in that their link with the consumer is wireless. This month's cover photo shows a high-power, multitransmitter FM combiner for a Harris-built transmission facility. Photo courtesy of Harris Corporation, Broadcast Division.

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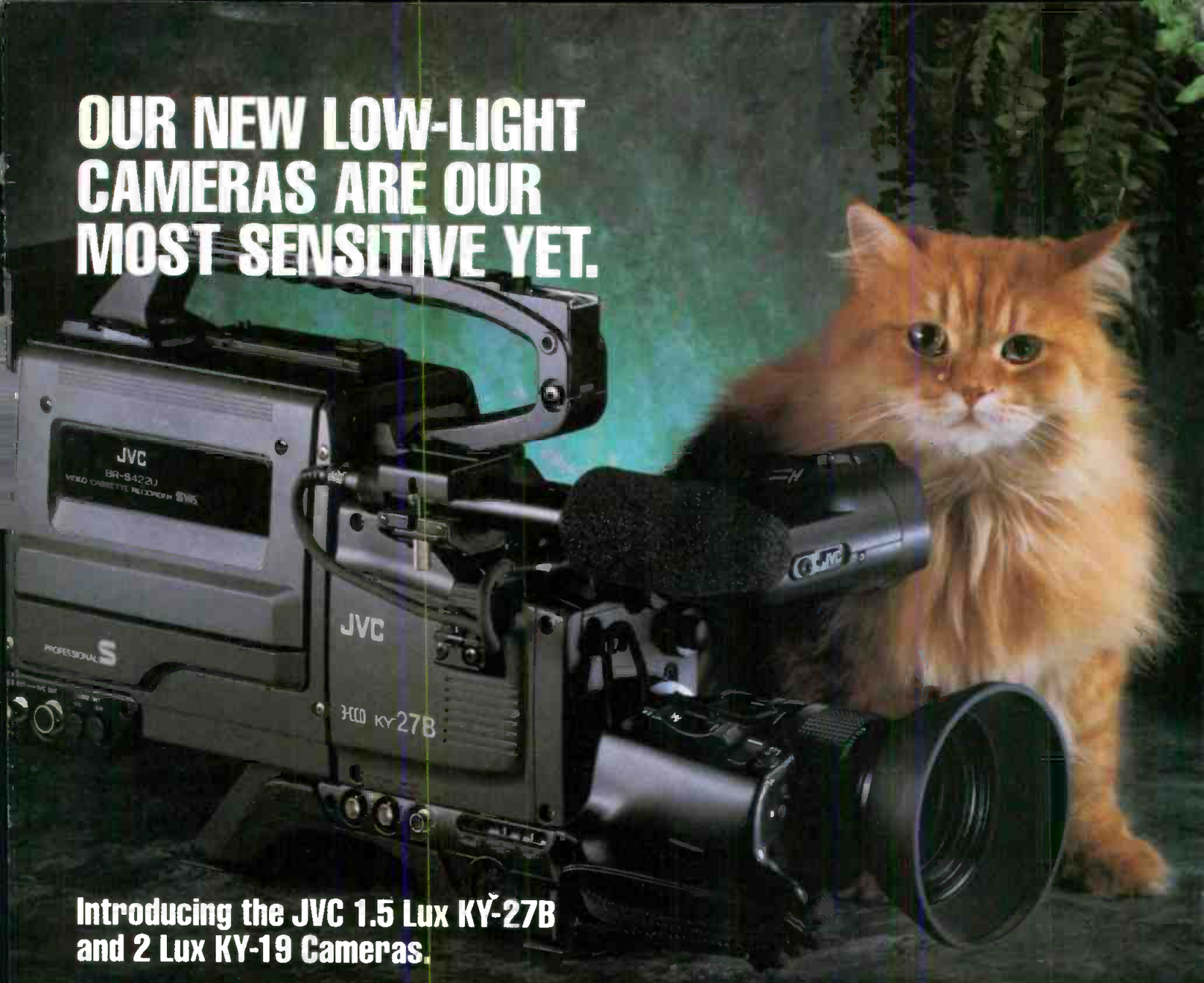

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JVC. The three most important letters in S-VHS.

News

By Dawn Hightower,
senior associate editor

Broadcasters seek proposals for COFDM transmission hardware

A group of broadcast organizations has issued a call for a coded orthogonal frequency division multiplexing (COFDM) system for evaluation as an advanced TV broadcast transmission subsystem.

COFDM uses hundreds or even thousands of individual, closely spaced carriers to carry digital information. COFDM's multiple carriers offer potential advantages for broadcasting including increased multipath immunity, improved spectrum efficiency, optional on-channel repeaters and greater flexibility.

The Request for Quote (RFQ) being issued includes target performance specifications and requirements for an optimum COFDM system for digital terrestrial TV broadcasting in North America. The RFQ is being issued by the COFDM Evaluation Project, a limited liability company formed by several broadcast organizations under the auspices of Capital Cities/ABC, Fox Broadcasting, the Association of Independent Television Stations (INTV), the Association for Maximum Service Television (MSTV), the National Association of Broadcasters (NAB) and the National Broadcasting Company (NBC).

An expert group of the FCC Advisory Committee on Advanced Television Service found that COFDM warranted monitoring, but noted there have been no plans to create a 6MHz COFDM hardware system that could be evaluated in the United States in the current advanced TV process. Meanwhile, COFDM is being developed in Europe and Japan as the basis for next-generation radio and TV digital broadcasting. The COFDM evaluation project is being established to evaluate the technology for TV transmission and determine whether it's a superior system for digital terrestrial TV broadcasting.

For a copy of the RFQ, contact Lynn Claudy at NAB at 202-429-5340 or by fax at 202-775-4981. For more information on the COFDM Evaluation Project, contact Michael Sherlock at NBC at 212-664-5531 or by fax at 212-664-7070.

CBS stations to equip all outlets with ATSC ghost cancellation system

All of CBS TV stations' owned and operated outlets will be equipped to transmit the ATSC-adopted Philips Ghost Cancellation Reference (GCR) signal by the end of this year. This will allow the CBS stations to offer an improved picture to viewers experiencing ghosting in their operating areas when consumer de-ghosting products come to market in 1995 from Philips.

WCBS-TV New York, KCBS-TV Los Angeles, WBBM-TV Chicago, WCAU-TV Philadelphia, and WCIX-TV Miami have made the nominal investment in equipment necessary to transmit the GCR signal. The two other CBS owned and operated stations – WCCO-TV Minneapolis and WFRV-TV Green Bay – plan to add the equipment in the second half of this year.

Preliminary results of an NAB Science and Technology survey indicate a dramatic increase in U.S. TV stations transmitting the GCR signal. The latest findings, drawn from 703 responses of 1,200 stations contacted during May and early June of this year, show a 66% increase in stations transmitting the ATSC-adopted GCR signal. This is compared to results of the previous survey conducted last year.

The GCR signal was unanimously adopted by the ATSC (Advanced Television Systems Committee) in 1992 as its own national standard, and has since received the endorsement of the International Telecommunications Union (Geneva).

A joint team of engineers and product marketers from Philips Consumer Electronics company, Knoxville, TN, and Philips Laboratories, Briarcliff Manor, NY, is on schedule to deliver the color TV industry's first consumer de-ghosting accessories in early 1995. Philips plans two compact Ghost Cancellers at under $200. One will be specifically for Philips and Magnavox projection televisions. The other will be for use with the tuner of any VCR or cable decoder and any brand of direct view or projection color television.

Stations wanting more information about implementing ghost cancelling technology may order *Ghost Cancelling: An Implementation Guide*, from the National Association of Broadcasters' services department at 800-368-5644.

■

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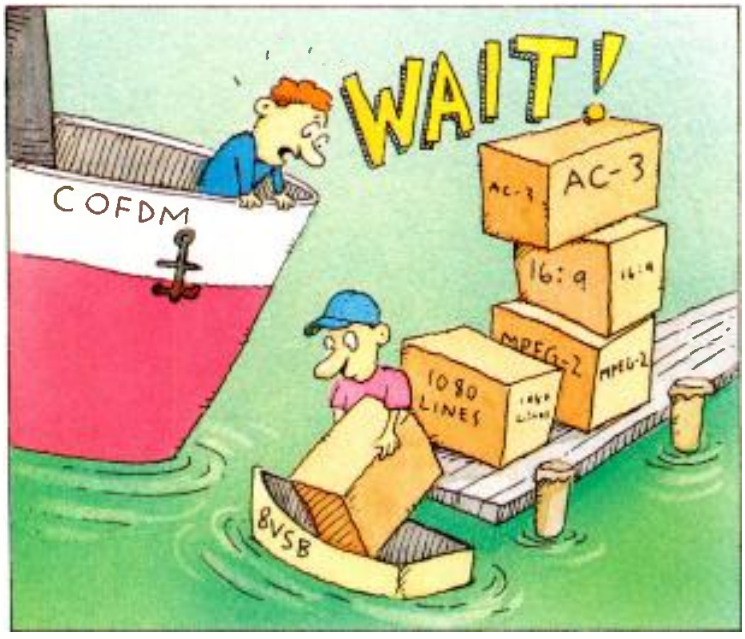
Editorial

Hold the boat, there's a better way

Just when our beloved HDTV system is about to be christened, someone has shouted, "Hold the boat, there's a better way."

In early 1994, a report prepared for the Advisory Committee on Advanced Television Service (ACATS) revealed that Coded Orthogonal Frequency Division Multiplexing (COFDM) offered several potential advantages over the (then) proposed VSB and QAM transmission systems. One of the most compelling reasons to consider COFDM, according to the committee's task force, was its ability to operate satisfactorily in severe ghosting conditions. Although the advantages of this technology seemed appealing, the Grand Alliance elected to proceed and ultimately selected the Zenith VSB transmission system.



But, hold the boat, there's now a movement afloat that might turn the tide from the current 8-VSB transmission system to COFDM. This radical, not to mention last-minute, suggestion is being offered by a group of leading broadcasters, networks and industry associations.

Under the auspices of Cap Cities/ABC, Fox Broadcasting, NBC, the Association of Independent Television Stations (INTV), the Association for Maximum Service Television (MSTV) and the NAB, a Request for Quote has been issued for the development of the necessary prototype hardware to perform the needed evaluations of COFDM. The initial development cost is expected to be $1.2 million. Folding the system hardware into the Grand Alliance testing process will require additional funds. More problematic for broadcasters is the delay of nine to 15 months required to design and test the prototype hardware. Is it worth the delay and cost? Yes!

There was plenty of talk at the NAB show about COFDM and the advantages it claims to offer to broadcasters. Its ability to reject ghosts is only one. It would also permit the use of on-channel, gap-filling repeaters and allow the optional use of multiple medium-powered transmitters operating on the same frequency instead of a single high-power transmitter.

These are all crucial performance factors as far as broadcasters are concerned. With all the potential advantages, where's the problem?

First, COFDM offers no improvements for cable transmission. Hence, the cable industry isn't supporting the technology. Second, and more important, the time required to first develop the prototype hardware and then work it into the Grand Alliance test sequence could kill the whole idea.

It's important to keep in mind that we're going to be saddled with whatever ATV system is finally approved by the FCC for the next 20 to 40 years. If that system, as a result of technical choices made now, unfairly penalizes TV broadcasters with an inferior signal, everyone loses. Broadcasters lose and viewers lose.

Now is the time for stations to join together and support COFDM testing. A few months delay and a few million dollars spent to develop the best possible ATV system seems a small price to pay for something as important as the future of the broadcast industry.

Brad Dick

Brad Dick, editor

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FCC Update

FCC amends rules governing LPTV

By Harry C. Martin and Andrew S. Kersting

The FCC has amended its rules and policies governing the low-power TV (LPTV) service. This will permit LPTV operators to request 4-letter call signs with the suffix "LP" rather than the current 5-character call signs that consist of letters and numbers. The FCC also modified its acceptance standards for LPTV applications, and expanded its waiver policy regarding terrain shielding.

• *Call sign requests.* By public notice, the FCC will establish a schedule by which licensees and permittees may apply for 4-letter call signs. Those stations that have been operating for the longest period of time will have the opportunity to apply first. Permittees will be required to certify that an equipment order has been placed, or that construction has begun.

LPTV operators may not request a call sign used by another broadcast station unless the stations are commonly owned or the LPTV operator has obtained the other station's written consent. In the event that identical requests are filed on the same day, the station with the longest, continuous broadcast operation under substantially unchanged ownership and control will be given priority. Full-power TV stations, as well as AM and FM radio stations, will prevail over an LPTV station should they request the same call letters on the same day.

• *New processing standard* The FCC amended its acceptance standards and no longer requires LPTV applications to be "letter perfect." The FCC will accept applications that are substantially complete, and will give applicants an opportunity to cure defects or omissions. If the defect prevents FCC staff from processing the application, a deficiency letter will be issued. The applicant will then have 30 days to correct the defect. If the defect does not prevent processing of the application, a deficiency letter will not be sent until pre-acceptance studies have been completed or a subsequent defect prevents further processing. At that time the applicant will be given 30 days to amend its application. To prevent undue processing delays, the 30-day period will be enforced. Corrected applications will be listed as "Accepted for Filing" in a public notice, in a lottery announcement for mutually exclusive applications or a proposed grant list for applications that aren't mutually exclusive.

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

Did your station meet the June 30 NRSC-2 deadline?

• *Terrain shielding.* Showings of non-interference to protected broadcast facilities on the basis of terrain shielding will be considered for all LPTV and TV translator applications. LPTV applicants seeking terrain shielding waivers should follow the existing criteria for demonstrating non-interference based on terrain considerations. This can be done by submitting either 1) detailed profiles of the terrain in pertinent directions toward the protected signal contours of potentially affected stations, or 2) letters of assent from the licensees of such stations agreeing that terrain shielding would prevent interference, but without surrendering the right to protection from any actual interference.

Mutually exclusive applicants may use either of these methods to demonstrate that their respective station proposals can co-exist without an interference conflict. The FCC will accept a satisfactory terrain shielding showing for the first time in response to a deficiency letter. The commission, however, urges applicants to address applicable terrain shielding conditions in their initial application.

Regulatory fees for fiscal year 1994

This past March, the FCC issued a Notice of Proposed Rulemaking regarding the assessment and collection of annual regulatory fees. The FCC proposed to establish three classes of regulatory fees: small fees, standard fees and large fees. Private radio operators, who are subject to small fees, would be required to pay their fees for each year of their license term in advance at the beginning of the license term. Those subject to standard fees would pay their regulatory fee, in full, on an annual basis. Regulatees subject to large fees (TV licensees with an annual fee exceeding $12,000 and cable TV systems with an annual fee exceeding $18,500) would be allowed to make two installment payments during each fiscal year.

Due dates for each fee category for the fiscal year ending Sept. 30, 1994, will be announced in a Report and Order. A draft order has been forwarded to the commissioners and is expected to be voted upon in the next few weeks.

The draft order proposes several different due dates for regulatory fee payments for the various services. The FCC will issue public notices announcing the deadlines for fee payments. It is expected to mail notices directly to regulatees informing them of the payment deadlines.

Following the FCC's release of the Report and Order, there will be a 30-day notification period prior to its effective date.

Unattended station operation

In 1992, Congress amended Section 318 of the Communications Act. The amendment eliminated a provision requiring attended operation of all broadcast stations. Consequently, the FCC may now waive or modify the general requirement of attended station operation if the commission finds it would serve the public interest. The Mass Media Bureau is examining whether to permit unattended station operation and is awaiting a decision from Chairman Hundt concerning whether to go forward with its proposal. ■

Date line

Annual ownership reports or ownership certifications for commercial broadcast stations in the following states must be filed by Aug. 1, 1994: North Carolina, South Carolina, Illinois, Wisconsin, and California. In addition, TV stations in California, and LPTVs and TV translators in Kansas and Nebraska, must file their renewal applications by Aug 1, 1994.

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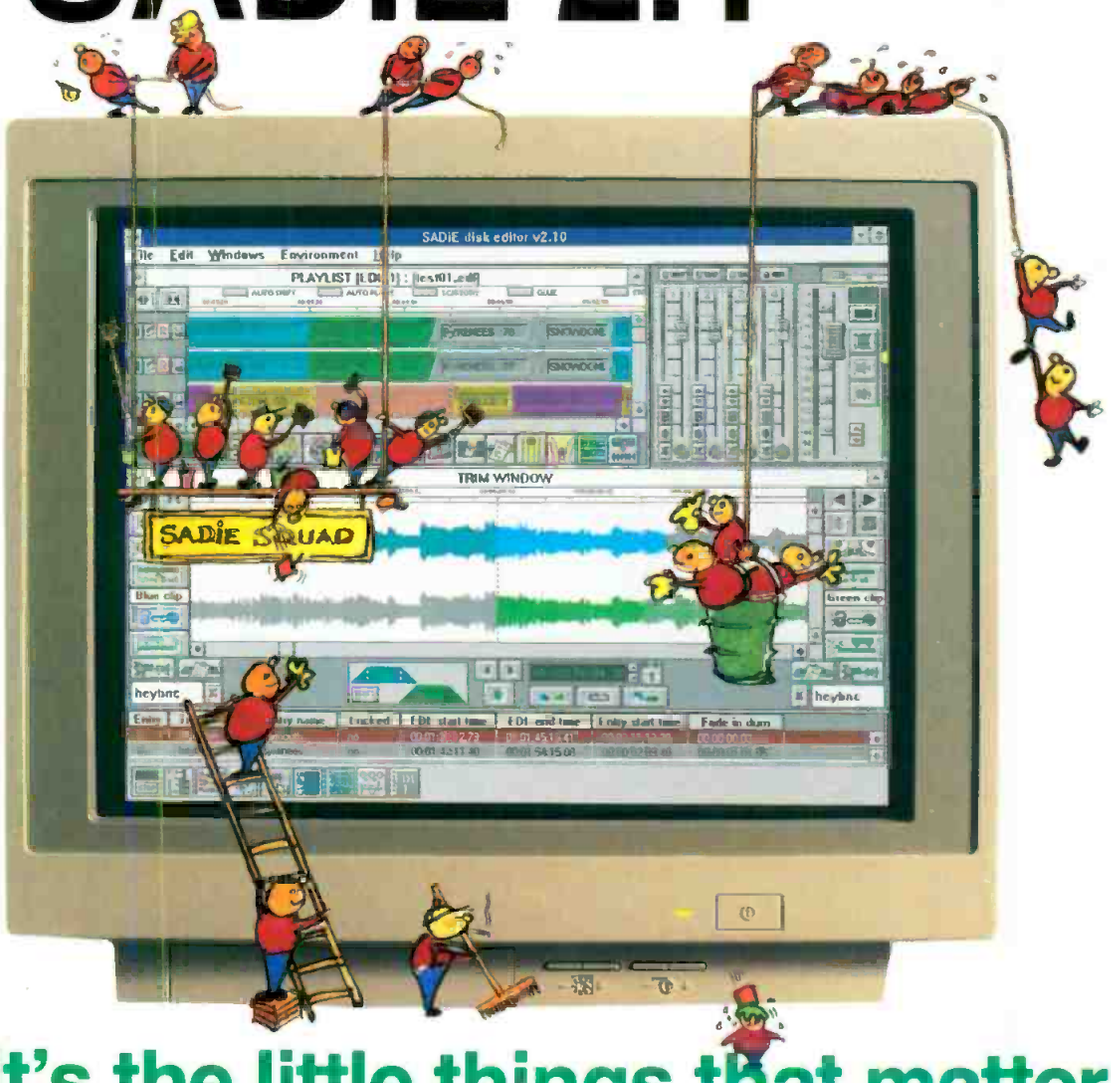

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Strictly TV

Line 21

By Curtis Chan

The FCC and the EIA have been busy at work structuring changes in FCC regulations governing the use of line 21 captioning and data services. The new changes impact not only broadcasters, but manufacturers and viewer-activated information providers as well. Specifically, line 21 addresses the government-mandated CaptionVision (CC), a closed-captioning capability available in all 13-inch or larger TV sets made after July 1, 1993. Currently broadcast on line 21, field one of the VBI, CC may be expanded to provide field 2 services, such as dual-language captioning and verbatim vs. easy-reading captions. A new entrant is the upcoming availability of Extended Data Services (EDS), but first here's a quick look at line 21 history.

Text and EDS have equal priority after captioning information.

Before and after obsolescence

Before EDS, four services were available for captioning and text data on line 21, field 1. The first was synchronous (synched with audio programming using time code) captioning for the hearing impaired. The second through fourth offerings were for a second language and two additional text services that may or may not be program related. To activate the service, a special signal was used on the first half of line 21, field 2 to enable the closed-captioning decoders. The second half of line 21, field 2 carried the beginning of active video. The soon to be standard (now known as RP-EIA-608) allows line 21, field 2 to include additional captioning and data services, effectively doubling line 21 capability.

Currently, four captioning and four text services are available plus the EDS. CC1 is the primary language captioning data that must be in sync with sound. The secondary synchronous caption service (CC3) is an alternate captioning data channel used for second-language captions. The special non-synchronous channels (CC2, CC4) carry data to augment information carried in the program and need not be in sync with the sound. In fact, delays of several seconds are to be expected. Text and EDS have equal priority after captioning information. Also, the EDS packets break down into several packet types. These include current and future program information, and different types of multiple fields (program length, title, length of show and type of show). These various formats open up a diversity of profitable opportunities.

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

What is EDS?

The line 21 group of packets offers many opportunities for information providers. EDS provides instant access to current and future program information, such as title, length of show and description. EDS may also provide disaster and weather alert information, program I.D. during commercials and pre-programming selection service. In addition, the ability to identify what network and local station you're watching and the ability to push a remote-control button labeled with a network's name on it are possible. Other possibilities include automatic programming of decoder VCRs to extend or delay recording if a program's start or finish time changes, automatic setting of VCR and TV clocks, and specialized programming from the broadcaster. All of these options are viable and we should see some implemented into TV receivers by year's end.

EIA-608

As mentioned earlier, EIA-608, prepared by EIA's subcommittee on TV Data Systems (TDS), is a book of voluntary industry technical standards for line 21, field 2 data services. It was drafted in 1993 to provide users with recommendations for transmitting data services information including the coding structure for EDS packets, EDS packet priority levels and EDS packet transmission scheduling.

For broadcasters, the first priority is to clear the line 21, field 2 channel. This can be done by canceling the Barker Code being placed in field 2 by EEG Smart and Simple closed-caption encoders. The Barker Code is an obsolete signal that will interfere with captioning and EDS data in programming material. SoftTouch has a free Barker Code cancellation kit.

EDS provides instant access to current and future program information, such as title, length of show and description.

To prepare for EDS, all that's needed is a computer and a text editor. The digitized format can then be converted to EDS encoder-friendly formats. Also, companies like TV DATA can take program schedules and download the appropriate information via modem to local stations that have the EDS encoders.

The benefits to broadcasters and advertisers are many. For the broadcaster, viewers can access information as needed, or have it on-hand during a program. Broadcasters will also have the opportunity to develop their own EDS applications that could include interactive television, home information and home shopping. For that matter, broadcasters can create a profit center by providing advertisers with extended marketing services for show-related products. In fact, EDS gives advertisers instant feedback as commercials air. Commercial monitoring could help advertisers who want to ensure their commercials air as per the contract. By combining commercial monitoring information with viewer response data, advertisers can adjust their creative programming focus accordingly. ■

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Management

Equipment acquisition

Planning and strategizing equipment purchases

By Rick Morris

Jane's station saw tough days in the last recession. Her staff had been cut, her parts budget had been slashed, and the equipment replacement budget had been near zero for a couple of years. As the economy picked up, so did the station's business. But the policy of "deferred replacement" was catching up with the station. Her responsibility as chief engineer (CE) turned from being innovative at making do, to having a technical vision for the success of the business.

Technical equipment is the "heart" of the broadcast facility. Part of a chief engineer's job is to manage the station's equipment resources to achieve the goals of the broadcaster. This requires that the CE plan for *equipment replacement*, *equipment upgrades* and *technological advances*.

Equipment replacement

Broadcast equipment begins to wear out the moment you begin to use it. Responsible engineering managers must have the foresight and prudence to plan for replacement costs. How do you determine when a piece of equipment will wear out? Primarily through experience. At the time of each equipment purchase (called a capital acquisition because you are buying a piece of equipment that will be capitalized under accounting procedures and Internal Revenue Service rules), a lifetime needs to be assigned to it. These lifetimes are based on broad categories and experience. For example, a camera used for ENG in a busy news organization may last up to three years; a transmitter may have a useful life of 15 to 25 years.

Create a chart of your major pieces of equipment, their in-service dates and their projected end-of-useful lifetimes. Some items will theoretically need to be replaced several times over the period of the chart. Actual replacement costs may not go by the chart because you will find opportunities to get a couple of extra years on individual items by extending equipment life through proper maintenance. Your station may decide to drop or change activities supported by some of the equipment, or changes in technology will eliminate the need for some items. The replacement chart will, however, give you a beginning point for keeping an ongoing business technical facility in operation. Limit your consideration to the next five years worth of equipment replacement. One piece of good news in equipment replacement is that technological developments may also have the effect of reducing the costs of equipment. Today, you can purchase several videotape recorders for the same price as a single 1-inch VTR when they were first introduced, the price-per-crosspoint of routing switchers has dropped and cameras are a better value every year.

Create a chart of major pieces of equipment with their in-service dates and projected end-of-useful lifetimes.

Interim upgrades

Sometimes equipment needs to be replaced before it reaches the end of its useful life. The requirements for these equipment upgrades also need to be included in your projections. To accomplish this will require an ongoing dialog with other departments to determine their needs. For example, in order to remain competitive, the news department may need to rebuild the news edit suite and add new effects and capabilities.

Technological advances and long-term thinking

Ask yourself questions about business issues, such as efficiency (how you can save money) and reliability (how you can reduce downtime and keep maintenance costs to a minimum). What about competition issues? Can you suggest a technology solution to management? CEs should be thinking how new technology, tapeless camcorders for instance, might fit into their plans; how serial digital will fit into their future; and what automation and digital information transfer could mean to their station.

The 5-year capital acquisition plan

Develop a 5-year plan that looks forward over the next five years. This long-term approach will permit you to conceptualize and plan for a technical vision of the station. It will let you look for the best solution to your technical issues, allow you to plan larger and more expensive projects, and help you to look at trends in technology.

The long-term equipment purchase budget integrates the three major types of equipment technology planning. (A new routing switcher, for example, may replace one that can no longer be maintained, upgrades to stereo audio with time code, and is sufficient for HDTV.) Each year you will need to review your equipment purchase plan and consider whether the technology you anticipated being available is ready for your station, whether your spending plans are the same as projected, and whether there are any new operational developments.

Have your accounting department participate in the planning decisions. Although many engineers may think the financial office is an obstacle to getting approval for purchases, one of the challenges of engineering management is educating, communicating and justifying your needs to upper management. Your objective is to win support for your plans. If the accounting department knows how long equipment lasts, when replacement is required, and the other business reasons for equipment acquisition, they will take ownership for the plans that they participate in developing with you. It will be easier to get your spending plans approved if the financial office concurs with your plans. When you submit your equipment requests each year, management should be supportive because they gave input and participated in the process.

With foresight, intelligent planning and involvement, the equipment budget process can be easier. ■

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

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Circle (5) on Reply Card

Computer-assisted logging

By David Leathers

Many interesting computer products are in development. Some, like AutoLog from Pipeline Digital of Kaneohe, Hawaii, work well, have a variety of uses and are affordable and useful right now. AutoLog is a simple and flexible tape logging program that can be used to log tapes on a set or prior to an editing session.

It can preset the time code of a record machine, roll the machine in record, display video at any size on the computer RGB monitor, select time-code marks with picons (picture icons) on the fly and add them to a custom-formatted list. If you then click any time-code mark or picon in the list, the machine will cue and replay on command.

AutoLog comes packaged in a 3/4-inch tape box. It consists of a single disk, an easy-to-read 30-page manual and a cable that connects any Mac modem port to the 9-pin serial control port of a professional VTR. Simply load the program onto your hard disk, connect the cable to the VCR and you're ready to log. There's no hardware installation required. Digitizing video, however, requires a digitizing board. A RasterOps Media Time Display adapter video and audio digitizing and display board were added to our Mac IIFX.

AutoLog doesn't do audio, but the MediaGrabber software from RasterOps that came with the board could perform basic Quicktime movie digitizing. This setup also offers a good mid-range solution for digitizing video and sound for other Quicktime programs, such as Adobe Premiere and Macromind Director. AutoLog also doesn't do L or S video control, it is strictly for professional serial machines.

The machine control of AutoLog is excellent. It makes professional machines using an RS-422 port act like they're being controlled by a professional edit controller. Even the fast ballistics of Sony Betacam decks were easily handled. It can log tapes in playback mode or can control the machine's record functions. This makes it ideal for video assist work as well as script supervising on set.

With tape rolling, the AutoLog accurately marks "in" and "out" points on the fly by the click of the mouse or equivalent keyboard commands. With the frame grab feature engaged, by holding down the shift key and marking a point, it adds a PICT to the list. Unlimited notes and comments can be added to each mark. The program will even keep track of reel, scene and take numbers.

Select any two points and the program will calculate the duration and add it to the list. Select any point or PICT in the list and the program will cue directly to it on command. Use the GoBak command and the machine will instantly stop, rewind the preset preroll amount and play the section again. This is a great feature for transcribing dialogue.

Dubner International's Scene Stealer.

AutoLog can also translate and save lists and PICT files to AVID, EMC and DFX formats. This allows pre-edit logging for those systems to be done on a relatively modest system, without tying up an expensive editing system. This is no trade-off either. The machine control and ease of manipulating the list make it a pleasure to use.

AutoLog is not an editor, an animation controller, audio recorder or video recorder. But it fulfills a certain niche that overlaps and provides continuity in the areas of video assist/video recording, script supervision, tape logging and preparation for on-line editing. The bottom line is that it has the potential to increase productivity and creativity while minimizing the time spent and duplication of efforts in handling the material from the set to the edit session.

Scene Stealer

The name of this product from Dubner International was coined from the old actors' adage about not working with children or animals because they would steal the scene. However, this is computer theft, and Scene Stealer can steal more scenes in an hour than all the kids and dogs in history.

Scene Stealer is a fully automated tape logging system that grabs and saves video, detects scene changes and creates a time-coded log. It works by using a sophisticated algorithm that compares the pixels in each frame of video and flags the frames where the scene changes. It is surprisingly accurate and the sensitivity can be tweaked by the individual user.

Scene Stealer comes as a single board with a single BNC connector and software that plugs into a 386 or 486 PC. It works with most available VGA and SVGA displays. Using an RS-232 to RS-422 adapter cable (not supplied), it can control serial tape decks and read time code.

Most of the parameters of Scene Stealer's operations are software programmable, including the frequency of frames stored and the configuration of the display. Once captured, the scenes can be played back and annotated. Frames can also be printed out. Ultimately, the video is erased and the log and notes are converted to a CMX340 format EDL that can be exported to other programs.

Scene Stealer is compatible with Imagine's Executive Producer Library Software and Creative Labs' Sound Blaster. This adds an audio record capability and subsequent review of captured scenes with audio. It's a great system that is like no other that we've seen. It's also a time saver. ■

➡ *For more information on AutoLog, circle (301), and for information on the Scene Stealer, circle (302) on Reply Card.*

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

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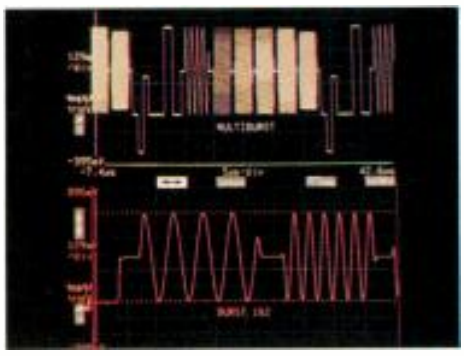
Part 1

Troubleshooting



Industrial computers

Attributes and advantages

By Alex Guthauser

The operating environment of today's broadcast facility is certainly cleaner than that of the average pulp and paper mill. But when it comes to everything that a chief engineer has to do to keep the evening news on the air, is the facility any less industrial? Not really. This may explain why ruggedized PCs, originally developed for harsh factory floor environments, are finding favor among broadcasters.

Whether it's for a milling machine or a multichannel video playback system, ruggedized PC systems can quantifiably improve these operational issues:

- Increasing PC reliability via higher component mean-time between failure (MTBF).
- Reducing downtime via lower mean-time-to-repair/replace (MTTR).
- Allowing greater expandability for present and future needs.
- Optimizing installation space requirements through rack-mounting.
- Lowering overall operating costs through a more cost-effective use of available technology.

There are fundamental differences between industrial computers and their office-style counterparts. Deciding which is best for a particular application depends as much on *where* as it does on *what*.

Hardware characteristics

First, consider what your minimum requirements are in the following areas:

- *Cost:* All else being equal, industrial PCs are more expensive because they are built to withstand the abuse of operating in a harsher environment. This requires costlier, more robust components, redundant fans and filters, EMI/RFI shielding, tighter specs and more, all of which boost the cost of manufacturing. If the operating environment is high-temperature, electrically noisy or I/O-intensive, most users think that investing in the more rugged and flexible system is justified by the increased price/performance ratio.
- *Reliability:* Regarding MTBF, a fully ruggedized industrial PC system should be good for 100,000 to 150,000 power-on hours (POH) vs. 15,000 to 30,000 POH for a good quality office-type unit. This is due as much to the use of more robust components as it is to extra cooling and filtration, which causes system components to last significantly longer by dissipating excess heat. For mission-critical applications (such as live on-air systems), more durable PCs are recommended because their reliability under stressful environmental conditions has been proven to be up to five times greater. Remote/mobile applications can also benefit from industrial PCs because of their superior shock and vibration tolerance.
- *Serviceability:* If MTTR is important to the application, consider that the passive backplane bus structure of the industrial computer allows major system components (including power supplies, feature cards and even the CPU) to be swapped out in five minutes or less. Compare this to as much as two hours for a typical office computer's motherboard installation. When problems occur, motherboard systems are often highly labor-intensive and, therefore, costly to repair.
- *Card slots:* A major advantage of the industrial PC form factor is the number of expansion slots allowed by the unit's passive backplane bus architecture. Most office units allow a maximum of around eight feature cards per chassis, vs. up to 20 for some industrial chassis.
- *Upgradability:* The industrial computer's intrinsic compatibility from one revision to the next allows users to upgrade their 286, 386/SX, 486 or Pentium plug-in CPU boards for use with their existing passive backplanes without having to disconnect their system wiring or buy a new PC.
- *Cooling and filtration:* The main cause of premature component failure is the heat generated by card-intensive applications. For example, digital signal processors generate tremendous amounts of heat inside a PC enclosure, exacerbated by high-power-usage CPUs or multiple processors. A 20-slot industrial computer system chassis can compensate for this by augmenting its natural convection cooling with up to six 45cfm cooling fans that eliminate any hot spots in the enclosure. Good design sets a uniform internal ambient operating temperature around 30°C (86°F). Though broadcast facilities are generally clean, multiple filters can be used to reduce the heat generated by the normal ingestion and build-up of dust and other airborne particulates into drives and other electronic components.

Industrial PCs' reliability under stressful conditions has been proven to be up to five times greater.

- *Mounting:* Office-style systems are somewhat limited in the way that they may be installed, which is usually on a tabletop, beside or under a desk, or sitting on the shelf of a rack enclosure. Industrial systems come with a variety of mounting options including wall-mount, tabletop, embedded and rack-mount. The most popular and space-effective are 19-inch racks, which allow mounting and easy access for as many as 10 industrial chassis in the same enclosure.
- *Noise rejection:* EMI/RFI abounds in a broadcast facility. It can cause many problems, including loss or disruption of data. The type of plastic housings that typically come with office-style computers do little to shield sensitive components from electrical noise. Most industrial systems come with steel or aluminum housings, which do an effective job at filtering out noise and provide better grounding.

Ultimately, the application should determine which type of PC system to buy — office-grade or industrial. Either way, to achieve maximum utility from your investment, consider present and future needs, and then specify the system that provides the best performance value for the application.

Next month will focus on how to select and configure an industrial PC. ■

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

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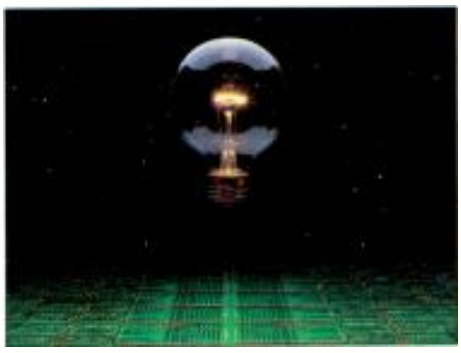

By Curtis Chan

By now, almost everyone has heard the much-hyped phrase "ATM will be one of the enabling technologies of the information highway." Recently, a number of top IC manufacturers, including AMD, Fujitsu, Integrated Telecom Technologies, National Semiconductor, Standard Microsystems and TI have jumped on the ATM bandwagon with committed silicon. ATM promises high-speed, switched, variable bandwidth "virtual" channels within broadband networks. It's ideal for video, audio, fax and file transfers over copper and fiber lines because the ATM protocol stack is a switched, multiplexed protocol that permits transmission of many types of mixed signals.

The ATM protocol stack is a switched, multiplexed protocol that permits transmission of many types of mixed signals.

What's so great about ATM?

ATM communications offer greater flexibility and efficiency over traditional LAN structures because it's a switched and multiplexed technology. Existing data communications networks use shared-media access techniques to grab a specific information stream from a broadcast signal. An ATM network, however, employs a switched and multiplexed architecture that establishes a temporary, dedicated channel within the bandwidth of the transmission path. Once this "virtual" channel is established, data packets need only carry the name of the channel with them rather than explicit routing information. This reduces overhead significantly. In addition, the 53byte data cells permit multiplexing of many datastreams in a broadband channel while still maintaining a fixed-time relationship between data cells. This attribute is important for time-sensitive transmissions like real-time voice and video.

The ATM protocol follows the 7-layer Open Systems Interconnection (OSI) model of the ISO. (See "Troubleshooting LANs," April through June 1994.) The protocol covers the reference model's physical layer (1) and link layer (2). Within the two layers, the ATM protocol further separates the functions it performs into sublayers. Sublayers include the ATM adaptation layer (AAL), an ATM layer (ATM) and sublayers in the physical layer (PHY).

The AAL is the bridge between native data and the ATM network. Data to the AAL layer is broken down into 48byte packets, then passed to the ATM, which adds a 5byte header for routing and control information and an 8-bit error correction code (ECC) header. The ATM layer also multiplexes the packets onto their virtual channels to assure sequential delivery of packets and monitors various performance criteria. The created ATM packets are then passed to the transmission-convergence (TC) sublayer within the PHY layer.

The final stage is through the physical medium-dependent (PMD) sublayer where cells are buffered to match the allocated rate of the datastream and converted into either an optical or electrical signal for transmission. When receiving data, the PHY layer synchronizes the bitstream and recreates the packets in a process known as cell delineation.

Ins and outs of the physical layer

At the physical layer, ATM packet data can be sent via copper or fiber. Using twisted pair unshielded wire, data rates of up to 155Mb/s can be sent up to 300 meters. The PHY/TC layer can offer many ways to prepare and digitize cells for conversion into robust analog datastreams and to recover data at the other end. This has given way to multiple variations on transceiver chip design for copper and fiber. This is because the ATM layer definition outlines the PHY/TC layer, which uses techniques that insert predefined characters to define the start of cells and the space between cells in the datastream.

Because of the many solutions available to the PHY layer, it's possible that a single LAN may include two or more types of transmission media. To help simplify things, the ATM Forum, which is made up of interested companies and users, has created a signal convention known as Utopia. Basically, Utopia defines an interface that provides separate transmit and receive data paths as well as control handshake lines. It also provides an interface that allows the system processor to set control parameters and perform self-test functions within the PHY layer.

Be aware that the one-chip ATM processor isn't a panacea for all applications.

Beware of the one-chip solution

Like all semiconductors, not all chips are designed the same even though they serve the same purpose. This holds especially true for ATM chips that address the ATM layer functions. For instance, while some chips employ an on-chip buffer, other companies leave this function to an external RAM chip that is useful if the forecasted data flow will have frequent burst rates exceeding the preferred channel bandwidths. Be aware that the one-chip ATM processor isn't a panacea for all applications (sounds like tape formats). In fact, the one-size-fits-all chip may span the entire set of ATM layers, and the user winds up paying for additional features that may not be needed.

Luckily, custom ATM ASICs are on the way so that it may be possible to design in some or all of the ATM functions along with custom logic that's tailored to the application. The bottom line to developing a cost-effective solution to future communications needs is to match chip-set capabilities to system requirements. ■

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

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SBE Update

Planning under way for SBE Engineering Conference

By Jerry Whitaker

Los Angeles will be the site for the first annual World Media Expo, a major industry event formed through the merger of four formerly separate trade shows. The convention, which will run from Oct. 12-15, combines the following events:

- SBE National Engineering Conference
- NAB Radio Show
- SMPTE Technical Conference
- RTNDA International Conference

All four organizations have pulled together to sponsor one large exhibition. Each group will offer its members a complete series of seminars targeted to their specific disciplines. A single exhibition floor, managed by the NAB, will permit attendees from each group to view the latest in broadcast and professional video/audio equipment. World Media Expo is expected to become a must-attend event, just as the big spring NAB convention is today.

Structuring the big event

During the planning process for World Media Expo, each association carefully considered how the overall event should be structured to best serve their memberships. From SBE's standpoint, it was clear from previous experience with the SBE National Convention that the society's strength is in organizing technical sessions, not trade shows. For this reason, SBE was pleased to give up that responsibility to NAB, which has a superb record of organizing and running conventions. The SBE portion of World Media Expo will duplicate the excellent technical sessions presented at previous SBE National Conventions, but all exhibition activities will be handled by NAB. This business arrangement will work well for both organizations.

The combined convention will in no way reduce the independence of SBE in putting together technical sessions targeted at the needs of its members.

The SBE Engineering Conference is being organized by a committee consisting of the following individuals:

- Dane Ericksen
- Douglas Garlinger
- Marvin Born
- David Carr
- Jerry Whitaker

Additional input has been provided by Jim Wulliman, who is spearheading the Ennes Workshop program.

The major components of previous SBE National Convention technical seminars will be preserved for the combined show. A full day of Ennes Workshops will be held the day before the exhibition opens. Technical sessions will run for three days, with radio and TV tracks. A ham radio reception also will be held, in addition to the SBE awards banquet.

At this writing, work on refining the session papers had shifted into high gear. Extensive promotion of the final program will be done during the summer months to SBE members and non-members who may want to learn more about broadcasting in general, and SBE in particular. A general outline of the technical session plan is given in Figure 1.

The October Conference will mark the first time an SBE national event has been held in Los Angeles. Key members of Chapter 47 have generously offered their assistance in planning various events and in helping to ensure that the show goes smoothly.

Some concern has been expressed about possible transportation problems in the Los Angeles area resulting from the earthquake earlier this year. The city, however, has done a superb job in making the necessary repairs to freeways and bridges. Crews are working 24-hours-a-day, seven-days-a-week to fix the remaining problems. By the time October rolls around, the transportation system should be back to normal insofar as most visitors are concerned.

The SBE Engineering Conference urges all SBE members to take advantage of the technical program planned for October. We are certain you will find it interesting and informative. ■

Whitaker, an industry analyst and the author of numerous technical books, is chairman of the 1994 SBE Engineering Conference.

1994 SBE ENGINEERING CONFERENCE - TENTATIVE SCHEDULE						
	WEDNESDAY, OCT. 12	THURSDAY, OCT. 13	FRIDAY, OCT. 14		SATURDAY, OCT. 15	
AM	ENNES WORKSHOPS	REGULATORY - GEN. SESSION FCC VS. FAA	AM/FM MODULATION PART I	HDTV - PART I PLANNING FOR HDTV	DIGITAL TECHNOLOGY FOR RADIO PART I	DIGITAL TECHNOLOGY FOR TV PART I
		REGULATORY - GEN. SESSION AUXILIARY BROADCASTING	AM/FM MODULATION PART II	HDTV - PART II STUDIO PLANNING	DIGITAL TECHNOLOGY FOR RADIO PART II	DIGITAL TECHNOLOGY FOR TV PART II
	LUNCH		LUNCH			
PM	ENNES WORKSHOPS	GEN. SESSION- BROADCAST MANAGEMENT	NEW TECHNOLOGY FOR RADIO REMOTE BROADCASTING	HDTV- PART III RF SYSTEMS	GEN. SESSION- COORDINATES SYSTEMS	
					GENERAL SESSION- RFR	

Figure 1. Activities grid for the 1994 SBE Engineering Conference and World Media Expo, Los Angeles.

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Transmission

I'm from the government

I was talking recently with the vice president of engineering for a small group of TV stations. We were discussing the coming HDTV regulations and the need for TV stations to begin making plans now for the switch to HDTV capability. He offered his perspective on the issue.

"Transitioning to HDTV is kind of like the government and taxes. The government's (FCC's) perspective is that the new regulations, whether it's taxes or HDTV, are beneficial to everyone. It is the 'I'm from the government and I know what you need' attitude.

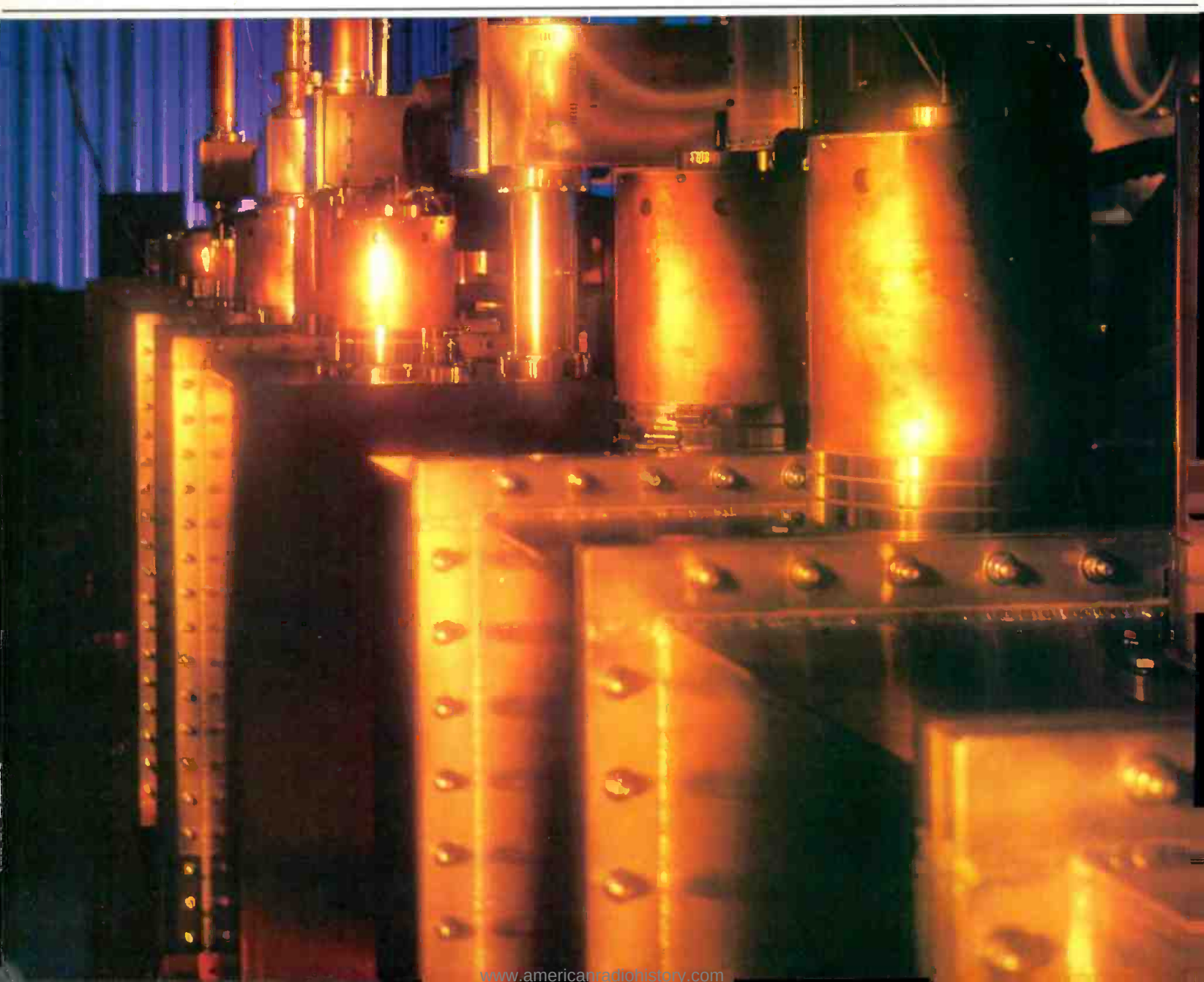
The problem is that the cost of new regulations (taxes) falls not on the government, but on the regulated populace (TV stations). In reality, the regulations represent (at least in the short term) punitive measures, designed to accomplish government plans (HDTV) while placing the cost of carrying out these measures squarely on the user, the TV stations."

Needless to say, this engineer saw the upcoming regulations as a significant challenge to his stations' future success. He, like many *Broadcast Engineering* magazine readers, is looking for answers.

Solutions needed

The pending HDTV regulations place TV stations in a dilemma. Although HDTV is just around the corner, stations still are going to be required to support an aging NTSC technology for the next 10 to 15 years. Any financial benefits of HDTV are years down the road, but the costs must be born up front.

Faced with such a quandary, it's not surprising that TV technical managers find themselves scrambling for



systems

and I'm here to help you.

solutions. The quest for my friend is how to make the transition to UHF HDTV, while maintaining an NTSC channel — without going broke in the process.

Solutions offered

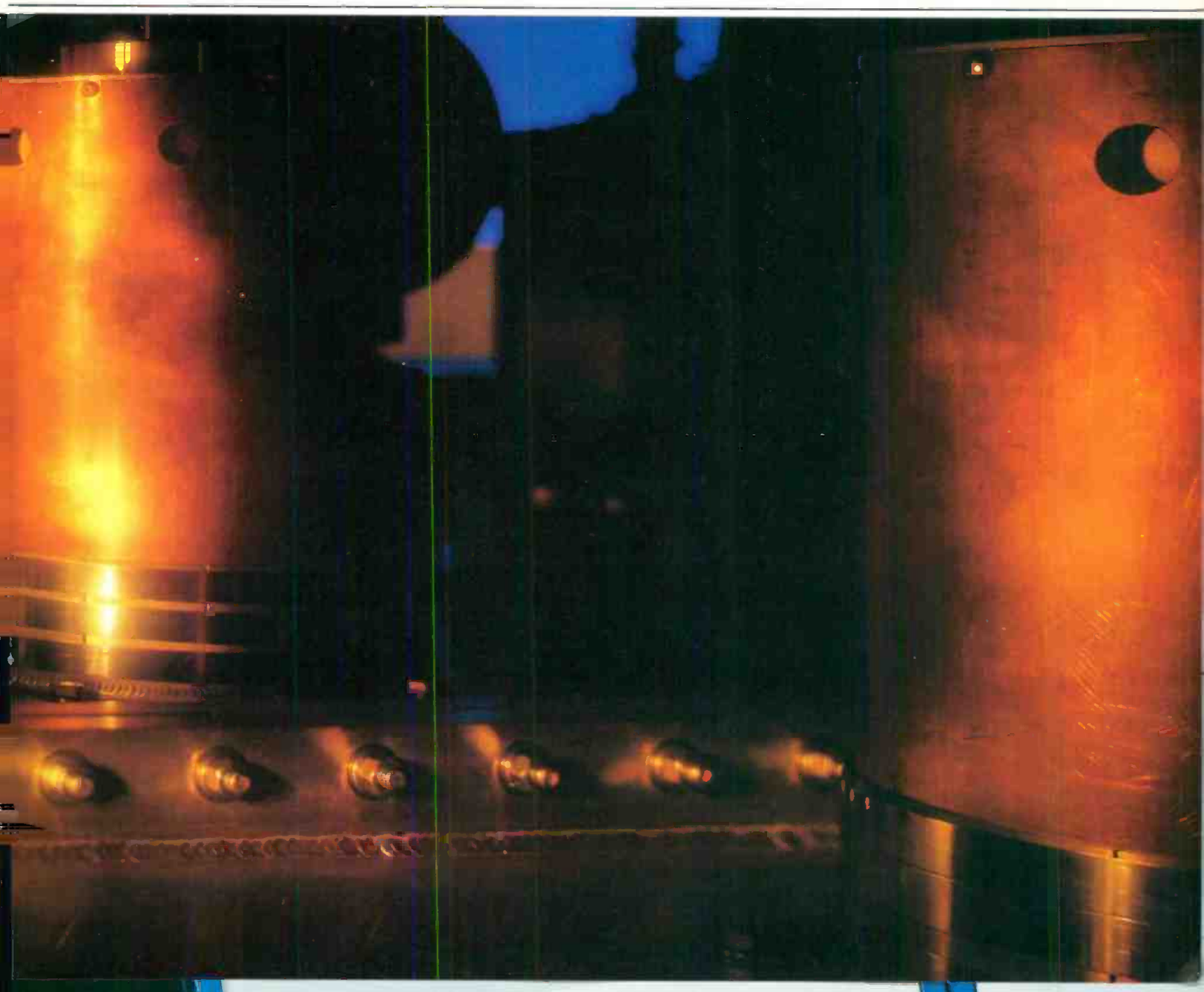
Fortunately, there are some answers out there and this month's *Broadcast Engineering* magazine provides solid guidance in this matter. For most stations, the first issue to be resolved centers on the transmission side. What transmitter do I need? What about an antenna? Will both the HDTV and NTSC antenna fit on my current tower?

Other less futuristic issues are always on the minds of technical managers. Here again, *BE* can provide guidance. This issue provides suggestions on the use of circular polarization and measuring TV antenna patterns by ground and aircraft. Finally, we look at the latest in field production camera technology.

Don't let technology roadblocks affect your station's future. Look for the answers you need inside *Broadcast Engineering* magazine.

Brad Dick

Brad Dick, editor



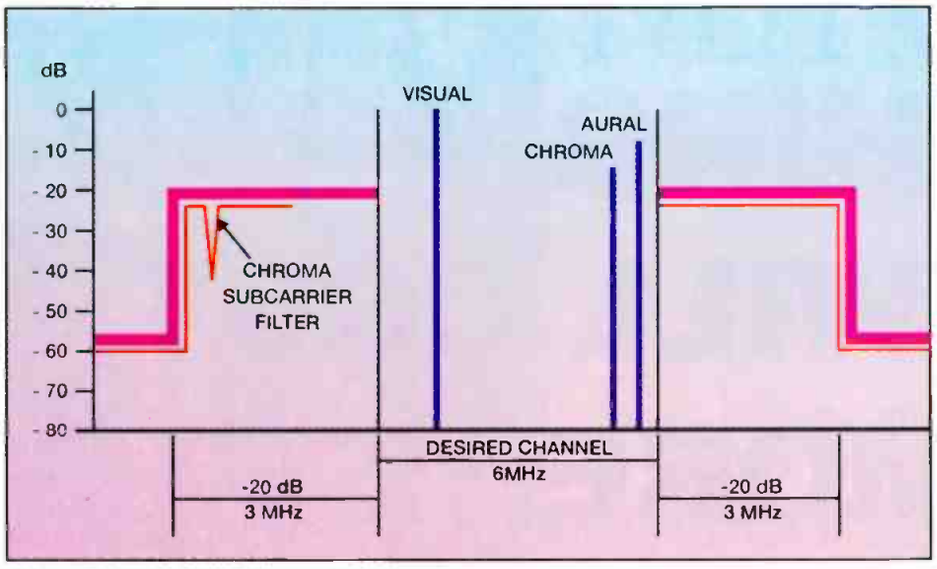


Figure 1. *Emission requirements for NTSC TV signals.*

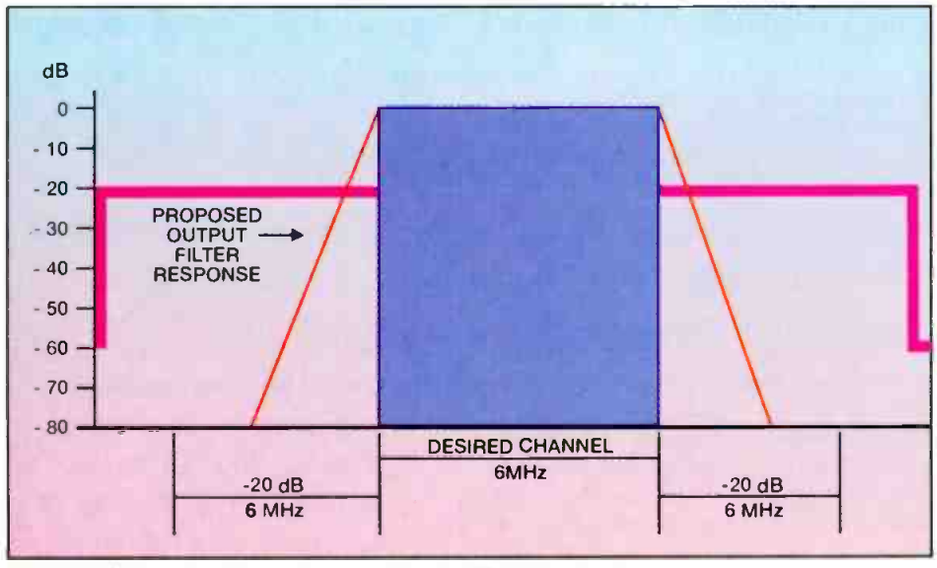


Figure 2. *Proposed emission characteristics for HDTV broadcasting.*

are becoming clearer. The 8-VSB system is an 8-level digital signal in a suppressed-carrier, vestigial-sideband format. The symbol rate is 10.76Msamples/s, which means the signal must change states and be at rest for sampling every 92.9µs. The spectrum produced by the rapid change in signal level is broadband and filtered to restrict the signal to the 6MHz channel. (See Figure 2.) Digital systems with this kind of spectral requirements are far more demanding than familiar analog systems.

These characteristics lead to a high modulation index and an extremely high occupied bandwidth. Any circuit that is required to pass this type of signal will require a wider bandpass and higher linearity attribute than traditional NTSC designs. Digital systems in general require better than 1% linearity from 0 to 100% modulation, and incidental carrier phase modulation of less than 2%. With these types of system restraints it could become expensive to produce the power that will be required to serve an existing coverage area. From these characteristics, some estimate can be made of likely new standards that the commission will adopt to ensure interference-free HDTV transmission.

HDTV power requirements

Much has been written about the power required for matching HDTV coverage for existing NTSC stations. A major problem within these discussions involves digital transmission's use of *average power* to quantify signal strength, while conventional television uses *peak sync power* as its unit of measure. This discrepancy has caused some confusion among those who have not thoroughly investigated the nature of the signals involved. In the world of transmitters, the peak power required at any instant is the limiting factor. The average power is a secondary consideration and is only a limiting factor in some types of RF amplifiers.

The NTSC signal has a peak-to-average ratio of 2.5dB while the 8-VSB HDTV signal has a peak-to-average ratio of 6.3dB for 99.9% of the power envelope. HDTV's error-free noise threshold (C/N) of 14.9dB cannot be related to the NTSC signal because acceptable noise level in NTSC is not a hard number. The FCC dictates that Grade B NTSC at UHF requires an RF signal level of 64dBu, but the RF signal-to-noise (S/N) is not defined. HDTV signals at a C/N below 14.9dB will not be received reliably, but at a C/N of greater than 14.9dB they will be received perfectly. As an example, at a noise floor of -90dB, the NTSC signal would have to be about 40dB above -90dB (-50dB) to produce a noise-free picture. With the same noise floor of -90dB, the HDTV signal would only have to be 14.9dB above -90dB (-75.1dB) to produce a noise-free signal. This comparison shows that the apparent 25dB difference between NTSC and HDTV depends on what is an *acceptable* NTSC signal. If the required NTSC S/N is reduced to 30dB, for example, the margin between the two systems becomes 15dB.

The FCC will establish an HDTV signal level that will be comparable to an NTSC Grade B quality with equivalent coverage. Until the FCC establishes the new standard, the controversy over required power levels will continue. Nevertheless, it is probable that required HDTV power will be less than NTSC by 6dB to 12dB average power and 3dB to 9dB peak power.

Optimizing HDTV systems

To establish a new HDTV station, either an existing/used transmitter or a new transmitter designed for HDTV can be employed. Considering the revenue likely to be recognized from this new service, many stations may want to investigate the use of existing equipment to establish HDTV service.

It will be possible to use most NTSC transmitters if they are of an *IF-modulated* design. A new encoder (modulator) could be purchased to provide the digital input to the transmitter. The existing visual exciter, aural transmitter and diplexer will not be needed because the entire HDTV signal is contained in one digital bitstream that will be broadcast through the visual transmitter.

A problem arises from the HDTV signal's requirement for an almost perfect RF amplifier. A traditional NTSC transmitter will produce extremely high intermodulation products due to its poor linearity. The in-band intermodulation products can be minimized by the use of a good IF corrector. The out-of-band products will be reduced by an IF corrector as well, but they will remain above the maximum allowable. To ensure compliance with the FCC specifications, a high-power filter will have to be placed at the transmitter output. Because of the high

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amount of peak energy that the filter will have to eliminate, an absorptive type filter should be used to prevent the out-of-band energy from being reflected back to the output stage. If the reflected energy is allowed to return to the output stage it can reduce efficiency and could cause instability.

A second consideration when using existing equipment is efficiency. Because most existing UHF transmitters use klystrons and operate in Class A, efficiency will be extremely poor. Pulsing cannot be used in an HDTV transmitter, therefore the basic NTSC efficiency will be reduced to only 30% to 40% if the tube is used at its rated peak power. Keep in mind that HDTV signals are rated in *average* power, meaning that a 60kW NTSC tube will only produce approximately 10kW of HDTV power. The normal 60kW klystron will consume approximately 150kW input power and produce 10kW of HDTV power for an efficiency of approximately 6.7%. To improve upon this, it is possible to overdrive the klystron, which will in effect, provide a soft clip of the digital signal and increase the average power (HDTV power) of the output signal. Again, an absorptive output filter is required to remove the undesired products produced by overdriving the klystron. This method of increasing efficiency will produce approximately 14kW of output power for an efficiency of 9%. This clipping of the signal has only a minimal effect upon the received HDTV signal because filters in the receiver/decoder will restore some of the signal's clipped portion.

The new HDTV system is coming faster than most imagine, so now is the time to start learning and planning.

On the other hand, a new transmitter designed for HDTV will be much more practical, with efficiencies on the order of 30% at 10kW (average). The absorptive output filter technique can also help with a new transmitter, although in this case the efficiency will remain constant while the output power can increase by 2dB or 3dB. This is because HDTV transmitters operate in Class B or AB, in which power consumption is proportional to power output. Some of the new HDTV transmitters on the market include an absorptive output filter, as does the UHF transmitter at the Charlotte, NC, ATV test site.

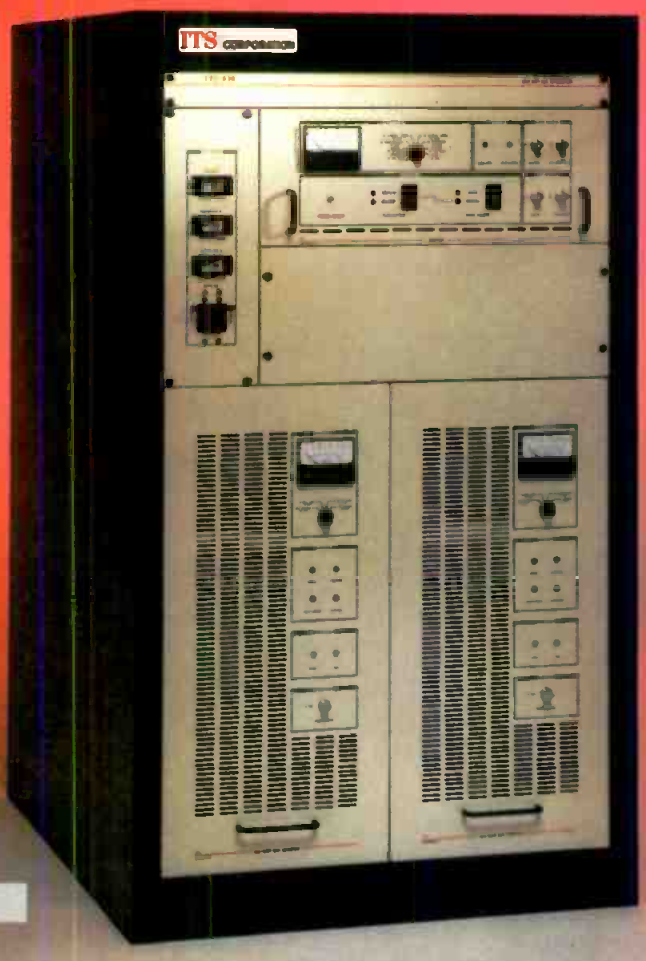
Plan now for future systems

The requirements and limitations of HDTV are becoming known. Broadcasters can now begin to plan their future systems. Keep in mind that the new HDTV system is coming faster than most imagine, so now is the time to start learning and planning. Many issues will have to be resolved — antennas, towers, STLs and studio facilities — and this article has only considered the transmitter system.

It appears that one new device that will be used is the absorptive bandpass filter, providing unique characteristics that ensure spectrum purity with low loss and a good impedance match to the transmitter to which it is attached. Although hard regulations do not yet exist, the short implementation window that is planned requires broadcasters to put in plenty of forethought on conversion now. He who hesitates will be lost in the mire of competition for the limited resources of this new technology.

■

A New Generation Of Transmitter Technology



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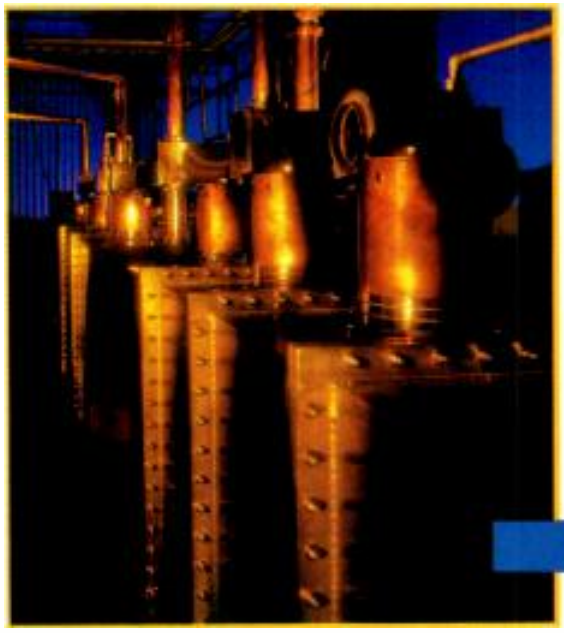

TV transmitter technology

A wide range of choices in options and features are available.

By Don Markley

The Bottom Line

One of the most important decisions a broadcaster makes is choosing a transmitter. Both the financial and long-term implications are staggering. Choosing wisely can make the difference between sleepless nights and resting easy. The technology has changed over the years, what follows is a quick look at what's currently available. With the approach of HDTV, buying a new transmitter is something that all broadcasters must face.

The state-of-the-art in TV transmitters continues at a rapid pace, as manufacturers prepare for the introduction of the TV standards whether called ATV or HDTV.

VHF TV systems are essentially the same as in the previous couple of years. Obviously, no manufacturer is going to plow heavy money into R&D for VHF television when that mode of broadcasting appears to be facing an eminent death. Companies have continued making minor changes to their solid-state VHF lines but many companies have eliminated tube-type VHF equipment completely.

In the UHF field, solid-state transmitters keep easing into the marketplace. At the low power levels, it is possible to buy solid-state UHF transmitters with better efficiency than comparable tube-type units. However, at those lower power levels, efficiency is not the critical factor it becomes when you attempt to obtain the high power output levels used by today's full-power TV stations.

As has been previously reported, the efficiency for high power UHF transmitters is still considerably lower than for their tube-type counterparts. These tube type transmitters include tetrode, klystron or IOT devices. It is also apparent that the IOT still seems to be the device of choice for most manufacturers, although the MSDC klystron is still available in modern designs.

All manufacturers of UHF equipment have clearly stated their transmitters are compatible with the proposed HDTV standards with the replacement of the exciters and some plumbing changes. In cases where multiple tubes are used, essentially all of the transmitters are capable of multimode operation. That is, the transmitters can be split with one amplifier being used for continuing NTSC service and the other amplifier and new exciter being used for HDTV service. Also, transmitters are available at high power levels with fully solid-state amplifiers. That technology can be expected to develop rapidly in the next couple of years as manufacturers prepare for an anticipated rush of sales as the industry converts to HDTV.

It's believed that all of the transmitters contained in the attached listing are capable of operating with multichannel sound systems. Also, all the transmitters are designed for color NTSC operation.

The listing simply identifies the transmitters by model numbers, power output, final amplifier type, band of operation and required AC input power. Significant differences do exist in the areas of differential gain, distortion and other significant parameters. That data has not been included to attempt to reduce the size of the overall listing.

Some transmitters have slightly different input power requirements depending on high or low VHF band operation. In those cases, the higher value is shown.

Markley is president of D.L. Markley and Associates, Peoria, IL.

For more information on transmitters circle the appropriate numbers on Reply Card:

	VHF	UHF
Acrodyne	(311)	(312)
Astre		(313)
Bext	(314)	(315)
Comark		(316)
EMCEE	(317)	
Harris	(318)	(319)
ITS	(320)	(321)
Larcan/TTC	(322)	(323)
Pesa	(324)	(325)

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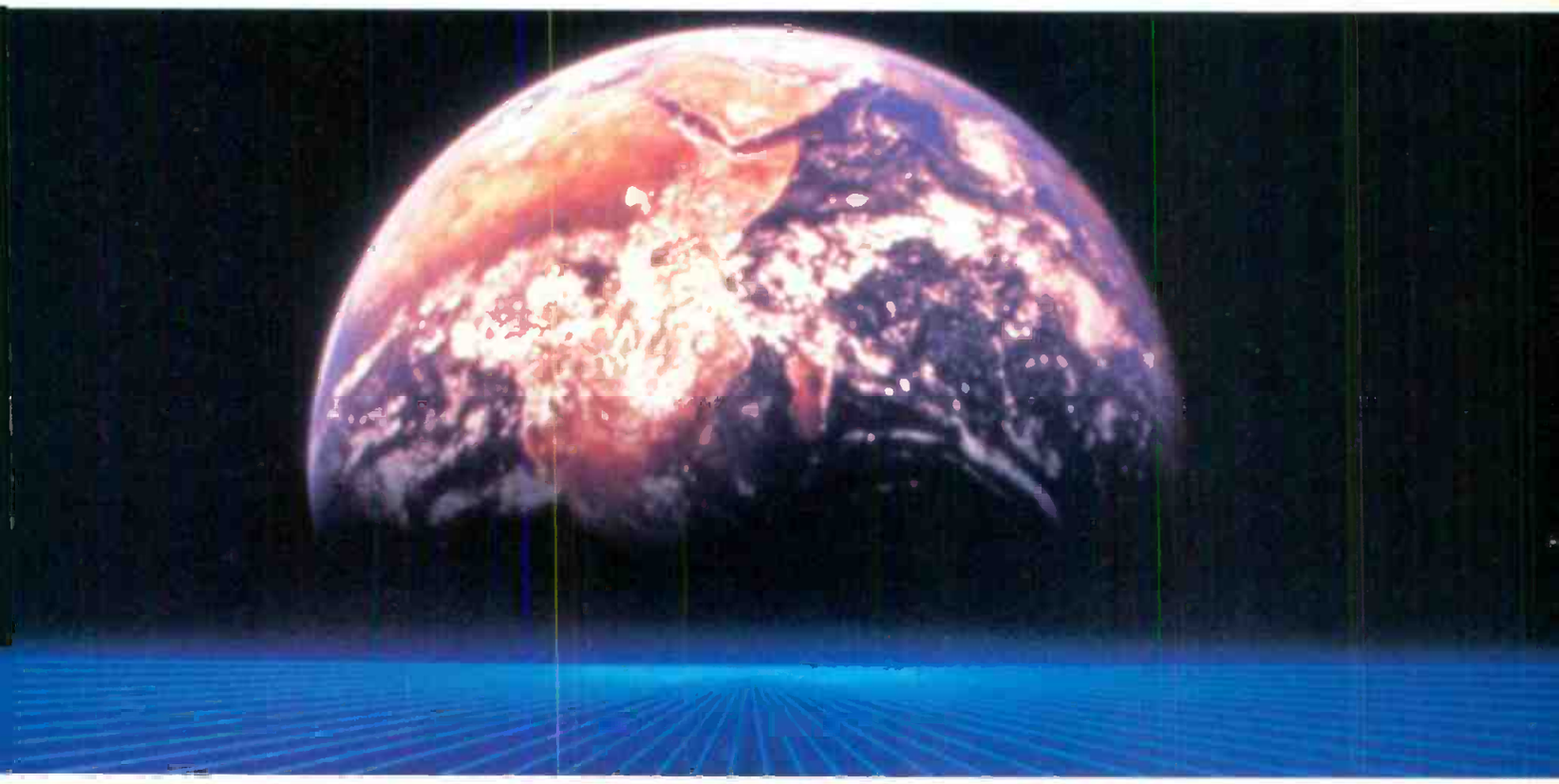

Despite what you may have heard, IOT technology wasn't born yesterday. We saw its potential to change the transmitter industry quite some time ago.

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VHF TRANSMITTERS (100W and greater)

MANUFACTURER	MODEL	OUTPUT POWER	AMPLIFIER TYPE	HIGH BAND	LOW BAND	INPUT POWER	MANUFACTURER	MODEL	OUTPUT POWER	AMPLIFIER TYPE	HIGH BAND	LOW BAND	INPUT POWER
ACRODYNE	TL/100E	100 w.	Solid state	x	x	1100 w.	ITS	ITS-1325/1425	500 w.	Solid state	x	x	2.5 kW
	TL/200E	200 w.	Solid state	x	x	2400 w.		ITS-1330/1430	1 kW	Solid state	x	x	3.5 kW
	TL/400E	400 w.	Solid state	x	x	5200 w.		ITS-1334/1434	2 kW	Solid state	x	x	5.5 kW
	TLL/1KACE	1 kW	Tetrode		x	4000 w.	LARCAN	TTS250M	250 w.	Solid state	x	x	1.1 kW
	TLH/1K	1 kW	Solid state	x		3200 w.		TTS500M	500 w.	Solid state	x	x	2.3 kW
	TRH/1K	1 kW	Solid state	x		3300 w.		TTS1M	1 kW	Solid state	x	x	3.5 kW
	TRH/2K	2 kW	Solid state	x		6300 w.		TTS3M	3 kW	Solid state	x	x	7 kW
	TRL/5KA	5 kW	Tetrode		x	21 kW		TTS5M	5 kW	Solid state	x	x	12 kW
	TRH/5KA	5 kW	Tetrode	x		21 kW		TTS6M	6 kW	Solid state	x	x	12 kW
	TRL/10KA	10 kW	Tetrode		x	31 kW		TTS10M	10 kW	Solid state	x	x	25 kW
	TRH10KA	10 kW	Tetrode	x		31 kW		TTS12M	12 kW	Solid state	x	x	25 kW
	TRL/20KA	20 kW	Tetrode		x	39 kW		TTS15M	15 kW	Solid state	x	x	35 kW
	TRH/20KA	20 kW	Tetrode	x		39 kW		TTS16M	16 kW	Solid state	x	x	36 kW
	TRH/30KA	30 kW	Tetrode	x		68 kW		TTS20M	20 kW	Solid state	x	x	48 kW
BEXT	TA280/TC370	100 w.	Solid state	x	x			TTS22M	22 kW	Solid state	x	x	49 kW
	TB280/SOLID STATE250	250 w.	Solid state	x	x			TTS30M	30 kW	Solid state	x	x	68 kW
	TB280/SOLID STATE500	500 w.	Solid state	x	x			TTS44M	44 kW	Solid state	x	x	98 kW
	TB280/221000	1 kW	Solid state	x	x			TTP60M	60 kW	Solid state	x	x	137 kW
	TB280/NS1000T	1 kW	Tetrode	x	x		PESA	TT5712/6812	100 w.	Solid state	x	x	1.3 kW
EMCEE	TTV100E	100 w	Solid state	x	x			TT5722/5822	200 w.	Solid state	x	x	2.5 kW
	TTV1000ES	1 kW	Solid state	x	x			TT5742/6852	500 w.	Solid state	x	x	3.5 kW
HARRIS	HT 1LS/HS	1 kW	Solid state	x	x	5.5 kW*		TT6813	1 kW	Solid state	x		5 kW
	HT 2LS/HS	2 kW	Solid state	x	x	6.9 kW		BT6723/6923	2 kW	Solid state	x	x	10.3 kW
	HT 5LS/HS	5 kW	Solid state	x	x	11.2 kW		BT6753/6853	5 kW	Solid state	x	x	19 kW
	HT 10LS/HS	10 kW	Solid state	x	x	19.3 kW		BT6714/6814	10 kW	Solid state	x	x	35 kW
	HT 15LS	15 kW	Solid state		x	25 kW		BT6724/6824	20 kW	Solid state	x	x	64 kW
	HT 15HS	15 kW	Solid state	x		28 kW		BT6734/6834	30 kW	Solid state	x	x	96 kW
	HT 20LS/HS	20 kW	Solid state	x	x	37 kW		BT6744/6844	40 kW	Solid state	x	x	128 kW
	HT 30LS	30 kW	Solid state		x	50 kW		BT6764/6864	60 kW	Solid state	x	x	192 kW
	HT 30HS	30 kW	Solid state	x		55 kW		TT4723	2 kW	Tetrode		x	13 kW
	HT 45LS	45 kW	Solid state		x	74 kW		TT5823	2 kW	Tetrode	x		6.5 kW
	HT 45HS	45 kW	Solid state	x		81 kW		TT5853	5 kW	Tetrode	x		20.5 kW
	HT 60LS	60 kW	Solid state		x	98 kW		TT5763	6 kW	Tetrode		x	23.5 kW
	HT 60HS	60 kW	Solid state	x		108 kW		TT5714	10 kW	Tetrode		x	36 kW
	HT EL500LS/HS	500 w.	Solid state	x	x	2.7 kW*		TT5814	10 kW	Tetrode	x		29 kW
	HT EL1000LS/HS	1 kW	Solid state	x	x	3.5 kW*							
	HT EL2000LS/HS	2 kW	Solid state	x	x	7 kW*							

*Measured with black picture

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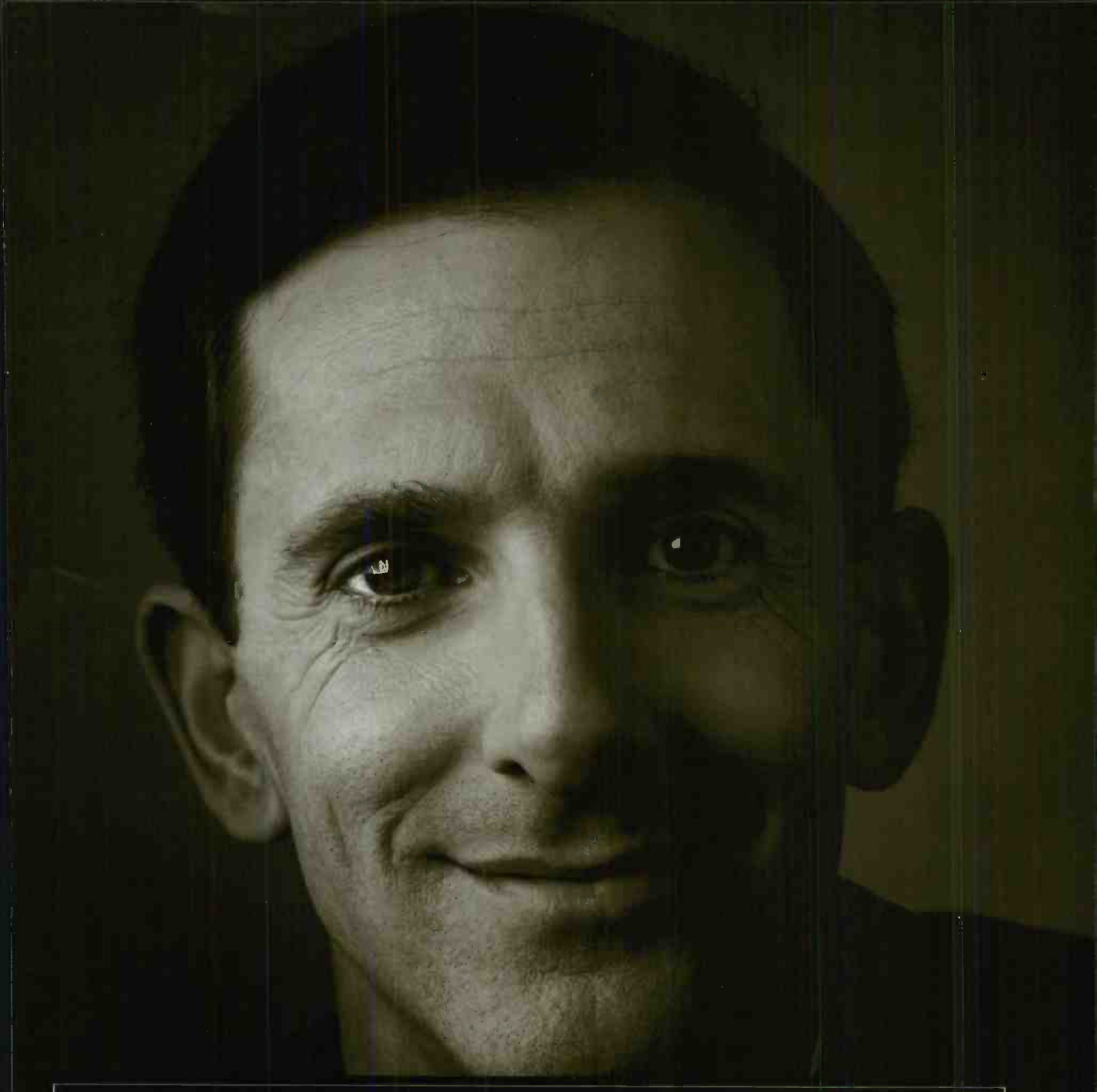
—E.B. (Gene) Wright, VP/Engineering, Turner Broadcasting System

With Digital Betacam equipment we're able to service clients who, in the past, were using analog component equipment, like Betacam SP. We give them improved picture quality without additional costs. In addition, the playback quality of an analog tape is actually better, when played on a Digital Betacam VTR. What's important to us is that Digital Betacam has closed the gap in digital formats between D-2 and D-1. We have a central machine room that has almost 100 VTRs. The Digital Betacam machines just plug in and fit the system. We've never run into a situation that anybody was complaining or that anyone could even point to artifacts that were a result of compression. It's performed flawlessly. It's the best introduction of a new format that I've ever experienced.

– Moshe Barkat, President, Modern Videofilm



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—Warren P. Kaplan, VP/Program Operations, Encore Media Corporation

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UHF TRANSMITTERS (1 kW and greater)

MANUFACTURER	MODEL	OUTPUT POWER	AMPLIFIER TYPE	INPUT POWER
ACRODYNE	TLU/1KACE	1 kW	Tetrode	3.2 kW
	TLU/1KSE/1KSCE	1 kW	Solid state	3.2 kW
	TLU/2KACE	2 kW	Tetrode	6.7 kW
	TLU/2KSCE	2 kW	Solid state	6.6 kW
	TRU/1KS	1 kW	Solid state	2.6 kW
	TRU/1KAC	1 kW	Tetrode	2.8 kW
	TRU/2KS	2 kW	Solid state	5.1 kW
	TRU/5KA	5 kW	Tetrode	14.9 kW
	TRU/10KV	10 kW	Tetrode	19.7 kW
	TRU/15KV	15 kW	Tetrode	29 kW
	TRU/30KV	30 kW	Tetrode	50 kW
	TRU/60KW	60 kW	Tetrode	100 kW
ASTRE	ST-15M	15 kW	Klystron (1-30)	70 kW
	ST-15	15 kW	Klystron (1-15)	62 kW
	ST-15DCM/30DC	15 kW/30 kW	MSDC Klystron (1-60)	40/50 kW
	ST-34M/60	34 kW/60 kW	Klystron (1-60)	145/160 kW
	ST-60DC	60 kW	MSDC Klystron (1-60)	88 kW
	ST-30	30 kW	Klystron (2-30)	85 kW
	ST-120	120 kW	Klystron (2-60)	295 kW
	ST-120DC	120 kW	MSDC Klystron (2-60)	157 kW
	ST-180DC	180 kW	MSDC Klystron (3-60)	248 kW
	ST-240DC	240 kW	MSDC Klystron (4-60)	320 kW
BEXT	TC280/SOLID STATE1000	1 kW	Solid state	
	TB280/NS1000S	1 kW	Tube	
	TA280/NS1000T	1 kW	Tube	
	TB280/NS2000	2 kW	Tube	
	TB280/NS5000	5 kW	Tube	
	20000W System	20 kW	Tube	
COMARK	CTT-U-30XIC/XICA	30 kW	IOT (1-40)	40 kW
	CTT-U-40XIC/50XIC	40/50 kW	IOT (1-60)	54/63 kW
	CTT-U-60XICR/XICRA	602 kW	IOT (2-40)	77 kW
	CTT-U-90XICR	90 kW	IOT(3-40)	115 kW
	CTT-U-80XICR/100XICR	80/100 kW	IOT(2-60)	103/123 kW
	CTT-U-120XICR/150XICR	120/150 kW	IOT(3-60)	148/184 kW
	CTT-U-P30XIC/XICA	60 kW	IOT(2-40)	79 kW
	CTT-U-P50XIC	80/100 kW	IOT(2-60)	105/126 kW
	CTT-U-P60XIC/XICA	120 kW	IOT(4-40)	158 kW
	CTT-U-P80XIC	160 kW	IOT(4-60)	210 kW
	CTT-U-P100XIC	200 kW	IOT(4-60)	252 kW
	CTT-U-60XIR	60 kW	IOT(2-60)**	71 kW
	CTT-U-120XI/XIR	120 kW	IOT(3-60)**	141 kW
	CTT-U-240XI/XIR	240 kW	IOT(5-60)**	282 kW
	**Not common amplifiers			
HARRIS	HD 30C1	30 kW	IOT(1-40)	48.1 kW
	HD 40C1	40 kW	IOT(1-60)	60.1 kW
	HD 60C2	60 kW	IOT(2-40)	94.1 kW
	HD 80C2	80 kW	IOT(2-60)	118.1 kW
	HD 90C3	90 kW	IOT(3-40)	140.8 kW
	HD 120C3	120 kW	IOT(3-60)	176.9 kW
	HD 120C4	120 kW	IOT(4-40)	187.7 kW
	HD 160C4	160 kW	IOT(4-60)	289.1 kW
	TV-60UM	60 kW	MSDC	92 kW
	TV-120UM	120 kW	MSDC	165 kW
	TV-180UM	180 kW	MSDC	184 kW
	TV-240UM	240 kW	MSDC	330 kW
	ULTRA-5	5 kW	Solid state	15 kW
	ULTRA-10	10 kW	Solid state	30 kW
	ULTRA-15	15 kW	Solid state	46 kW
ITS	ITS-830	1 kW	Solid state	3.5 kW
	ITS-834	2 kW	Solid state	7 kW
	ITS-1835	5 kW	Solid state	17 kW
	ITS-1240	10 kW	Tetrode	22 kW
LARCAN	TTS5U	5 kW	Solid state	24 kW
	TTS10U	10 kW	Solid state	45 kW
	TTS20U	20 kW	Solid state	85 kW
LARCAN/TTC	XL-100U & XLS-1000U	1 kW	Tetrode	4.8 kW
	UHF-10HDR	10 kW	IOT	
	UHF-30HDR	30 kW	IOT	
	UHF-60HDR	60 kW	IOT	
	UHF-120HDR	120 kW	IOT	
PESA	TT6913	1 kW	Solid state	6.2 kW
	BT6953	5 kW	Solid state	21.6 kW
	BT6914	10 kW	Solid state	42 kW
	BT6924	20 kW	Solid state	83 kW
	BT6934	30 kW	Solid state	128 kW
	BT6944	40 kW	Solid state	167 kW
	BT6964	60 kW	Solid state	258 kW

Automated TV signal-strength measurements

Here's how one station produced its own impressive array of reports on TV signal quality in its market.

By Philip Hejtmanek

The Bottom Line

Every TV station wants to know how well its signal covers the market and how it looks against the competition. Determining this with any precision has traditionally involved hiring a consulting firm and paying a hefty fee. With today's test gear and computer equipment, however, a station's own technical staff can collect this data. For only a moderate investment of staff time, the resulting reports can provide critical information to management about the station's and its competitions' signals.

In order to determine the quality of its signal coverage, the staff of one station in Chicago recently took a survey of its TV signal strength. The survey procedure was designed for speed, repeatability and minimal drain on station technical resources. The techniques used could be applied to other stations and markets.

One major goal of this survey was to find out if the station presented a competitively strong signal to the antenna jack of an average home television. To that end, the field-strength study was conducted with a procedure that differed somewhat from the process outlined in the FCC rules. The measurement apparatus was designed around a computer-controlled spectrum analyzer and considered five VHF stations and one UHF station in the market. Instead of using the FCC method — which uses a continuous chart recorder plot for a mobile run of 100 feet at every measurement location — this test's procedure sampled each station's signal at five fixed points separated by 10 to 15 feet from each other at every measurement location. The adjust-

Hejtmanek is director, Communications Technology, SIU Broadcasting Service, Southern Illinois University, Carbondale, IL. Respond via the *BE* FAXback line at 913-967-1905.

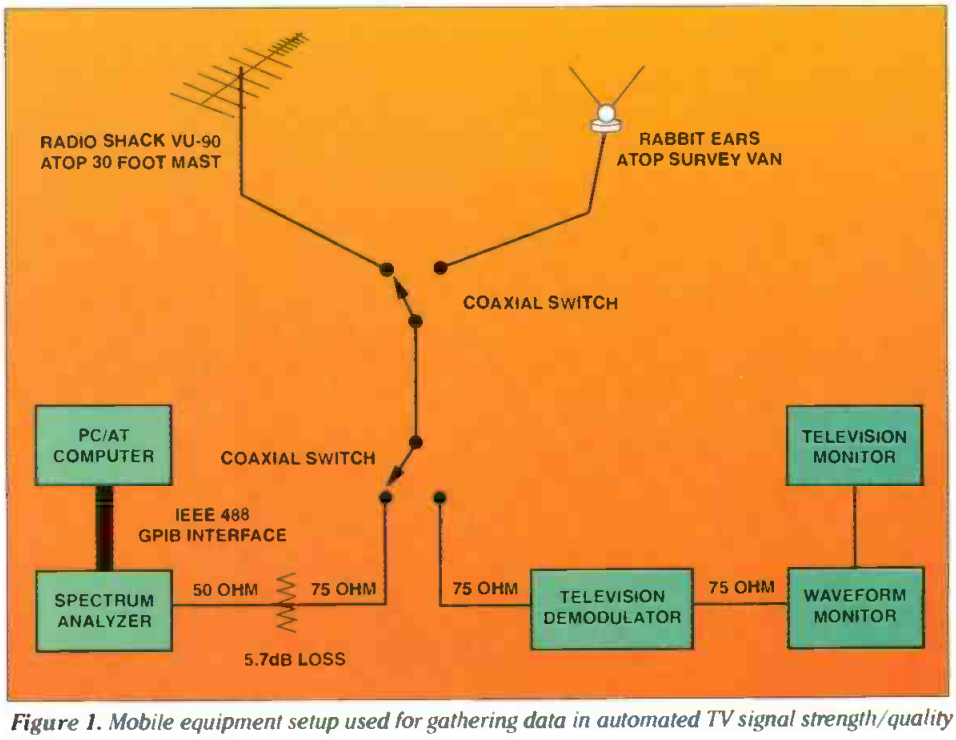

Figure 1. Mobile equipment setup used for gathering data in automated TV signal strength/quality tests.

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ment in methodology and equipment allowed measurement of all of the desired stations at one time, without repeating the run for each station.

Another important part of this project was an examination of picture quality. For these subjective measurements, observations of the six TV stations were made at each survey point, using the mast-mounted antenna and a set of rabbit ears. (A previous audience survey conducted by the station had indicated that almost half of its non-cable viewers used rabbit-ear antennas.)

Selection of radials and points

The project collected data from 124 measurement locations. Ten radials from the station's John Hancock Center transmission site were selected. Chicago's orientation on Lake Michigan dictated that no meaningful data would be available from 0° through about 120° (all radials are referenced to true north). Therefore, the 10 radial directions examined were 135°, 160°, 180°, 206°, 225°, 245°, 270°, 295°, 315° and 335°.

USGS sectional topographical maps in the 1:24,000 (7.5 minute) scale were used to plot these radials from the center of radiation out to a distance of 35 to 40 miles. Then, following FCC standards for this measurement process, points were selected at approximately 2-mile intervals, starting at 10 miles from the center of radiation and continuing out to 35 or 40 miles, depending upon the radial. These points were selected with ease of access in mind.

Each radial had approximately 13 measurement points associated with it, except for the 135° radial, which extends over water for the first 27 miles from the Hancock Center. It had five points in northwest Indiana.

Measurement apparatus and procedure

Measurements were taken using an RF survey van equipped with a 30-foot pneumatic mast. (An ENG truck with a similar mast could also be used.) The survey apparatus consisted of the antennas described earlier, a TV demodulator, a waveform monitor, a color TV monitor, an IBM-compatible computer and a digital spectrum analyzer. (See Figure 1.) The computer and the spectrum analyzer were connected via a GPIB interface to facilitate automated measurement. Custom software was developed to sequence the analyzer through the measurement routine. Results were saved on disk and were also printed out at the time of the measurement for backup.

The mast antenna was mounted on a pan/tilt head. The rabbit ears were mounted on a short aluminum rod that was

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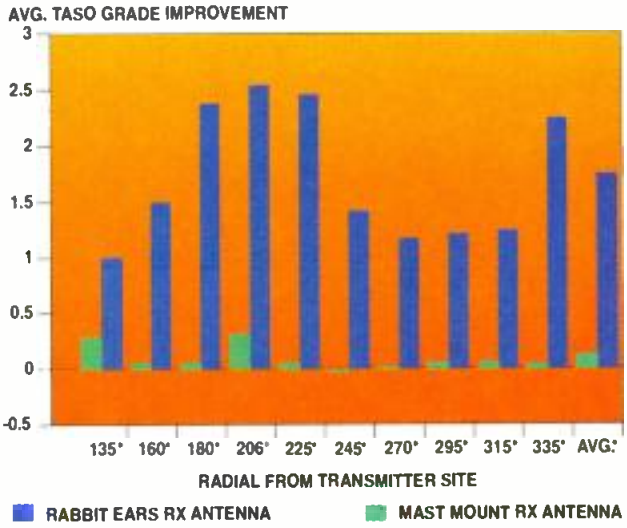

Figure 2. An example of the PC-generated display possible by processing data gathered in field measurements. Here, the perceived change in received picture quality between a station's old and new transmit antennas is graphed along each radial (and averaged). Results are shown for signals received on a 30-foot mast antenna and rabbit ears.

placed on the roof of the van. Transmission lines from each antenna entered the van via an access port in the roof and were connected to a coaxial switch. The output of this switch fed a similar coaxial switch that routed RF either into the TV demodulator for picture viewing or into the spectrum analyzer through a 75Ω to 50Ω matching pad. This pad introduced a loss of 5.7dB, for which a compensation factor was applied in calculating measured results.

In order to conduct the signal-strength measurements for all six stations in a timely manner, computer automation of the test process was employed. At every sampling point, the spectrum analyzer was automatically tuned to each of the 12 frequencies to be monitored (aural and visual signals for six stations), and 11 samples of maximum signal amplitude were taken. The first sample was discarded and the remaining 10 were averaged. Each frequency's average was stored on floppy disk, using a separate file for each measurement location. The truck was then moved a short distance and the process repeated, until five separate sets of measurements were taken at each location. At the completion of each location's full complement of signal-strength tests, the computer file contained five averages of 10 samples for each of 12 discrete signal frequencies, totalling 600 values per measurement location.

A program written in BASIC was used to sequence the spectrum analyzer through the 12 measurement frequencies. For each measurement, resolution bandwidth was set for 300kHz and video bandwidth for 100kHz, resulting in a display that allowed easy measurement of peak power. Each of the measurement samples was taken by making a single sweep of the spectrum and using a peak-reading marker function. Each of the desired measurement frequencies was programmed as the center frequency of the analyzer with a span of 5MHz to prevent the peak marker from reading the wrong signal. The computer could then interrogate the spectrum analyzer and capture the power value in dBuV. The program also included user prompts, a printing utility and disk storage routines.

For the subjective evaluations, the mast-mounted antenna and the rabbit ears were fed into the demodulator and viewed on the television. The picture quality for each station with each antenna was graded using a 6-level standard corresponding to the *Television Allocation Study Organization* (TASO) recommendations. (TASO was an industry group that advised the FCC on technical aspects of TV channel allocations in 1959.)

At each measurement point, the time, weather, obstructions, nearby power lines and other pertinent observations were logged, using a standard form. The location was also carefully described,

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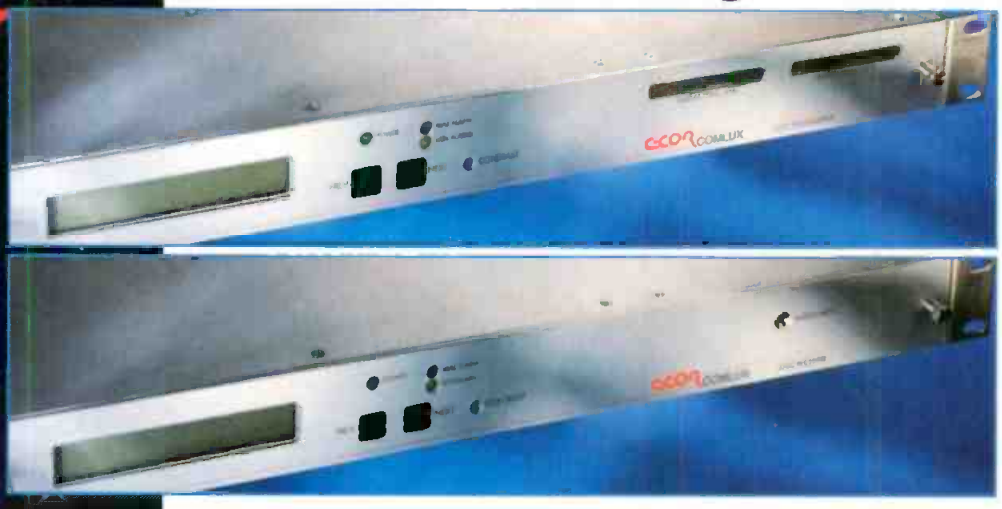

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so valid subsequent tests could be conducted for signal-comparison purposes.

Both mast and rabbit ear antennas were adjusted for best orientation at each measurement point. Safety was also stressed: The mast was never to be raised without looking up for power lines and obstructions, and it was always to be lowered when the vehicle was moved. Those conducting the survey also should have proper identification — you'll be amazed at what some people will think you are doing.

The full set of tests was completed in approximately three weeks. At the conclusion of the survey, the raw data was loaded into a spreadsheet program and averaged to give a single aural/visual value for each station at each map point. A correction was also applied to compensate for the 50Ω to 75Ω minimum-loss matching pad at the spectrum analyzer input. This information was then combined by radial to give a signal-strength profile of each station along that radial direction from about 10 miles to 35 miles from the transmission site.

Graphical data presentation and observations

The spreadsheet program was used to transform mind-numbing rows of numeric data into displays that allow easy visual comparison of relative signal strengths for the stations of interest. In addition, TASO rankings could be displayed. (See Figure 2.)

Perhaps most useful are graphic comparisons of results from multiple tests taken under different conditions. In this case, the station conducting the tests ran the full set *twice* — once before and once after the installation of a new, circularly polarized (CP) antenna.

Comparing these before-and-after curves showed that the visual signal levels for the new antenna varied from slightly lower to approximately the same as the old antenna. (Remember that the signal-strength tests were made with the horizontally polarized mast antenna only. No attempt was made to measure the vertical component because there are no CP consumer TV antennas available that would take advantage of the additional radiated signal.)

On the other hand, comparing the before-and-after tests' *subjective* results showed significant improvements. Figure 2 shows the average differences in TASO grade between the station's original batwing antenna and the new CP unit, with each radial's results displayed separately, plus an overall average for the mast and rabbit-ear receive antennas. A positive value represents the number of TASO grades of improvement, and a negative number represents a degradation.

Results were especially noticeable with the rabbit-ear receive antenna. Of the 124 points measured with rabbit ears, five points showed no improvement and three points showed degradation. The other 116 points showed an improvement, some by as much as four TASO grades. The overall average improvement for the entire viewing area was about 1.7 TASO grades. This represents the difference between a marginal picture to one of high quality that provides enjoyable viewing.

Such surveys collect real-world data about the nature of received signals in a TV market. Management can then be confident that the station's signal covers the market with a strong and high-quality signal and compares favorably with the competition. The use of automated testing makes this possible in a relatively fast and cost-effective manner. ■

➡ *For more information on automated RF test equipment, circle (311) on Reply Card.*

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Antenna pattern analysis by aircraft

By Steve Rowell

Most engineers agree that ground-based field-strength measurements leave a lot to be desired. A scattered number of points taken over a few days with only rough ground coordinates to plot with is not an ideal method. Trees, power lines and ground-signal interference all contribute to skewing of the data.

An obvious alternative is retrieval of field-strength measurements from the air. It is not a new idea. Anyone with a news helicopter and a field-strength meter has probably given it some thought and perhaps even attempted it. Others have developed it into a business. One such company is the Georgia-based A/D Technologies. Examining the company's approach is a good way to understand the general principles of aerial field-strength measurement. The company uses sound engineering and computerized signal-gathering equipment to present a concise and arguably more precise picture of an antenna's actual radiation characteristics.

On-board test equipment

A/D Technologies uses a custom-made sampling antenna. The design is an offset dipole mounted in-line, underneath the body of a small plane. The dipole was designed to be as close to as many multiples of broadcast frequencies as possible.

Inside the plane are an automated spectrum analyzer and a computer. The computer takes the raw data from the spectrum analyzer and compares it with the known characteristics of the broadcast site to determine the radiation pattern. The computer also compensates precisely for the receive antenna's gain characteristics at the measured frequency to assure a flat response from the dipole. This method allows reception anomalies created by the aircraft's structure to be nulled as well.

Limits for the plane's heading deviation are also determined, so that line-of-sight to the broadcast antenna will clear the wing and tail of the aircraft at all times.

In the air

A circle of two nautical miles radius around a station's tower is used as a nominal measurement path. Altitude remains fixed at 1,000 feet. Measurements taken from this distance are computed based on the free-space path loss ratio.

Before the crew leaves its home base, a detailed flight plan is plotted. Deviations from the 2-mile circular path due to natural or man-made obstructions (often other broadcast towers), as well as restricted air space, are figured into the plan. Sometimes exceptions may be granted for access to controlled air space. For obstructions, a wider circle or a slightly skewed path must be used. Such deviations to the flight path are not problematic. Enough raw data is accumulated throughout the flight that non-equidistant samples from known positions can be normalized to the nominal flight path and corrected.

In the air, a GPS receiver is used to feed precise ground fixes for every measurement point. This location data is coupled with spectrum analyzer samples, adjusted to the receive antenna's gain characteristics and recorded by the on-board computer. Each sample's data is correct to 0.1° of pattern arc, providing an overall pattern accuracy to 1° of pattern arc.

Two passes around each tower are used for verification purposes. Fixed attenuators are used to optimize the spectrum analyzer to the power of the station being measured. Often, multiple stations are measured on the same flight, so these attenuators are exchanged in the air.

Hard copy results

By using the latest topographical information provided by the USGS, a customized map is generated for plotting the station's pattern. The map can include political and physical topography — anything from state, county and city boundaries to roads and rivers. The client can select the combination of geographic demarcations that will best aid in relating population and coverage to the pattern data.

A pattern's *reference plot* includes a selected dBuV contour superimposed over this selected topographical information. This type of plot should not be confused with standard FCC field-strength plots. Reference plots depict the *antenna's* exact pattern — the radio horizon and terrain are *not* considered. User-specified contours can also be included. The data is stored so that subsequent measurements can be easily compared. Color is used to make the printed data easy to understand by non-engineering staff. (See Figure 1.)

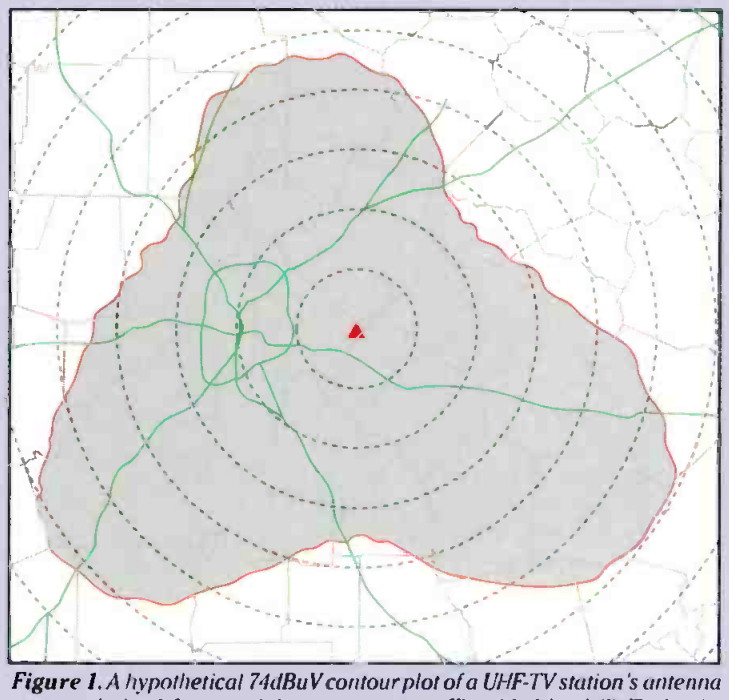

Figure 1. *A hypothetical 74dBuV contour plot of a UHF-TV station's antenna pattern derived from aerial measurements. (Provided by A/D Technologies.)*

Why do you need this?

The obvious application for this kind of survey is the proofing of an antenna. A new antenna can be verified for its signal strength and pattern by this kind of plot. Orientation, feed line and transmitter power coupling can also be confirmed.

Existing facilities can also benefit from such tests, however. Wind, rain and the inadvertent bumps by tower crews can cause those puzzling phone calls that make an engineer wonder if there is something wrong up there.

A/D Technologies suggests to its clients that this service be put on a periodic schedule. For example, engineers have seen small new nulls develop on subsequent visits (which are nothing to worry about), but later visits may show the null deepening and another developing on the opposite side of the pattern (which could be a serious problem).

These kinds of tests not only alert a station to problems, but the hard copy also can be sent to the antenna manufacturer, who can use the data to troubleshoot the problem. The tower crew can then climb knowing what to look for when they get to the antenna. ❑

Rowell is chief engineer at WOFL-TV, Lake Mary, FL. Respond via the *BE* FAXback line at 913-967-1905.

➡ *For more information on antenna pattern analysis by aircraft, circle (312) on Reply Card.*

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Antennas for NTSC/HDTV simulcasting

Factors affecting performance include antenna bandwidth, pattern and mounting.

By Joseph A. Zuba

The Bottom Line

Slowly, but surely, planning for HDTV implementation continues. Numerous questions remain, but one thing is sure, a major portion of the costs associated with conversion to HDTV will go into the transmission system. Understanding the differences between HDTV and NTSC, as well as being aware of implementation options, will help those involved get the most from their decisions.

The migration to digital has been readily accepted for studio equipment. And, as transmitter purchasers begin specifying "HDTV-adaptable" configurations, they are more closely examining the last link in the path, the transmission line and antenna. This article will discuss antenna system options and factors to consider for the transition from NTSC to HDTV. These options include such configurations as side-mounted antennas, top-mounts, stacks and multiplexing. In every case, the relationship between the tower and antenna system requires analysis.

Equivalent coverage for HDTV

The first question usually asked is "What HDTV power (or ERP) will be required to obtain reliable HDTV coverage comparable to NTSC?" Industry opinion varies, ranging from approximately 50% to even 200% of NTSC powers. This discrepancy is due to delays in the ATV system field tests, scheduled for completion in 1995, and the yet to be finalized "planning factors" that incorporate such issues as channel assignment (14 vs. 69 for example), time and location variability, and the HDTV receiver (antenna and low-noise amplifier gain).

Consensus seems to be that on a "peak" basis, HDTV ERPs should fall between 50%-100% of NTSC. Although early discussions of peak/average ratio for digital signals have ranged from 6dB to 10dB, the current ratio being used is 6.2dB.

System considerations

Intermodulation distortion and RF system efficiency (including line and antenna) will affect the amount of transmitter power/ERP required for HDTV transmission. Common amplification mode transmitters have exhibited excellent phase and amplitude linearity over the 6MHz channel. Such linearity requirements also can be extended to passive RF components. Severe non-linearities will result in the loss of digital information. Inefficien-

Zuba is director of broadcast sales and marketing for Dielectric Communications, Raymond, ME.

Figure 1. *Dielectric TFU-24G antenna used for Charlotte, NC, ATV field tests.*

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cies within the transmitter RF system or transmission line path will also result in wasted energy and loss of coverage.

In addition to VSWR or *input bandwidth*, antennas have been evaluated for elevation and azimuth pattern measurements at NTSC carrier frequencies. Now the antenna output bandwidth performance requires examination across the 6MHz channel.

Any study of digital HDTV-equivalent coverage must look at the *threshold contour*, the distance beyond which picture and sound are lost where the minimum carrier to noise ratio (CNR) of the digital signal is barely maintained. At that contour, approximately one mile of coverage will be lost for every 1dB of signal reduction. (See Figure 2.) Far away from the transmitter, weak NTSC signals result in fuzzy or snowy pictures. For HDTV, there will be a picture or nothing at all. This is an extremely important point and has major implications for antenna selection, choice of pattern and method of antenna mounting to the tower.

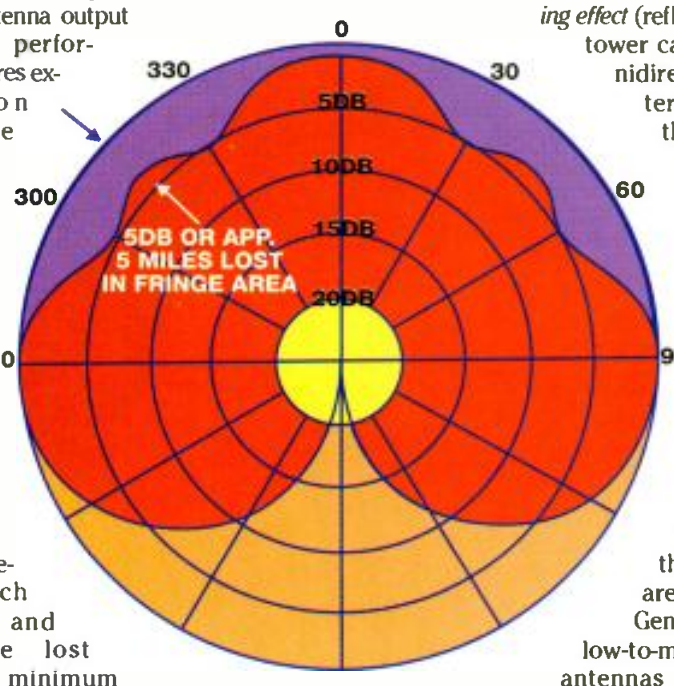

Figure 2. Possible variation of threshold contour with antenna azimuth pattern.

The strength of a digital TV signal is usually expressed in *average power.* Much attention has been focused on the lower-power, lower-cost aspects of the transmission facility. However, the evaluation of "passive" components (filters, transmission line and antenna) must be done on a "peak instantaneous power" basis that can reach levels well above average. This means the transmission line and antenna will be about the same physical size as present NTSC systems.

Antenna options

Top-mounted slotted cylindrical antennas will always offer the best performance. The antenna supplied for ATV field tests in Charlotte (see Figure 1) is a top-mounted type and is similar to available NTSC designs. Long term, if at all possible, an HDTV top-mounted antenna should be a goal. However, many stations may elect to use a side-mounted antenna for initial HDTV implementation.

One issue yet to be determined is what minimum power/ERP/facility the FCC will allow stations to comply with its on-air HDTV timetable. Stations that now use directional antennas for NTSC will most easily implement this type of system. This is because of the *scattering effect* (reflections) the tower causes in omnidirectional patterns. For NTSC this effect is not drastic, but for HDTV, tower effects can distort the threshold contour and result in significant "holes" in the coverage area.

General belief is low-to-medium gain antennas with elevation gains of 20-25 will work best for HDTV. To perform a tower analysis, you could estimate an antenna physical size by assuming the aperture of a higher-gain antenna (30 perhaps) with associated transmission line.

While some stations are planning a modest entry into the HDTV era using a side-mounted system, others are preparing to get a jump on the competition.

Stacked systems provide a top-mounted solution. These involve mounting two antennas, either VHF/UHF or UHF/UHF, atop one another to provide the best coverage for NTSC and HDTV channels. Several stations are planning or implementing such systems now by: 1) building new or strengthening existing towers, and 2) installing stacked systems using a dummy tower or pole section to be replaced by a future HDTV antenna.

Broadband UHF panels provide UHF stations with the ability to combine NTSC and HDTV signals into the same antenna. Maryland Public Television Network's WCPB-TV Channel 28, Salisbury, is taking this route. The antenna to be installed (see Figure 3) is a top-mounted panel type designed for operation on any future HDTV channel. Omnidirectional UHF panel antennas require a support tower with a small cross section (about 27 inches square) for good circularity and coverage (±2dB). They are somewhat power limited by feedline size and structurally offer higher windloads than slotted cylinder types. The tower can be reinforced,

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which may offer a cost-effective solution to top-mounted simulcasting.

Wraparound panels (around the tower) have been mentioned as a simple solution to the addition of a UHF HDTV channel or for multiplexing. Because the panels are small (and towers generally large), the resulting azimuth patterns can be severely distorted, deviating up to 20dB from omnidirectional in some cases. Such distortions will result in an unacceptable loss of service. In directional applications, the use of side-mounted broadband panels for combined operation could find acceptance. Side-mounted HDTV-ready/NTSC standby systems using broadband UHF panels and broadband lines provide an immediate NTSC backup and HDTV-ready system.

For broadband antenna systems, broadband transmission lines are mandatory and two choices are available. At sizes up to three inches, semi-flexible cables are less expensive and less costly to install than rigid lines. For diameters larger than three inches, broadband rigid line provides higher efficiency, higher power handling, ease of installation and better VSWR response than the semi-flexible alternatives.

Figure 3. The broadband TUP panel antenna for WCPB/28, Maryland PTV.

Vertical polarization

Vertical polarization has been mentioned for HDTV transmission in an effort to reduce interference from HDTV into NTSC. Because most UHF antennas are slotted cylinders, vertically polarized UHF antennas may be larger with larger windloads. These antennas in the presence of other antennas or towers (side mounts) exhibit higher distortion, or scattering, than horizontally polarized units. Vertically polarized signals propagate and are attenuated differently, requiring a new set of planning factors for ERP determination.

Finally, vertical polarization would require two antennas at the receive end. This is not to imply vertical polarization can't or won't be used. Circular or elliptical polarization for HDTV still needs to be evaluated.

Choosing the best system

Which antenna system is best? Unfortunately, there is no single answer. How well the system performs will depend on the factors discussed and the options available to each station. The initial choice of an antenna system for digital HDTV will also depend upon market size and the revenues expected from HDTV transmission. Economics and the FCC implementation schedule will affect the decision. One thing is clear, the planning process should begin now.

Acknowledgment: The author would like to thank E. Noel Luddy and Dr. Oded Bendov for their comments.

➡ *For more information on HDTV antennas, circle (313) on Reply Card. See also "Antennas, TV Transmitting" on p. 67 of the BE Buyers Guide.*

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Field production cameras

Tools for shooting video in the field continue to improve.

By Marcus Weise

The Bottom Line

Advances in camera technology have made it difficult to separate the quality and flexibility of studio cameras from electronic field production/electronic news gathering (EFP/ENG) cameras. Operational features of these cameras have become quite sophisticated, while increased integration and automation allow more to be carried in small, ergonomic packages. If your field cameras are of an older vintage, upgrading them today can have dramatically beneficial effects on your remote programs.

The technical specifications and video-processing capabilities of EFP/ENG cameras have become practically identical to their studio counterparts. Field cameras can now boast such features as 10-bit to 13-bit digital signal processing, signal-to-noise ratios of 62dB, three 600,000-pixel 2/3-inch CCDs, available triax and fiber-optic cable outputs and up to 900 lines of resolution. Most manufacturers offer auto-setups, memory storage capability for setup parameters and detailed color correction in six vectors, just as they do in their studio cameras. Quite often, an EFP/ENG camera is nothing more than a smaller version of a manufacturer's studio camera, carrying all the same operational capabilities of the larger body.

Weise is president of Marcus and Associates, Hollywood, CA. Respond via the *BE* FAXback line at 913-967-1905.

The reduced size of EFP/ENG cameras can be a blessing or a curse, depending on the needs of your production.

EFP/ENG cameras generally add an integrated VCR or the ability to dock to a variety of external decks. Sony and Ikegami offer camera control unit adapters for their field cameras, making them better than dockable — they can record in the camera and also feed studio tape machines. They also can be controlled remotely by phone lines or radio units.

The JVC KY-27B field production camera.

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The Panasonic AG-DP800 Supercam camcorder.

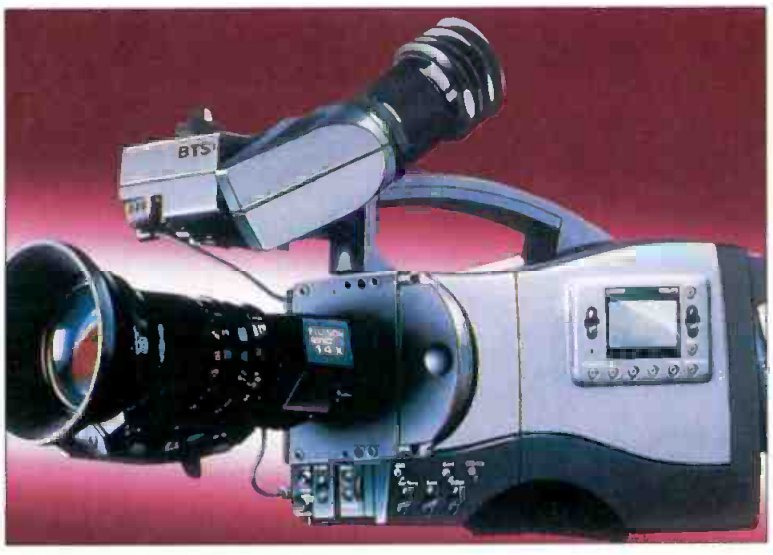
in-picture (PIP) in the viewfinder is also offered. This allows the operator to see a return from the studio for special effects, for example, without losing the image in the viewfinder that the camera is presently shooting. The images are switchable so the small image can be swapped with the larger one if more detail is needed. The PIP image can also be moved to any quadrant in the viewfinder.

Automatic black-and-white shading compensation corrects unevenness caused by internal circuit characteristics or by lenses and prisms. Camera setups including all parameters are storable on card memories or internally, allowing the same setup to be repeated days or months later and assuring the same setup on all cameras.

Video gain circuits are available with ranges from -3dB to +30dB and minimum specifications of 3.2lux illumination. Color correction can be performed through dual internal filter wheels in addition to electronic correction. Variable shutters, with speeds from $^{1}/_{60th}$ of a second to more than $^{1}/_{2,000th}$ of a second, allow synchronization of the camera with any image it is photographing. This prevents video phasing problems, such as bars on a computer screen, and it can also be used to eliminate blurred images in

The reduced size of EFP/ENG cameras can be a blessing or a curse, however, depending on the needs of your production. In confined quarters, such as an aircraft, you need a smaller camera. On the other hand, at a sports event, such as golf or baseball, the stability and inertia of a studio camera is desirable. There are new and interesting adaptations for size and weight considerations when using field cameras.

For example, although most field cameras will mount onto studio pedestals, the feel and look are not the same as a real studio camera. Ikegami has designed what it calls a *System Expander*. It takes a portable camera and converts it to a studio camera by placing it inside an enclosure that gives it operational qualities of a studio camera mounted on a standard studio pedestal. The viewfinder is full size instead of an eyepiece type. The enclosure allows the use of a larger studio lens and offers intercom and monitoring capabilities. It takes about five minutes to install or remove the camera from the enclosure, and either camcorder or camera-only models can be used.



The LDK 10P field camera from BTS.

Several new EFP/ENG cameras are switchable between 4:3 and 16:9 aspect ratio outputs.

Quite often, an EFP/ENG camera is nothing more than a smaller version of a manufacturer's studio camera.

Flexible new features

Several new EFP/ENG cameras are offered in versions that are switchable between 4:3 and 16:9 aspect ratio outputs. Outputs are also switchable from serial digital to analog, and from component to composite. Thereby, one camera can cover a multitude of uses.

For camera setup, many models have through-the-lens setup systems that are automated and storable. Picture-

Ikegami's HK-377P field production camera.

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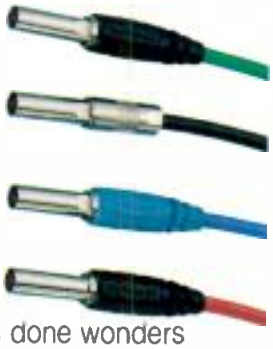

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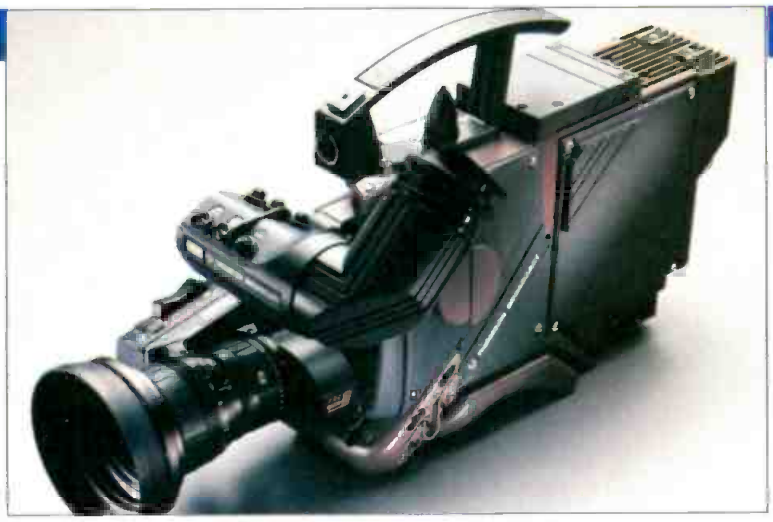


The TTV 1657 field production camera from Thomson Broadcast.

high-speed action or smearing and lagging.

Setups are now much more detailed in their correction abilities. Flesh-tone detail and color-correction in six vectors allow fine-tuning of the color output from the camera. The horizontal details in the picture also can be enhanced over a broad range to accommodate the content of the scene and the bandwidth of the record or transmission system.

Panasonic has introduced *progressive scanning* to EFP/ENG camera technology. With this system, two luminance-channel buffers are used, each holding one full field. The camera can be set for interlaced scan, in which each buffer dumps its field to the output sequentially in standard alternating fashion. It can also be switched to progressive scan mode, in which each line is output from the two buffers alternately, so the output is a full frame at a time (at 60 frames/second) rather than two interlaced fields. This feature and a switchable 4:3/16:9 aspect-ratio capability make the camera a candidate for ATV use.

Most cameras contain some form of cable length compensation in the event that the cable runs get into the hundreds of feet.

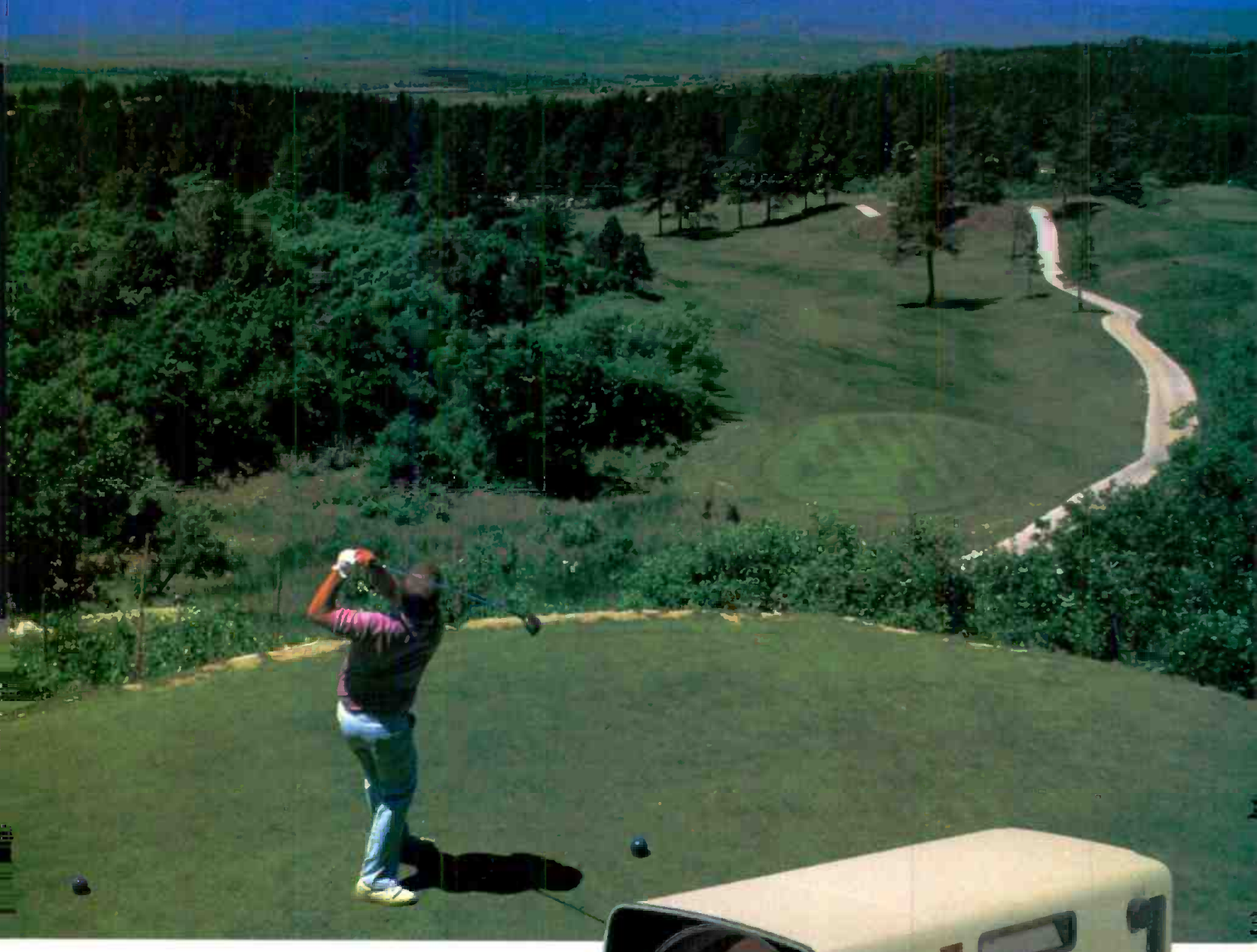
Associated systems

Most cameras contain some form of cable length compensation in the event that the cable runs get into the hundreds of feet. The newer cameras contain compensation that allow cable lengths from 1,000 feet up to 12 miles in fiber optics without signal deterioration. Cable runs are not always feasible, however. Therefore, a number of RF systems are available for wireless, long-distance transmission of camera signals. These systems can suffer from the usual problems of RF transmission systems: spectrum space limitations and RF fading or interference.

Canon has introduced a system for dealing with such troublesome long-distance camera placements in the field, such as a golf remote or an automobile race. It uses a laser beam to transmit signals, eliminating the usual analog RF interference. No frequency allocation is required. The system is line-of-sight, bidirectional and usable for distances up to one mile. The camera operator can see a return of the studio feed via the link. Cameras can also be remote controlled using this system.

For field production, a remote-control

Fujinon's new 66X field production lens. It turns a long shot into a chip shot...in one shot.



The odds of converting a long shot into a chip shot have never been better, thanks to Fujinon's high-performance Ah66 X 9.5ESM field zoom lens. From a wide angle of 9.5 mm to an extreme close-up of 1250 mm (2X), the Ah66 X 9.5ESM has the highest magnification and best F-stop ramping of any field lens you can buy.

So whether you're shooting sports or concerts, any time the situation calls for a long shot, increase your odds with Fujinon's Ah66 X 9.5ESM. For more information about Fujinon's superb new Ah66 X 9.5ESM, call Fujinon at 1-800-553-6611 or consult your local Fujinon representative.

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system is available called CAMS that gives the operator the feel and look of having a regular camera in hand. The remote-control unit resembles a regular camera with zoom and focus controls on the handles, and it has a full-size viewfinder. The camera, however, can be up on a tower or outside an aircraft or wherever cables from the remote controller can be run.

The advantage of this system is that the camera operator has the feeling of operating a regular camera head. Normally, remote camera controls have knobs, joysticks and buttons that don't feel or look like a regular camera. No new "feel" has to be learned with this camera. It responds as though the operator was holding the camera and looking into its viewfinder.

Sony's DVW-700 portable Digital Betacam camcorder.

In a world becoming smaller through communications, the equipment that makes it happen is getting smaller as well.

In a world becoming smaller through communications, the equipment that makes it happen is getting smaller as well. At the same time, the quality, flexibility and power of the equipment is increasing. Today's systems allow choices without compromise. It's usually possible to find the right tool to fit any job. Nowhere have these factors been more apparent than with EFP/ENG cameras. At the rate new field camera technology is emerging, the biggest question is not so much what to get, as when to get it. ■

➡ *For more information on field production cameras, circle the following numbers on Reply Card. See also "Cameras, Video," p. 60 of the BE Buyers Guide.*

BTS	*(303)*
Hitachi	*(304)*
Ikegami	*(305)*
JVC	*(306)*
Panasonic	*(307)*
Sony	*(308)*
Thomcast	*(309)*

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Applied Technology

Quantel Clipbox

By Steve Haines

Readers who have seen the movie *Broadcast News* may remember one scene with clarity; Joan Cusack's frantic, and acrobatic, dash from edit suite to master control, tape in hand. It's a video nightmare familiar to every broadcaster, as is the regular maintenance, alignment, cost and inflexibility of post-producing and airing off tape.

As an industry, we've grown eager to find a more efficient and effective alternative to tape-based broadcasting. Ideas have been plentiful, but the translation of theory to working product is less straightforward than it has been portrayed.

The Clipbox is a multi-user, multiport, post-production and presentation system with unique capabilities including uncompressed CCIR 601 storage and true random access. Clipbox has arisen from many years of Quantel R&D effort and considerable feedback gained from the broadcast community.

Disk-based storage

The attractions of disk storage to the future of broadcast operations are obvious. Digital storage means loss-free multigeneration work. Pictures are instantly available, no VTR spooling and preroll. With MTBFs quoted in hundreds of thousands of hours, there is also the promise of near maintenance-free operation.

Now the bad news. Uncompressed CCIR 601 4:2:2 video requires 21MB of storage per second, or approximately 1GB to store 50 seconds. Parallel transfer disks, originally developed for mainframe computer applications provide the necessary performance but have been costly, bulky and low in capacity. PC disks continue to rise in capacity and drop in price, but cannot offer the necessary speed. It's a technical problem that's usually met with a marketing response — the claim that image compression reduced data rates, are universally acceptable.

Although broadcasters may concede compression, if it's done well, to be appropriate for hard news, there are other areas where compression remains unacceptable. For example, no advertiser pays to see half or a fifth of his commercial aired and pay-per-view audiences expect to see a movie in full detail.

Non-linear working

When video applications started to appear on disks, their operation came to be described as "non-linear" or even "random access" because clips could be addressed in any order. However, this flexibility did not necessarily extend to individual frames. The position of the next frame on the disk is important as the heads may not be able to reach it and read the first data of the next picture in the frame interval. For video replay, the frames must be arranged to be contiguous.

This imposes a considerable management burden on disk recorders and restricts their flexibility. Ideally, systems would provide 'true random access,' the ability to recall any frame in any order with all of the operational advantages that this approach offers.

Dylan

To meet the need for fast, cost-effective, high quality and true random access storage, Quantel developed Dylan, an intelligent array of 20 standard, unmodified, high density, 3½-inch SCSI drives that deliver CCIR 601 images at rates faster than video. Reliability and service issues have been addressed with the aid of built-in error detection and correction operating alongside storage redundancy.

This scheme is so robust that a disk drive can fail without any impact on operation. The disk error is simply flagged to the operator. When downtime can be arranged, the faulty disk is slid out and a new one inserted, after which Dylan rebuilds the missing data and records it back to the new disk. Service is thus subordinate to operational requirements rather than the other way around.

The concept of combining the data transfer speeds of individual drives to create the faster rate required for video is easy to grasp, but there was a further requirement — the need for true random access making the project far more de-

Haines is Clipbox product manager for Quantel, Newbury, Berkshire, England.

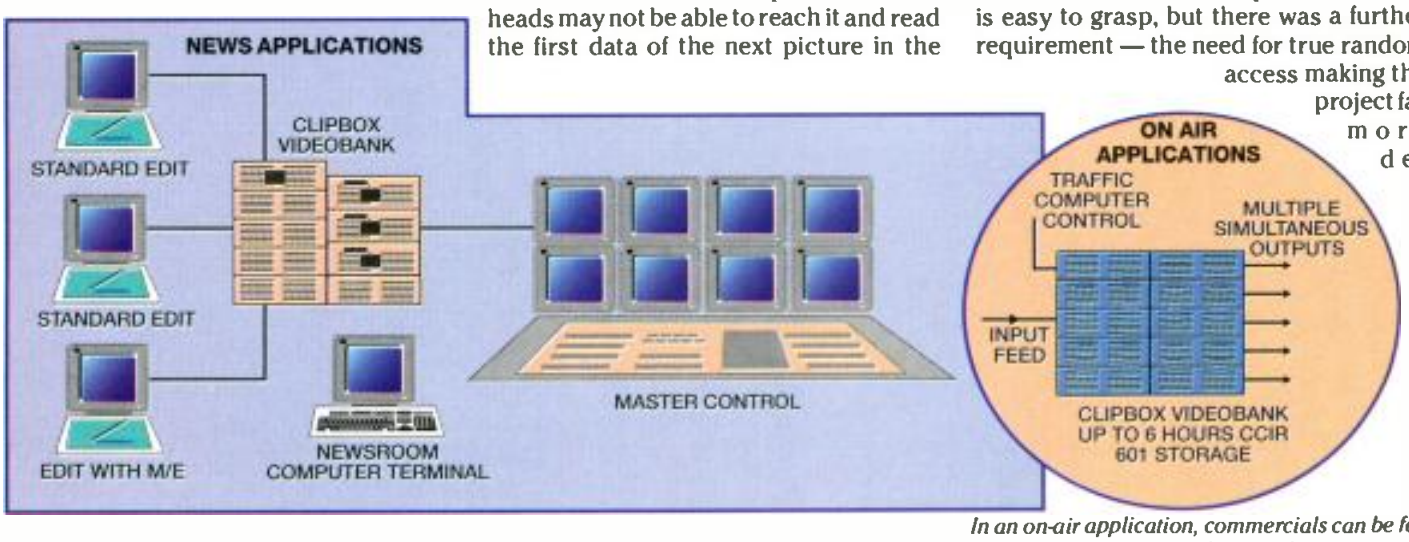
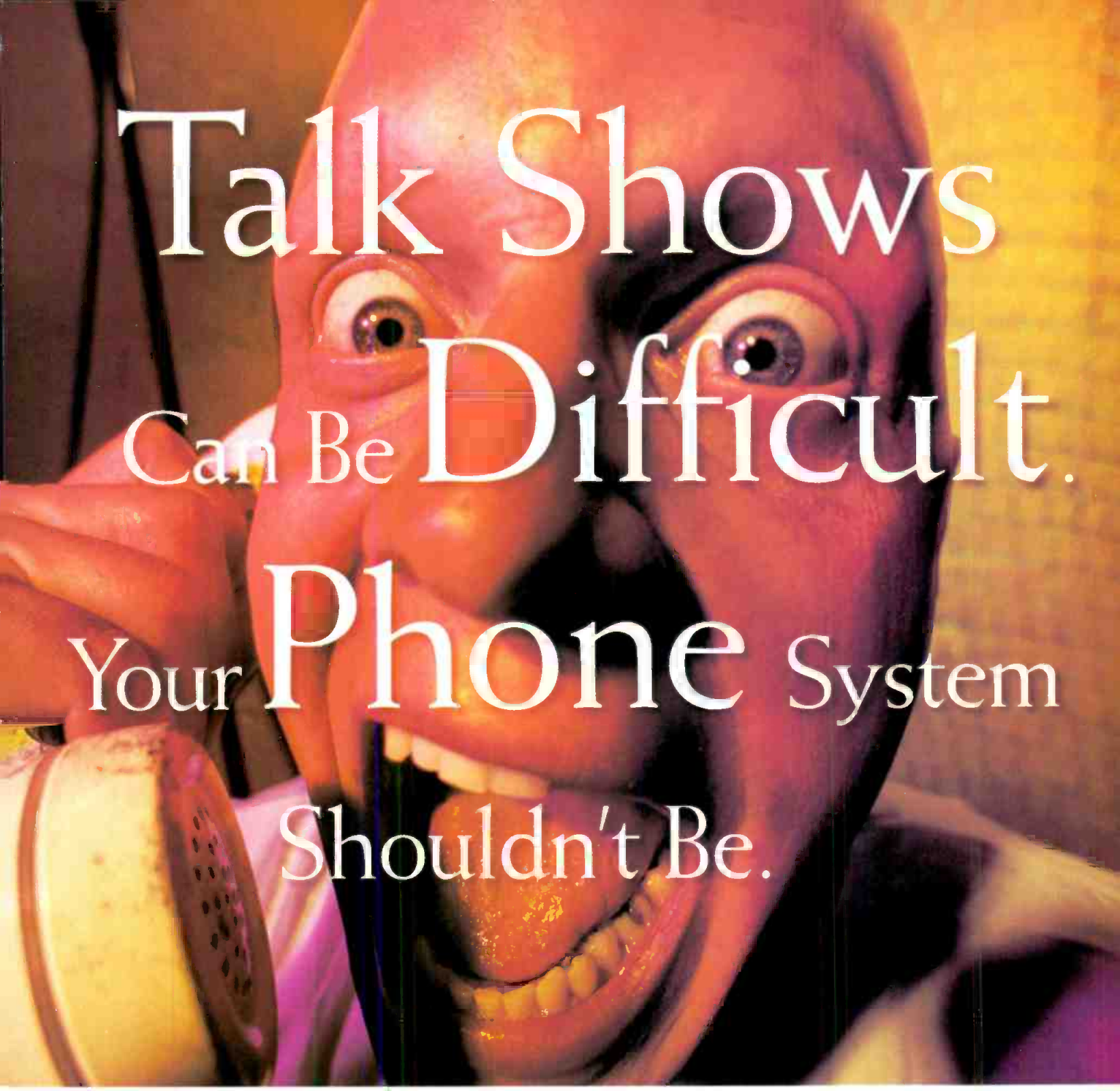


Figure 1. For news applications, Clipbox allows multiple users to access shared storage.

In an on-air application, commercials can be fed to multiple outputs simultaneously.



Weirdo on line one. Bitter psycho on two. Irritated mom on three. Religious zealot on four. Talk shows seem so simple. At least your phone system is, if it's the new TS612 from Gentner.

The TS612 is a six-line (expandable to 12) Telephone System. It features Gentner's Direct Connect Technology™, which allows you to hook it into a regular phone line. Plus, its built-in handset and keypad eliminate the need for another screening phone. With the TS612, you can talk to callers (even the Pizza Guy) off-air, while other callers are on-air.

RadioWorld Cool Stuff Award

NAB Radio 1994

Technologically, the TS612 features built-in mix minus, to compliment Gentner's digital audio enhancement. It has two DCT Superhybrids, automatic level control, dual air control surfaces, optional screener control surface, and dual audio bus operation. You also have DCT connection to your hard disk or studio PC, for screening and controlling calls. But what would you expect — the TS612 was designed specifically for talk shows.

See your Gentner rep today, or call 1-800-945-7730 and make your life easier with the TS612. After all, that psycho's still on line two.

Gentner

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manding. The solution, known as Chatter Disk Management, includes the use of large quantities of RAM in the disk interface to act as a buffer.

Why true random access?

True random access permits a different approach to disk storage. By definition, it means there is zero disk management, apart from the basics of loading material in and playing the results out. It is efficient, all the space available can always be reached. Effectively, the disk system can be totally fragmented with the frames of a clip scattered anywhere. Even more important, true random access eases the manipulation of images. Editing becomes fast and easy. Cuts and splices are a simple re-arrangement of the playing order, there is no need to physically address or re-record the footage. No matter how many versions are created, no additional storage is required.

For dissolves and wipes, which involve sourcing of two or more clips, the transmission is processed instantly, but only the processed frames need to be recorded back to disk. It's possible to change or slip this transition in any way, even to the extent of substituting a different shot. With facilities like Segment Replace, the shot is changed and the transition is automatically and immediately remade.

The Quantel Clipbox, a multi-user, multiport disk-based video system.

From industry feedback to finished product

As development continued in the labs, NAB '93 provided an opportunity to gauge industry response through the presentation of a 'concept product.' Clipbox returned in 1994 based on the same principles of fast Dylan disk storage/retrieval, uncompressed CCIR 601 quality and flexible true random access, but radically advanced in terms of capability.

The Clipbox is based on a central store or 'Videobank' holding six hours of uncompressed footage. This serves up to eight user 'seats' simultaneously. Four different types of seats can be used in any combination. They are standard editing, editing with mix/effects (for sophisticated promos and productions), a replay station with full manual control (similar to the Picturebox still-store) and a remote-control interface (using protocols similar to those developed for use between Picturenet systems and all major automation suppliers).

The Clipbox can be flexibly configured as a broadcast tool capable of simultaneous input, editing and replay. As with true random access and 601 quality, the only way to achieve this level of performance is through technology designed specifically for the job. Quantel has ex-

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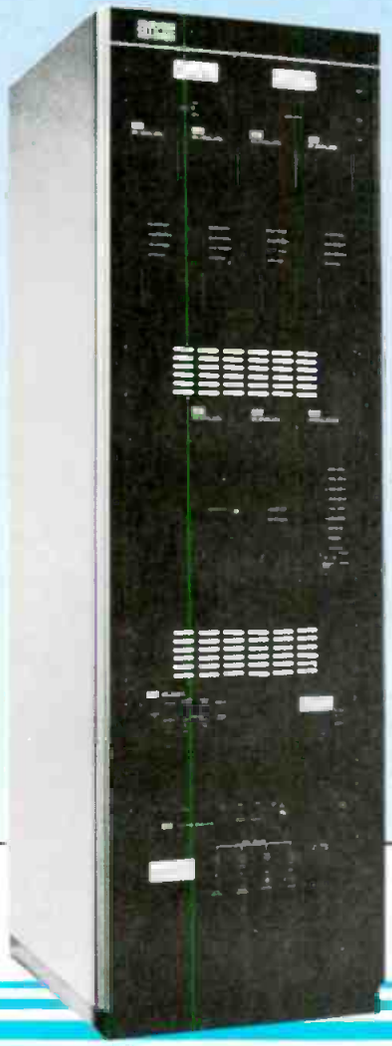

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Circle (40) on Reply Card

tended the Dylan concept to encompass multiple arrays with a central controller. Even if eight users want simultaneous access to the same frame or clip, the system can accommodate them all without delay.

One concern was the association of wasteful downtime during recording with most disk-based systems. In Clipbox the problem is eliminated through the Edit Seats' Scene Select facility that tags shots 'on the fly' during input for rapid rough-cut assembly. Because material must be taped from a live feed at many stations before editing can begin, the Clipbox approach is faster without taking into account the greater efficiency of shared storage and random access working

Clipbox was designed to handle uncompromised video. Accommodating the desire for flexible access to uncompressed and compressed footage was a downhill stroll rather than an uphill struggle. Users have complete freedom to mix, on a clip-by-clip basis, full quality 601 images with up to 30 hours of material compressed using Quantel's proprietary Grid techniques.

The quality headroom and storage flexibility provided can prove invaluable even when working entirely with compressed material. In Clipbox, a compressed section can be extracted, manipulated and the result saved uncompressed to maintain consistent quality throughout the piece.

Applications

Modular storage, flexible configuration and no compromises on quality, access or manipulation mean that Clipbox has aroused interest across the broadcast spectrum since NAB '94.

- Newsroom users are attracted by the efficiency of shared storage, the flexibility of distributing the workload between multiple edit suites, the speed of editing and the potential for modifying items and running orders instantly as stories break.
- For on-air applications, reliability is the key, with the potential for cost savings in capital outlay, maintenance and the perennial problem of make-goods. Clipbox's multiport architecture has proven advantageous, offering the potential to cover multiple regional splits and/or several channels from a single system.
- Post facilities interpret Clipbox as the facility of the future, with clients editing in multiple suites while telecine staff and librarians at other seats load and prepare elements for later sessions and archive finished work from earlier jobs.
- In pay-per-view, factors include quality, reliability and a single system that could start a movie every 15 minutes during a 2-hour cycle without major investment in digital VTRs.

Conclusion

Life is full of compromises, but only the broadcaster knows what compromises he or she can afford to make. If compromises are imposed by inadequate technology, efficiency and cost-effectiveness suffer and the consequences show up in the worst possible place — on-air. Clipbox has been designed as a modular, flexible and high-quality system that allows broadcasters to make the decisions that help shape profitability, creativity and efficiency.

After seeing the clip from *Broadcast News* during the NAB demonstration, some attendees laughingly pointed out that Clipbox would take some of the excitement out of television. We hope so. It's the kind of excitement that every broadcaster will happily do without. ■

➡ *For more information on the Clipbox, circle (340) on Reply Card.*

SVS

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Circle (43) on Reply Card

Applied Technology

Multichannel automation using optical discs

By Richard Bauarschi

The upsurge of regionalized TV feeds across the country is creating an expansion of programming opportunities. This is resulting in a potentially overwhelming influx of spot scheduling on a day-to-day basis. This broad-based, profitable phenomenon need not challenge the resources of broadcast facilities, however. A collection of companies has pooled technology to come up with a commercial insertion system incorporating control and management of daily logs by maintaining an on-line disc library. Missing commercials for the day's schedule are automatically retrieved from a tape-based off-line library system and sent to the on-line disc library.

Such a system is practical and economical because it makes the most efficient use of tape as an archiving format, while exploiting disc media's instant access and freedom from degradation. By using the automated tape library (ATL) for library purposes only, maintenance costs are reduced because there is far less wear on the VCR heads and mechanisms. Better use of manpower occurs because VCR maintenance is also kept to a minimum. The use of disc media allows schedule changes at the last second with the stroke of a key.

At NAB '94, commercial insertion systems that combined ATLs and disc-based recorders were demonstrated by Odetics, American Broadcast, Columbine Systems, Alamar USA, FloriCal Systems and Pioneer.

Bauarschi is manager of broadcast marketing at Pioneer New Media Technologies, Upper Saddle River, NJ. Respond via the *BE* FAXback line at 913-967-1905.

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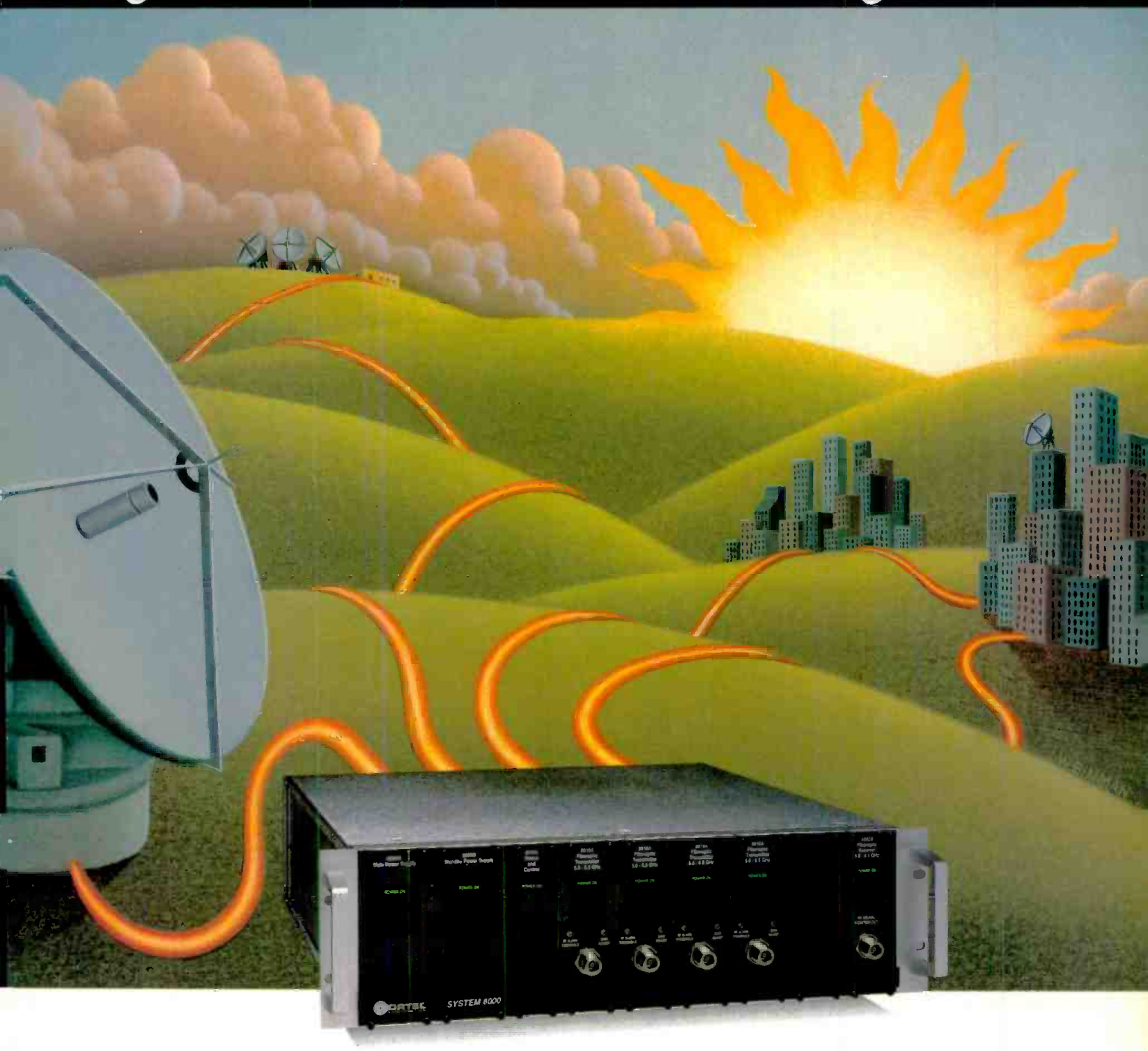

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Circle (46) on Reply Card

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system. They have direct impact on the economics of stations of all sizes. The Pioneer VDR-V1000 rewritable videodisc recorder is most suitable for this application because it offers a high degree of redundancy. In times of emergency, the answer to the inevitable question, "Where is my commercial?" is accommodated by local front-panel control (in the case of control system failure) and removable media (in the case of hardware failure). Should a VDR-V1000 require maintenance, its disc is easily transferable to another unit. Its instantaneous data retrieval and dual-head, cue-while-play features facilitate last-minute changes quickly. The lack of wear and tear (a common problem with VCRs) cuts maintenance costs, saves time, and helps to maintain image quality.

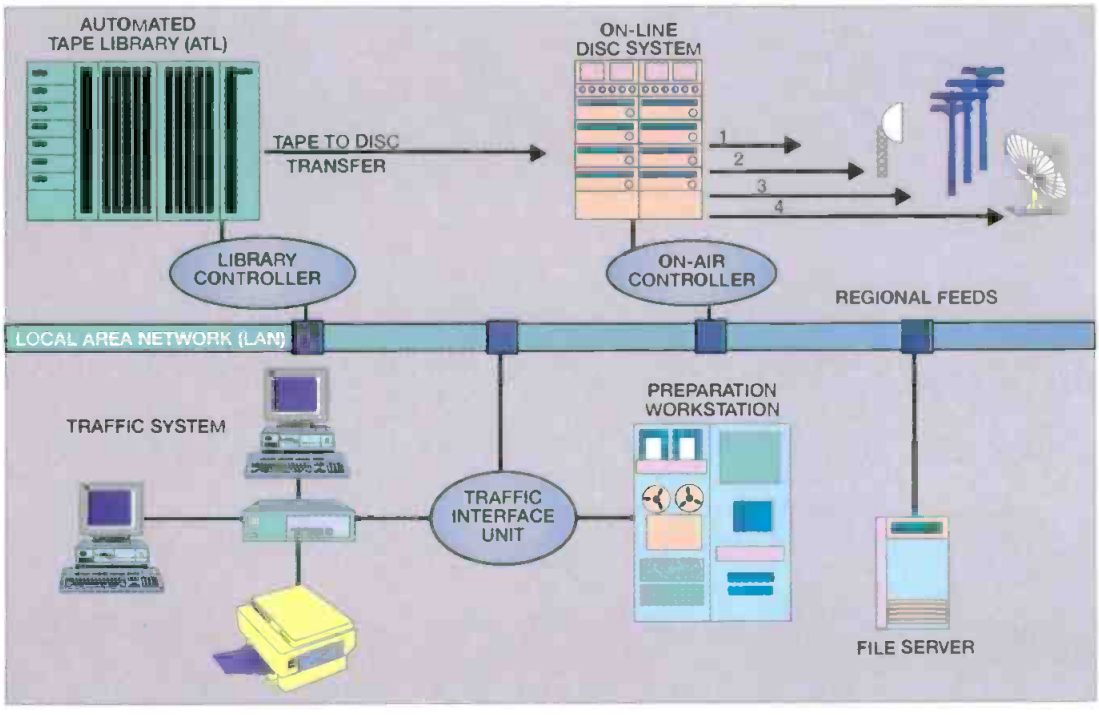


Figure 1. A sample configuration for a multichannel commercial insertion system.

Using a disc-based system with a VCR-like front panel is an ergonomic bonus for operators used to using tape machines under local control. An industry standard RS-422 port facilitates easy integration into existing broadcast systems. Multiple channels can be accommodated by simply adding more disc units. Last-minute commercial adds can be dumped to disc directly from an exter-

nal, stand-alone tape machine.

Multichannel automation

Today's automation manufacturers are dealing with the important new concept of a single system feeding multiple, independently programmed output channels.

"We take a very modular approach," says Doug Hurrell, president and founder of Alamar USA, "so that the stations that have single-channel or multiple-channel applications can use this type of equipment." Among Alamar's recent multichannel installations is a large system at Hughes' DirecTv head-end in Castle Rock, CO. The components of this modular design include software for media library management, playback of single/multiple channels, record processing of off-line feeds, and time delay/time shifting.

FloriCal Systems has automated TV stations worldwide with its CartDirector, a multichannel database and control system for the Sony Flexicart. This system can download spot breaks to the Pioneer VDR-V1000 using the CartDirector to transfer spots from the ATL based on a station's traffic logs. Automatic playback is controlled by the FloriCal AirBoss on-air automation system.

Pioneer VDR-V1000 magneto-optical video disc recorder.

FloriCal president, Jim Moneyhon, values the optical disc approach for its reliability. "To the extent that a commercial appears over and over and over again, over a period of several hours, it only needs to be recorded once on the Pioneer disc." This reduces the number of passes required from the library tape. For multichannel applications, this efficiency increases further. If the same commercial plays on more than one of the channels, it's possible to play the library tape once, have it recorded on two of the laser discs, and then be available on each of those two channels for multiple play many times during the next several hours, if not during the entire day. (See Figure 1.)

Regarding the movement to multiple-channel operation, Moneyhon is of the opinion that TV stations are going to have to become more like miniature local networks. He also observes that in the single-channel world, retail operations,

such as drug stores and restaurants, might not be able to afford to advertise in a large market, yet they could take advantage of the opportunities offered by a local, targeted TV channel.

The ability to feed a program with a dozen different commercial inserts, geographically oriented, is going to increase the ability of the stations to reach small, targeted marketplaces and increase their income. Therefore, moving not only to multiple channels, but also to multiple feeds of a single channel is going to be crucial. It's in these applications that the VDR provides a unique solution.

The use of disc media allows schedule changes at the last second with the stroke of a key.

At American Broadcast Systems, president/general manager, Donald Forbes, comments that the ABS MicroCart 100 auto-disc sequencer/controller can "operate a Pioneer unit as a random-access device in a true dual-head (cue-while-play) operational mode. It has the ability to accommodate both the VDR-V1000 and other sources, such as tape machines of various formats. We currently have one in operation at WFMZ, Allentown, PA. It's been on line for over a year. The single-channel, disc-based system includes four Pioneer VDR-V1000s and four VCRs." Such a system is the basis for expansion into the multichannel environment. (See "Optical Disk Storage for Spot Automation," April 1994.)

At XETV, a Tijuana-based Fox affiliate serving the San Diego market, a Sony LMS is installed, for which ABS has developed a buffer system using the Pioneer VDR-V1000. It gives the station the ability to buffer the output of the LMS to air. The station runs approximately 500 spots per day. Once the day's programming is recorded on a set of laser discs, the average number of repeats that have to be recorded for the next day's operation is about 60. Another advantage of the laser recorder is the lack of playback conflicts, such as would be expected from a tape-based system.

Forbes differentiates between a buffered multichannel and a "true" multichannel system. The latter uses dedicated, separate spot libraries on disc or tape (or both) for each channel. "In the buffer system," Forbes points out, "the ATL has its most effective use in library storage — probably the entire library of the television station — so that spots are always accessible to the buffer system to build platters from the traffic schedule. And the multichannel playback is accomplished by individual playback control systems and VDRs that run each channel, individually." Forbes also notes that in general, the cost of a true multichannel system is a little lower than that of a buffered multichannel system.

Disc media has established its place as a viable, waste-cutting option. An increasing number of commercial-insertion systems are being designed with the virtues of disc-based media in mind. Despite the variety of budgets, available manpower, channel configurations and time constraints from station to station, this combination of tape and disc technologies can serve most situations cost-effectively. ■

➡ *For more information on the Pioneer VDR-V1000, circle (310) on Reply Card.*

New Products

Video storage
By Utah Scientific

• **DigiStore:** a disk-based system used to acquire, store and play back material for a TV station's on-air operations; operates on a Windows-based PC; features full pre-programmability to automate video playback; uses AdWare and RemoteWare applications. With the addition of DigiStore to the Utah Scientific product line, Utah can install and support complete on-air broadcast systems.

Circle (350) on Reply Card

Serial switcher
By Sierra Video Systems

• **Model 1616D:** a 16x16 serial digital video routing switcher; uses high-speed GaAs switching logic; can pass data from 140 to 400Mbps; has cable equalizers on each input; a 2GHz GaAs crosspoint array; automatic signal equalization for up to 300 meters of cable; a host port allows control of switcher by a graphics workstation or post-production editor.

Circle (351) on Reply Card

Serial switcher
By Thomson Broadcast

• **9200:** a high-level component digital switcher with 10-bit processing; features M/E or multilayer mode, key or video framestore, double transition, level correction, source memory, Mem Box with keyframes and sequences, timeline management, six auxiliary video or key buses and DVE control.

Circle (352) on Reply Card

Oscilloscopes
By LeCroy

• **9300A series:** eight new oscilloscopes available in two and four independent channels in three different record lengths; also available in 200MHz and 400MHz; each model uses 8-bit flash ADCs that digitize single-shot events at rates up to 100MS/second.

Circle (353) on Reply Card

Power amplifier module
By Acrodyne Industries

• **800W:** a UHF module similar to Acrodyne's 300W unit; fully developed and ready for production; features captured forced air cooling, integral blower and overtemperature protection, microstrip splitting and combining sections and a DC-operated blower motor for a lower parts count.

Circle (354) on Reply Card

TV pattern generator
By TTi

• **Model 408NPS:** conforms to the NTSC, PAL and SECAM transmission systems; incorporates video-sweep and multiburst signal functions for checking the frequency characteristics of video equipment; an all-channel synthesized RF output allows the adjustment and checking of TV sets and video recorders with TV-band tuners; 'Genlock' and blackburst functions allow the pattern generation facilities to be used as a sync signal source; the RF frequency can be set directly from the panel; sound modulation of 400Hz and 1kHz can be applied to the RF output; the applicable country, band and channel can be selected from internal data.

Circle (355) on Reply Card

Lighting controllers
By Xcel Controls

• **ECN series:** a new line of lighting controllers for the existing Control Power Systems; specifically for towers with one beacon and one level of obstruction (side) lights; available in three models: the standard model, model for towers that require a load balance resistor and model with dual controller to work with a red/white lighting system.

Circle (356) on Reply Card

Audio workstation
By Digital Audio Research

• **SoundStation Gold:** a complete, integrated production center comprised of an assignable, dynamic automated mix controller, a dedicated edit control console and an enhanced processing unit that contains both hard and optical disk storage facilities; available in 8- and 16-channel versions; provides a recording capacity of up to 22 track-hours on hard disk, with removable, dual-density optical disks for instant project playback and easy media exchange between DAR and other workstations.

Circle (357) on Reply Card

New Products

Serial switcher
By Video Gainesville

• **CV132:** a component digital video switcher that features 32 serial inputs with eight available aux buses; the ME version has two full-function keyers with "Cyber Key" for perfect keys and advanced 2-D filtering to perfect difficult keys; each version features a +/-50-line input timing range, a key mask bus, eight color matte generators with two color backgrounds, more than 100 wipe patterns; foreground suppression chroma-keying for input; design packages features in a compact mainframe occupying 3RU.

Circle (358) on Reply Card

Lightning protection system
By Rabun Labs

• **ILD/P:** responsive electronic detector monitors atmosphere of approaching storm; detects lightning before it is close enough to do damage; gives alarm, switches power sources, and/or automatically disconnects power, phone and coax lines until storm is out of the area; automatically reconnects.

Circle (359) on Reply Card

Feed-through connector
Bi-Tronics

• **TCS-415P:** a panel-mount, female-to-female, feed-through SVHS connector; features an all-metal housing with a crisp black finish; available by itself or preloaded in racks or wall plates of various configurations.

Circle (360) on Reply Card

Broadcasting tube
By Thomson Tubes Electroniques

• **TH 680 Diacrode:** a high-power tube type derived from tetrode technology made for UHF broadcasting transmitters; provides solutions for power levels beyond 30kW and up to 60kW in common amplification with the excellent transmission characteristics of grid tubes; designed to adapt to future UHF broadcasting requirements such as digital television.

Circle (361) on Reply Card

New Products

Battery charger
By Frezzi Energy Systems

• **AR304:** an all-purpose digital charger that charges any Nicad battery used in video production; compact (LWH: 9.5 x 5.6 x 3.1 inches) and lightweight (2.35 pounds); ability to operate anywhere provides seamless operation; charges batteries in the range of 12-30V, 1.7-10AH.

Circle (366) on Reply Card

VBI data encoder/decoder
By Broadcast Video Systems

• **VBI-232:** encoder/decoder that plugs into a Grass Valley Group or Leitch video DA frame; inserts RS-232 data from a PC into a user-selectable line in the vertical blanking interval of a looped-through video signal.

Circle (362) on Reply Card

UHF transmitter
By ITS Corporation

• **ITS-830:** a 1kW solid-state internally diplexed UHF TV transmitter; features dual high-gain power amps driven from the exciter, eliminating a single driver stage; has output circulator protection, bandpass and trap filtering; has full remote-control capability, +/-1kHz frequency stability and video ALC; translator versions available.

Circle (364) on Reply Card

Power conditioner/monitor
By Furman Sound

• **PM-8:** provides protection where the PL-PLUS's pullout lights are not needed; assists in monitoring AC line status by including an accurate AC voltmeter (90-135V) and an rms-reading AC ammeter (0-20A); rated at 15 amps; power is provided by conditioning circuitry; eight rear outlets are controlled by a lighted front panel master switch.

Circle (363) on Reply Card

MediaNet enhancements
By Sonic Solutions

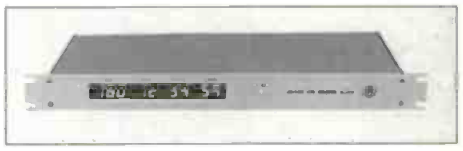
• **Version 1.1:** supports the "Redundant Arrays of Inexpensive Disks" (RAIDs), which permit sustained transfer rates exceeding the 3.0MB/s with standard SCSI disks; supports hard disks of unlimited size and up to 14 drives from a single MediaNet server card.

Circle (365) on Reply Card

New Products

GPS master clock/time-code generator

By ESE

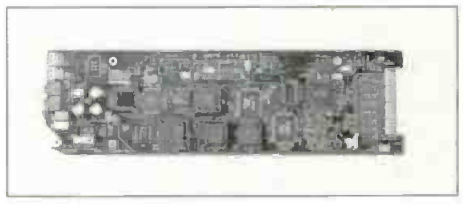


• **ES-185**: a 6-channel receiver makes it possible to track up to six satellites simultaneously; accuracy is better than 300ns of UTC; standard time-code outputs include SMPTE/EBU, ASCII, IRIG-B and ESE; features a 5-hour battery backup, 1PPS TTL output, automatic daylight-savings time correction, time zone offset, antenna, rugged rack-mount enclosure.

Circle (367) on Reply Card

Video test generator

By Leitch



• **VTG-6800**: provides up to 32 digital 4:2:2 test signals; features an embedded audio tone; generates regular 4:2:2 signals at 270Mb/s or 360Mb/s; EDH embedded error detection in the serial stream is optional.

Circle (368) on Reply Card

Peak hold metering option

By Wohler Technologies

• **PKH-1**: consists of a digital memory circuit and a toggle switch with positions for normal, peak and reset; memory circuit raises as it tracks input signal levels; in normal position the meter provides instantaneous indication; the highest level registered in either normal or peak mode is displayed on the meter until memory is cleared with reset; monitors programmable "safe level;" available on MSM-1, MSM-2, AMP-2, and any AMP-1A series unit ordered with metering option.

Circle (369) on Reply Card ■

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KCA-10 BRS	7.89	KCA-20 BRS	8.39
KCA-30 BRS	9.29	KCA-60 BRS	12.99

XBR 3/4" U-matic Broadcast Master (In Box)

KCS-10 XBR (mini)	8.49	KCS-20 XBR (mini)	9.79
KCA-10 XBR	8.99	KCA-20 XBR	10.29
KCA-30 XBR	11.49	KCA-60 XBR	14.99

KSP 31/4" U-matic SP Broadcast (In Box)

KSP-S10 (mini)	9.19	KSP-S20 (mini)	10.69
KSP-10	9.69	KSP-20	10.99
KSP-30	12.49	KSP-60	16.39

BCT G Betacam Broadcast Standard (In Box)

BCT-5G (small)	4.99	BCT-10G (small)	5.89
BCT-20G (small)	7.39	BCT-30G (small)	9.39
BCT-5GL	9.29	BCT-10GL	10.39
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- *Emmy Award-winning Digital Signal Processing DSP technology:*
  - Dark Detail Circuit enhances contours under varying lighting conditions. Uses luminance sensitive algorithms to determine the optimum degree of enhancement in dark areas of the picture without altering the brightness of other areas in the picture. Enhances contours of objects as fine as strands of human hair, even under challenging lighting conditions.
  - Chroma Detail compensates for poor resolution in high chroma areas of the picture. Provides a wide dynamic range image with clear reproduction in the chroma area.
  - 2-Dimensional Low Pass Filter reduces cross-color caused by high level brightness signals mixing into the sub-carrier. Reproduces fine stripes and lattice patterns with a minimum of color blur.
  - Highlight compression circuit expands the dynamic range of highlighted areas and prevents halation. Produces detailed images when viewed against a bright backlight
- Switchable R-Y, B-Y, or Y/C system allows direct docking to S-VHS, M-II, or Betacam SP docking VCRs.

- To further enhance operational speed and flexibility, a total of four easy to use Scene File modes are available:
  - Scene File One is the Standard Mode which sets the WV-F700 to adjust to studio lighting.
  - Scene File Two is the Illuminance Mode, which provides for different shades of black to be reproduced clearly in dark locations without requiring lighting alterations.
  - Scene File Three is the Fluorescent Mode. Under fluorescent lighting certain color hues tend to be reproduced slightly in the blue spectrum. With Scene File Three, these hues are adjusted while using the white balance to provide natural tones.
  - Scene File Four is the User Mode for flexible data setting. Twenty different digital adjustments can be set including gamma, knee-point, chroma detail, detail, matrix and shading. Individual settings are available for 11 of the 20 items at gains of 0dB, +9dB, +18dB and +24dB. These digital adjustments also allow the WV-F700 to be matched to other color cameras in a studio environment for quick set-ups.

JVC KY-27UB

3-CCD Color Video Camera

- New ⅓" CCDs with 380,000 pixels (360,000 effective) with advanced electronics delivers resolution of 750 horizontal lines and reduced smear.
- Sensitivity of f/8.0 at 2000 lux Min. illumination 7.5 lux with f/1.4 lens. +18dB.
- LOLUX mode allows shooting scenes that were previously impossible due to insufficient lighting. CCDs are maximized for low light sensitivity equivalent to an electronic gain of 24dB plus a JVC pixel readout system which provides an additional 6dB. Together they provide +30dB without the noise and picture degradation normally associated with this much gain.

Excellent color balance is maintained even down to 1.5 lux illumination.

- Auto Shooting Mode where you only have to zoom, focus and record. All other parameters are controlled automatically.
- Enhanced ALC (Automatic Level Control) mode for continuous shooting in all light levels. This allows continuous automatic shooting from dark interiors to bright outdoors.
- The Multi-Zone Iris Weighting system gives preference to objects in the center and lower portions of the picture. The Automatic Peak/Average Detection (APB) provides intelligence to ignore unusual objects such as bright lights.
- Auto knee circuitry extends a scene's light to dark dynamic range reproduction by up to five times without overexposure.
- Has large 1.5-inch viewfinder with 500 lines of resolution and SMPTE color bars. Status system provides audio levels, accumulated or remaining recording time and VTR operation. Also battery voltage and camera setup. Zebra pattern indication and safety zones with a center marker are also provided.
- Equipped with Variable Scan function. This allows flicker-free shooting of any computer screens. Variable scan enables a precise shutter speed from 1/64 to 1/60 of a second in 256 increments to be set, matching a computers scan rate.
- Star filter creates dramatic 4-point star effects. Users can also select from a wide range of optional filters.
- Advanced Memory System (AMS) stores customizable settings for various shooting conditions.
- Uses just 12.4 watts of power with camera adapter and viewfinder, so battery time can be allocated to VTR operation.
- Easily adjustable pedestal and detail enhancement through the Camera Setup Menu.
- Docks directly to JVC BR-S422U, BR-S411UB and BR-S420CU professional S-VHS recorders. Model KY-27 UPCH docks directly to Hi8 and BetaCam.

sachtler

VIDEO 14/100 FLUID HEAD

- Sachtler Touch and Go System
- Integrated sliding battery plate
- Strengthened dynamic counterbalance in 2 steps
- Frictionless leak proof fluid damping with three levels of drag
- Vibrationless vertical and horizontal brakes
- Built in bubble for horizontal leveling
- Compatible with wide range of tripods series 100

HOT POD TRIPOD SERIES

Especially developed for use in ENG, the Hot Pod tripod is the fastest in the world. The central locking system is activated on all three legs at the same time, while the pneumatic center column easily makes it possible to have the lens at a height of over 7 feet. The elevation force of the center column is factory set and doesn't require any setup. When moving to another location it can be carried by its handle located at the center of gravity.

ENG TWO-STAGE TRIPOD SERIES

Sachtler two-stage tripods have an enlarged height range (lower bottom and higher top position) so they are more universal. Legs can be locked in seconds with Sachtler's quick clamping. There are also heavy duty versions for extra stability. The heavy duty aluminum has a 20mm diameter tube vs. 16mm and the heavy duty carbon fiber has a 24mm diameter tube vs. 22mm. Also all heavy duty two-stage tripods have a folding tripod handle.

SACHTLER SYSTEM 14 PACKAGES

SYSTEM 14 PRO I — Economic standard with two-stage aluminum tripod video, includes: 14/100 Fluid Head + ENG 2D Two-stage Aluminum Tripod + SP100 spreader + ENG 2 Padded Bag 3450.00

SYSTEM 14 PRO II — Light standard system with two-stage carbon fiber tripod video, includes: 14/100 Fluid Head + ENG 2 CF Two-Stage Carbon Fiber Tripod + SP100 spreader + ENG 2 padded bag 3995.00

SYSTEM 14 PRO III — Quickest tripod system, extremely high extension possible by the pneumatic center column, includes: 14/100 Fluid Head + Hot Pod Tripod + Padded Bag 100 II 3695.00

VID

The NovaBlox individual funct NovaCard mod synchronizers, sy transcorders, dist NovaCards have the puter or one of four modules. NovaCards sion slot including Am RS-232 serial date for o Windows, and Amiga soft applications. the C-2B chas the C-4 single rackmount ch four NovaCards and the three features 15 slots. To provide o using one of the NovaChassis Control Units to choose from. T play with four button operation or enhanced operation with dedicated LCD status display.

C-2A

NOVAMATE TBC/Frame Synchronize

One of the NovaCard modules of the NovaBlox system, th NovaMate is a unique TBC/Frame Synchronizer that satisfies a wide range of VCR signal correction and video interface requirements from desktop video to satellite systems. NovaMate plugs directly into a computer or one of several chassis configurations. Control is performed either by software or NovaTrol control units. The flexibility of its modular design and microprocessor control plus its superior quality make NovaMate the ideal alternative to stand-alone and computer based TBCs.

WE CARRY ALL OTHER NOVACARDS: ENCODERS, DECODERS, TRANSCODERS, DISTRIBUTION AMPLIFIERS AND ROUTING SWITCHERS

HORITA

BSG-50

Blackburst/Sync/Tone Generator

The BSG-50 provides an economical means for generating the most common RS-170A video timing signals used to operate various video switchers, effects generators, TBCs, VCRs, cameras and video edit controllers.

- 6 BNC video/pulse outputs
- Now available: 6 blackburst, 4 sync, 2 subcarrier
- Each sync output individually settable for composite sync, composite blanking, H-drive, or V-drive
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- Outputs can easily be configured to meet specific user and equipment needs $269

CSG-50

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- Generates full/SMPTE color bars, blackburst and composite sync signals.
- Built-in timer can automatically switch video output from color bars to color black after 30 or 60 seconds. Easy and convenient for producing tape leaders and striping tapes with color bars and black.
- Front panel selection of full-field or SMPTE color bar patterns or colorblack (blackburst) video output
- Includes crystal-controlled, 1KHz, 0dB audio tone output.
- Outputs: video, sync, ref frame, 1 KHz, 0dB
- Audio tone switches to silence and color bars change to black when using 30/60 second timer
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TSG-50 –	NTSC Test Signal Generator
SCT-50 –	Serial Control Titler "Industrial" CG, Time-Date Stamp, Time Code Captioning
SAG-50 –	Safe Area, Convergence Pattern and Oscilloscope Line Trigger and Generator

Industry Briefs

BUSINESS SCENE

Otari, Foster City, CA, and **Creation Technologies**, Vancouver, BC, have announced an agreement that gives Otari worldwide exclusive rights to market and distribute the RADAR random access digital audio recorder.

Denon Electronics, Parsippany, NJ, has provided Re America's RDS encoder and Denon's TU-380RDS tuner for 26 National Public Radio member stations in 21 markets.

Panasonic, Secaucus, NJ, has supplied USA Networks, Jersey City, NJ, with the D-3 1/2-inch composite digital format recorders.

NBC has purchased 15 Panasonic D-3 1/2-inch composite digital VTRs and American Cablevision has ordered digital signal processing cameras and four D-3 1/2-inch composite digital VTRs.

KYFC-TV, Shawnee Mission, KS, has purchased four AQ-11 digital signal processing cameras.

WXXA-TV, Albany, NY, has purchased the MII enhanced series equipment and a WV-F250 3-CCD color video camera.

Group W Network Services, Stamford, CT, is doubling the size of its transmission control center at the Glenbrook Earth Station in Stamford.

Digital Audio Research, Surrey, England, has installed SoundStation Gold at Wild Tracks Audio Studios in London.

Kline Towers, Columbia, SC, and **Dielectric Communications**, Raymond, ME, have been awarded a contract for an HDTV design study for Sutro Tower, San Francisco.

Euphonix, Palo Alto, CA, has installed a CS200 digitally controlled system at Pacific Ocean Post Sound, Santa Monica, CA.

JVC, Elmwood Park, NJ, has sold ABC-affiliate WAAY-TV, Huntsville AL, equipment to upgrade to the S-VHS format as part of an ongoing re-engineering program at the station. Several BR-S622 and BR-S822 editing recorders have been installed in addition to seven GY-X1 compact camcorders.

LNR Communications, Hauppauge, NY, has received a U.S. government award for tri-band portable satellite terminals.

Ampex, Redwood City, CA, has sold DCT equipment to the Post Group, Los Angeles; Tropical Video, Miami, FL; Prime Images, Pennsauken, NJ; and SVC Television, London.

TouchVision, Chicago, IL, has moved its corporate headquarters. The new address is: 8755 W. Higgins Road, Suite 220, Chicago, IL 60631; phone 800-8-DVISION (838-4746); corporate office 312-714-1400; fax 312-714-1405.

Editel, Los Angeles, has plans to unveil the first part of its new 5,500-square-foot digital wing in the summer of 1995.

Sony, Montvale, NJ, has sold three Digital Betacam VTRs to Hollywood Digital, Hollywood. Hughes Direct TV DBS Service has purchased 200 Digital Betacam VTRs and 60 Flexicart automated playback systems.

Orbit Satellite Television Network, Rome, has purchased 120 Digital Betacam VTRs and Encore Media is using three component digital edit suites incorporating Digital Betacam VTRs.

Solid State Logic, Oxford, England, has installed an SL 8088 G Plus console with Ultimation at Paisley Park, Minneapolis.

Fox Tape has purchased two Scenaria digital audio/video post-production systems. Also, MTI/The Image Group, New York, has added the Scenaria to its digital audio network.

Henninger Capitol Video, Washington, has installed the SSL's ScreenSound digital audio editor and SoundNet digital audio network system.

Quantel, Darien, CT, has delivered a Henry special effects editing system that includes the Max special effects package to New World Rising, Birmingham, AL.

Belden Wire and Cable, Richmond, IN, has announced that the company's administrative offices, distribution center, engineering center, and all U.S. manufacturing facilities have been registered to the International Organization for Standardization (ISO) 9000 series standards.

American Lightwave Systems, Meriden, CT, has been selected by Suburban Cablevision to build a digital metropolitan area network.

Avid Technology, Tewksbury, MA, announced that WCFC-TV, Chicago, has begun using AirPlay, Avid's disk-based, digital playback system.

AVS Broadcast, Northvale, NJ, has sold DX210 and DX120 digital format translators to Image Mix, MTI and Post Perfect in New York, and VDI and Modern Video Film in California.

Abekas, Redwood City, CA, has sold an A83 component digital switcher, two A66 disk recorders, a 2-channel A57 with SuperWarp capability and a variety of transcoders to Cable News Network, Atlanta.

Strassner, North Hollywood, CA, has placed an SES-2020 PRO editing system with IWERKS Entertainment, Burbank, CA.

Pro-Bel, Dunwoody, GA, has delivered the latest version of its System 3 controller to Editel's Hollywood location.

Pro-Bel has also supplied an HD audio and video routing system to the broadcast engineering department of British Columbia Telephone.

Odetics, Anaheim, CA, has sold a TCS90 cart machine to ABC-affiliate WZZM-TV, Grand Rapids, MI.

Xymox Systems, Van Nuys, CA, has moved to a larger facility. The address is: 7139 Woodley Ave., Van Nuys, CA, 91406; phone 818-786-8801; fax 818-343-5104.

PEOPLE

Robert P. Seidel has been appointed vice president of engineering at CBS.

Lucinda Hutter has been named director of engineering at KTVI-St. Louis.

Jim McGrath has been appointed vice president of engineering at A.F. Associates, Northvale, NJ.

Shel Gunther has been appointed new product manager for wireless microphone systems at AKG, San Leandro, CA.

Dr. James Mannos has been named vice president of engineering for Abekas, Redwood City, CA.

Bob Quinn has been appointed product manager of commercial communications at EEV, Elmsford, NY.

Hugh Gillogly has joined AVS Broadcast, Northvale, NJ, as western sales manager.

Criss Onan and **Susan Dingenthal** have joined Broadcast Electronics, Quincy, IL, as regional sales managers for digital sales. ■

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MAINTENANCE ENGINEER - Wanted for fast growing independent television station. Ability to perform under pressure. Minimum 2 years experience in TV Broadcasting. SBE TV Broadcast Engineer or FCC First Class Certification preferred. Familiarity with Sony Betacam, Grass Valley Group Switchers, and Audio Consoles a plus. Must be able to work various shifts, and be on call when needed. Drug-Free environment, drug test required. EOE. NO CALLS/WALK-INS. Send cover letter with salary requirements and resume to ME/MH, 602 Courtland St., #200, Orlando, FL 32804, no later than 7/30/94.

MAINTENANCE ENGINEER: Excellent opportunity at the corporate headquarters of a quality minded company, The New York Times Broadcast Group. Fully automated facility with the latest digital equipment. Knowledge of computer & digital electronics required. Experience with satellite uplink vehicles & ENG maintenance preferred. Must have formal electronics training, SBE certificate a plus. Career opportunity in a newly remodeled studio overlooking the Mississippi River. Females & minorities encouraged to apply. Send resume to Willie Douglas, WREG-TV, 803 Channel 3 Drive, Memphis, TN 38103.

ENGINEERING MANAGER. Immediate opening for exp. video engineer to manage serv. & install dept of AZ largest broadcast video dealer. Should have exp. in systems design, installation and management. Supervise staff of 4. Competitive pay and benefits. Send resume & salary history to: Personnel Manager, AVR, 4433 N. 7th St., Phoenix, AZ 85014 or fax to 602-274-7416.

Classified Ads Continued on Page 80

Classified

HELP WANTED

CHIEF ENGINEER needed to take hold and move top 75 market station into the future. Applicant will need impeccable communications and capital budgeting skills. Applicant must have 3-5 years managerial or assistant managerial experience including full knowledge of station operations with a strong news emphasis. Candidate should be fully computer literate and slip right into a high level of station automation including newsroom computer, robotics, master control systems and an automated G-Line transmitter and very soon, digital. Engineering degree preferred. EOE. Reply to: Dept. 745. Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66282-2901.

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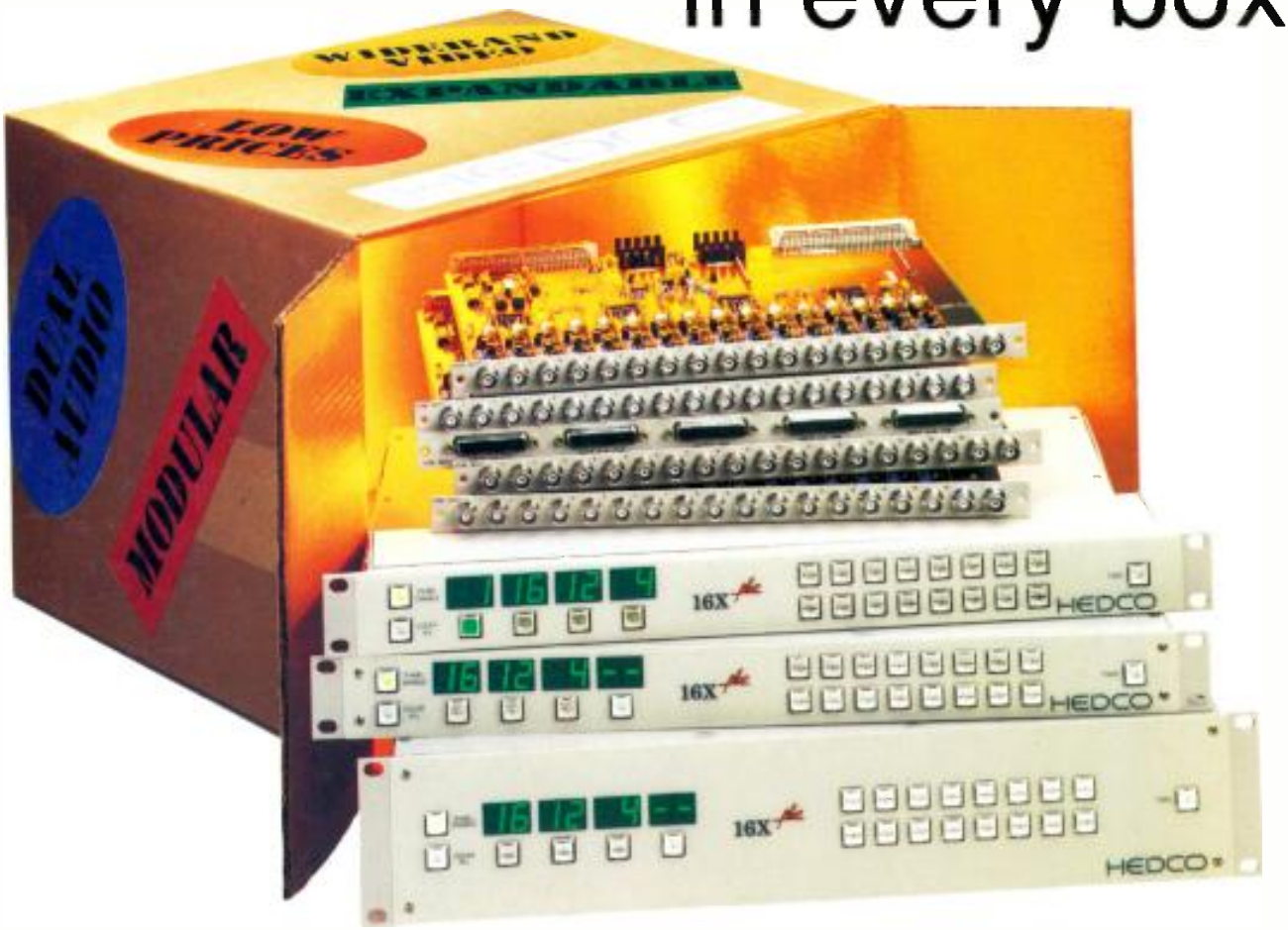

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