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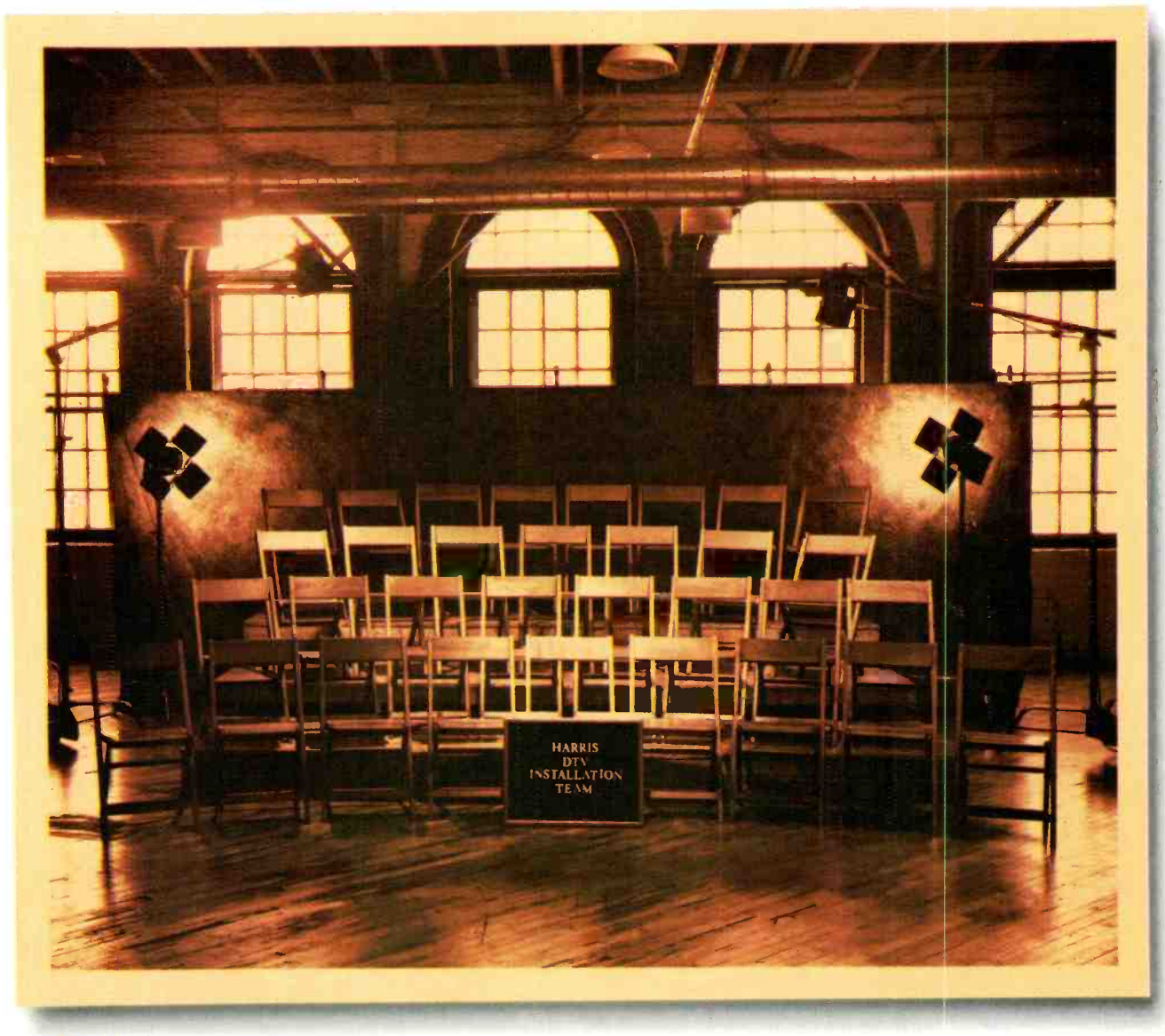

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August 1999
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Questions? Contact:
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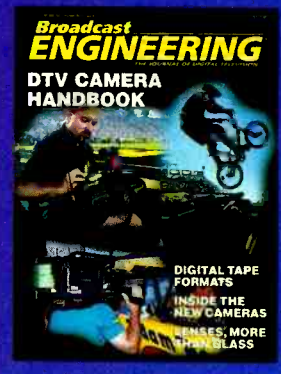
FREEZE FRAME

A look at the technology that shaped this industry.

Know your tape formats?

Name at least 10 of the current digital videotape recording formats. Hint: See August 1998 *Broadcast Engineering*, "Digital Tape Formats," page 74 for a partial list.
Submit your answers to: brad_dick@intertec.com. Correct answers will win a *Broadcast Engineering* "digital" T-shirt.



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Editorial

Heavy on the BS

For years now, the consumer electronics industry has been screaming that the new DTV architecture, complete with its 8VSB modulation, is a robust, well-engineered system. "Trust us," we're told. "Any DTV reception problems will be cured in the next generation of TV sets." Yet, when it came time to propose a new class of service, guess what modulation scheme they chose — COFDM!

I almost fell out of my chair in late July when I received CEMA's proposal for a new class of "service" called *Mobile Multimedia Broadcast Service* (MMBS). Hidden in this acronym is a new broadcasting service that threatens to damn FM stations to an analog future and kill any chance TV stations have of developing auxiliary data services.

The proposed MMBS is designed to deliver digital audio and data on TV channels 60-62 and 65-67, and it does so using COFDM. For years CEMA has endorsed the ATSC group's selection of 8VSB as the superior modulation scheme for DTV. However, now that CEMA has designed its own digital delivery service it wants to be sure that COFDM is used.

To explain the apparent shift in position, we turn to *lawyer speak*. In a footnote, to its proposal, CEMA states, "CEMA believes its consideration of COFDM modulation is appropriate and distinct from other arenas (e.g., DTV), since CEMA's vision for MMBS is a service with vastly different offerings intended for robust mobile reception." Continuing, CEMA states, "Past studies have demonstrated the advantages of coded orthogonal frequency division multiplex (COFDM) modulation to overcome difficult mobile multipath reception environments successfully."

OK, so what "past studies" are CEMA referring to and why do those studies prove that the laws of physics concerning COFDM apply to MMBS but not to DTV?

TV and radio station owners need to be concerned about the proposal. Hidden in the hoopla about the advantages of MMBS, CEMA suggests that FM digital services are inferior. "It remains to be demonstrated...that an [digital in-band, on-channel FM] IBOC approach can provide compact disc audio, compatibly with robust coverage and performance." In other words, there won't be any CEMA support for digital radio.

Television station owners should be even more concerned. The MMBS proposal clearly targets the delivery of data. Any possibility of TV stations gaining additional revenue by transmitting consumer data is being eliminated by CEMA's plans.

While CEMA's proposal is clearly focused on creating a new class of consumer electronic products — designed to profit its members — what is most disturbing is that it would kill any chance of current broadcasters developing new digital products for viewers and listeners.

While the FCC and Congress will clearly salivate at the chance to auction off more spectrum, and CEMA members will get to sell new products, it is less clear how the consumer will benefit. Where is the advantage in adding another *entertainment device* to lug around (in addition to a portable radio/TV, laptop and perhaps a digital palm device) with yet another box that may duplicate existing services? If you ask me, this whole MMBS scheme is light on the multimedia and heavy on the BS.

Brad Dick

Brad Dick, editor

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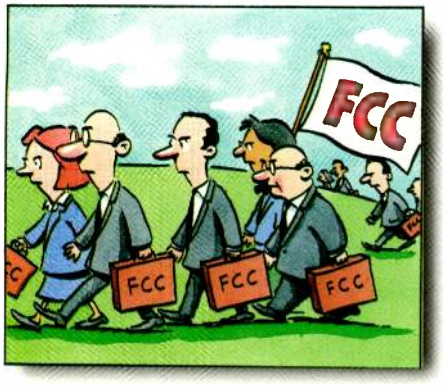


DVB knows best

Hi Brad,

From your May '99 editorial: "Why don't the TV sets have built-in tuners? ... Right now, a consumer would need three set-top boxes (all of which don't exist) just to get local TV, cable and satellite. Recording these signals is a whole other set of incompatibility problems. ..."

Well, forgive me Brad, but you can't blame the FCC for that; you should blame yourselves. Terrestrial broadcasters in every other market of the world realized long ago that digital TV services derived from non-terrestrial delivery would take hold and take their business. They intelligently leveraged the power of these forceful pay-TV networks to create the DVB "family" of specifications. DVB-T came last, but it benefited from the enormous momentum of DVB-S, DVB-C and MPEG-2 MP:ML.

The DVB terrestrial camp can now watch as IDTVs (integrated digital TV) are manufactured and inside are "tuners" for DVB-T, DVB-C and DVB-S. Nestled under a flap at the front are DVB-CI (Common Interface) slots; I notice that belatedly the ATSC has adorned DVB-CI with a new name POD (point-of-delivery). The DVB-CI facilitates pay-TV with a simple insertion of a CAM (conditional access module), a pay-TV service delivered via any of the above "tuners."

Sitting on your collective backsides and believing NTSC would go on forever, over-air, free TV would always make money and that Zenith and General Instrument knew what was good for you all, was very stupid.

I hope your readers do listen to Nat (Ostroff); the industry starts talking to each other, including the pay-TV operators; and then together you tell the FCC what you've decided. Maybe Zenith will claw its way back from Chapter 11.

CHEERS,
IAN WHEELER
PRESIDENT & TEA-BOY
ARRAY COMMUNICATIONS LTD. (UK)

HDTV is ridiculous

Dear Editor:

While perusing a recent issue of *Broadcast Engineering*, I ran across a letter to the editor from a TV engineer regarding DTV.

I am a TV technician on the satellite transmission end of the business, and, among other things, I have been wondering about all the hubbub and rush to get DTV into the home. HDTV in the home is a luxury at best, afforded by only the very wealthy (or foolish). Watching a football game in HDTV is about as ridiculous as it gets. Most viewers (at home) are content to watch a game on an ordinary TV wired up to rabbit ears or, if they are lucky, a mediocre cable system. Some may have ghosts and sparkles in their picture, but let's face it, if the picture is watchable, they will be satisfied, especially after a six pack or two.

Broadcasters should quickly concern themselves with the cleaning up of the existing signals and the quality of the programming provided. Do something with the over-the-air signals reaching millions of homes and viewers now. It seems it would be money better spent.

ALLAN FREEDMAN
PACIFIC SATELLITE
SEATTLE

To Paul McGoldrick

Paul,

I read your editorial, "Good maintenance is not an accident" (May 1999), with great interest. You're right on! More manufacturers need the benefit of your wisdom. Keep preaching! Good Work! Maybe someday the message will get through to them.

73,
D. J. GAUTHIER,
W2FUP

Thanks

Just a note to express my appreciation for your publication over the years. I have been a passive reader until recently when I responded via e-mail to a DBS article you published. I was surprised to receive a follow-up phone call from Larry Bloomfield, who shares my passion regarding removal of network feeds from DirectTV subscribers. We had a lengthy discussion during which he imparted valuable information to me regarding ongoing legislation and congressional contacts.

I was most pleased to receive this individual attention to share my viewpoint.

Keep up the good work.

ROGER FRANCISCO, C.A.S.
AUDIO SERVICES MANAGER
HUMAN KINETICS
CHAMPAIGN, IL

This month's T-shirt winner

LARRY SUES
ROME, NY

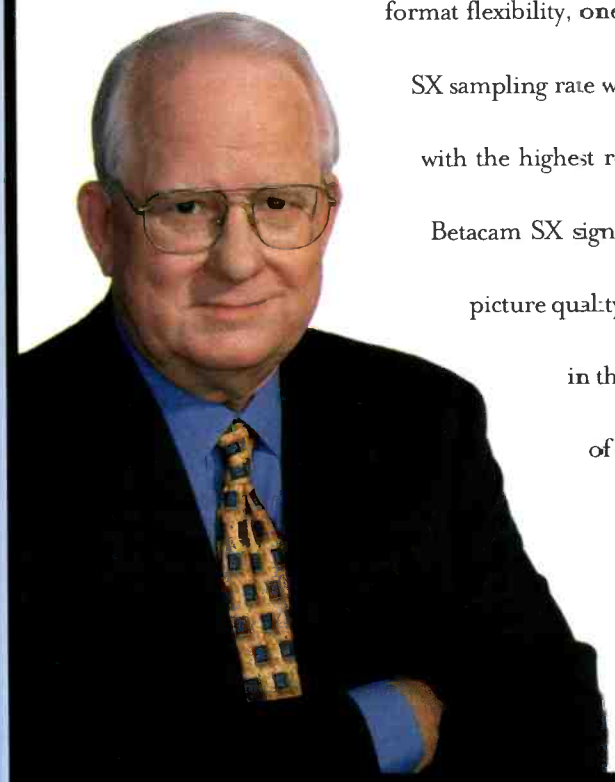
Have you won your *Broadcast Engineering* T-shirt? See page 8 for this month's contest. Freezeframe winners receive a "digital" *Broadcast Engineering* T-shirt. ■

"Sony's Betacam SX equipment is rugged enough for reporters and flexible enough to handle backward compatibility."

-Bob Turner, Vice President of Engineering, Belo Corp.

"Reporters do their jobs in all kinds of conditions. Rain. Extreme heat. Dust. But now they're also going to need to do it in the realm of DTV," says Bob Turner, Vice President of Engineering at Belo Corp. "And Sony Betacam SX products can handle it all." Which is why he found Sony's Betacam SX equipment the perfect choice for the next ENG generation. "Sony's robust Betacam SX technology gives us a light, rugged camcorder and a way into the new DTV world," Turner points out. "We also need equipment that's flexible, and with Betacam SX's backward compatibility with Betacam SP tapes, we don't need to have an analog tape machine in every edit suite just to playback our vast library of archive tapes. With SX's format flexibility, one SX machine will do the work of two." The 4:2:2 Betacam SX sampling rate was also a plus for Belo because "you always want to start out with the highest resolution possible. And with 4:2:2, we can upconvert the Betacam SX signal to our HDTV channel and still maintain the superior picture quality of the original image," Turner is quick to add. "Ruggedness in the field, backward compatibility, and the superior resolution of 4:2:2 sampling are the features that have made Betacam SX equipment the choice for news production and migration to the HDTV future in the Belo stations."

DNW-A75 VTR



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News

WDIV, KRON begin multicasting

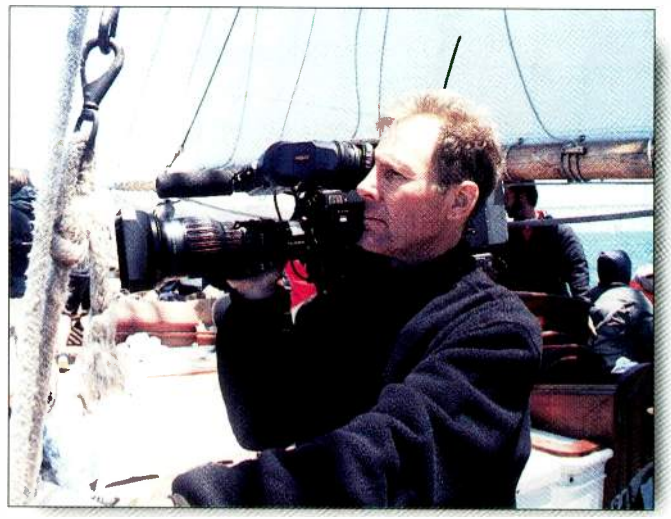
BY LARRY BLOOMFIELD

Besides improving image and sound quality, digital broadcasting offers stations additional avenues for providing revenue-generating content. Two stations, WDIV in Detroit and KRON in San Francisco, have made some of the first forays into one possible avenue: multicasting.

A crucial element of digital television is bandwidth management. The quality of a signal depends upon managing the multiplexed bitstream. Broadcasters only have 19.4Mb/s that must fit into 6MHz. Stations must determine the level of picture quality when material is displayed.

Marcus Williams, chief engineer at WDIV-DT in Detroit, said his station began multicasting on April 1. The station is running three simultaneous channels of program material on WDIV-DT channel 45. Williams said the WDIV-TV/DT uses a General Instruments multiplexer that permits them to set the bit rate per channel. Station engineers selected constant bit rate bandwidth management so they could experiment with various rates on each channel until they arrived at the quality per channel they desired. Content is the deciding factor.

Channel 45-1 tracks content on the local NTSC channel (Channel 4). They deal with the kind of material as it is available. If WDIV, Channel 4's source is NTSC, it is upconverted to digital. Williams said there is no question that standard-definition digital looks much better, and the station uses it whenever it is available.



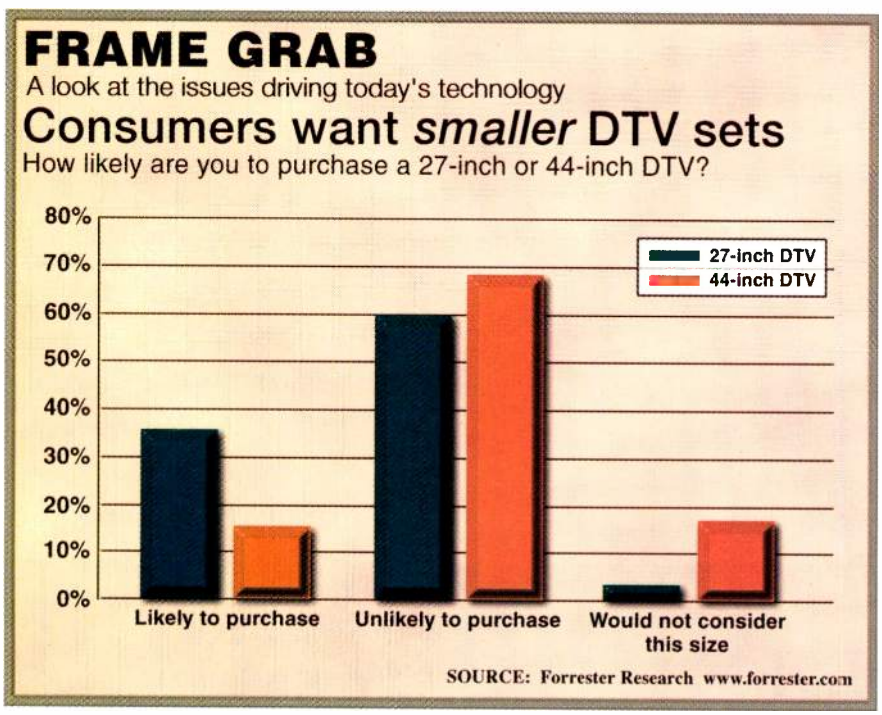
Photographer David Koehn gathers material for KRON-DT in San Francisco. KRON-DT and WDIV-DT in Detroit are now offering multiple channels of content with the help of General Instruments encoders and multiplexers.

Channel 45-1 is nominally set for 12Mb/s. According to Williams, 12Mb/s is a compromise, and it is difficult to see any difference in image quality in a variety program if the bit rate does not fall below 12Mb/s. Williams does not believe this would be a good bit rate for any kind of action or sports programming. The station drops the other two channels in favor of a better quality program when broadcasting high-action programs.

Channel 45-2 is a skycam that looks at the Detroit skyline. Because it is somewhat static, meaning there is not much change in picture content, the station broadcasts a standard digital picture around 4Mb/s even when HD material is being broadcast on 45-1.

Channel 45-3 is a constant screen capture of their WDIV's local Doppler radar. Because of the static nature of the radar's output, the station programs its multiplexer for 2Mb/s for this channel.

San Francisco's NBC affiliate KRON began broadcasting its multichannel fare on May 19 over KRON-DT Channel 57. Roy Trumbull, KRON's assistant



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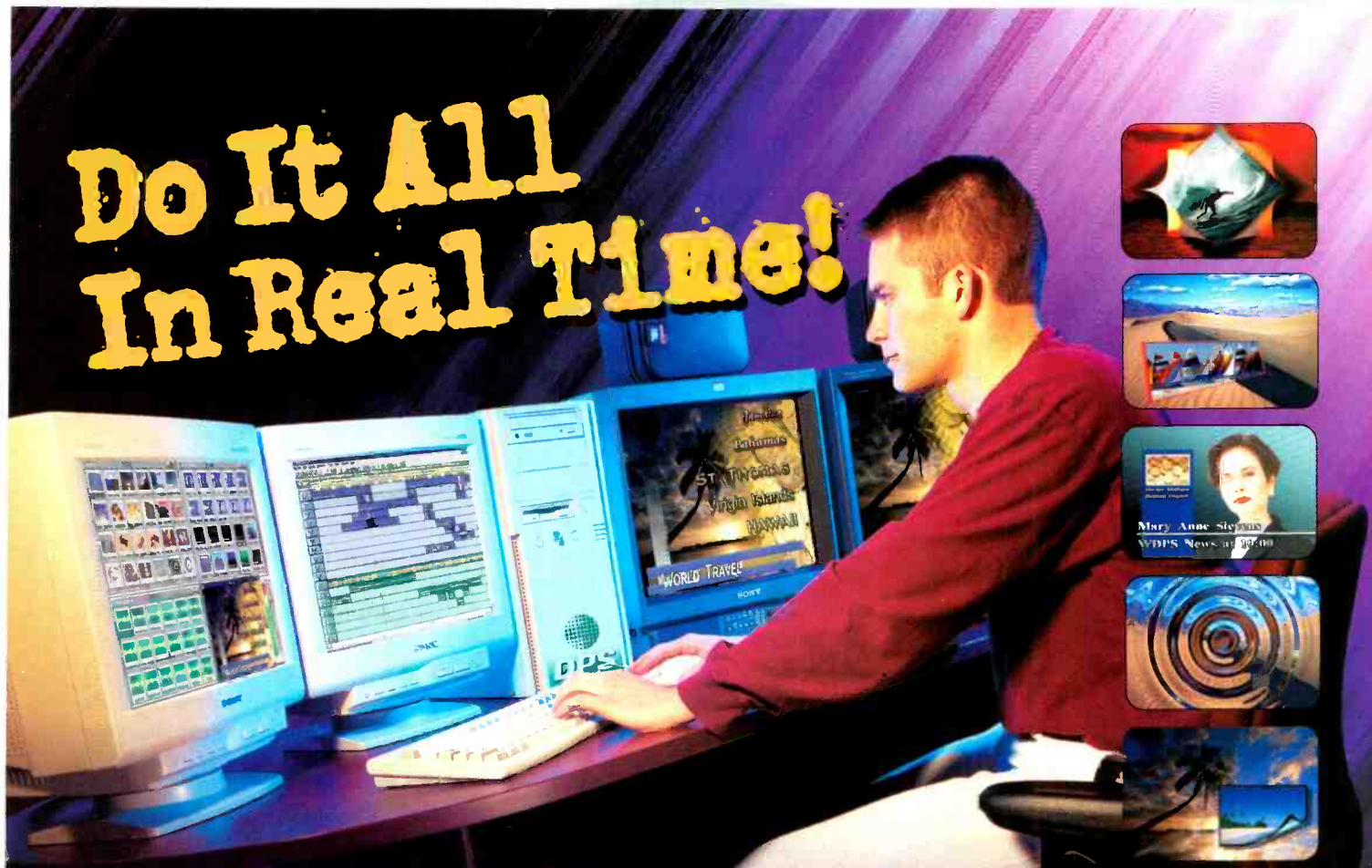

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chief engineer, said the station employs a General Instruments encoder with a SD frame capable of multiple channels and a HD frame. The streams are muxed together.

KRON-DT currently airs HD and upconverted NTSC in the 1080i format. The stations SD channel offers a feed from a traffic camera and is mainly used for demonstration purposes. Trumbull said PSIP data links channel 4 to channel 57, with the HD channel tuning at 4.1 and the SD channel tuning in at 4.2.

KRON has a tradition of being on the cutting edge of technology and new services. "We expect an upgrade to permit datacasting soon."

Development in the area of multiplexers and encoders is only half the battle. Demuxing the bitstream is another chore that seems to be somewhat lacking for attention. To date, Trumbull said three set-top box makers have visited him wanting to see how their units respond to a complex stream.

In looking for an encoder that would do multicasting, Trumbull said, "From what I've seen of the encoders on the market, most are one-trick ponies — that is, they'll do HD or SD, but not both. They can't even do elementary PSIP data."

As far as KRON's future plans, he said, "We don't have any long-term plans for how we'll use multichannel." ■

Is 720p high definition?

A recent announcement by the International Telecommunications Union (ITU) has affirmed that ABC's selected production and transmission standard of 720p is not considered high definition. The announcement caught many by surprise, especially with progressive scanning getting rave reviews at last fall's SMPTE conference.

Giuliano Rossi, senior counselor and head of the study group department of the ITU Radiocommunications Bureau, said 720p is presently not considered a HD format because of "claimed lesser performance" when compared to other formats included in Recommendation ITU-R BT.709-3.

"The reasons for not including at present the 720p format among the recommended HDTV production formats were based on the lack of sufficient evidence about its performance vis-à-vis any other system," Rossi said. "In particular, a comparison based on subjective tests was actually considered necessary. The above reasons have lead to the establishment of an expert group which will evaluate the system with the task to come to conclusions in the next (few) months."

David Wood, head of new technology at the EBU technical department, said, "In terms of a definition for *high-definition television*, an existing ITU report (809) cites a requirement when the HD system is interlaced scanned of twice the number of lines as in conventional systems. Thus a 1080i system could be considered HDTV. When the system is progressively scanned however, the definition does not technically apply." The controversy clearly leaves ABC and anyone else considering 720p in a lurch; that may be especially the case for companies planning on manufacturing 720p production equipment.

When asked about the controversy, ATSC Executive Director Craig Tanner claimed it was a "production format issue ... on which ATSC does not have a formal opinion. We have both 720p and 1080i and 1080p (at 24 and 30 frames per second) in the ATSC DTV standard, but we have no effort underway to make judgements about these production formats. Our emission standard accommodates both. It is an appropriate issue for ITU-R, however."

While the ITU does not recognize 720p as an HD *production* format, it does recognize it as a *delivery* format for HD broadcasting.

ABC responds

Antoon G. Uyttendaele, ABC-TV science and technology senior adviser and member of the U.S. ITU delegation was more direct saying, "It has been suggested by the ITU Radiocommunications Assembly that only one technical standard should be recommended for each radiocommunication application unless good reasons can be offered to do otherwise. This is a very laudable objective but hardly applicable in an environment where standard setting activities cannot keep up with the fast pace of technology change.

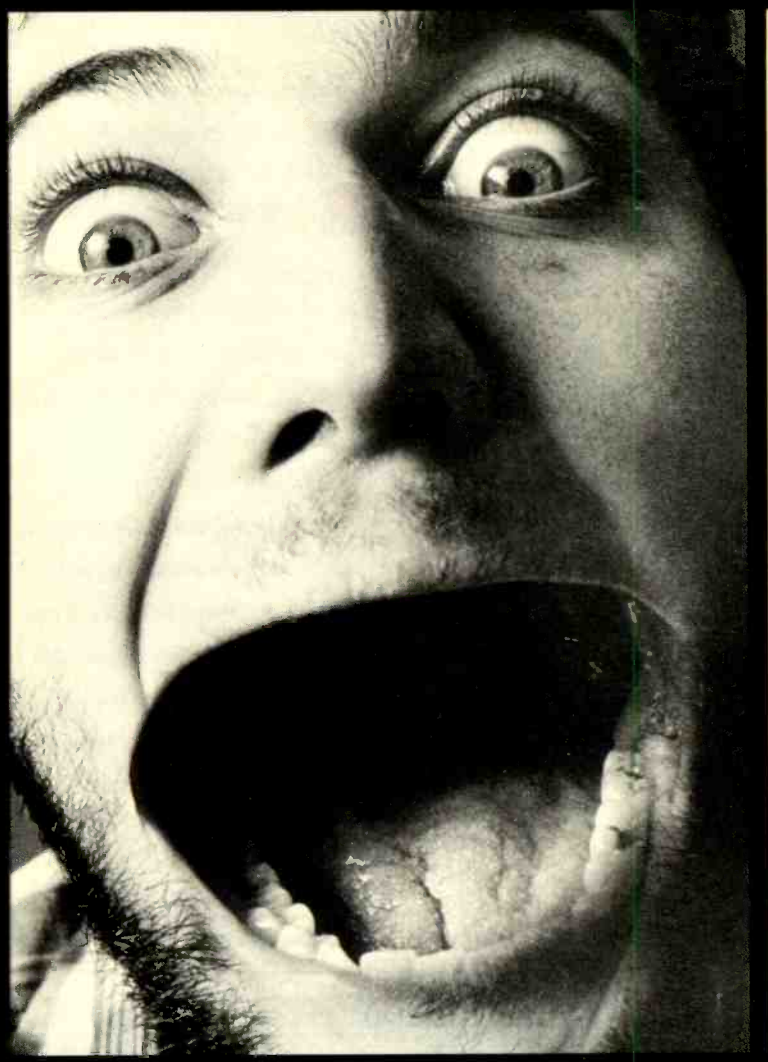
"Since we at ABC had no HDTV equipment at the time we had to make our decisions, we had the choice of using the 1080i format or a superior non-ITU format," he said. "Should we have chosen 1080i just because it was an ITU Recommendation? We believe that 720p will deliver superior pictures to our viewers as it is well known that interlace is a considerable source of difficulties for all forms of picture processing, including compression."

While ITU-R BT.709-3 states that 1080i meets the "quality goals" set for HDTV, Uytenndaele said, "Unfortunately, we have not been able to find an ITU document that states what these 'quality goals' are and how it has been shown that 1080i meets these goals."

One explanation is that the existing ITU report (809) requires that any interlaced HD system be scanned at twice the number of lines as in conventional systems. Thus, a 1080i system could be considered HD by this definition. However, the definition does not apply to a progressively scanned system.

To possibly head off a final confrontation, the U.S. has requested the ITU form a 720p technical group to investigate the possibility of the 720p becoming a second HDTV *production* format. One interesting twist is that while the ITU does not recognize 720p as a HD *production* format, it does recognize it as a *delivery* format for HD broadcasting.

Although no one at ITU would comment on European countries venturing into HDTV, Wood did say, "donning an EBU hat, of course, we all know that eventually television will migrate to HDTV, and the difference of view are largely only about timing." Unfortunately for ABC and others planning on using the 720p format, timing is everything. ■



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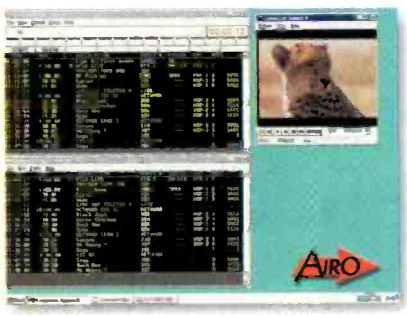

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Circle (106) on Free Info Card

Pinnacle Systems acquires HP's video server line

Pinnacle Systems Inc. and Hewlett-Packard announced that Pinnacle has agreed to purchase HP's video server business in an asset-puchase agreement.

According to Pinnacle Systems, the full purchase price is expected to be about $40 million. HP will end up with a vested interest in Pinnacle. The acquisition is being made with a combination of cash and Pinnacle common stock. Pending approval from regulatory agencies, the deal will be completed this month.

Pinnacle's recently expanded plant should have little difficulty accommodating the additional key technologies and intellectual property gained in the HP acquisition. The MediaStream family of products and selected additional assets are included in the deal. Most of the HP managers and employees will join Pinnacle Systems, and the remainder of HP employees who do not join Pinnacle Systems will be reassigned within HP.

The acquisition of HP's assets gives Pinnacle a legacy of success and tradition dating back to HP's introduction of one of the first successful video servers in the broadcast industry in 1992. "This acquisition will complement our existing products in the broadcast market and extend our customer base," said Bob Wilson, vice president and general manager of Pinnacle's broadcast division.

"We value the relationships we have built in this marketplace and will implement a program with Pinnacle to provide a seamless transition for our existing customers," said Tom White, vice president and general manager of HP's Communications Solutions Group. "We believe that they will be better served by the new breadth of services under Pinnacle Systems' management."

HP's video communications division developed MPEG-2-based video servers. HP's newest entries, the MediaStream 700 and 1600 are third-generation products.

What makes the merger of the two companies' product lines beneficial to the market place is the MediaStream family of products is targeted at installations where a large number of playout channels are required, while Pinnacle's Thunder product line is intended for users who need two or four channels of record/play. Both products were introduced this year at NAB.

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JVC introduces new DV camcorder, VTR

JVC introduced a line of products that it says will take its place alongside its Digital-S and D-9 HD formats.

JVC's tossed its hat into the professional DV ring with two products. The first, the GY-DV500 camcorder, is a component digital, three 1/2-inch CCD camcorder that uses standard interchangeable bayonet mount lenses with an integrated, industrial grade mini-DV recorder in a package that weighs less than 11 pounds.

JVC's GY-DV500 camcorder is a new DV camera designed for broadcast, cable, videography and multimedia applications.

The second product, the BR-DV600 VTR, is what JVC calls a recorder/feeder that was designed to complement its new camcorder and become a part of any editing suite. It was designed around the IEEE-1394 connectivity standard, which will provide lossless digital transfers to and from most nonlinear editing systems. The new JVC unit also has the inherent recording quality of all of the 25Mb/s DV-based systems. This recorder/feeder should fit right into most legacy S-VHS, Hi-8, or even Beta SP linear editing systems because of its Y/C and component video out and RS-422 and JVC 12-pin control connectors.

JVC believes there is a need for more programming for broadcasters, cable TV, satellite channels, DVD, CD-ROM and even for Internet-based broadcasts. These venues have spawned a whole new generation of creative and aspiring producers. The company hopes its new, more affordable product line will attract existing and aspiring professional DV users. JVC says its new product line is intended to appeal to "network broadcasters, corporate videographers, small-market television stations, cable operations, event videographers and multimedia producers." ■

Sinclair modulation tests near completion

After months of testing, Baltimore-based Sinclair Broadcasting Group is preparing to release the results of its comparative field trials of the 8VSB and COFDM modulation systems.

The U.S. television community can expect the results of the "Baltimore Reception Tests" to be published and made public in September. The head-to-head field trial conducted by Sinclair engineers could help settle the modulation system issue. With Sinclair's numerous television stations, the company set out to compare COFDM and 8VSB and determine which system is better.

COFDM was partly developed at Bell Labs years ago, but it did not become commercially available until some time in 1997. COFDM and related multicarrier technology have consistently been demonstrated as a robust technology in hostile propagation environments, namely copper twisted pair. 8VSB was developed by the ATSC to replicate the coverage of broadcasters' current NTSC coverage.

Ed Williams of PBS, who observed some of the Sinclair tests, says there was about 28dB S/N and 3.1 percent EVM for the 8VSB signal, which is well within normal operating specifications. The COFDM system operated in 2K, 64QAM, 3/4 FEC, 1/8 spacing, at a 24.88Mb/s gross data rate mode. The useful data rate for 8VSB was 19.39Mb/s. The COFDM data rate was 18.66Mb/s, which is close enough for useful comparison. The COFDM bandwidth occupancy was 5.7MHz and 5.38MHZ for 8VSB. The wider band-

Tektronix to form two separate companies

Tektronix recently announced its plans to form two separate companies, one that encompasses its test equipment division and a second that includes its color printing and imaging division.

One of the new companies will retain the Tektronix test equipment identity and will be formed from the Measurement Business Division (MBD). Tektronix' VideoTele.com business unit is now a part of MBD. The new measurement company will retain the Tektronix name and be headquartered in Beaverton, OR. Carl Neun, senior vice president and chief financial officer of Tektronix, will become its chief executive officer.

The other company will be formed from the Color Printing and Imaging Division (CPID) and has not yet been named. It will be headquartered in Wilsonville, OR. Upon completion of the separation of the two companies, Jerry Meyer will become chief executive officer of the new color printing and imaging company.

Both Meyer and Neun will continue in their current positions at Tektronix until the spin-off is complete. Rick Wills, currently president of MBD, will become president of the new measurement company and Gerry Perkel, currently president of CPID, will become president of the new color printing and imaging company.

Jerry Meyer, Tektronix's chairman and chief executive officer, said, "We are also confident that we will sell or find a strategic partner for our video division and that it will continue to be a leading provider of operational equipment to the professional video and broadcast markets."

Tim Thorsteinson, president of the Grass Valley Group, would not confirm or deny any prospective buyers, but he did indicate there is interest in the division from several companies. ■

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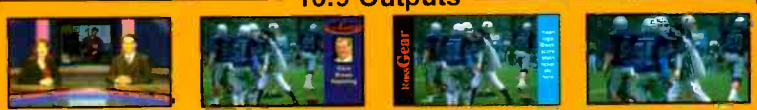

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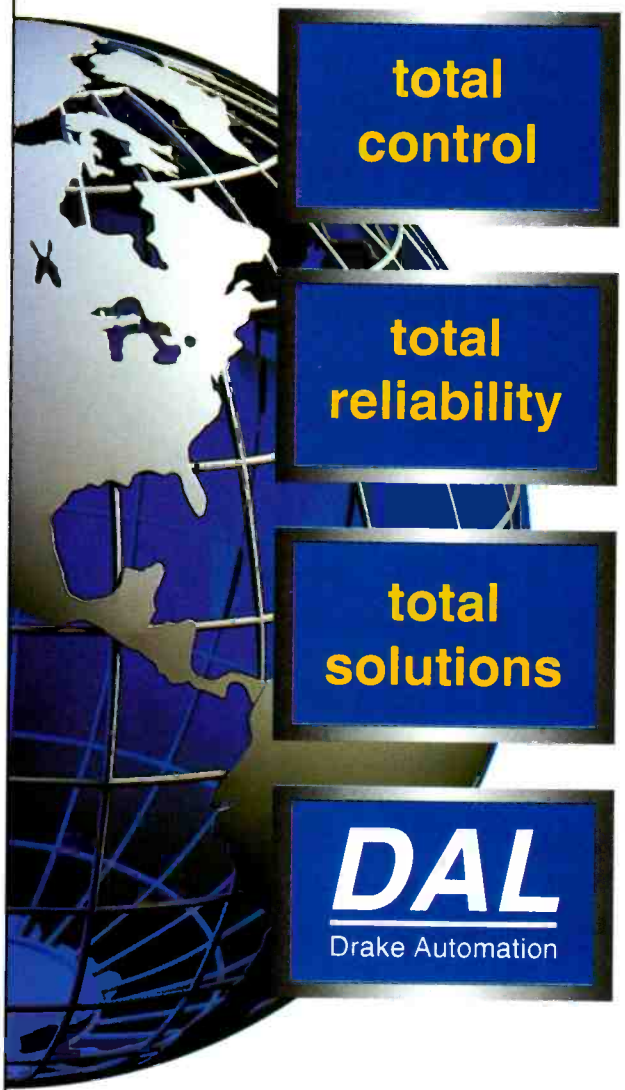

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width for COFDM forced a compromise on the bandpass filter so it did not meet FCC specs, but that was not needed for this test.

Sinclair transmits NTSC with its LMA on Channel 54 and is assigned Channel 40 for DT transmission. The ERP for both signals was about 50kW using a 30-gain antenna about 1000 feet above ground. Peak-to-average power was 8.5dB for COFDM and 6.5dB for 8VSB. One of four 60kW IOT power amplifiers normally used for Sinclair's channel 45 station was used for the DTV tests at an average output power of about 5.5kW.

The COFDM signal consisted of a seven-second clip of SD PAL material with an encoded rate of about 3.5Mb/s, followed by bit stuffing in the Rhode & Schwarz modulator for the 18.66Mb/s total. For 8VSB, some HD material was provided from a server. There was no real complaint about using SD on one and HD on the other, but it did generate some discussion about what effect the difference could make in reception.

Two UHF antennas, a single, stand-alone bow tie and double bow tie with reflector, were used for the demonstrations. A diagnostic display on one of the COFDM receivers provided indications of the transmit mode of the COFDM system.

Sinclair station engineer Harvey Arnold (far left) and Ray Kiesel (far right), a member of the Sinclair New Technology Group, discuss their modulation testing methods with a group of broadcasters.

Williams visited two sites, and based on those tests he thought COFDM was easy to receive while 8VSB was more difficult. Both could be made to fail. Sinclair allowed visitors to conduct their own tests at each site. At two of the locations where both 8VSB and COFDM could be received, the margin to threshold was nearly identical despite the significant variations among the two COFDM receivers and the two 8VSB receivers.

Williams said, "There clearly is a difference in receivability. He believes the next step is to determine the theoretical limits of 8VSB reception followed by implementation of circuitry to meet the criteria as closely as possible. It is no longer a comparison between NTSC and DTV, it is now between two conceptually different DTV modulation systems.

Citing the importance to both consumers and broadcasters, Rep. Billy Tauzin, chairman of the House Subcommittee on Telecommunications, Trade and Consumer Protection, said, "Obviously, I am very concerned about potential indoor, digital reception problems encountered by Sinclair Broadcasting. I intend to ask Chairman Kennard at the FCC to investigate this issue and report his findings back to the House Telecommunications Subcommittee."

Pia Pialorsi of Sen. John McCain's office said the senator's Communications Subcommittee staffers "are aware of the issue and are monitoring it, however, the senator has not made any statement on the matter." ■

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Lucent, ViaGate send HD on a twisted pair

Two companies have developed a method to transport HD video and other digital content at 26Mb/s over high-speed digital lines and existing infrastructure.

In early June, ViaGate and Lucent Digital Video demonstrated the first HDTV signals over a single pair of telephone wires using very high-speed digital subscriber lines (VDSL). Filling this gap is a significant milestone in the delivery of multimedia broadband material to residential, small business or remote office locations. VDSL technology has the ability to provide 20Mb/s to 50Mb/s of digital bandwidth over a single pair of copper wire. With the judicious bandwidth management, this will allow high-quality video streams to be transmitted to a user's location without rewiring.

The ViaGate equipment, called an "access switch," aggregates or masses HDTV content, along with Internet data, voice telephony calls and other digital fare, into a dense cluster on a single platform for high-speed delivery to the subscriber. Bit rates are 26Mb/s downstream and 3Mb/s upstream. ViaGate's residential gateway product then separates the various signals. Lucent Digital Video's role is to provide HD encoding and decoding systems. Viewers will be able to see a HDTV display, a standard TV display and receive regular phone calls over the same telephone wire.

This technology can be used to transport digital content as long it remains within the bandwidth limitations of the transport media. By managing disparate data streams from a single source close to the customer, telecommunications companies and other service providers will be able to deliver HDTV and other high bit rate material in a cost-efficient manner.

The nearly half dozen FCC-licensed open video systems are proposing to offer their consumers any number of digital video services, high-speed Internet and much more. All services would be provided from the OVS central office and will be deliver via fiber optic cables to local phone companies who would, in turn, deliver the services to neighborhood nodes or local hubs via fiber optic cable. From there it will be delivered via copper wire (a drop wire) to a decoder/terminal box in your home, business, etc. The only weak link being the copper drop.

To date, the drop has been the weakest link with respect to digital bandwidth in the modern telecommunications infrastructure. The local telephone operating companies can replace the miles of multipair copper cable with fiber into neighborhood nodes but replacing each and every copper drop from their "junction boxes" to the multiplicity of demarks is costly and impractical.

By using VDSL lines, telephone service providers will be able to deliver HDTV signals to customers at the same time that the terrestrial broadcast television industry converts to digital television. ■

Larry Bloomfield is a former chief engineer an industry consultant located in Morgan Hill, CA.

Send questions and comments to: larry_bloomfield@intertec.com

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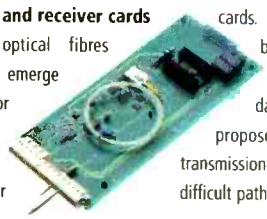

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FCC Update

FCC to require closed-captioning capability on DTV receivers

BY HARRY MARTIN

The FCC proposed to amend its rules to include requirements for the display of closed-captioned text on digital television receivers. This action was taken to ensure that closed-captioning services are available in the transition from analog to digital broadcasting.

Closed-captioning information is encoded and transmitted along with the video signal of television broadcasts. The text is not ordinarily visible. In order to display closed-captions, viewers must use either a set-top decoder or a television receiver with integrated decoder circuitry.

In 1990, Congress passed the Telecommunications Decoder Circuitry Act. The Act requires that television receivers with picture screens 33 centimeters (13 inches) or larger contain built-in decoder circuitry designed to display closed-captioned television transmissions. The Act also requires that the FCC take appropriate action to ensure that closed-captioning services continue to be available to consumers. In 1991, the FCC amended its rules to include standards for the display of closed-captioned text on analog television receivers. The development of digital broadcasting prompted the FCC to again update its rules.

The FCC is proposing to incorporate sections of the EIA industry standard into its rules. The standard provides instructions for the encoding, delivery, and display of closed-captioning information for digital television systems. It supports user options that enable captioned displays to be customized by a viewer. For example, closed-caption decoders functioning pursuant to the standard may permit viewers to change various attributes of caption text such as its font, spacing, color or screen position. This allows viewers to change the appearance of captions to suit personal needs or tastes. The FCC proposes requiring that digital television receivers be capable of receiving and displaying closed-captioned data that is formatted according to the EIA standard.

In 1997, the Commission adopted rules to phase in the closed-captioning of analog video programming. The rules require an increasing amount of captioned new programming over an eight-year transition period with 100 percent of all new non-exempt programming required to be captioned by Jan. 1, 2006.

Once standards for the display of closed-captions on DTV receivers are adopted, programming prepared for display on DTV receivers will be subject to the transition schedule for the captioning of new programming.

Is Internet access a cable service?

Internet Ventures Inc. has asked the FCC to rule that Internet access via cable is a video programming service entitled to leased access under the 1984 Cable Act. Under the Act, a cable system having more than a certain number of activated channels must set aside channels for lease by programming providers. Internet Ventures, an Internet service provider (ISP), argues that video streaming over the Internet makes the Internet a source of video programming similar to that provided by a TV station. That would qualify ISPs for leased access. If Internet Ventures prevails, then medium-sized and large cable systems must open their leased access channels to ISPs, who can compete directly with cable company ISPs such as @Home.

So far the FCC has resisted ISP efforts to draw the agency into the cable access dispute. FCC Chairman Kennard even denounced the recent Portland cable access decision (opening the TCI-AT&T cable system there to access by unaffiliated ISPs) as a possible source of chaos, and he all but invited the cable industry to file petitions for declaratory relief. Commissioner Powell, in a recent speech to the Federal Communications Bar Association in Chicago, suggested the FCC should pre-empt municipal ordinances requiring cable franchises to grant access to unaffiliated ISPs. The FCC sought public comment on the Internet Ventures request, and may eventually have to rule on it one way or the other. ■

Dateline

Commercial television stations in the following states and territories must file their biennial ownership reports on new FCC Form 323 on or before October 1: Alaska, Florida, Hawaii, Iowa, Missouri, Oregon, Washington, American Samoa, Guam, Mariana Islands, Puerto Rico and Virgin Islands.

All commercial stations that have not yet filed DTV applications (i.e., stations that are not network affiliates in markets 1-30) must do so by November 1, 1999.

Network affiliates in markets 11-30 must have completed construction of their DTV facilities by November 1, 1999, and all other commercial stations must do so by May 1, 2002.

NCE-TV stations must file their DTV applications by May 1, 2000 and complete construction by May 1, 2003.

Harry C. Martin is an attorney with Fletcher, Heald & Hildreth, PLC, Rosslyn, VA.

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A look at adding antennas

JERRY WHITAKER, BE CONFERENCE CONSULTANT

It is no surprise that the transition to DTV brings with it a host of difficult issues that must be addressed by television stations. What has surprised many engineering managers, however, is just how vexing one of the key elements of the conversion process can be. This issue — the transmitting tower itself — can defy simple engineering and business decisions when, by necessity, it ventures into the realm of local zoning and then, by definition, into the realm of local politics.

In the early years of television, a new transmitting tower in a community was a symbol of progress, of new entertainment and information services to residents. Now, however, a new tower, or even additional devices on an existing tower, is viewed like the plague by nearly everyone within line of sight of the structure.

This being the case, the need is great for some technology to accomplish the following objectives:

- Enable emission of one or more DTV signals with appropriate coverage patterns;
- Enable emission of one or more NTSC signals with appropriate coverage patterns;
- Accomplish the two previous objectives without replacing the tower.

For many stations, the solution to this problem has been the broadband panel antenna.

It is important to remember that FM broadcast radio stations successfully addressed this issue, in a slightly different form, a decade ago. The tremendous facility buildup in the mid-1980s that accompanied the FCC's Docket 80-90 decision forced competitive stations to combine efforts and signals to meet the technical, financial, and regulatory issues (many of a local nature) that were at hand. The same scenario, albeit under even greater pressures, seems to be playing itself out for DTV.

In this month's column, we hear two perspectives: Bob Hess of WBZ-TV in Boston and Sam Matthews of Micro Communications.

SEND Send questions and comments to: jerry_whitaker@intertec.com

VENDOR

Sam Matthews, Micro Communications Inc.

Broadband panel arrays, like most products, have their advantages and disadvantages. In broad terms, their major advantage lies in their flexibility; their disadvantage is their high windload relative to other types of broadcast antennas.

Specific disadvantages of panel antennas include the following:

- Tower loading: There is no avoiding the fact that this type of antenna imposes a much higher windload on the tower than slotted poles or turnstiles. This is the price we pay for the ability to handle multiple channels in a single antenna.
- Azimuth pattern circularity: To get an omnidirectional pattern, the standard approach is to use four panels per bay. This gives an azimuth pattern that has deeper nulls than using a slotted pole. There is the approach of using five panels per bay to lessen these nulls, but not all manufacturers offer this solution. Of course, adding an extra panel per bay also increases both tower load and antenna cost.

Specific advantages of panel designs include:

- They work at both NTSC and DTV. Panel antennas can broadcast in digital or analog, or both at the same time.
- Group delay. Panel antennas do not suffer from the group delay problems associated with end fed slot antennas.
- Modular flexibility. The panels can be configured to give the azimuth pattern, beam tilt and ERP that you need.
- Power handling. Due to recent developments in power handling capabilities for UHF panels, broadband antennas can now compete favorably with designs such as slot antennas. Previously, the relatively low power handling of individual panels was a constraint on design effectiveness in high-power UHF applications. Several manufacturers now produce panels that will handle 7.5- to 10kW.

When built into an array of large numbers of panels, the individual panel capacity soon adds up to accommodate the sort of power levels associated with waveguide feeders. An interesting side effect of the higher power panels is that, in some circumstances, it is possible to work with fewer panels than previously thought possible. There have been instances where the number of antenna bays was dictated not by the required gain but by the need to cope with the power being pumped up the main feeder to achieve the desired ERP. Apart from the cost savings, there is the added benefit of getting a broader vertical beam by having a lower gain antenna.

- System redundancy. The dual input configuration makes it possible to go to half antenna if service is required — one way to contend with damage resulting from a lightning strike. This capability is like having a standby built right into the main antenna.
- Broadcast multiple stations simultaneously. Several broadcasters can team up to share original equipment and costs, or one owner can "rent" equipment usage to other broadcasters. To illustrate the point, MCI supplied a single broadband antenna to handle 17 NTSC stations at a site in Minnesota, with plans to add DTV channels into

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the same system in the near future.

• Resale value. If there is ever a need to sell off the equipment, there is a ready market for this type of antenna, as the panels can be tuned to any frequency in the UHF band and reconfigured to give different azimuth patterns.

As with many things technical, the issue of antenna types can be as much a business decision as it is a technical one. In any application, the relative strengths and weaknesses must be weighed carefully. In the case of an antenna, the evaluation process is critical to the success of the project. A well-designed and installed antenna will pay dividends for years to come; a job done poorly will haunt you for nearly as long. ■

Sam Matthews is sales and marketing manager with Micro Communications.

EXPERT

Robert Hess, WBZ-TV

According to the 1999 edition of the Television and Cable Factbook, 1585 TV stations were on the air in the U.S. as of Jan. 1, 1999. Presumably, all of these stations will have (or already have) to deal with the installation of a DTV transmission system. This means an additional transmitter and, in most cases, an additional antenna. With most towers already overloaded, where are all of these stations going to put their antennas? Certainly, in many areas towers have become taboo in the minds of the local populace, so it will not be easy to put up a new tower for each station in a market.

Assuming your tower can accommodate another antenna, your problem is solved. If the windload capacity of your tower prevents you from installing a new antenna, it is time to be creative. In the case of an upper or lower adjacent DTV channel, it may be possible to multiplex both signals on the same antenna, depending on the bandwidth of the antenna. In some cases, it may be possible to stack another antenna on top of an existing antenna or vice-versa. In many cases, however, the answer is just not that simple.

WBZ-TV's tower in Boston is home to four of Boston's TV stations and had absolutely no excess windload capacity. The engineers of all four stations began studying the options several years ago and decided to rely on broadband antennas to deal with the problem. WBZ's channel 4 and WCVB's channel 5 will be combining on a broadband, circular-polarized antenna, thereby eliminating the individual channel 4 and channel 5 antennas. The DTV allocations for the tower's stations are channels 19, 20, 30 and 43. In addition, there is an analog channel 44 on the tower. The decision was made to purchase a pair of stacked, top-mount, broadband UHF panel antennas to accommodate all of the DTV channels. The broadband antenna system will also accommodate the analog UHF channel, thus eliminating one more individual antenna on the tower. With significant reinforcement of the tower, the design structural engineer on the project, gave his stamp of approval.

If the windload capacity of your tower prevents you from installing a new antenna, it is time to be creative.

Construction is underway and subsequent to the decision to do the project, several other Boston stations have expressed an interest in combining their DTV signals into the broadband antenna system.

A broadband antenna system requires either a panel antenna or, perhaps, a super-turnstyle antenna. In addition, a broadband transmission line system is required along with a transmitter combining system. Combining broadcast signals into a single antenna has not been a common practice in the U. S., but it is common practice in many European countries. The high power levels in our country, along with the ease of obtaining zoning permission to erect tall towers in the past are the primary reasons why broadband broadcast antennas have not seen much use. The opposite conditions exist, resulting in the common use of broadband antenna systems in Europe.

Broadband antenna technology in the U.S. has remained stagnant until recent times. Azimuth patterns have looked like four-leaf clovers, windloading has been abysmal, and bandwidth and power handling capacity has been limited. Times have changed, however. Some manufacturers are now offering antennas that will cover most, if not all, of the band with acceptable circular patterns, incredible power-handling capacity and more aerodynamic, effective projected areas reducing windload and resonant vibration.

A truly broadband UHF antenna system prevents use of waveguide as transmission line. Instead, large diameter rigid line is the preferred alternative. Large line, however, is not without its problems. To quote Myat Inc., "All rigid transmission line systems exhibit VSWR spikes caused by the build-up of flange interface reflections." This can inhibit the use of the line on certain channels. Coax moding also becomes a problem, with eight-inch line effectively limiting use of the line to channels below 52. As with antennas, power-handling capacity becomes a concern when several transmitters are fed into the same line. Technology has addressed most of these problems.

The combiner is the third major component in a broadband antenna system. Power-handling capacity and bandwidth limitations are concerns the broadcast engineer should address. The ease of adding future channels to the combiner should also be well thought out. Recent technology, however, has made transmitter combiners a viable option.

Technology has made the broadband antenna system a realistic alternative to traditional antenna systems when dealing with the contemporary problems of tower approvals and excess wind-loading. Economies of scale make such systems affordable when several stations are involved and a multistation antenna system can be a money maker for a tower owner. ■

Robert Hess is director of broadcast operations/engineering, WBZ-TV/AM, WODS-FM, Boston.

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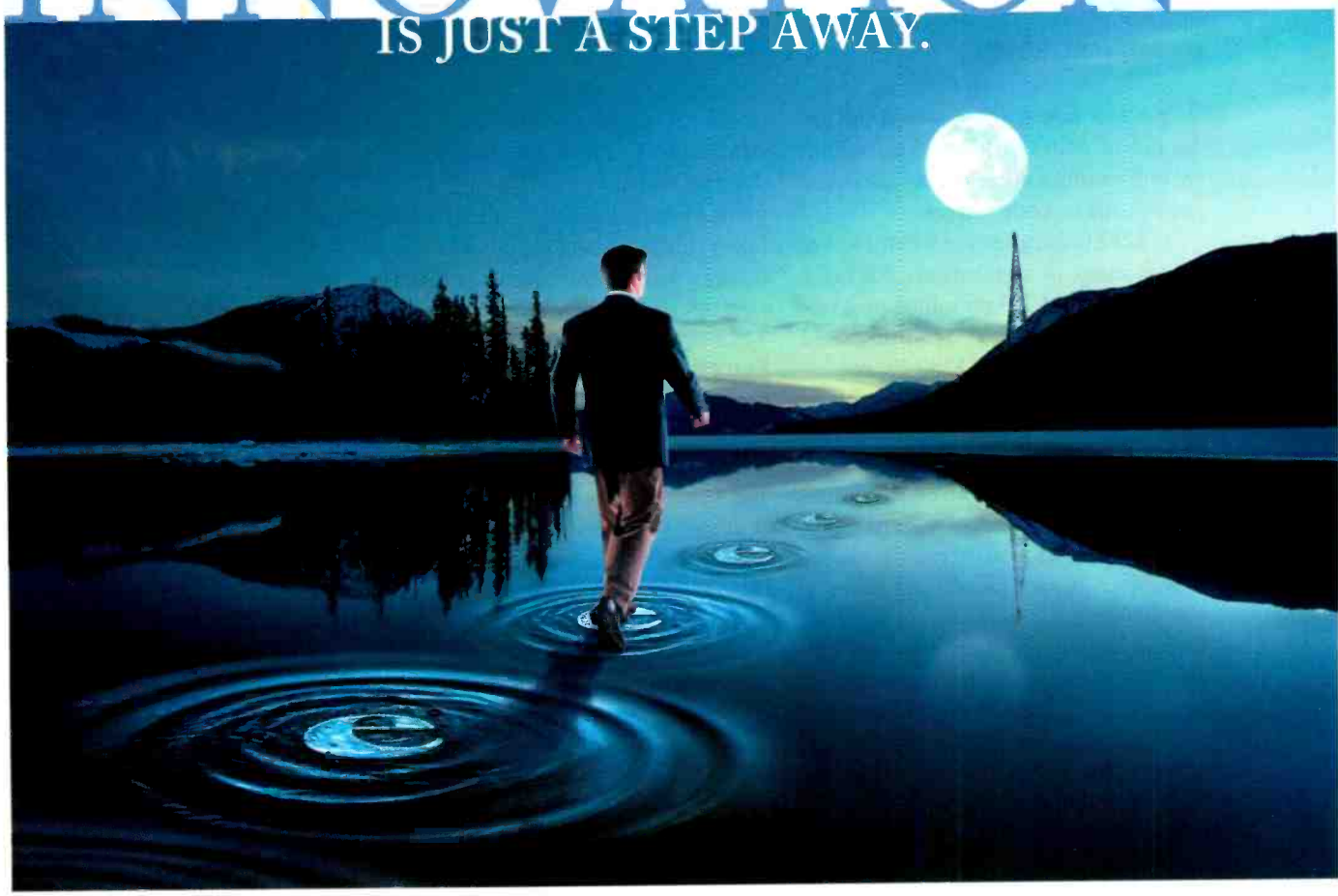

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Transition to Digital

MPEG Coding, Part 2

BY MICHAEL ROBIN

Last month's article covered the basics of MPEG coding. This month we will examine some of the individual pieces used to code images.

The MPEG compression scheme serves a wide range of applications. MPEG-1 is restricted to 4:2:0 sampling, progressive (non-interlaced) scanning and source-input format (352x240) resolution. MPEG-2 offers a wider choice of parameters resulting in millions of possible combinations. Because of this, the concept of profiles and levels was introduced to restrict the choice of parameters. These restrictions affect the choice of the picture size (horizontal pixels x active lines), the frame structure (I, P, B), the maximum data rate and the sampling structure. (For more information, see Table 1, July 1999.) The choices offered allow for standard-definition (720x576 or 720x480) as well as high-definition formats whether North American (1280x720 or 1920x1080) or European (1920x1152 or 1440x1152).

The 4:2:0 sampling formats are adequate for signal delivery applications either direct-to-home or as post-production distribution. The 4:2:2 sampling formats are adequate for contribution purposes and further studio processing, including chroma keying. The vertical picture size constraints (e.g. 1152 and 576) are based on the larger European pictures. The simple profile supports only I and P pictures and has a maximum bit rate of 15Mb/s. The main profile supports 4:2:0 I, P and B and offers four choices ranging from source-input format (constrained to 352x488) all the way to European HDTV (1920x1152). It is designed for a large proportion of uses. The main 4:2:2 profile is an SDTV contribution quality level allowing for further studio processing and full compatibility with digital production equipment. The SNR and spatial profiles are scaleable, i.e. allow for the simultaneous transmission of a main signal and a helper signal. In the case of the SNR scaleable level, the main signal can be decoded separately by a relatively inexpensive decoder to deliver a limited quality picture (e.g. low S/N). A high-quality decoder would use the main signal and the helper signal to deliver a better quality picture (e.g. high S/N) hence the term SNR scaleability. In the case of a spatially scaleable level, the inexpensive decoder displays a low-resolution picture (e.g. on a small screen receiver). A large screen receiver would use a high-quality decoder to display a full HD picture.

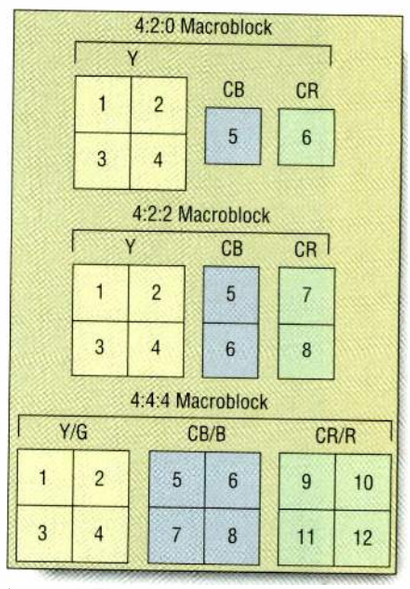
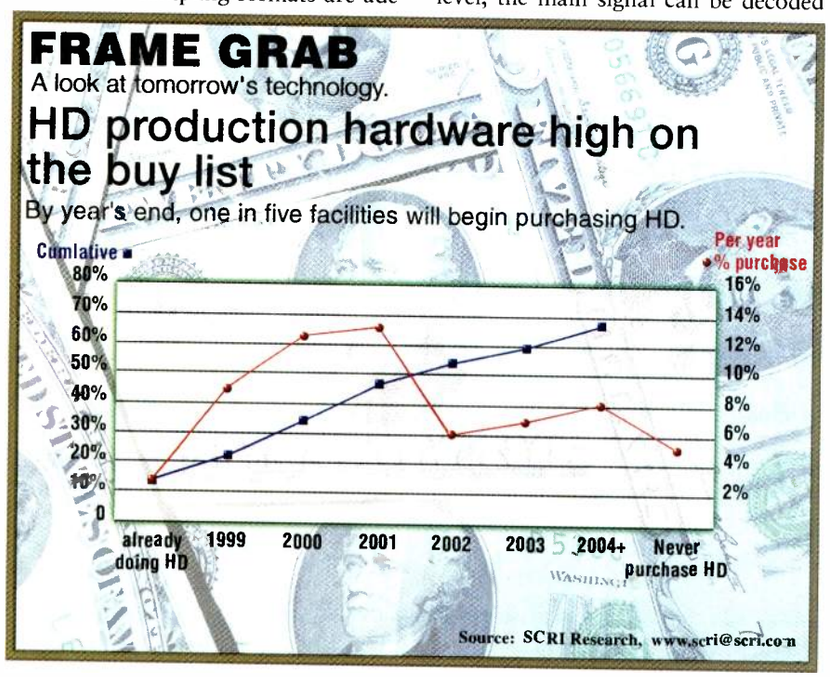


Figure 1. Blocks made up of 8x8 pixels are combined into macroblocks. In all cases, luminance values are formed into a 16x16 pixel macroblock. The number of chroma pixels associated with the luminance macroblock varies based on the sampling structure used.



Data structures

The MPEG-1 and MPEG-2 data structure is made up of six hierarchical layers. These six layers are the block, macroblock, slice, picture, group of pictures (GOP) and the video sequence.

Luminance and chrominance data are separated in 8x8 blocks of Y, CB and CR values. Macroblocks consist of four blocks of 8x8 Y values (16x16 pixels)

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along with their associated CB and CR values. The number of chroma blocks in a macroblock depends on the sampling structure. Figure 1 shows three cases. The block numbering indicates the sequence that the blocks are sent to the DCT process. A header indicates the type of macroblock (Y or CB or CR) and the motion compensation vectors.

A slice is made up of a number of contiguous macroblocks. The order of macroblocks within a slice is the same as the conventional television scan: from left to right and from top to bottom. Header values indicate the position of the macroblock within the picture and the quantizer-scaling factor.

The picture is the primary coding unit of a video sequence. It consists of a group of slices that constitute the active picture area. It also contains information needed by the decoder such as the type of coding (I, P or B) and the transmission order.

The GOP is made up of a sequence of various combinations of I, P and B pictures. It starts with an I picture which provides the reference for following P and B pictures and identifies the starting point for switching and tape editing. GOPs typically contain a maximum of 15 pictures after which a new I picture starts a sequence of P and B pictures.

The video sequence includes a sequence header, one or more GOPs and an end-of-sequence code. The header contains information about the picture such as the size (pixels x lines), the pixel aspect ratio, the bit-rate and the picture rate as well as decoder minimum buffer size. The video sequence is known as the video elementary stream. Figure 2 shows the makeup of a video sequence.

MPEG picture types

In MPEG compressors, the original signal is preprocessed to reduce redundancies before any compression takes place. The first step is noise reduction and the elimination of NTSC/PAL decoding artifacts such as residual subcarrier. The second step is downsampling. Most MPEG-2 applications use 4:2:0 sampling, which requires vertical chroma downsampling of 4:2:2 signal sources. This results in an equal vertical and horizontal chroma resolution of half that of the luminance resolution. MPEG-1 downsamples luminance to a 352x240 resolution and chroma to a 176x120 resolution to produce a source-input format.

After preprocessing is achieved, the actual signal compression takes place.

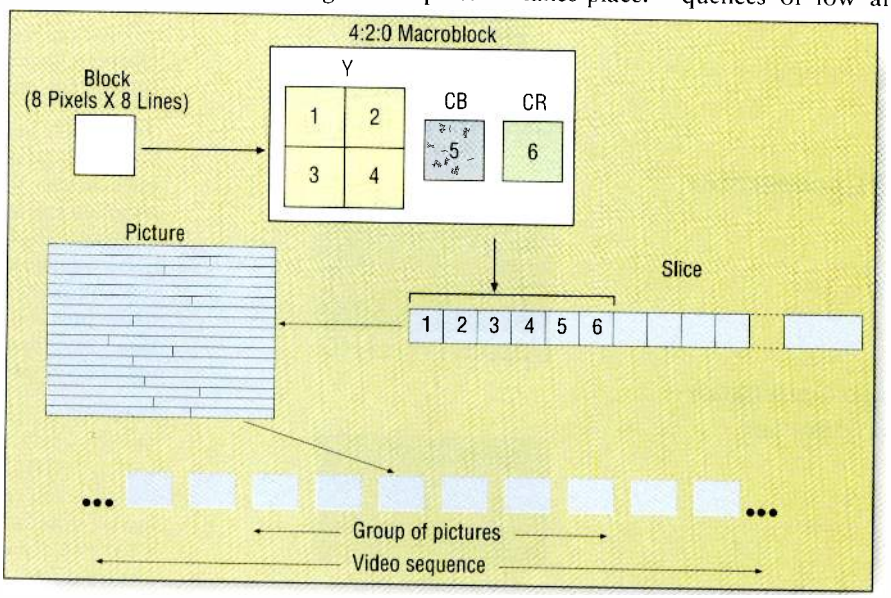

Figure 2. The MPEG data hierarchy builds from pixels up to the datastream. Blocks of 8x8 pixels are formed into macroblocks. A series of macroblocks make up a slice. Slices form a picture (frame), and pictures are assembled into groups. Groups of pictures (GOPs) are used to build a video sequence.

The MPEG compression scheme results in three types of compressed pictures: intraframe, interframe and bidirectional. To illustrate the three coding approaches we will use a generic MPEG coder block diagram with three variations (I, P and B). For every coding scheme the picture will highlight the relevant processing elements and the unused elements will be greyed in.

I frames: I pictures are coded using a combination of lossy and lossless compression schemes applied to information present only in the picture itself. I pictures do not depend on information from other pictures. Only the spatial redundancies in the image are removed. Because most television systems employ interlaced scanning, there is a temporal difference between the two consecutive fields. MPEG allows pictures to be either a field or a frame so there can be intrafield coding, producing two pictures per frame. I pictures provide only moderate amounts of compression. Figure 3a shows a conceptual block diagram of an I compression scheme. The full bit-rate SDI 270Mb/s signal (4:2:2, 10 bits per sample) is first reduced to an 8-bits per sample 4:2:0 representation before feeding the compressor. The input signal enters a spatial coder consisting of a DCT processor and a requantizer (REQ). The requantized DCT coefficients are read out in a zigzag fashion. The resulting long sequences of low amplitude, near-zero values are variable-length coded (VLC) and subsequently run-length coded (RLC) and feed a buffer. The buffer controls the REQ to prevent the occurrence of overflow or underflow. Quantizing table information is fed to the buffer by the REQ.

P frames: Interframe compression reduces both the spatial and the temporal redundancies to increase the efficiency of the data compression. Figure 3b shows a conceptual block diagram of an I/P compression scheme. The output of the spatial coder feeds a spatial decoder which consists of an inverse REQ (IREQ) and an inverse DCT (IDCT) which reconstruct the predicted (past or I) picture. A fixed store memorizes and delays the I picture and feeds the motion estimator. The motion estimator compares the I picture with the present picture to create forward motion vectors. The I picture is shifted by these vectors to generate a predicted P picture. The predicted P picture is subtracted from the real (present) P picture and produces a forward prediction error, which is fed to the spatial coder (DCT and REQ). In the motion compensation block, vectors are calculated that can best predict the present frame. However, because frames may be differ-

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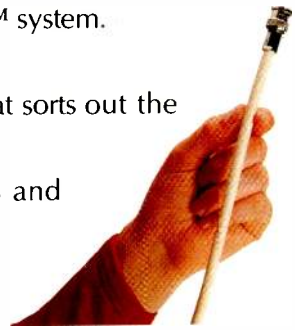

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ent in various manners, the prediction may not be perfect. If there were no motion and no other changes, the present frame could be perfectly predicted and the difference frame output would be zero (very easy to compress). When the two frames are different, the difference frame can still have much less information and will be easier to compress. The output of the spatial coder feeds the VLC and the RLC. A multiplexer (MUX) combines the compressed data with the motion vectors and quantizing table information (for the decoder). That data is then fed to the buffer. The buffer-generated rate control ensures that the bit rate at the requantizer output will not cause buffer underflow or overflow.

B frames: A new (B) picture from the input contains predictable information present in the I and P pictures as well as unpredictable (discovered) information. Figure 3c shows a conceptual block diagram of IPB compression. The motion compensator compares the B picture with the preceding I or P picture and the P picture that follows it to obtain bidirectional vectors. Forward and backward motion is used to generate two predicted B pictures. These are subtracted from the current B picture. The resulting forward and backward data are switch-selected depending on which of the two are nearer to reality. The picture differences are then spatially coded in the usual manner and feed the VLC, RLC and the buffer. The multiplexer is fed motion vectors coherent with the selected video data. The buffer controls the requantizers in the normal fashion and is fed quantizing table information from the two requantizers.

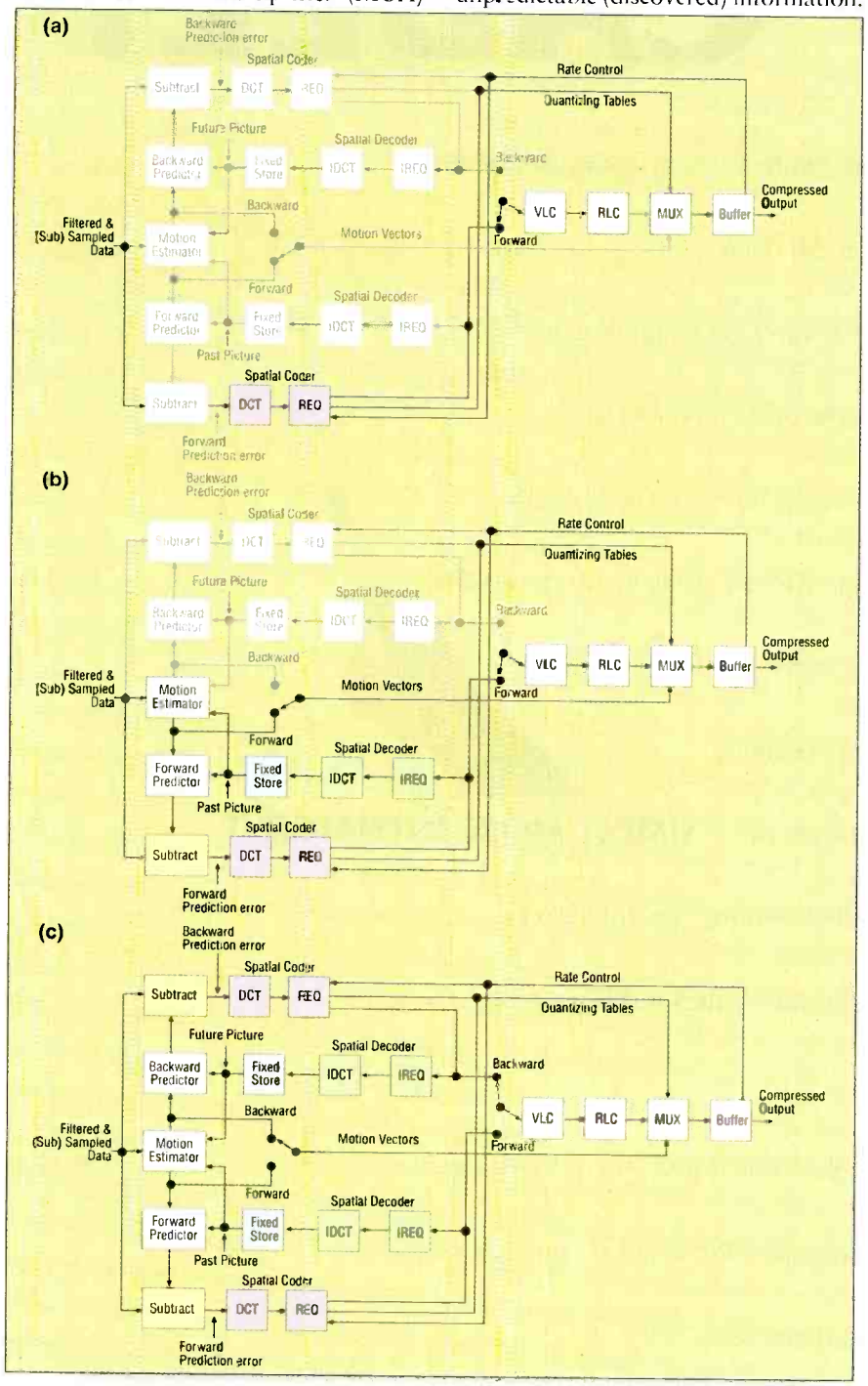

Figure 3. MPEG encoders have three basic signal paths. Each corresponds to the type of frame being processed: I-frames (a) simply use the spatial coder that consists of the DCT (discrete cosine transform) and REQ (requantizer). The resulting data is variable length (VLC) and run length (RLC) coded. This information is multiplexed with the quantizing tables and output through a buffer. P-frames (b) use the same process, but add forward prediction and motion estimation. B-frames (c) add backward prediction and motion estimation.

I, P, B sequences

The I, P and B frame coding results in a GOP starting with an I picture followed by a sequence of P and B pictures. The P pictures are formed using as a reference previous I or P pictures. The B pictures use both past and future pictures as a reference. The MPEG algorithm allows the encoder to choose the frequency and location of I pictures. In applications where random access is important, I pictures are used twice every second. The encoder also chooses the number of B pictures between any pair of I or P pictures. The MPEG encoder reorders the pictures in the videostream to present the pictures to the decoder in the most efficient sequence. In particular, the reference pictures needed to reconstruct the B pictures are sent before the associated B pictures.

As MPEG systems find their way into broadcast facilities, understanding the coding process will make it easier to troubleshoot and monitor these systems. ■

Michael Robin, former engineer with the Canadian Broadcasting Corporation engineering headquarters, is an independent broadcast consultant located in Montreal, Canada. He is co-author of Digital Television Fundamentals, published by McGraw-Hill.

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Network troubleshooting tools

BY BRAD GILMER

So your network hasn't been right lately? Transfer times are high, collisions are through the roof, and users are having difficulty logging in at times. Or maybe one computer simply refuses to talk on the network. Where do you start, and how do you get the network back on track?

Start with the NIC

One of the most common troubleshooting tools is the desktop computer itself. Most network interface cards (NICs) have one or two diagnostic LEDs. One is usually for link integrity. When lit, it indicates there is a physical connection between the network card and something at the other end of the wire — usually a hub. It does not mean that the cable type is correct or that the frequency response of the installation is sufficient to provide reliable communications. It works well as a quick check of whether a connection exists. In addition to indicating that a connection exists, most NICs provide a visual indication of link activity. This may be a second LED, or by simply blinking the link integrity LED. The link activity LED blinks on and off in rough approximation to the activity on the network. Considerable information is available from these LEDs.

Under normal conditions, the link integrity LED is steadily lit, and the link activity LED blinks on and off at a random rate. However, if the link activity light is off, and you know other computers can communicate, there is no activity on the wire, even though it is physically connected to a hub or another computer. Conversely, if the light is on almost continuously (blinking at a high rate), the problem could be traffic saturating the network. Symptoms include network timeout messages, inability to log on to a server, or slow server-based applications.

Okay, you have blinking lights, but things still do not talk. Locate the NIC's driver disk. Many NICs have test software that not only allows the card to be checked in the computer, but to also test communications between two similar NICs across the network. If these tests are successful, the network is up, and can support low-level communications. However, this does not guarantee that all the necessary software drivers are properly installed or that network applications can communicate.

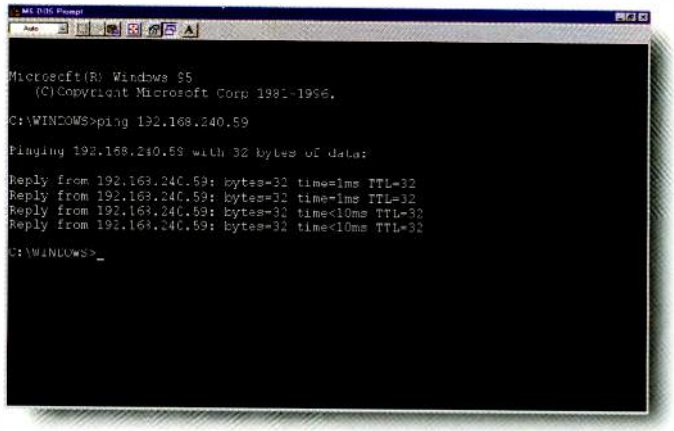

Figure 1. Ping is a network utility that can be run from a command prompt on a variety of operating systems. It sends a message to the address indicated on the command line and provides information on any responses.

If you are having problems with a single computer, and are running Windows 95/98/00/whatever, there is a helpful application built into the system called Device Manager. To use it, select Start/Settings/Control Panel/System (or right-click on the My Computer icon and choose properties) and then select the Device Manager tab. Device Manager tells you, in real time, how various devices on your system are doing. Look for a yellow or red circle with an exclamation mark next to the "Network Adapters" entry. If there is a problem here, it is fairly certain the computer will not function properly until it is corrected.

To verify your NIC is working properly, expand the network adapters section to view the various network devices. Select the appropriate card and then view Properties. Under the "General" tab, there should be a message in the device status window saying that the device is working properly. Next, choose the "Resources" tab. The message, "No conflicts" should be in the conflicting device list window.

If you do see a yellow or red warning flag, there are a variety of things that could cause problems with your network card or drivers. The best bet if you are having problems in this area is to contact technical support for your specific hardware. (A quick note – one of the unfortunate things not included in WindowsNT is the Device Manager. You can get information about drivers under Start/Control Panel/System, but it does not automatically detect if the drivers are working properly.)

A network or server designed by a nonvideo person may fail to take into account the special demands that video can place on a network.

TCP/IP troubleshooting

If you are running TCP/IP, there are a few commands that may help isolate the problem. First, find the IP address of another computer on the network that is working normally. To do this, go to a normally functioning computer and select Start/Run and type WINIPCFG (IP-

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CONFIG if you are running WindowsNT). Write down the IP address. Next, go to the computer that is having difficulty, and select Start/Run. Type "Ping [IP address]", where [IP address] is the address of the computer that is working normally (see Figure 1). Reply messages from the other machine indicate that communication is taking place. If you see the message, "Request timed out," this probably means that there is a basic problem either with the wiring or the driver. Check the link integrity and link activity lights previously described.

If Ping works normally, but you still cannot communicate, the problem is most likely associated with a higher-level problem in your networking software. Be sure you have the proper clients loaded for the type of network you are running. You might also check to be sure that the services you are trying to access are TCP/IP based. For example, some networks employ multiple protocols. If the server you are trying to reach is a Novell server running IPX, Ping may work correctly between two computers, but without the IPX protocol loaded on your computer, you will never be able to log on to a Netware server.

Moving beyond the workstation

If you have tried all of the above, and you are still having problems, or if your problems are not confined to a single computer, your network or server may be at fault. Problems are generally divided into one of several categories. Likely culprits are:

1) Very heavy network traffic caused by an overloaded network topology;
2) An overloaded server;
3) Bad or improperly installed cabling;
4) Intermittent software or hardware conflicts;
5) A datastorm caused by a faulty piece of equipment connected to the network.

It is no surprise that there are several tools to help isolate and correct these problems. Let's first look at the tools you may already have before moving on to dedicated troubleshooting devices.

Whether you are running NT, Novell, UNIX, or some other sort of server, these systems typically include monitoring software to help isolate and correct problems. One useful tool is the server system monitor. Specific implementations vary, but generally, this software runs on the server and keeps track of resources devoted to various tasks. Read the manual to find out what tools you have at your disposal. Areas to check are overall system utilization, disk space available, memory space available, and the number of simultaneous connections. Bear in mind that a network or server designed by a nonvideo person may fail to take into account the special demands that video can place on a network. If you have a 10-BaseT system (slower/older technology), and are using that network to transfer large numbers of graphics or streamed video images, performance will likely be unacceptable, especially as the number of simultaneous users increases.

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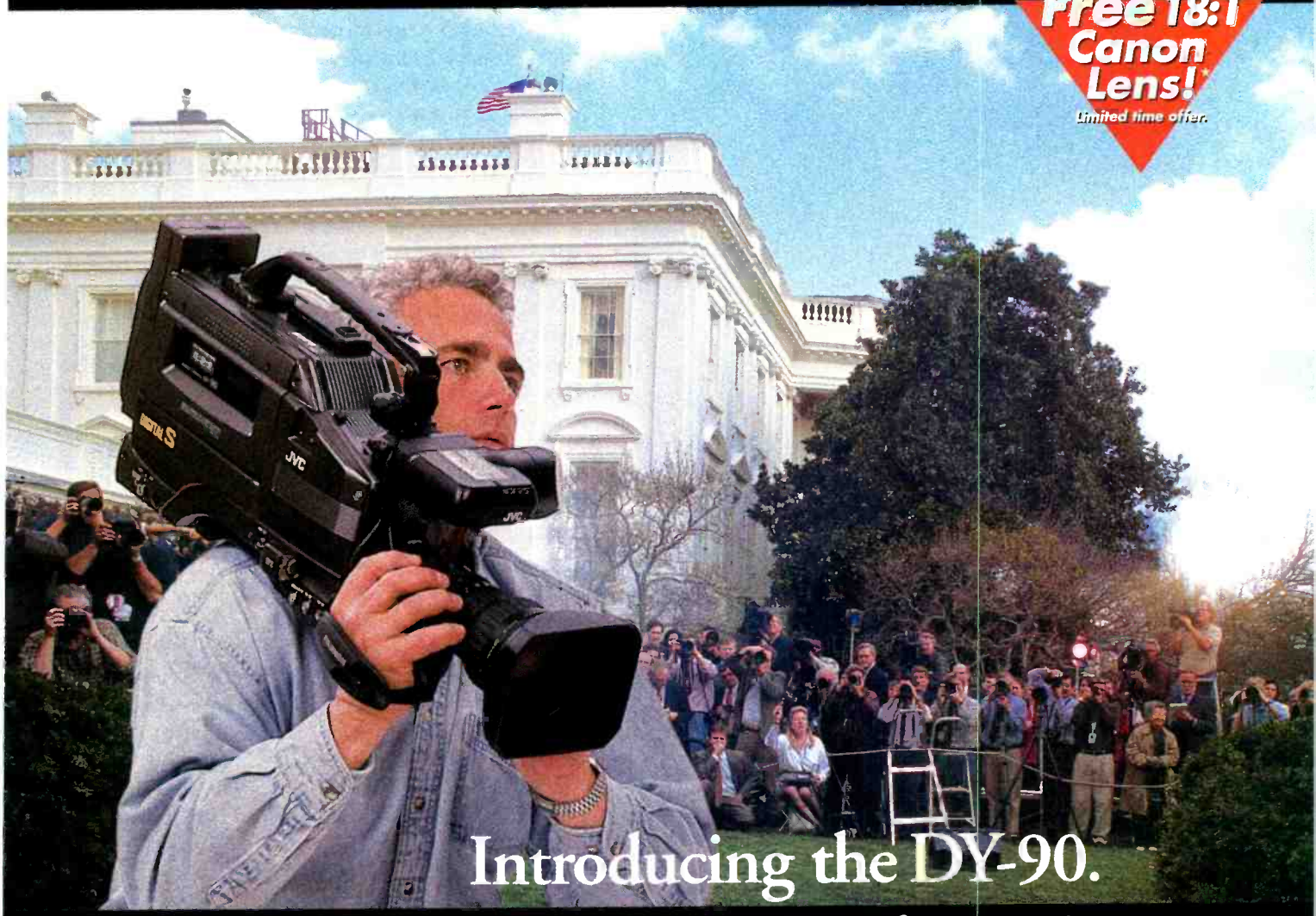

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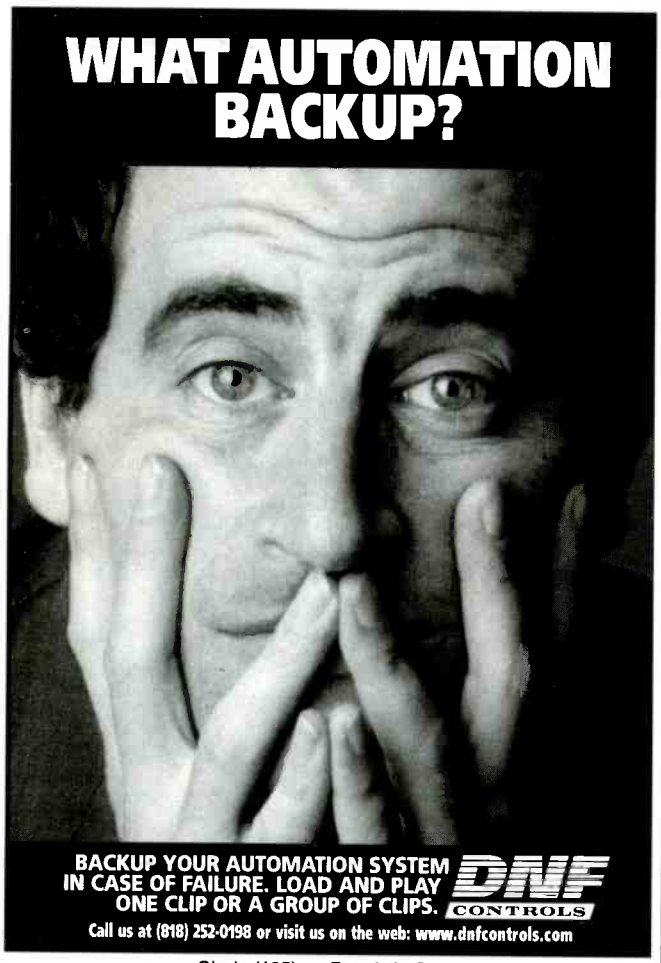

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Tools for testing

There are many sources of information on tools and testing for networks. Point your Web browser to any of the usual search engines and look for LAN cable testing or cable test equipment. Here are some sites you might want to explore.

- www.fotec.com/testbook – a Web-based book on fiber optic testing and instrumentation
- www.fluke.com/scripts/nettools/utpprimr.asp – an excellent document discussing the TIA UTP test standard, TSB-67
- www.anixter.com/techlib – a collection of white papers regarding cabling and testing
- www.fluke.com/scripts/nettools/tchnotes.asp – another collection of white papers and technical notes on cabling and testing

The following sites provide information about the products discussed in this article

- www.fluke.com - Fluke Corporation
- www.microtest.com – Microtest Corporation
- www.photonixtechnologies.com – Photonics, Inc.
- www.siecor.com – Siecor Corporation

Server-based problems are usually easily fixed with the liberal application of money. Purchasing larger disk drives, more memory, or additional network interface cards may put life back into an over-burdened server. If the problem turns out to be insufficient network capacity, however, you may have to add some hardware to segment traffic on your network. (See "Selecting a Network Topology, Part II," July 1997 for a further discussion of network segmentation).

If the PC-based tools do not help, it may be time to look at some dedicated test equipment to help resolve the problem. Numerous manufacturers make test equipment for testing Untwisted Shielded Pair (UTP), coax, and fiber optic network cable. Whether you are talking about fiber optic or copper, there are similar testing products for both applications. Generally there is a low-end continuity tester product, and then there is a series of products that lead up to very elaborate test sets with graphical capability, traceable standards measurement, and a host of other advanced features. In many cases, the low-end test equipment works just fine and can identify the majority of cable problems.

What follows are some examples that will give you an idea of what's out there. The Microscanner from MicroTest is an example of a continuity tester. While it is small and inexpensive, it checks wire continuity, wire configuration, pinpoints opens, shorts, crossed and split pairs, it measures wire length, and generates multiple tones for locating cables. The Photonics LanLite is a product that provides simple power and loss measurement for fiber optic cabling.

For more elaborate testing, most manufacturers produce products that run from moderately expensive to downright frightening. As you would expect, features and performance increase accordingly. ■

Brad Gilmer is president of Gilmer and Associates, a management and technology consulting firm.

SEND Send questions and comments to: brad_gilmer@intertec.com

The Perfect Choice

Extron's Matrix 6400 Video model is the perfect choice for applications requiring true 64 x 64 matrix switching for use with high quality, wide bandwidth HDTV signals. Maximum signal integrity is insured with 80 MHz (-3dB) video bandwidth – when fully loaded. Fully customizable and able to be upgraded in the field, Extron's Matrix 6400 Video model provides 132 user-configured preset switching configurations and Extron's exclusive System Virtualization/Control Software for flexibility and ease of use.

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Three optional control systems are available: Extron's intuitive LCD front panel controller (FPC 1000), MCP 1000 Remote Control Panel and MKP 1000 Remote Keypad. All control and configuration capabilities found in Extron's Virtualization/Control Software are found in the FPC 1000, but mounted conveniently to the front of the matrix enclosure. For remote control and configuration, connect up to 64 MCP 1000 Remote Control Panel or MKP 1000 Remote Keypads through Extron's exclusive Comm-Link communications port. Third-party RS-232 control systems are also supported.

For pricing please call an Extron Customer Support Representatives.

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MCP 1000

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Making sense of CAV standards

BY STEVE EPSTEIN, TECHNICAL EDITOR

This is just a basic question to confirm my understanding. We are having problems with our Abekas 8150 digital switcher. It has an analog Y, R-Y, B-Y output for the edit monitor. Abekas, Scitex-Accom (we call it ASiA around here) says the monitor out, while not recommended as a program output, does have a full bandwidth signal, both luminance and chrominance. It seems this output's chroma level is 20 percent low. They have asked us to check the digital output and with 75 percent bars it is OK. We are also using a serial digital program output and converting it to analog component via a Leitch USM6800 D/A card. This output also has chroma that is 20 percent low. We have three of these cards and all check out the same. This card feeds a Sony BVW-75 that, when given any component signal except the switcher's, nails the scope right on.

Am I trying to match apples and oranges? The deck signals are fine, the D/A cards have bars out and they are fine, but add in the switcher and I lose chroma. We have tried so many possibilities and combinations that I have lost track. I am beginning to question my own knowledge, as nothing is making sense. Any comments or suggestions would be appreciated.

OK, so it might not be a basic question.

Scott Sandstrom
Senior online editor and part-time engineer
Buckeye Cable System
Toledo, OH

Dr. Digital responds:

You may have a problem in the specification the switcher is set for — there is NO SMPTE specification for analog component video in North America. MII component analog signals are different than Betacam signals. For detailed info see the "Transition to Digital" column in *BE* May 1998 and/or the May '99 Dr. Digital column.

Basically, the following signal levels are used:

	NTSC	EBU N10	BETACAM	MII
Peak White	714.3mV	700mV	714.3mV	700mV
Setup	53.57mV	0mV	53.57mV	0mV
B-Y	+/-313.54mV	+/-350mV	+/-466.65mV	+/-324mV
R-Y	+/-438.5mV	+/-350mV	+/-466.65mV	+/-324mV

If the switcher/DA card is outputting MII component, the Betacam deck will see it as low. If the output is EBU N10, the chroma would be about 25 percent low when the luminance is cranked up to 714mV. Using a DA if necessary, try adjusting the levels as per the chart and let me know.

A few days later, Scott responded:

Here is what we have found with regard to our D/A component situation. As Michael Robin's article says in italics "There is no equivalent North American SMPTE standard." If only the manufacturers would realize this.

The 8150 analog monitor out is a Y, R-Y, B-Y signal and the manual says it is set for SMPTE/EBU N10 (700mV). You were correct when you suggested we crank up the D/A card to 714mV to make the Betacam levels as correct as they can be. The Leitch DA card says it is Y, R-Y, B-Y out and (like the Accom 8150) the specifications say the output is actually 700mV not 714mV.

Sounds like Sony is the one out of sync (no pun intended) when it comes to Y, R-Y, B-Y signals.

Your reply was a lifesaver as we were doubting our knowledge when each of these manufacturers' customer service departments started questioning our test scopes. (They wanted to know when the scopes were last calibrated, etc. — they are brand new.)

Apparently, the new Leitch D/A DAC-6801 can output RGB, SMPTE/EBU, Betacam and MII. (Buyers might want to verify those outputs before jumping to any conclusions.) Too bad I didn't have this card originally. I may have to switch to this one because I really hate to use a 700mV card and crank the gains up — not good engineering practice.

Thanks again. Your input connected all the pieces and restored our confidence in what we knew.

Scott Sandstrom

It seems CAV questions, like U-matic, are not going away anytime soon. Just yesterday I received a question concerning CAV relative to DVDs. It is very easy to get caught in a trap. The I/O ports are marked Y, R-Y, B-Y, and it is only a short step in the wrong direction to assume the signal levels match — after all, the labels do. These kind of problems have been around for a long time in the audio world (which pin is hot? –10, +4, +8?). There are plenty of things to keep track of with today's video signals, and the various CAV standards are an unnecessary evil here in North America. Some time ago, I spoke with the folks at SMPTE about this and they were fairly tight lipped about the real reasons a standard does not exist. I believe the key word here is *politics*. Well that's nothing new. If you need some help or have a question/comment, drop me a note at drdigital@compuserve.com. ■

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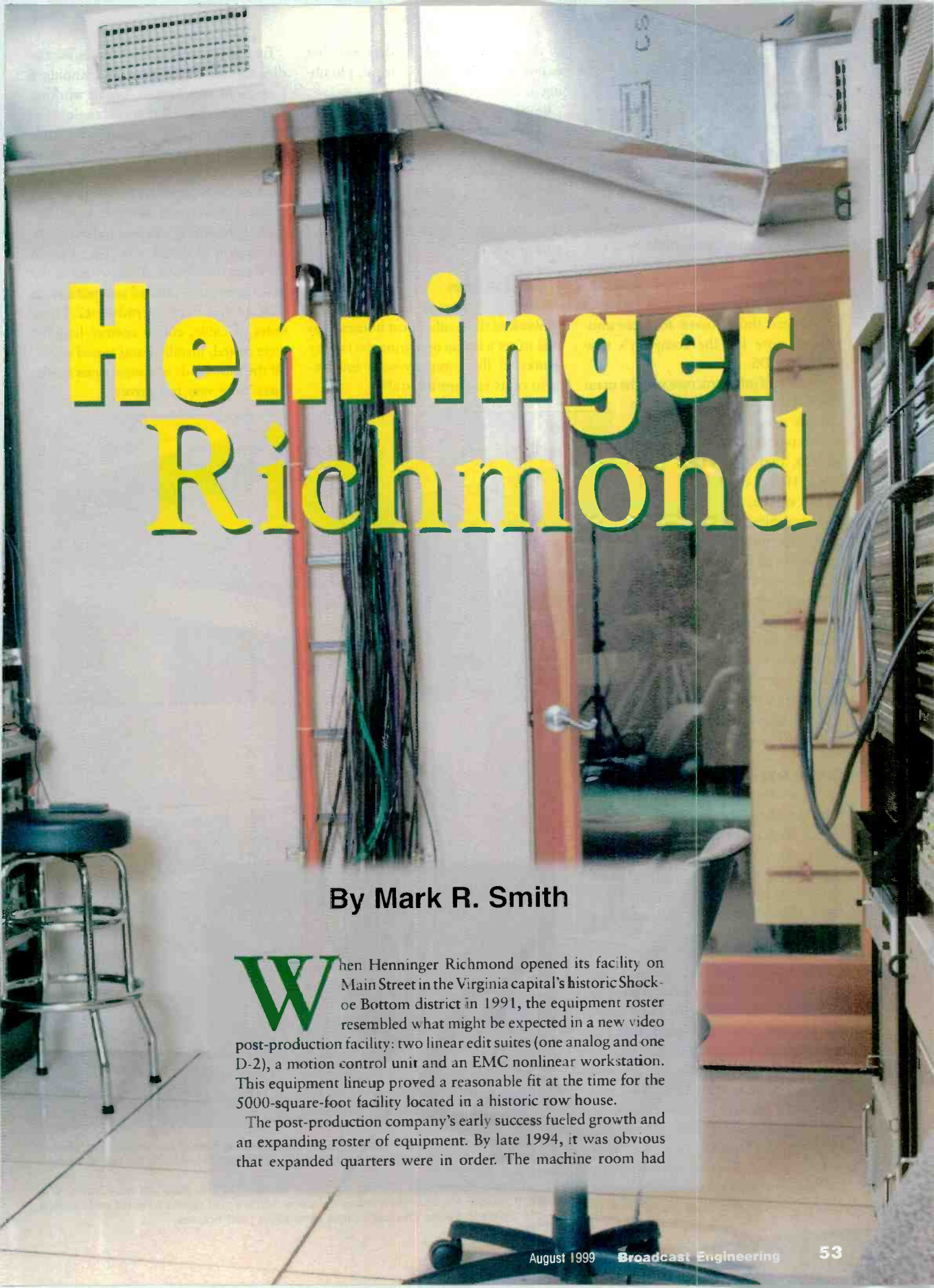
SYSTEMS DESIGN SHOWCASE

Engineers installed a Philips BTS video router in the machine room at the Henninger Richmond post-production facility. The 64x64 router is formatted to carry timecode, serial digital and 4:2:2 video signals throughout the facility. Photos by Arthur Stephens.



Henninger Richmond

By Mark R. Smith

When Henninger Richmond opened its facility on Main Street in the Virginia capital's historic Shockoe Bottom district in 1991, the equipment roster resembled what might be expected in a new video post-production facility: two linear edit suites (one analog and one D-2), a motion control unit and an EMC nonlinear workstation. This equipment lineup proved a reasonable fit at the time for the 5000-square-foot facility located in a historic row house.

The post-production company's early success fueled growth and an expanding roster of equipment. By late 1994, it was obvious that expanded quarters were in order. The machine room had

Henninger Richmond

expanded far beyond its original design and capacity. Electrical and HVAC systems were rapidly becoming incapable of handling the load presented by the increased business, and employees were doubling and tripling up in offices because of the lack of useable space. In one instance, Henninger staff members rearranged three rooms to accommodate a suite for the company's new Softimage DS.

The lack of infrastructure was the main issue in the old building; the firm quickly grew to include a Discreet Logic Smoke, two Discreet Flames, two Avid Media Composer 1000s, component digital linear online, motion control, Mac graphics and Softimage DS suites. The hunt to find a suitable space proved frustrating. Several near misses over the next few years pushed back the expected move to the point where the issue was almost dropped and a major renovation was considered.

In early 1998, Henninger set its sights on an 8000-foot space just west of the old facility and finalized the deal in October 1998.

Design and construction

A clean slate proved invaluable to the success of the new shop. Henninger Richmond assumed a proactive stance by developing a detailed plan that encompassed nearly every detail. The post house also drew heavily on the experience of other Henninger facilities as well as a few other trusted firms.

B.O.B. (Beyond Ordinary Boundaries) Architects of Richmond, served as the project's architect. The firm was familiar with Henninger's search for a new home and became part of the team that put together the new facility from build out to installation in a very limited amount of time. B.O.B. was granted a long creative leash by the company, which allowed it to create a new identity for Henninger Richmond.

Rather than hiding the infrastructure, Henninger went with an open look that showed off the technical infrastructure of the building. Cable ladders were left exposed, as were the electrical, plumbing and HVAC systems.

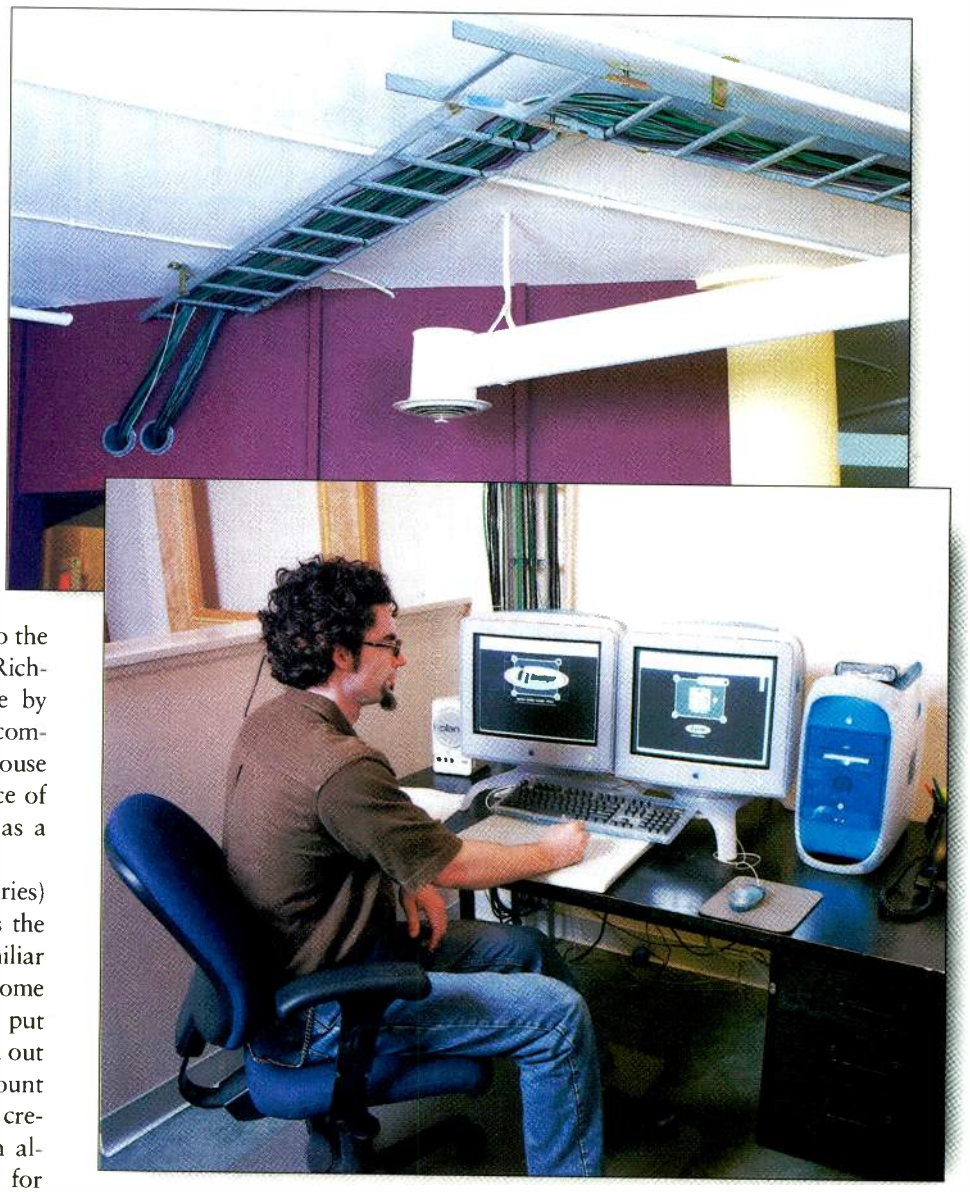
Brooks and Company Construction of Richmond, handled the construction aspects. The architect and general contractor worked closely to preserve existing walls when possible and efficiently create space. After three months of construction, the crucial job of technical wiring began.

The installation

Henninger, through its mid-Atlantic network of three other post houses, was able to get a leg up on wiring the facility thanks to the company-wide involvement of its engineering staff.

Two weeks before the final move the director of engineering at Henninger Capitol in Washington, began working with a Henninger Richmond engineer to coordinate the staff, execute and complete the project so the facility could quickly resume business as usual. Both worked on equipment locations in the racks, patch panel layouts, wire diagrams, grounding schemes and wire lists.

Attention to detail was crucial given the short time frame. Every cable in the new facility was labeled and notated in VidCad and Excel spreadsheets. Three miles of cable, cut to custom lengths, were tested, installed and tested again. Of the thousands of connections made, there were very few errors.



B.O.B.'s design attempts to highlight the technical aspects of the facility (top photo) by leaving the building's infrastructure, such as this cable ladder in the client lounge, exposed.
Artist Rhett Henderson (above) develops material in the MacGraphics Suite. The facility's local and wide area networks allow editors and artists to send and receive video between suites and from other Henninger post houses.

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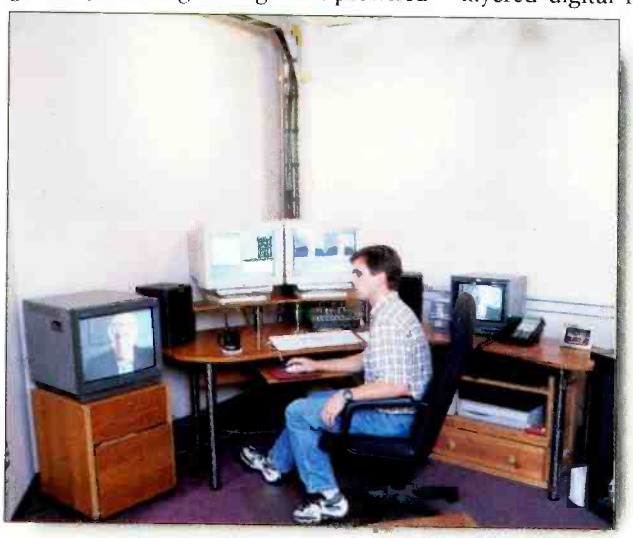
Henninger Richmond

The new facility allowed the staff to draw upon its experience and improve the workflow. At the heart of the facility, a Philips BTS video router allows editors and artists to send audio, video and graphics between suites seamlessly. The router carries timecode as well as serial digital and 4:2:2 video and has become an essential piece of equipment at the new facility. To accommodate future growth, Henninger's engineers prewired rooms that were not slated to become edit suites. That forethought has allowed the facility to convert its tape library to a second Flame workstation.



Scott Witthaus, general manager and senior editor, works on one of the facility's two Avid Media Composer 1000s.

During the move, engineers installed the equipment and began fine-tuning the facilities wiring. Two engineers wired the BTS router and another wired the Nvision AES audio router. Other engineers worked to wire equipment, patch panels and internal wiring of the VTRs. Editors and artists tested equipment in each of the suites and reported problems, which allowed the engineers to develop priority lists and quickly resolve problems.

Each room was also prioritized based upon the need for each of the suites in the coming weeks. When Henninger Richmond reopened for business, its Smoke, Flames, Avids and 3D graphics were in use. A third room, the Sony linear online room, was ready for use by the end of the first business day.

The technical design for the space networks machines that share data on a 10-base-T LAN. The local network is linked to other Henninger facilities and the Internet through a T-1 WAN. The networks allow Henninger's Mac, Windows 95, Windows NT, SGI and Chyron platforms to communicate with one another through software interfaces. The facility's Ensemble Designs Multibuffer DS1 and DS2 are also linked to the network and transport computer-generated graphics to videotape. The BTS video router allows artists and editors to move images around the facility quickly and without a loss of quality. The multilayered digital network allows for the easy sharing of images between a Smoke on SGI, and Softimage DS on Windows NT. Data can be shared with clients and remote facilities, which eases finishing and offline applications.

For example, a job was being offlined in Richmond on the Avid, but audio was being done in California. Frame-accurate Quick Time movies were sent to a composer in Santa Monica so he could accurately synchronize his music instead of waiting for a package thereby saving days on the project. Henninger Richmond received the production audio via e-mail, without a loss of quality.

Henninger Richmond's move to its new facility drew heavily upon the experience and expertise of its own engineers as well as that of other engineers from the Henninger network. By planning and completing the installation of the technical plant itself, the facility's staff was able tailor the facility's technical capabilities to meet the needs of clients and the demands of future growth. The end result is a world-class installation that encourages creativity and improves productivity. ■

Mark R. Smith is a technical writer focusing on the broadcast industry in Crofton, MD.

Building design team

Tracey Tecza, assistant general manager, Henninger Richmond
Bob Steele, principal, B.O.B. Architecture, Richmond
Scott Witthaus, general manager, Henninger Richmond
Doug Kelsner, principal, B.O.B. Architecture, Richmond
Terry Wylie, principal, B.O.B. Architecture, Richmond
Paul Remson, principal, Strategic Realty Advisors, Richmond

System design team

Dan Holler, engineer, Henninger Richmond
Ken Miller, director of engineering, Henninger Capitol

Installation team

Sam Crawford, engineer, Henninger Capitol
Don Crawford, chief engineer, Henninger Capitol
Jim Howell, owner, Video Services Inc., Richmond
Brad Hughes, chief engineer, Henninger Arlington
Dave Komas, engineer, Henninger 1150 Post
Mike Provenzano, engineer, Henninger Arlington
Aaron Rehm, engineer, Henninger Capitol
Steve Wiedemann, senior vice president of technology, Henninger Media Services
Mark Braden, engineer, Henninger Arlington

Equipment list

Sony Digital Betacam A500 (4)
Sony D1 2100
Sony 6100 Component Switcher
Sony 9100 Editor
Sony DME 3000
Discreet Logic Flame (2)
Discreet Logic Smoke
Softimage DS
Macintosh G3 dual-monitor workstation
Softimage 3-D Intergraph GTZ workstation
Vyvx Fiber spot distribution system (send and receive)
Motion Products Motion Control 2000
Avid Media Composer 1000 (2)
NVision 64x64 AES audio router
Philips/BTS 64x64 Video Router
Ensemble Designs DS1 and DS2

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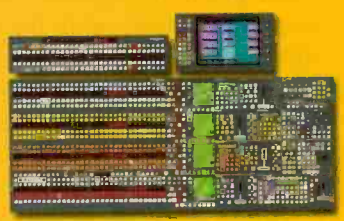

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Transmission & Distribution

Transmitters have to breathe, too

BY DON MARKLEY

We are all familiar with the requirements for liquid cooling of high power transmitters, including the various exotic liquors that keep ice at bay. However, we often tend to forget that the air furnished to the transmitters as well as the air taken away have their own highly significant requirements.

Transmitter specifications clearly state the expected range of temperatures for operation. Actually, most transmitters will stand operating conditions that are unacceptable to operators. However, it really isn't wise to make your entire transmitting facility live under those conditions. A long and trouble-free life is more likely if the equipment is pampered just a little bit by keeping the temperatures in check. Far beyond the idea of pampering is the need to furnish clean air — whatever the temperature may be.

The importance of clean air

Solid state devices need appropriate cooling. For the electronic components themselves, the temperature may well be less significant than the cleanliness of the air supply. Dust, as has often been discussed in this column, is an avowed enemy of modern electronics. A layer of dust on circuit boards acts as insulation and prevents the desired cooling process from taking place. Without proper cooling, the heat buildup inside components is greater than their design will tolerate. The result is premature failures and increased maintenance. The solution is simply to filter the air supply to the building and to provide blowers on the input air supply. This permits adequate cooling air to be provided while maintaining positive air pressure in the building.

The concept of positive air pressure in the building is simple but extremely important. If the blowers are only used to exhaust air from the building, a slight vacuum will exist within the building itself. That means air will be drawn not only through any filtered input but also from any crack or opening in the building. This unfiltered air is a source of dust that will ultimately reach the equipment. It's no different than maintaining a slight pressure on transmission lines. That pressure ensures dry air, or nitrogen, will leak out of the line rather than moisture-laden air leaking in. For buildings, let clean air leak out, not dirty air leak in.

Air conditioning is not an absolute must. Transmitting equipment will operate very well at typical outside temperatures. The problem is when a room is shut up and adequate air is not moved to prevent heat buildup. Without adequate air circulation, the temperature in a transmitter room can reach levels that will be harmful to the equipment. The best method of avoiding this is to contact an experienced HVAC (heating, ventilating and air conditioning) contractor to design your system and its controls. The system should be designed to adjust for varying outside conditions to control the interior temperature and provide adequate airflow.

In cold conditions, the amount of air drawn into the building can be minimized through the use of motorized vents. Transmitter exhaust air can be used for building heat. If that is not sufficient to keep the building warm, the necessary additional heat can be provided through either space or duct heaters. As the temperature increases, more outside air can be added to the mix to maintain the indoor temperature at a reasonable level. Finally, when the outdoor temperature gets even higher, the airflow is increased from the outside, through filters, with no recirculation of the of the transmitter exhaust. Again, the blowers on the air supply should try to provide slightly more air than the exhaust system will eliminate to maintain positive building air pressure.

Consider an auxiliary-heating source such as propane in cold climates where liquid cooling is used. Transmitters typically can keep a building warm if they

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Technology profile of DTV adoption segments

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Median household income	**$58,000**	**$49,000**	**$23,000**
College-educated	71%	62%	29%
Cable TV subscribers	71%	68%	53%
Satellite TV subscribers	27%	14%	11%
Own PC	**100%**	**46%**	**0%**
Online	**100%**	**33%**	**0%**
Know what DTV is	**85%**	**77%**	**59%**
Buy DTV within 3 years at current price	**15%**	**5%**	**35%**
Would not buy a DTV	11%	20%	35%

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loss of electricity can cause the building temperatures to drop quickly in cold weather. Systems that use distilled water for cooling can easily freeze under these conditions. Having a backup heat source that does not require electricity can prevent distilled water from freezing in the condenser coils or, even worse, in a klystron/magnet assembly. Again, have an experienced HVAC contractor design an adequate system and the necessary controls.

Unprotected louvers such as these are at risk of freezing shut in icy conditions. Installing a protective shroud can ensure they will work properly regardless of the weather.

AC is an option

The ideal situation is to cool the transmitter facility entirely with an air conditioning system. This maintains the interior temperature at comfortable working levels that are preferred for both the equipment and the technicians who must work there. The air conditioning system can add some outside air to the mix to provide the desired positive building air pressure. That incoming air must be filtered either by passive means or by an electrostatic filter system, which should be designed by a competent HVAC contractor. The filter system will keep the building and the equipment clean and maintain the optimum environment for the operation of both the equipment and the operators. As with a naturally cooled system, the transmitter exhaust air can be used for heating in winter with additional heat added as needed. Traditionally, that additional heat will be via duct heaters but simple space heaters can be used. Depending upon the part of the country, some additional humidity may need to be added by the system. While parts of the country have a problem of too much humidity in the summer, a little moisture in the air is desirable for comfortable working conditions. The problem is that adding humidity requires a source of water that is probably not be available at many sites.

Now, let's look at some more of the basics. First, the exhaust system should be well away from the input air supply, avoiding the situation of the hot air being recirculated back into the building. If no air conditioning is used, the input air should be as cool as possible. Next, put covers over the input and output louvers. These are not just to deflect the air but also to prevent the build up of ice on the louvers. The problem is that the louvers will close during cold weather. All of that nice aluminum is great for the accumulation of ice during sleet or freezing rain conditions. A slight warming of temperature causes the building system to request more air. Of course, this happens before the ice has melted from the louvers. All of those little actuators end up working harder than a freshman trying to look into dorm windows. The result is obvious: Pieces break, the louvers don't open, temperatures go up and the system tries harder to adjust.

It is a good idea to install thermometers at several places in the system. For example, place one in the hood above the transmitter where the exhaust air is routed away from the equipment. This will help identify when the air handling system inside the transmitters themselves is developing a problem. One client used a meat thermometer inserted through the side of the exhaust duct. That led one day to a phone call that the transmitter had gone from rare beef to pork, which was a little difficult to understand without further explanation. The problem in that case was simply a slipping belt on the blowers, which caused the interior temperatures in the transmitter to increase.

In summary, modern equipment will tolerate a reasonable amount of heat. It is best if air conditioning can be installed in the transmitter facility but not absolutely essential. What is essential is that the equipment be given a chance to breathe. A positive pressure source of filtered air is also an absolute necessity. Add to that the little item of routine maintenance to change filters, lubricate actuators and confirm proper operation of the system. This really is one of those pay now or pay more later deals. If you don't give the equipment clean air to breathe, it will soon die, and you will face the associated costs, off-air time and loud voices from the front office. ■

Don Markley is president of Markley and Associates, Peoria, IL

SEND Send questions and comments to: don_markley@intertec.com

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Camera goodies

BY BENNETT LILES

Specialized craftsmen are gone. The general trend in ENG/EFP is toward do-everything equipment and one-man-band videographers. Single gadgets that do more than one thing and solo shooters who can light, mix sound, hook up power and make good pictures are in strong demand today. Knowing how to use the latest Swiss-Army-knife gizmos and having a solid background in the basics is the ticket.

One multipurpose item is the beanbag or sandbag. Some models of beanbags have straps so that they can be folded and held in the shape of a small saddle. Single beanbags can serve as a soft mount for 35mm or small video cameras while several can be piled up or strapped together for ENG uses. When not needed for the camera, they can serve as sandbags for light stands and the zippered openings allow them to be stuffed with several types of filler for different consistencies. Straps allow a little creativity in combining and configuring them for various uses.

Carrying bags come in an amazing variety of types and sizes. Selection here is largely a matter of personal preference. Get the right one and it will be your buddy for years. Hip packs come in several sizes from those to hold gloves and batteries to larger models. Many have extra compartments on the top and front, have curved shapes to fit comfortably against the body and may even include a water bottle on the side. Some bags designed to carry cameras feature a crush-proof protector that

ENG and EFP applications require lightweight, reliable equipment that can meet more than one demand. Newer models of bags, camera cases, lights and battery rechargers are designed to be easy to use and practical.

Dock Clip

The Telemetrics' TM9255B is the only coax camera control system that you can configure three different ways. You can direct dock it, clip it or carry it on your hip. So you can order the TM9255B to meet your specific requirements and applications.

In fact, the TM9255B is the only coax system that offers direct docking capability. Which means there's no additional camera adapters or connections to fa Simply dock the unit directly to your camera an plug in your standard coax cable. Its seamless inte gration that's only available from Telemetrics.

For use with today's new generation of high perfo mance single-piece camcorders, Telemetrics TM9255B coax system connects to the camcorder'

helps cushion the viewfinder and lenses. Some of the newer camera bags also have sections that can be folded inside out to serve as white balance cards.

Well-built traveling cases ensure that your fragile equipment makes it to locations unscathed. Some are built of structural resin that expands and contracts with temperature and sport a neoprene O-ring seal. Other features include release valves that serve to equalize pressure buildup during high-altitude treks by land or air. Some models are designed to take a serious dive as well, and some manufacturers claim their models are watertight to 30 feet.

Once the gear has safely arrived on the scene of the shoot, lighting becomes the paramount concern. Since lighting conditions and effects span the wildest imagination, this is a broad area on its own, but the basic and most frequent task in ENG/EFP is making good pictures of one or two subjects in fairly close proximity to the camera.

Many interior light locations will be within one F-stop of 40 foot candles so a camera-mounted fill light will need to produce about 40fc at one to two meters (five feet) with a beam that can fill all the usual lens angles. Several manufacturers are now offering minilights capable of providing adequate interior lighting without affecting color temperature. New camera lights are able to operate at low power for hours while weighing only a few ounces. Some models can be built into a camera and controlled by the record button.

These new, do-it-all tools for field video are making shooters' rigs lighter, more reliable and easier to use.

When a camera has to be connected to an ENG truck for a live shot or multicamera shoot, communication problems come into play. Intercom systems linking cameramen or cameramen and ENG trucks are important, even when it's just a situation with two self-contained camcorders. Videographers must be able to communicate to avoid duplicating each other's shots or changing shots on both cameras at the same time.

All these wonderful tools would be nothing but scrap metal without a reliable source of power. Imagine you're firing up your gear in a now-or-never situation, only to find that your wireless receiver is showing low batt or your IFB system is conking out. On-site battery rechargers allow users to trade fresh batteries and recharge spent batteries for extended shoots. Some operators also piggyback multiple battery packs on the camera, allowing them to quickly swap low batteries for fresh packs and keep the camera on the scene. Given the variety of battery-powered equipment in use at a shoot, no one method will offer the ideal solution in every situation.

These new, do-it-all tools for field video are making shooters' rigs lighter, more reliable and easier to use. ■

Bennett Liles is an audio engineer at Georgia Public Broadcasting, Atlanta.

or Carry

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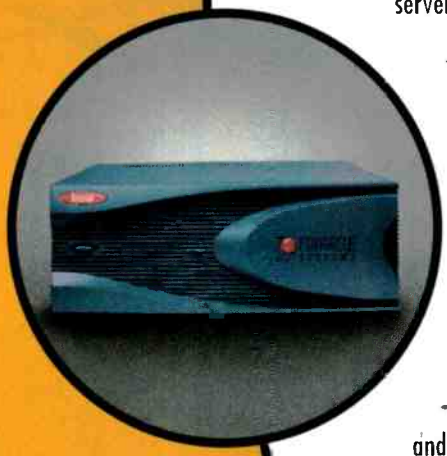

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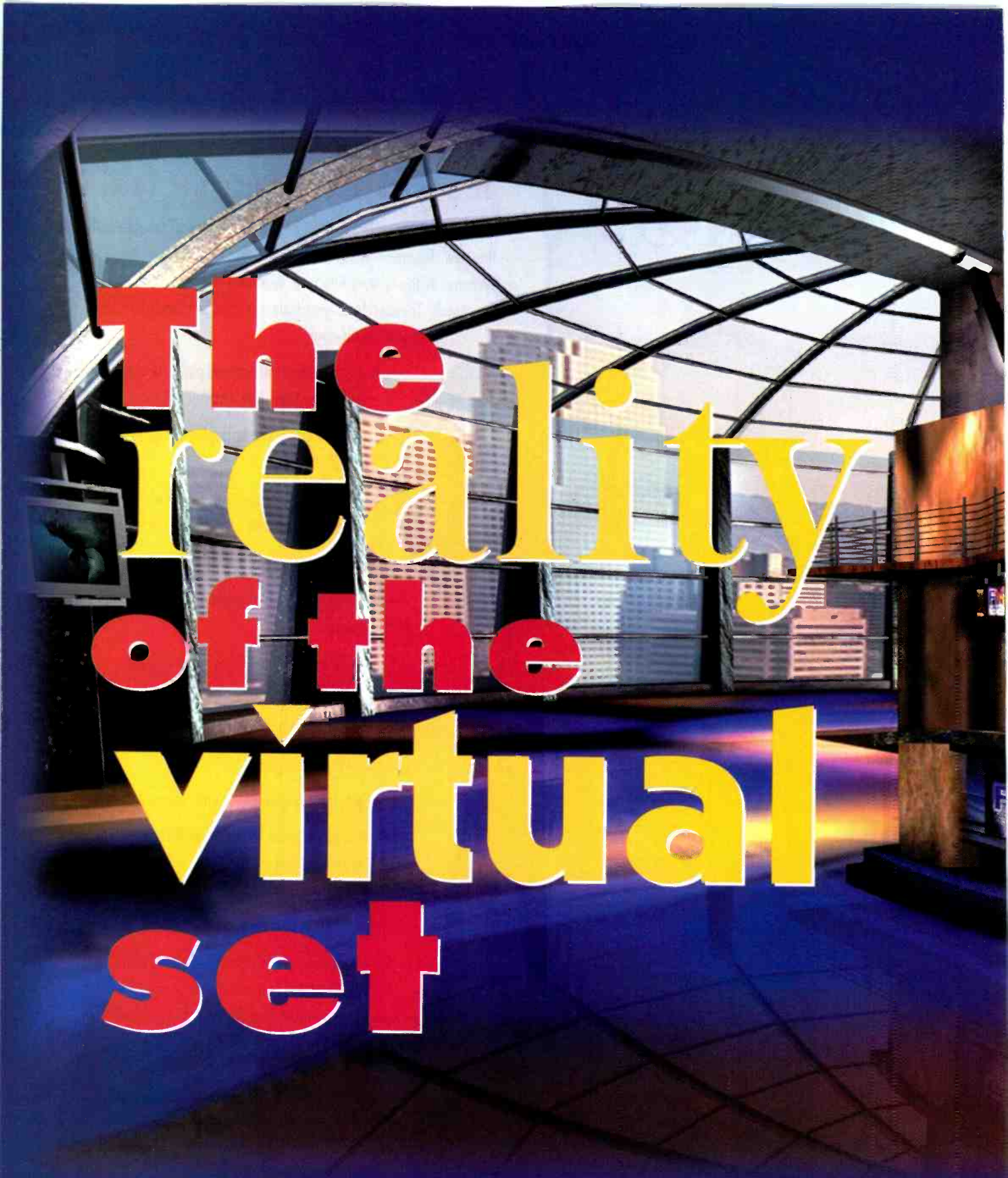
The reality of the virtual set



Florida's News Channel (FNC) uses this set for its daily virtual newscasts, which are distributed statewide. FNC uses Orad's Cyberset 3.0, DDG's SoftSet 1.0, SGI's ONYX2 IR and O2 computers. Photo courtesy Devlin Design Group.

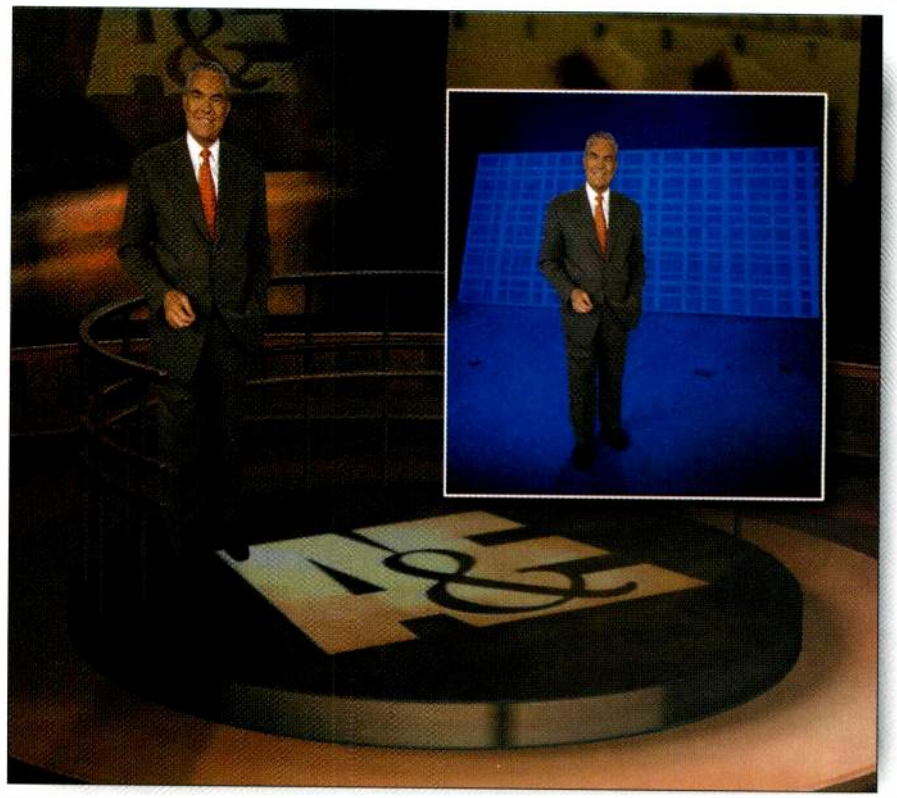
By Matt Straeb

Virtual set technology has developed very fast. Virtual sets have moved from being an expensive esoteric technology suitable and affordable for only very high end applications into the mainstream of broadcast — now affordable for most applications. For those who have not taken a look at virtual sets recently, it's probably a good time for an update. Virtual sets are being used in the studios of major networks as well as at local stations and even small production houses. Applications range from local news production and talk shows to music videos and sporting events. Prices continue to come down, and quality continues to go up — dramatically. Those of us trained in the TV

virtual set

industry can usually tell when a virtual set is being used, but often the average consumer doesn't notice until it is pointed out to them.

Given the great inroads that virtual set technology has made in just the past 18 months, there is still a sense that it is new. I often find that broadcasters are not even sure what questions to ask when first looking at virtual sets. If you are considering the purchase of a virtual set, what do you look for? For example, how do you evaluate the "real cost" of the set when you take into account space savings and construction costs of a real studio? Can you use your existing hardware — cameras, lenses, chroma keyer, lighting, etc. — or will you have to build a complete studio from the ground up? Finally, should you even consider the purchase of a virtual set today given that everything may go to HD in a short time? Not all of these questions have straightforward answers, but by examining some of the issues, you should be able to determine whether or not a virtual set is right for your operation and then be in a position to evaluate the various solutions that are available.



One of Orad's most visible uses of its Cyberset technology is through Post Effects in Chicago. Note the pattern recognition grid, which allows the set to be accurately tracked in a 3D space. Photo courtesy Post Effects.

Definitions

Let's start by defining what we mean by a virtual set. In basic terms, a virtual set or virtual studio system is a tool which allows you to place live actors in graphically generated 3D environments for live productions. In a typical virtual studio production, the talent will perform in front of a bluescreen background. The background that will appear in the final output is a graphic 3D image that resides in the computer. The foreground and background images are digitally composited using a chroma keyer. The concept is much the same as the familiar bluescreen and keying technology used for television weather reports. The difference with virtual set technology is that the image keyed onto the bluescreen is a 3D graphical set that those on camera interact with. More importantly, with virtual sets you have the ability to move the camera freely, and synchronizing the camera with the 3D graphical set convinces the eye the set is more realistic. It provides a believable and visually interesting show for the viewer.

The computer graphics are produced with modeling software packages and then imported into the virtual studio software. To build a realistic set or at least one that is believable, the software needs controls for proper texturing, lighting and model parameters.

> I often find that broadcasters are not even sure what questions to ask when first looking at virtual sets.

During production, actors move about the virtual set, the camera operators follow the action, and the set is synchronized with a true perspective. Both foreground and background objects may be moved and manipulated in real time; therefore, an actor can not only go in front of or behind virtual objects but also walk or move inside them.

How it works

A virtual studio system consists of four basic components: a camera tracking system that electronically or mechanically extracts and calculates the camera position parameters; a computer workstation; an off-the-shelf 3D modeling software package for rendering a 3D virtual set; and a chroma keyer that combines the foreground and background for the seamless picture.

Integrating real-time TV images with a 3D, computer-generated environment is achieved through software that functions as a virtual camera — it maps the images of the virtual scene (including virtual characters) onto the real camera images.

For seamless blending of the virtual scene with the real actors without jittering or jumping, the virtual camera has to be given a complete set of accurate position data from the real cameras and the actors. The virtual set software analyzes the coordinate spaces of the real world and the virtual world and then matches them to each other exactly. To do this, the computer graphics system

obviously has to have information about the real world coordinates — x, y, z, and pan, tilt and roll axes as well as distance units. This information gives the position, orientation and scale data needed to place real world objects properly in the virtual environment. Today, there are three different techniques employed to obtain the necessary position data: opto-mechanical, pattern recognition and infrared detection. Virtual set systems may use one technique exclusively or use various techniques in combination.

The first technique utilizing opto-mechanical sensors is a technology that has been around for a number of years. Mechanical sensors are mounted and tightly coupled onto a pan/tilt head to measure the pan and tilt motion as the camera is handled. The lens is coupled with mechanical gears that measure the zoom position. This information is usually combined and sent to the rendering computer to position the 3D model. The advantages of this system are accuracy and cost-effectiveness in single camera systems. However, costs go up with each additional camera simply because of the high cost of the sensor-configured pan/tilt heads. Other disadvantages are the inability to move the camera for x, y and z, and that the system calibration requires the pan/tilt head to be measured very accurately.

In the pattern recognition method, a vinyl carpet is painted in two Ultimatte colors (blue and super-blue) in a line formation, the "grid," on which every point is unique and identifiable by the computer as the image is received from the camera. The concept is not dissimilar from the way in which bar codes work. The vinyl carpet can be any size and is hung flat on a wall. The foreground video is fed to a fast, parallel-processing computer that recognizes the grid. By analyzing the grid angles and applying predetermined mathematical algorithms the computer can calculate the x, y, z, pan, tilt, zoom and roll camera location. About 10 percent of the grid needs to be in the frame of the camera shot for the computer to have enough information to calculate camera position. The advantage of this method is that cameras can be moved freely — and this is true for handhelds, Steadicams and dollies. It supports multiple cameras and no calibration is required on an ongoing basis. The disadvantage is that the grid must be in the frame of the shot, which limits the shooting angle to about 180°.

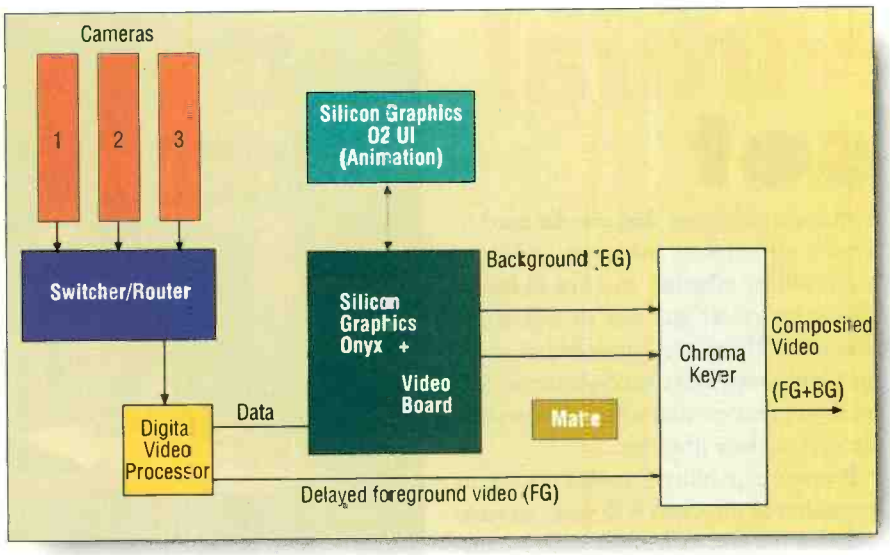


Figure 1. A simple virtual set consist of a video input, a 3D engine and a keyer to combine the various images.

For the infrared detection method, IR beacons and directional receivers are used for automatic location of moving objects in the studio — such as the cameras and actors. IR detection modules are used for automatic depth keying and other functions that require precise locations.

Beyond the basics

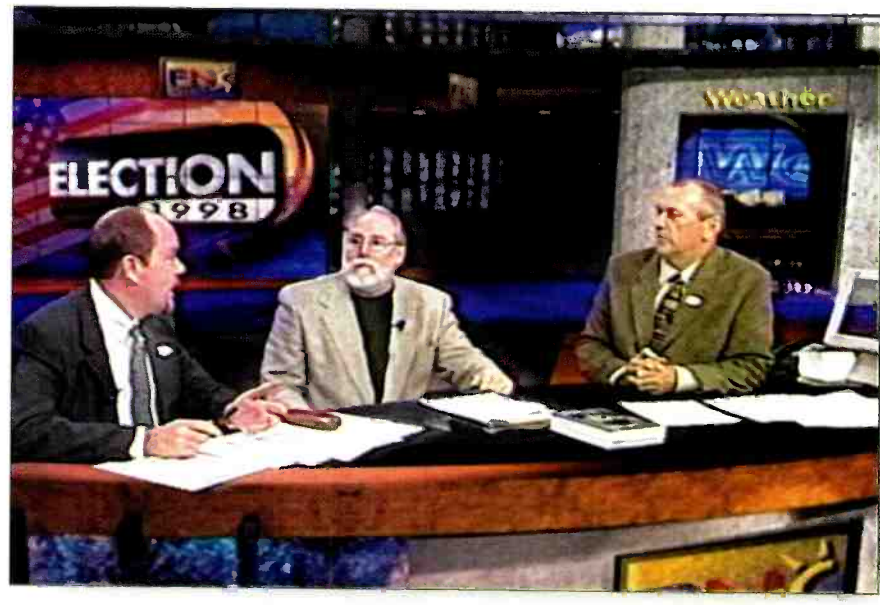
There are a number of items to note and consider when looking at virtual sets. For instance, major consideration will have to be given to the design of the virtual set. There is an array of 3D

Startup Digital News Network (DNN) will employ DDG's SoftSet 1.0, and SGI's ONYX2 IR2 for the set of its entertainment show. As of yet a virtual operating system has not been selected. Photo courtesy Devlin Design Group.

virtual set

software programs that can be used to create virtual sets, but your real decision will be whether to have in-house designers create the sets or outsource the task. There are a number of independent companies specializing in virtual set creation that offer off-the-shelf sets from their libraries.

Preview capability is another factor to consider, as directors will want to view camera outputs before switching cameras. Shadow capabilities are now more widely available, so that real shadows from live talent can be seen or shadows can be created in the virtual set software. Lip sync must also be accounted for — some systems have a delay of one or more frames, which will vary depending on which tracking system is used.



Florida's News Channel (FNC) runs DDG's SoftSet 1.0, ORAD's Cyberset 3.0, and two (2) SGI ONYX2 IR's on this flexible special coverage set used, in this case, for election coverage. Photo courtesy Devlin Design Group.

Benefits

There are a great number of benefits to be obtained from the use of virtual sets. Below is an outline of the major issues.

· **Virtual sets save space.** A virtual studio setup requires approximately 10'x10' of stage for the bluescreen environment. This is a substantially smaller space than is generally associated with physical sets, and yet the end result can appear as a much larger space. An excellent example of this technique was the set used by ABC News for coverage of the last presidential elections. ABC was looking for an expansive high-tech look with banks of computers and television screens visible to suggest the constant polling of data. There was not adequate studio space available and procuring additional space could not be justified for just the one special production. The solution was a virtual studio against an 8'x10' bluescreen. A very small space indeed, but the graphically rendered virtual studio was 80-feet long, rose to two stories and was complete with virtually created banks of computers and television screens in the background.

One of the great advantages of virtual sets is that you can produce several programs in the same space, and that means you will no longer need to tie up a studio with one ongoing project. When a project is completed for the day, simply load in the software for the next set and you can be ready to go in as little as 30 seconds.

Not only can a single virtual set be used to produce several programs, but you can also produce slightly different outputs for the same program. For instance, if you had programming that required different branding for different markets, two independently branded outputs could be generated.

• **Virtual sets save money.** Through the use of virtual sets, savings can be achieved by eliminating the costs associated with the design, construction, storage and maintenance of sets. Other space-related costs such as lighting, air conditioning and so on are also dramatically reduced. ABC News indicated during a press conference last year

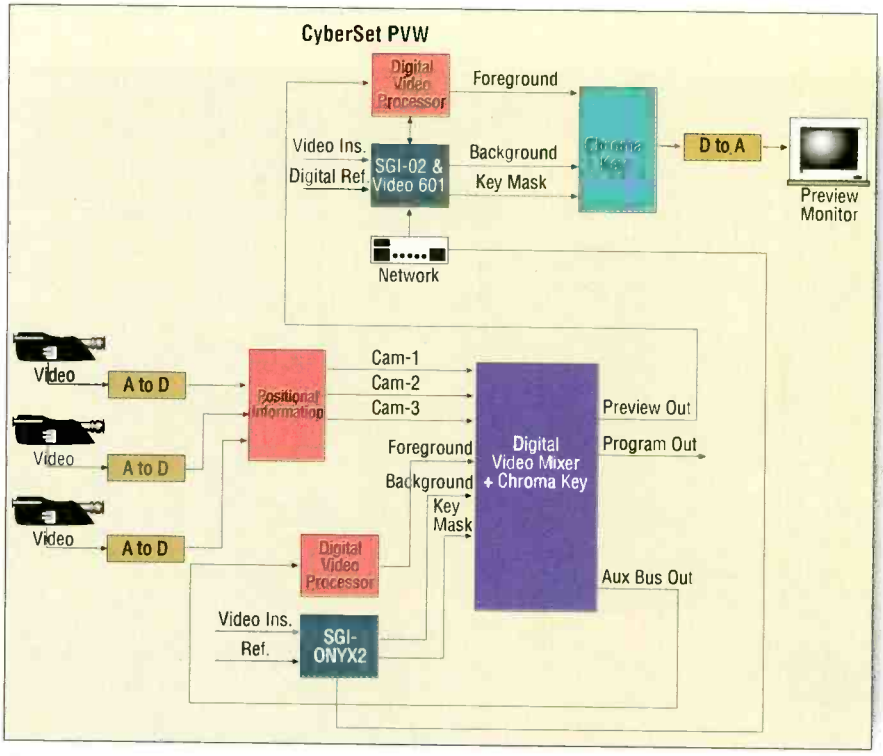


Figure 2. Virtual set technology varies, but typically requires postitional information, a high-performance computer to build the 3D virtual set, and a video mixer to properly combine the real and virtual images. In this case, positional information is derived through the lens, and a second system is used to provide a preview image.

that the programming costs associated with a recent virtual studio production came to about $50,000 compared to a conventional set which would have cost $350,000.

• **Virtual sets are more flexible.** Virtual sets can be built more quickly than traditional sets, and the entire process is more flexible. During the design phase of a project, virtual studio technology allows you to change set designs as the program or commercial format and theme materializes. During the design process you can request many design reviews and actually put your talent into the evolving set to assess the look of various textures, sizes and colors. Later, changes to existing sets can easily be accomplished to accommodate new trends, formats or even special offers without incurring substantial costs.

• **Virtual Sets Expand Creative Options.** Virtual studio environments can place talent anywhere. They have been used to reconstruct buildings that are no longer standing, provide lifelike animation to graphically rendered characters, and simulate an enormous computer-filled technology center with video walls. Virtual studio technology is also being utilized to address specific programming issues. On-location projects can benefit from the simple design and space requirements of the virtual set. Remote interviews can also be conducted by integrating subjects from two separate locations seamlessly in one virtual set.

Weighing the cost and making a selection

You may be surprised to learn that entry-level systems are now available as low as $100,000. When you consider this along with some of the other savings discussed above, virtual sets can no longer be dismissed on a cost argument.

You may be surprised to learn that entry-level systems are now available as low as $100K.

The first step in evaluating a virtual studio is to assess your specific requirements. You will want to determine the number and range of productions that might be affected. This is important because some virtual studio architectures are better equipped to support multiple productions from one bluescreen area. If you are planning only one virtual studio production, then positioning of the cameras can be fixed. However, if you are going to support several productions from a single virtual studio, you will have to take camera recalibrations into account.

When evaluating virtual studios, be aware of your existing facility and what equipment can be utilized in a potential virtual studio set up. Some virtual sets will require specific approved equipment. This is not necessarily a disadvantage if you are building a studio from scratch, but you should perform a cost analysis. General requirements for all virtual studios include a chroma keyer, bluescreen area, computer (SGI or Windows NT) and lighting. Check with the virtual set vendors as to what existing equipment can be used with their system. Finally, given the developments in our industry related to DTV and the fast pace at which we are moving toward HD production, any virtual set you invest in today should have an existing upgrade path to HD.

One of the news sets that ONtv, Ontario, Canada, uses to deliver its all virtual news. ONtv is running ORAD's Cyberset 3.0 and Devlin Design Group's (DDG) SoftSet 1.0 on an SGI ONYX 2 IR. Photo courtesy Devlin Design Group.

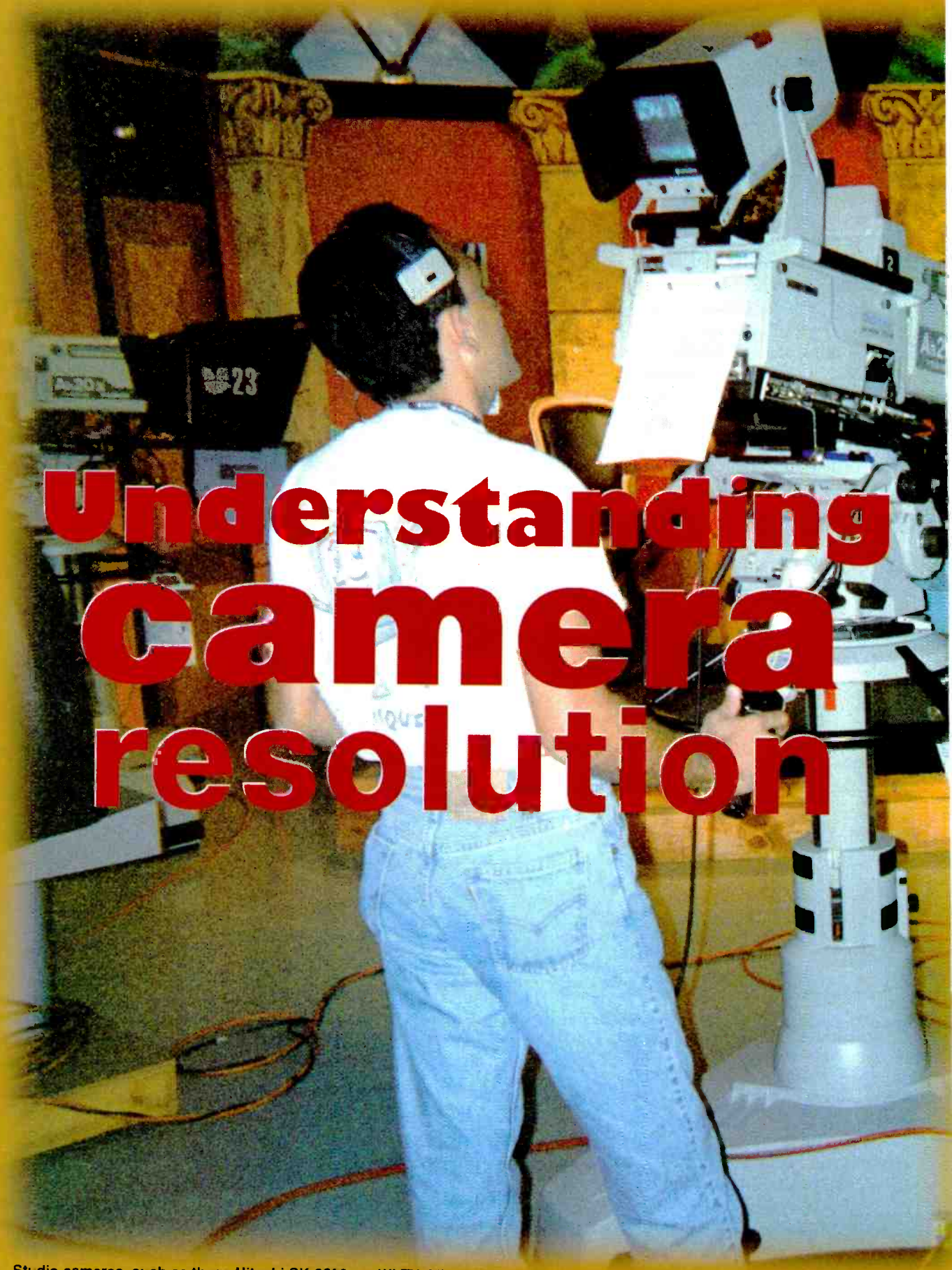
Enhancing reality

Techniques and computer processing power have improved to the point where virtual sets are no longer criticized for their lack of realism. Today, virtual set techniques allow for closer interaction of the actors with the virtual set. Actors can walk in front of or behind virtual objects, or even inside them. On one news channel, the anchor walks to the center of the set, a virtual railing rises from the floor to surround her, and she is transported to the upper level of the virtual set.

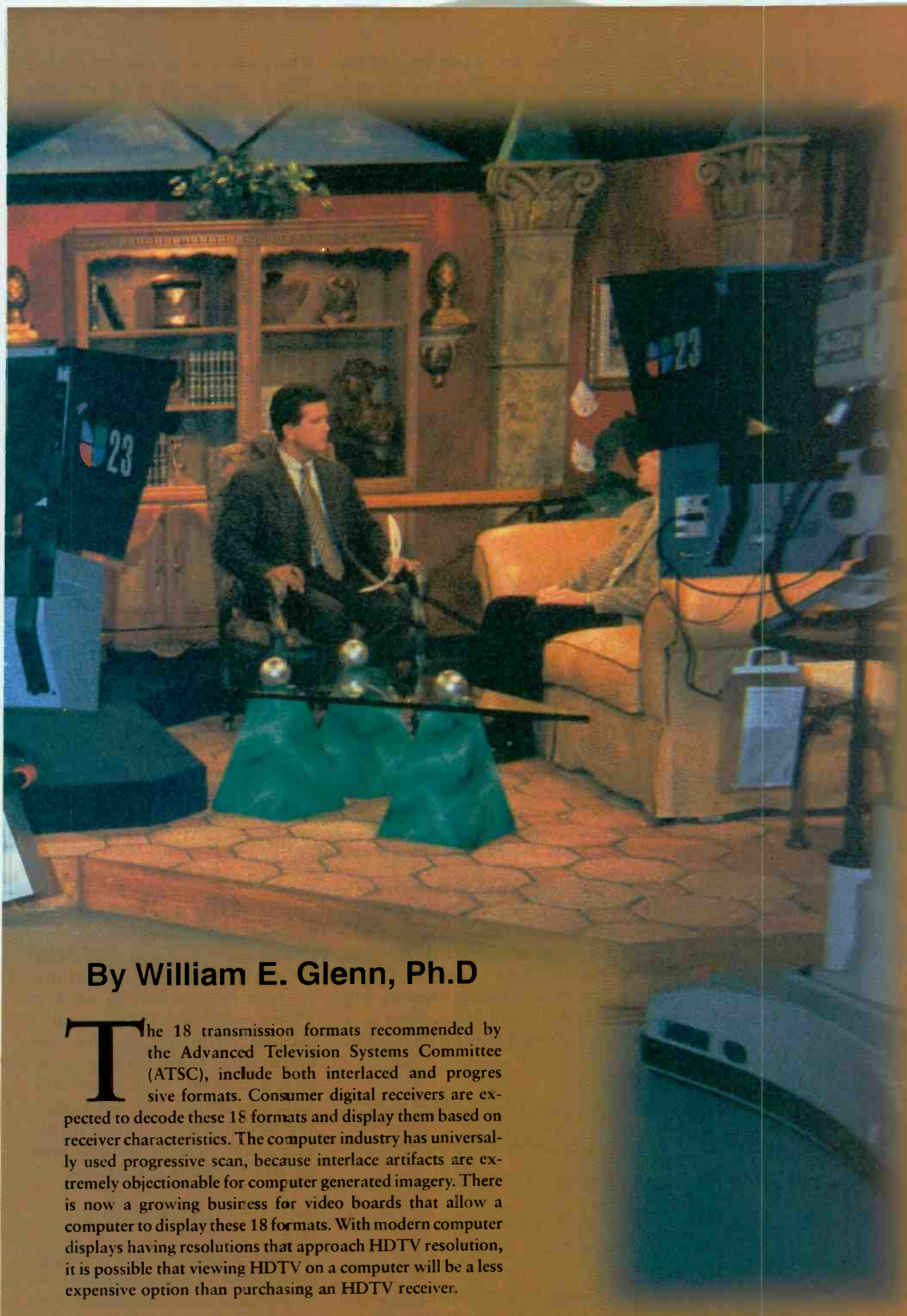
The technology has advanced so much that users no longer simply attempt to create sets that are valid imitations of real life. Their aspirations are greater now. In fact, many virtual set users have it as their goal to create totally unique visual experiences — experiences that are better than "real." ■

Matt Straeb is president of Orad Inc.

Understanding camera resolution



Studio cameras, such as these Hitachi SK-2600s at WLTV, Miami, have always been a mainstay for locally produced programming. Photo courtesy Hitachi.

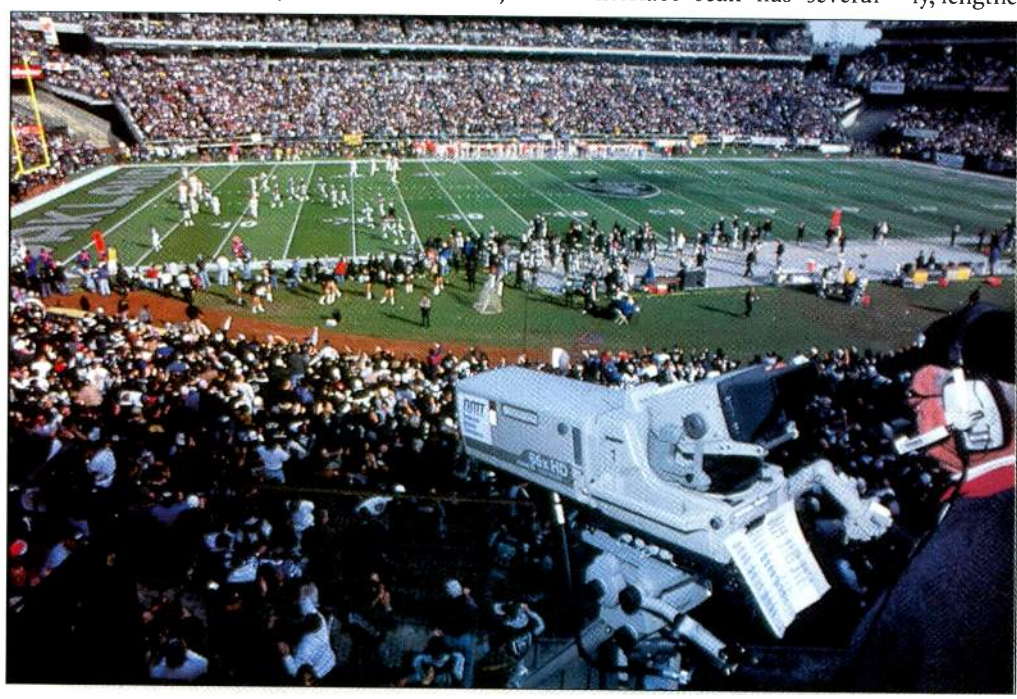


By William E. Glenn, Ph.D

The 18 transmission formats recommended by the Advanced Television Systems Committee (ATSC), include both interlaced and progres sive formats. Consumer digital receivers are expected to decode these 18 formats and display them based on receiver characteristics. The computer industry has universally used progressive scan, because interlace artifacts are extremely objectionable for computer generated imagery. There is now a growing business for video boards that allow a computer to display these 18 formats. With modern computer displays having resolutions that approach HDTV resolution, it is possible that viewing HDTV on a computer will be a less expensive option than purchasing an HDTV receiver.

camera resolution

There has been considerable controversy over the pros and cons of interlace vs. progressive scanning, with little quantitative evaluation of the perceived resolution of images displayed in the two formats. We have made a detailed study of the performance limits of these two formats. One result, has been the design of a method of converting interlaced transmissions to progressive display without carrying the interlace artifacts to the progressive display.



It is expected that many early HDTV broadcasts will be sports oriented. Here, Sony's HDC-700 high-definition cameras are capturing football in 1920x1080. Photo courtesy Sony Broadcast.

Interlace scanning

Interlace was a solution to a transmission bandwidth problem. Using 30frames per second (f/s) progressive scan for a CRT display causes objectionable flicker at normal viewing brightness. The alternating field lines flicker at 30Hz, however, this cannot be seen because the human visual system's response to detail is much slower than it is to low resolution information. Interlace increases the large area flicker frequency to 60Hz while still taking 1/30 second to reproduce vertical detail. Low resolution information is reproduced at 60f/s by the field line display. This gives good motion rendition, as motion perception is a low resolution phenomenon. 60f/s gives motion rendition free of judder. Interlace scan has several obvious artifacts under normal viewing conditions, they are: interline flicker, line crawl, and loss in vertical resolution compared with the Nyquist limit.

Interline flicker is caused by alias frequencies (a difference frequency beat) between the field line sampling structure and the vertical detail in the image. For example, in a 480-line scan, a 480-line image will have all lines white in one field and all lines black in the next. This produces large area 30Hz flicker. This is quite visible at normal screen brightness until the alias spatial frequency gets high enough. Depending on viewing distance, this is between 200 and 350 lines. At normal screen brightness, 30Hz large area flicker is easily visible. This flicker would not be visible if the complete frame was displayed for 1/30 second. However, if the display time of the frame is increased to 1/30 second to avoid interline flicker, there is objectionable motion blur. Consequently, lengthening the display time constant is not a good solution to the problem.

When an object in the scene moves vertically at the line crawl velocity, (one line every 1/60 second) the eye tracks this pattern. The moving image is then scanned as if it were a progressive scan at the field line spacing (twice the frame line spacing). Consequently, interline flicker is not visible under this condition. However, the resolution is reduced because the image is scanned with half the number of lines.

In a typical display, the spot size is equal to the frame line spacing. Consequently, the frame lines for a static image are not visible. When an object moves vertically at near the line crawl speed, the field line structure becomes easily visible because the line spacing is twice the spot size. If a person is asked how far apart the scan lines are on their TV, they will show a distance equal to the field line spacing since the field line structure is highly visible under these conditions. With progressive scan, this artifact does not appear. The line structure of a properly designed display is always invisible, even for vertical motion in the image.

> With modern computer displays having resolutions that approach HDTV resolution, it is possible that viewing HDTV on a computer will be a less expensive option than purchasing an HDTV receiver.

Interlace loss of vertical resolution

Several factors cause loss of vertical resolution in an interlaced display. In the interlaced camera, the image is typically scanned out two lines at a time for one field, shifted down one line, and

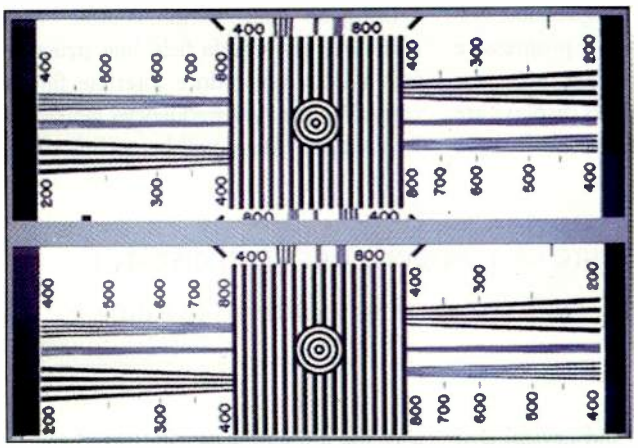


Figure 1. Sampled image with a pre-filter of 1.3 times the Nyquist limit (top) compared with an unsampled image filtered to a resolution of 1.3 times the Nyquist limit (bottom).

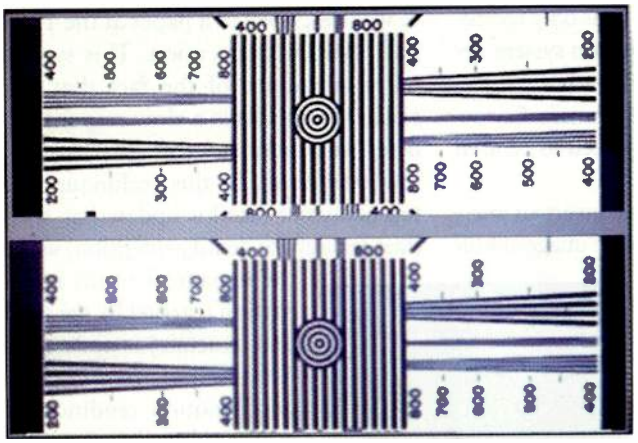


Figure 2. Sampled image with a pre-filter of 1.3 times the Nyquist limit (top) compared with an unsampled image filtered to a resolution of the Nyquist limit (bottom).

then scanned two lines at a time for the next field. This discharges the entire sensor every 1/60 second, and there is very low motion blur. This loss in vertical resolution minimizes interline flicker for vertical detail and reduces the vertical resolution.

When vertical detail is near the field line spacing, the low spatial frequency beat frequency flickers at 30Hz. A low spatial frequency flicker masks perception of detail in our visual systems. Consequently, part of the perceived resolution loss for interlaced scans is due to the masking effect of interline flicker on detail.

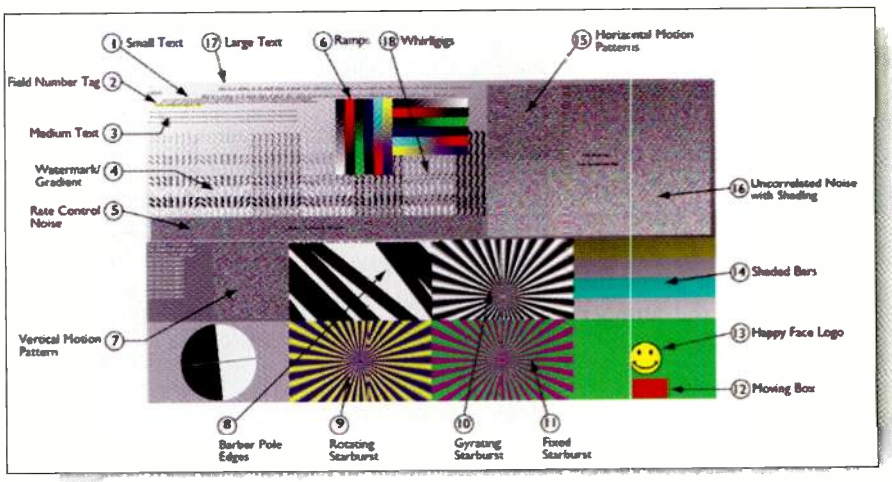
For an image moving vertically at the line crawl speed, there is no interline flicker. However, there are two other causes of loss in perceived resolution. First, the image is sampled with twice the line spacing under this condition reducing its resolution. Second, there is a highly visible field line structure. This field line pattern also masks perception of detail in our visual systems within an octave of the field line structure. Consequently, the perceived resolution is further reduced.

Perceived vertical resolution with progressive scan

Progressive scan does not have interline flicker, a visible line structure, or line crawl. Therefore, the vertical resolution is limited only by the frame sampling structure. Actually, the perceived resolution of an image can be slightly higher than the Nyquist limit. People have often commented that a little aliasing is a good thing. Visual perception measurements show the reason. Our visual systems analyze images in octave wide bands. All spatial frequencies within an octave appear to be the same. Microelectrodes on a neuron in the ocular dominance columns of a monkey's brain will be stimulated by all spatial frequencies within an octave and within ±22 degrees orientation. In other words, all spatial frequencies in this region stimulate the same neuron and appear to be the same. This explains the octave-wide masking effect mentioned above for interlaced scan. It also explains how an image can have a perceived sharpness slightly above the Nyquist limit under some conditions.

If an image has spatial frequencies slightly above the Nyquist limit, the alias frequency will be slightly below the Nyquist limit. This is not to be confused with the lower spatial frequency alias causing interline flicker in an interlaced scan. If this alias is within an octave of the correct spatial frequency, it will stimulate the same neuron within the ocular dominance column. Consequently, it appears to be the correct spatial frequency. It is important to use an optical pre-filter that has very low response above 1.3 times the Nyquist limit to prevent alias frequencies from appearing at less than .7 times the Nyquist limit as these are outside this octave range.

To test this phenomenon, we scanned some images with a very fine pixel structure. We then digitally pre-filtered the images with a cut-off of 1.3 times the Nyquist limit of a coarse sampling pattern. Next, we post-filtered the images with a cut-off at the Nyquist limit and displayed them. The same original, oversampled images were filtered with different two-dimensional cut-off frequencies. In a two-alternative forced-choice comparison, the sampled and filtered images were compared. The subject was asked, "Which image looks sharper?" When the choices were 50:50, we compared the resolution of the unsampled images to the sampled images. The spot-size of the unsampled image was 0.7 that of the sample spacing of the sampled image; (the sampled images had a perceived sharpness higher



As we move toward HD, new test patterns are needed. This is one frame of a 32-frame loop developed by the Sarnoff Corporation to stress and evaluate DTV encoder performance.

than the Nyquist limit). In other words, it took twice as many pixels in the reference image to produce the same sharpness as the properly filtered sampled image. From these comparisons, one would conclude that a progressive image can have a resolution higher than the Nyquist limit. With a sharp cut-off pre-filter, a progressive image can have a perceived resolution as much as 1.3 times the Nyquist limit. That is almost a factor of 2 in perceived vertical resolution compared to an interlaced display. Figure 1 shows a sampled image with a pre-filter of 1.3 times the Nyquist limit compared with an unsampled image filtered to a resolution of 1.3 times the Nyquist limit. Figure 2 shows the sampled image compared with an image filtered to the Nyquist limit. The filtered image is actually higher resolution than in an interlaced scan.

Notice that in the 480 line sampled image, lines are visible in the test chart up to about 700 lines. Above 480 lines, these are alias frequencies. Notice that at 700 lines, there are only two cycles in the width of the wedge not the four that were in the original pattern. However, the readability of the numbers on the chart is at least as good as in the 600-line filtered image. The readability is much better than the image filtered at the Nyquist limit. Notice that the numbers in the test chart have no scanning artifacts (zig-zag edges, etc.). If a scene had a very fine picket fence with a resolution above the Nyquist limit, it would have the wrong number of pickets. However, at just below the Nyquist limit, the number would be correct.

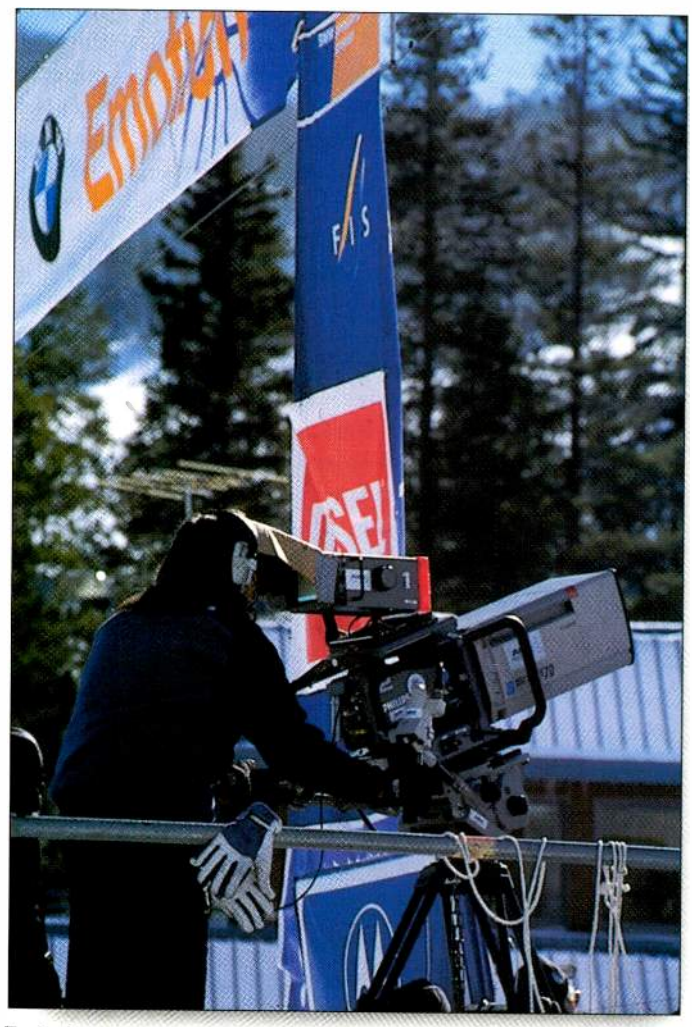
System improvements

The simplest way to achieve the benefits of progressive scan is obviously to use a progressive camera, a compression system designed for this and a progressive display. Progressive displays are now readily available. Computer displays are always progressive and the newer types of displays (plasma, liquid crystal displays, light valve projectors, etc.) all have to be addressed with progressive scan. In the 1920x1080 format, a progressive camera at 60f/s was only recently developed. A compression system designed for this format does not exist in the 18 ATSC broadcast formats. Consequently, other strategies need to be used in the short term.

One strategy is to scan convert an interlaced image to a progressive image at 60f/s using an interpolation routine. This eliminates the visible field line structure but it does not reduce interline flicker caused by the alias frequencies generated by interlace. There will be no line structure for motion at the line crawl speed, making the resolution under these conditions appear to be somewhat better.

> The line structure of a properly designed display is always invisible, even for vertical motion in the image.

A second method, as shown in Figure 3, was described in a paper at the 1998 Fall SMPTE Convention. This system takes advantage of the fact that our visual systems have a slow response to detail and motion detection is done at low resolution. In this technique, the top octave of detail is updated at 30f/s (fast enough for detail perception) while the remainder of the information (carried by the field line structure) is updated at 60f/s. This preserves the good motion rendition of the image displayed at 60/s. In that system, the detail and alias frequencies are subtracted from the incoming interlaced signal, and then the alias-free detail is added back to the 60f/s image at 30f/s. This process eliminates the field line structure and the interline flicker. If an interlaced camera is used, the vertical resolution is increased to about 0.9 times the Nyquist limit since the masking effects of interline flicker and line crawl have been eliminated. If a progressive camera or a film scanner is used with the proper optical prefilter, the perceived vertical resolution is actually about 1.3 times the Nyquist limit.



Today's cameras are expected to operate under a wide variety of conditions, including weather extremes. This Philips LDK23 high-speed, ultra-slow motion camera was used at the 1999 World Alpine Downhill Ski Championship in Aspen, CO. Photo courtesy Philips.

Future directions

We have analyzed the visibility of interlace artifacts and their effect on perceived resolution. An all-progressive system can eliminate

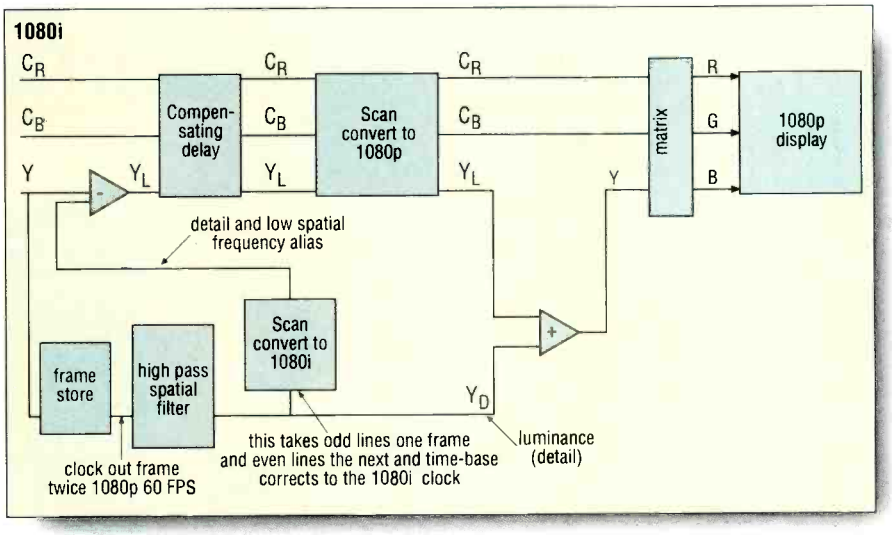


Figure 3: Block diagram of an interlace to progressive converter that could be used in a digital receiver.

these artifacts and produce a perceived vertical resolution almost double that of an interlaced system. With proper receiver processing, the advantage of progressive scan can be realized even if the transmission is interlaced.

Based on the two-alternative, forced-choice experiment described, we can now compare perceived resolution of various systems. Let us assume that progressively sampled cameras use a pre-filter with a cut-off that is 1.3 times the Nyquist limit. Interlaced cameras can also use a similar pre-filter in the horizontal direction. Figure 4 shows a comparison of the perceived resolution of a 480-line interlaced system and of the systems now being seriously considered for digital transmission. For small displays, we see that 480 progressive (VGA) is far superior to present NTSC resolution. For large screen displays, 1080i will look slightly sharper than 720p, but will have interlace artifacts. If the display of a 1080i transmission is properly scan converted to 1080p, even an interlaced camera origination has a considerably improved sharpness and will be free of interlace artifacts. A progressive camera or a film scanner will have by far the highest perceived sharpness without interlace artifacts if this process is used with progressive display.

A better way to understand the comparison in Figure 4 is to observe how we view images. At normal viewing distances, the limiting resolution on the viewer's retina is about 22 cycles per degree. This is true for both television and motion pictures. The difference between images of different resolutions per picture height is the field of view. These are all the same resolution on the viewer's retina. At 22 cycles per degree, we have about 32 million pixels in our total field of view. At normal viewing distance, NTSC television subtends about 1/2% of our field of view. 1080 line television, 720 line progressive television and 35mm projected motion pictures subtend about 5% of our field of view. 1080 line progressive images subtend about 11% and an IMAX theater subtends about 67%. The larger the field of view, the closer the experience is to being part of the image.

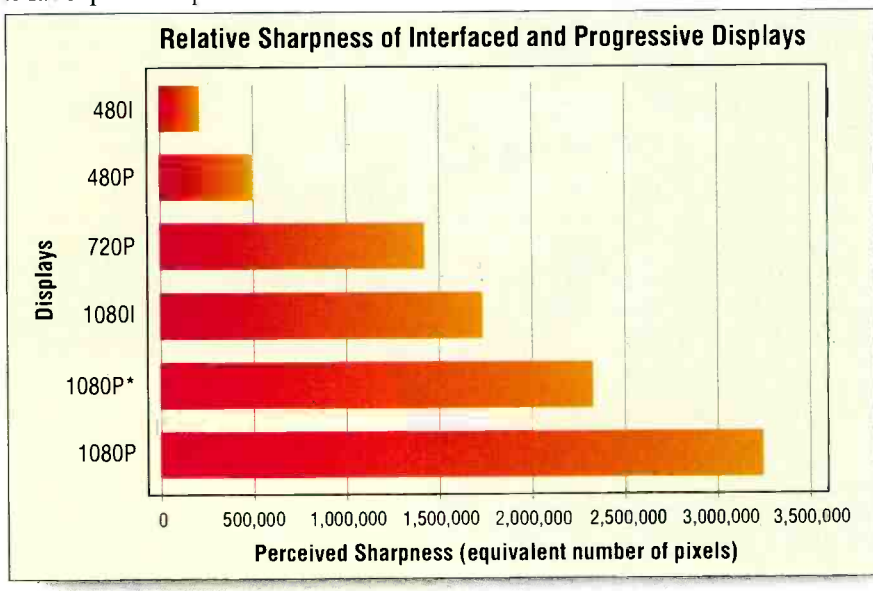


Figure 4: Relative sharpness of interlaced and progressive displays. Both camera and display are either progressive or interlace except for 1080p*, which is a hybrid system.

From these comparisons, we can conclude that using a progressive camera and a 1080 line progressive display of interlaced transmission with proper processing can provide the best perceived sharpness of any of the digital transmission systems under consideration. ■

William E. Glenn, Ph.D the director of the Communications Technology Center of Florida Atlantic University, Boca Raton, FL.

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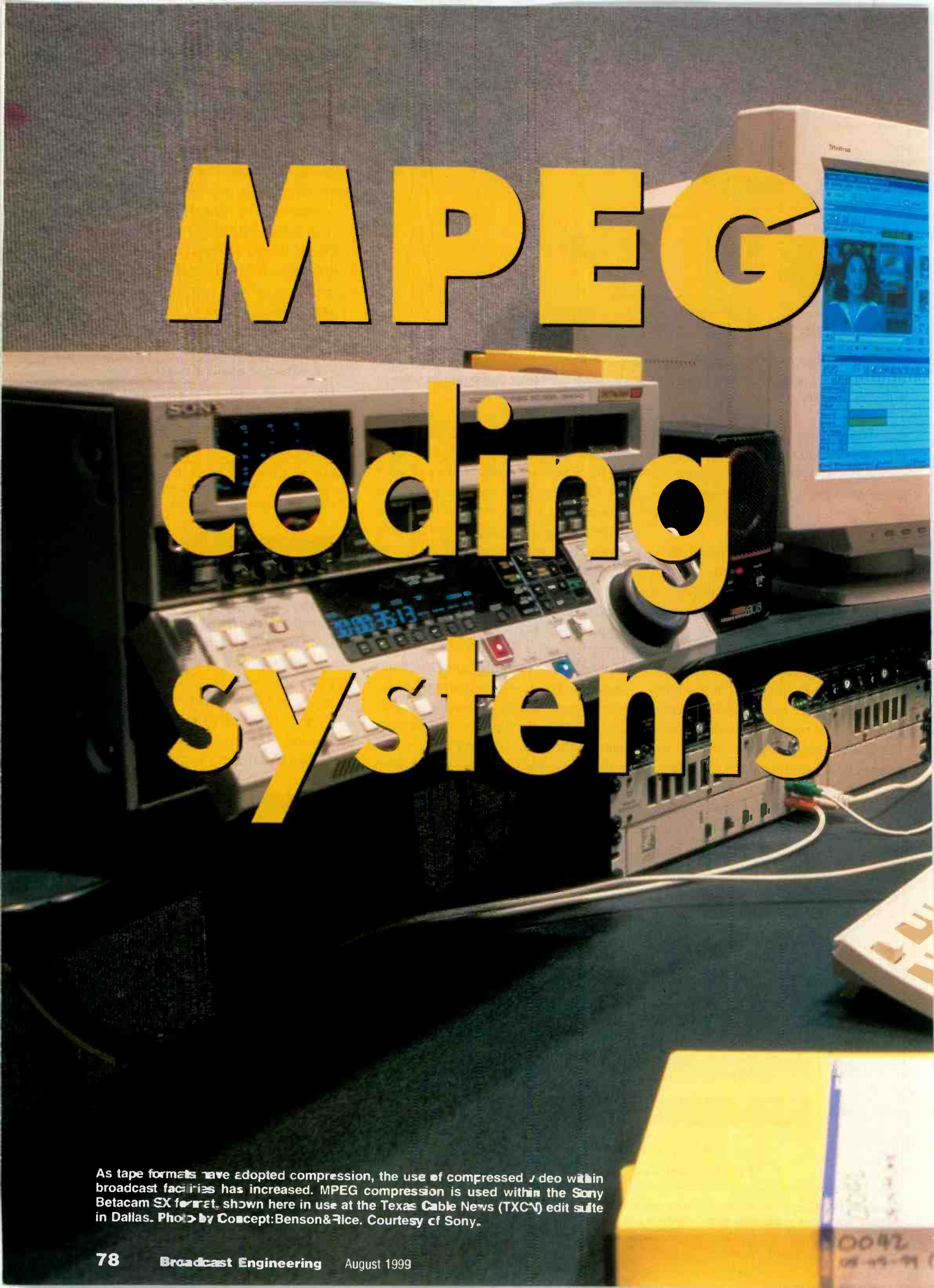
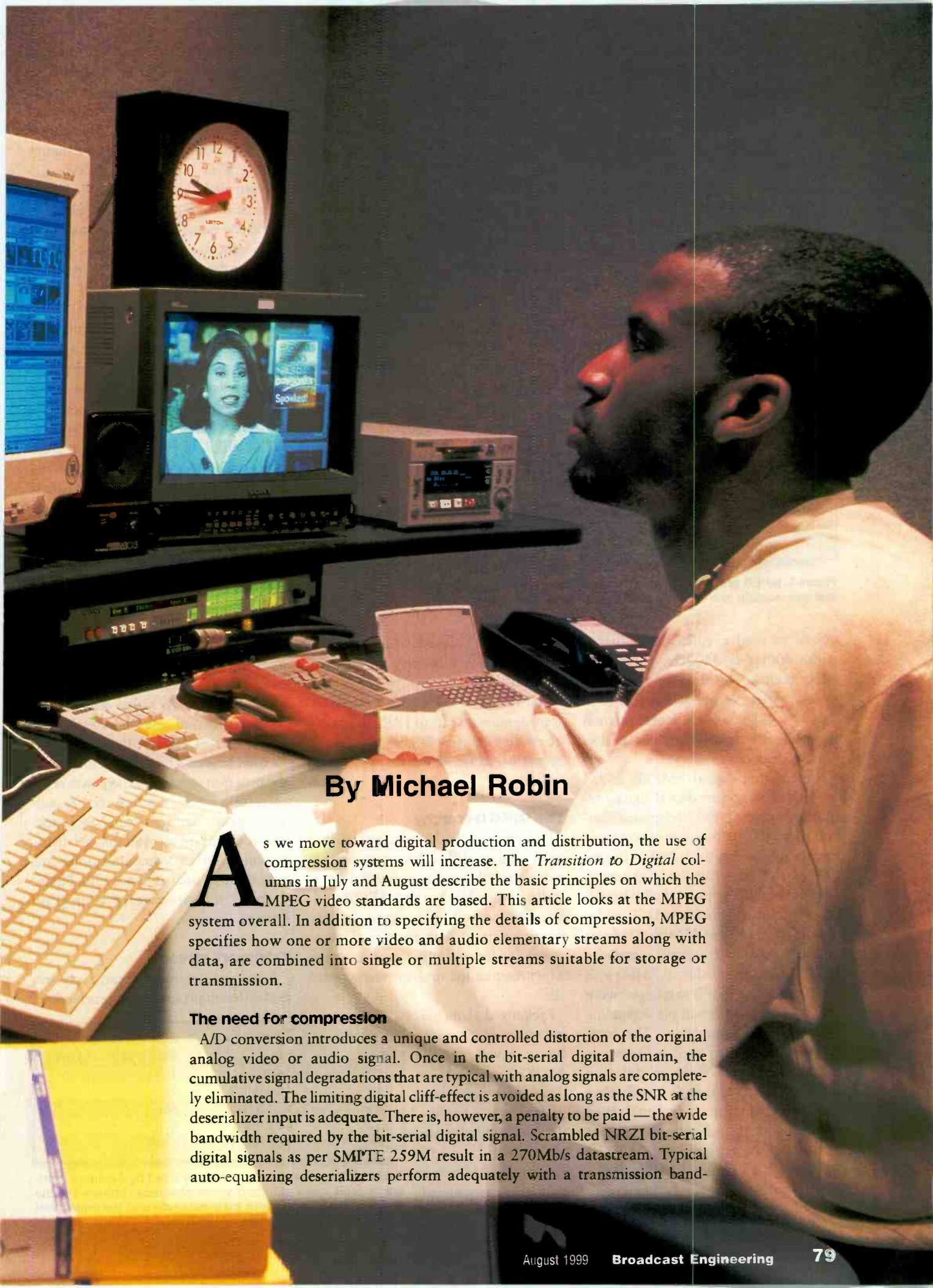
MPEG coding systems



As tape formats have adopted compression, the use of compressed video within broadcast facilities has increased. MPEG compression is used within the Sony Betacam SX format, shown here in use at the Texas Cable News (TXCN) edit suite in Dallas. Photo by Concept:Benson&Rice. Courtesy of Sony.



By Michael Robin

As we move toward digital production and distribution, the use of compression systems will increase. The *Transition to Digital* columns in July and August describe the basic principles on which the MPEG video standards are based. This article looks at the MPEG system overall. In addition to specifying the details of compression, MPEG specifies how one or more video and audio elementary streams along with data, are combined into single or multiple streams suitable for storage or transmission.

The need for compression

A/D conversion introduces a unique and controlled distortion of the original analog video or audio signal. Once in the bit-serial digital domain, the cumulative signal degradations that are typical with analog signals are completely eliminated. The limiting digital cliff-effect is avoided as long as the SNR at the deserializer input is adequate. There is, however, a penalty to be paid — the wide bandwidth required by the bit-serial digital signal. Scrambled NRZI bit-serial digital signals as per SMPTE 259M result in a 270Mb/s datastream. Typical auto-equalizing deserializers perform adequately with a transmission band-

width of 135MHz. While signal distribution inside a studio with cable lengths not exceeding 200M (a typical headroom of 100M ahead of the cliff effect) is perfectly possible, transmission and storage constraints require compression to lower bit rates.

Transmission constraints are related to the bandwidth required by the transmission of digital signals. Common-carriers have developed a set of digital transmission hierarchies which are multiples of 64kb/s, the bit rate required to send a voice signal (bandwidth 300Hz to 3400Hz, sampled at 8kHz with an accuracy of eight bits-per-sample) for telephone conversations. Table 1 lists some of the more common digital distribution hierarchies used in North America.

Transmitting digital SMPTE 259M bit-serial component digital signals requires displacing 4032 telephone conversations (DS4) or some means of compression, allowing the signal to fit into one of the other available channels. One of the most popular digital hierarchies in North America is DS3, colloquially referred-to as 45Mb/s. DS3 was initially used to transmit composite NTSC signals sampled at 10.7MHz with an accuracy statistically varying between six and nine bits-per-sample depending on the picture complexity. The compression technology used is known as differential pulse code modulation (DPCM), and even though it is obsolete today, it remains the major digital signal distribution level in North America. As the state of the art improved, MPEG-2 signals with a bit rate of 8Mb/s offer a picture quality subjectively superior to that of a 45Mb/s DPCM composite NTSC signal. A DS3 45Mb/s channel can accommodate several multiplexed SDTV MPEG-2 8Mb/s digital signals of distribution quality.

Transporting SDTV digital video data can be empirically divided into four generic picture quality classes (see Table 2). It is assumed that studio-level program generation and applications such as EFP/sports use a 4:2:2 sampling structure and generate a 270Mb/s datastream. Using a sampling structure of less than 4:2:2 (such as 4:1:1 and 4:2:0) generates a lower bit-rate and might be acceptable for news gathering provided there is no extensive post processing.

As compression technology improves, bit rates for the four classes will undoubtedly be reduced, while still offering comparable subjective picture quality levels.

The advent of DTV with a terrestrial transmission bit rate of 19.4Mb/s opens an entirely new set of signal distribution scenarios, most of which have yet to unfold.

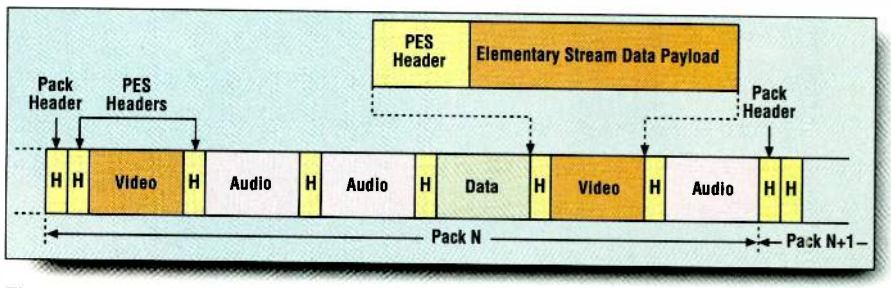


Figure 1. MPEG program streams are composed of packs. Each pack has a pack header and can contain one or more packetized elementary streams (PES).

The MPEG hierarchy

Packetization is the principal mechanism used in MPEG-2 for transporting video and audio compressed data as well as other data to the MPEG decoders. The method used is time division multiplexing of data packets. A compressed video or audio signal results in a bitstream called an elementary stream (ES).

Packetized elementary streams (PES) are the basic level of the MPEG-2 system layer. They carry one source of data for one application such a video stream or several audio streams. In addition to data, they carry a header used to identify the data. Each PES starts with a 24-bit start code prefix followed by a stream ID that identifies the contents of the packet. Some of the most important parts of the structure are the decode time stamps (DTS) and the presentation time stamps (PTS). With bidirectional encoding, a picture might have to be decoded some time before it is presented to enable it to act as the reference for a B picture. The DTS indicates the time when a picture must be decoded and the PTS indicates when it has to be presented to the decoder output. The PTS and DTS are added to the PES header and the program clock reference (PCR) is contained in the transport stream. PESs are usually multiplexed with other PESs into a more complex data stream such as a program stream or a transport stream.

The MPEG-2 program stream combines one or more PES, of variable and relatively great length, into a single stream. The PESs forming the program stream are encoded using a common master reference clock or system time clock (STC). This stream might be a video stream and its associated audio stream or a multiplex of several audio streams. The entire MPEG-2 program stream is called a *pack* and contains a number of packets. A pack starts with a pack header. It can contain up to 32 audio streams, 16 video streams, 16 data streams and a number of miscellaneous streams. Each of the streams has its own header. The variable bit rate of the program stream conflicts with error correction schemes, which require constant bit rates (constant length PES packets). It is thus mainly suitable for distribution in an error-free and noise-free environment such as in a studio. Figure 1 shows the structure of a program stream.

Transport streams

Transport streams (TS) can carry several different programs using noncorre-

Hierarchy level	Bit rate	Equivalent number of 64kb/s voice channels
DS 0	64kb/s	1
DS 1	1.544Mb/s	24
DS 2	6.312Mb/s	96
DS 3	44.736Mb/s	672
DS 4	274.16Mb/s	4032

Table 1. The transmission hierarchy used by common carriers is built upon standard voice channels. Shown are the various levels, along with their data rate and the equivalent number of voice channels

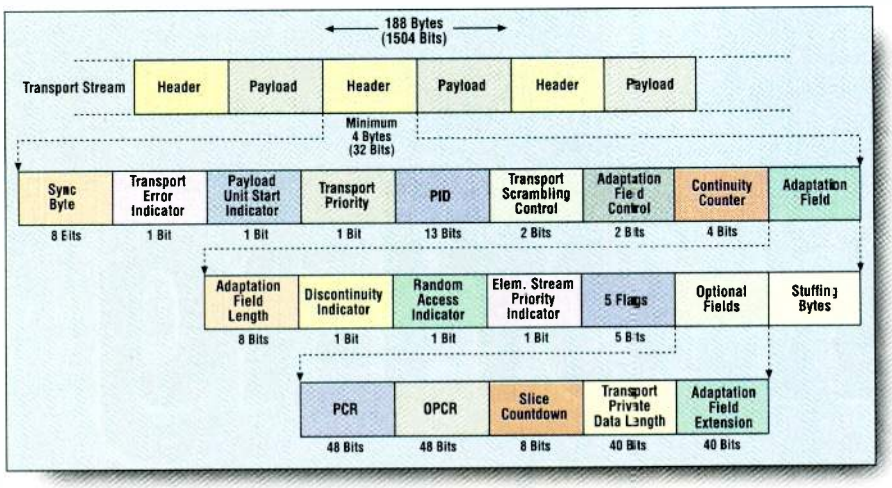


Figure 2. MPEG transport streams are composed of 188-byte packets. Each packet is made up of a four-byte header (minimum) followed by 184 bytes of payload. Headers can be lengthened based on the contents of the adaptation field control bits.

lated compression schemes (e.g. different compression ratios) and variable bit rates. Transport streams are used in DBS and ATSC applications. The overall bit rate is maintained as constant by a process called statistical multiplexing (stat mux) which statistically allocates bit rates to programs with variable data rates. The goal is to make the best use of the available transmission bandwidth. Less bits per sample are allocated for talking head materials, which have relatively low temporal resolution, and correspondingly more bits per sample are allocated to scenes with a great deal of movement, such as sports programs.

TS packets are 188 bytes long and are subdivided into a four-byte header and a 184-byte payload. Figure 2 shows the structure of the Transport Stream Packet. Among the information contained in the header is:

- **Sync byte:** Sets the start of a TS and allows transmission synchronization.
- **Transport error indicator:** Indicates that the packet may contain errors.
- **Packet identification (PID):** The 13-bit PID identifies the channel. It contains the information required to find, identify and reconstruct programs.
- **Continuity counter:** Used to determine if any packets are lost, repeated or out of sequence.
- **Adaptation field:** There is a provision for an optional, variable-length, adaptation field in the header. The adaptation field, when used, provides additional information about the payload data and causes a reduction of the payload to maintain a constant bit-rate.
- **Program clock reference (PCR):** Samples of the 27MHz clock used by the video and audio encoders. These samples provide a context for interpreting the PTS and DTS values in the PES header. MPEG requires that PCRs be sent at least ten times per second.
- **Splice countdown:** The splice countdown is an eight-bit counter that decrements as a potential splicing point approaches. It helps locate the precise packet at which switching within a particular PID must take place.
- **Discontinuity indicator:** The discontinuity indicator informs the decoder that the detected signal flow disruptions are intentional (e.g. a consequence of switching of an elementary stream) and not the result of channel errors.

The TS has the capability of multiplexing multiple programs into a larger (and faster) datastream. Figure 3 shows a simplified block diagram of the encoding and decoding of a multiplex of programs making up a transport stream. Whether there are many programs or only one (e.g. a 19.4Mb/s compressed HDTV signal conforming to ATSC), another PID stream is inserted containing a table listing the PID streams that carry program map tables (PMT). This table is called the program association table (PAT). The PAT is always carried in packets with PID=0. By reading the PAT, the demultiplexer can find the PIDs of the network information table (NIT) of each PMT. Finding the PMTs allows the demultiplexer to find the PID of every elementary stream. A reference to the PAT and the PMT is all that is needed to find the PIDs of all the necessary elementary streams and decode the chosen program. Access to a conditional access table (CAT) is also required if the program is encrypted. ■

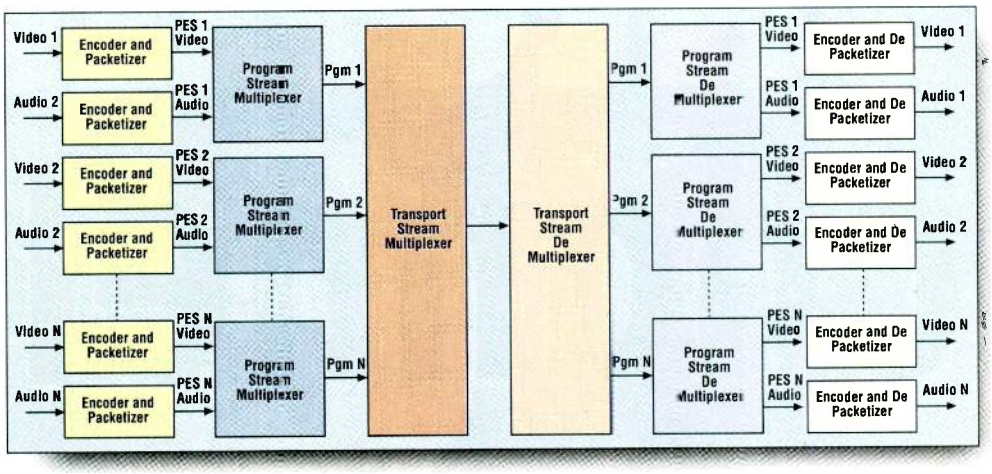


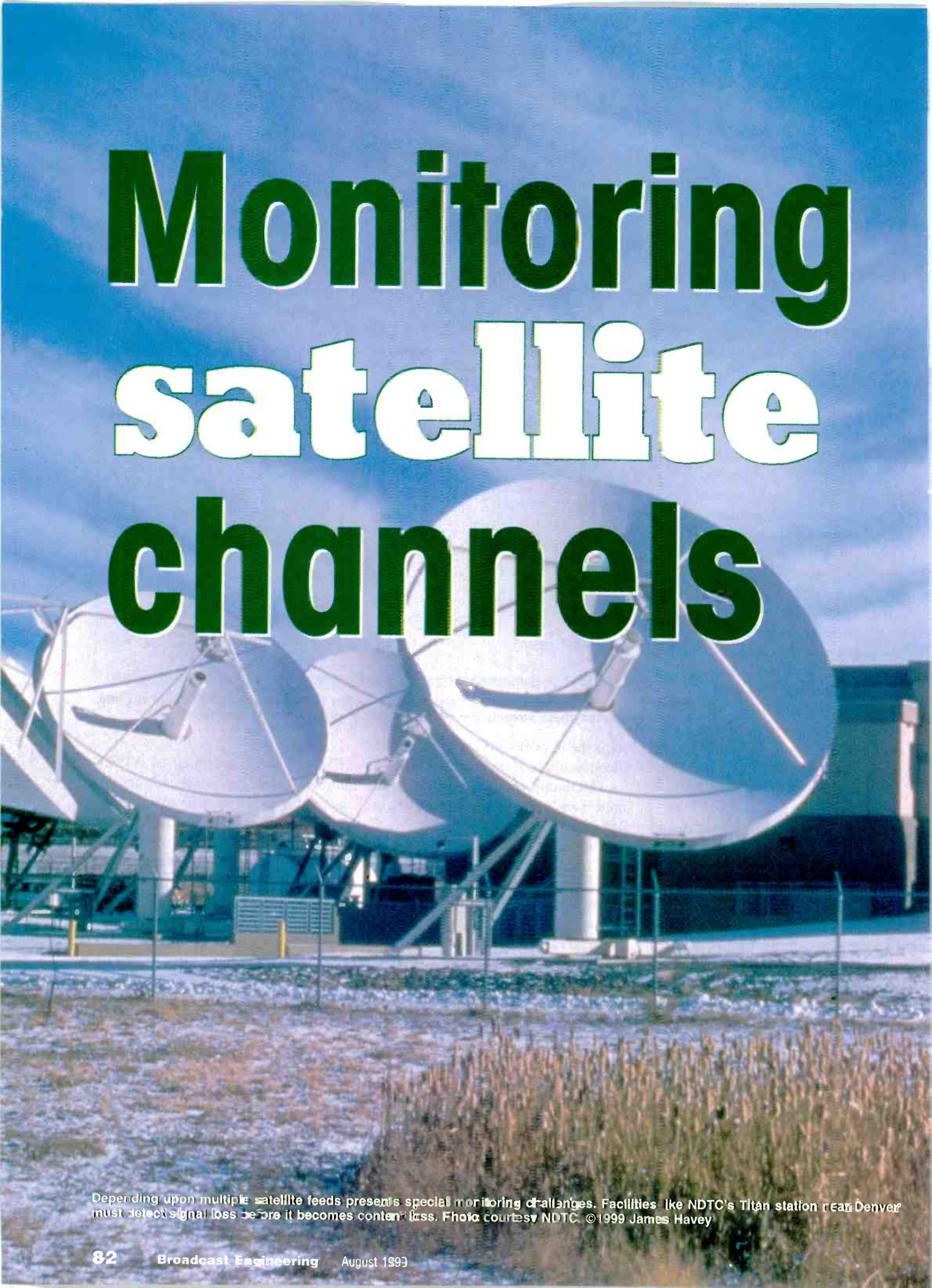
Figure 3. Transport streams can be used to multiplex any number of audio/video/data streams. Once transported, these streams can be demultiplexed using a similar process.

Class	Use	Bit rate
Production	Program generation	270Mb/s
Contribution	Remote location to studio	45Mb/s
Distribution	Studio to transmitter	15Mb/s
Emission	Transmitter to home	3- to 8Mb/s

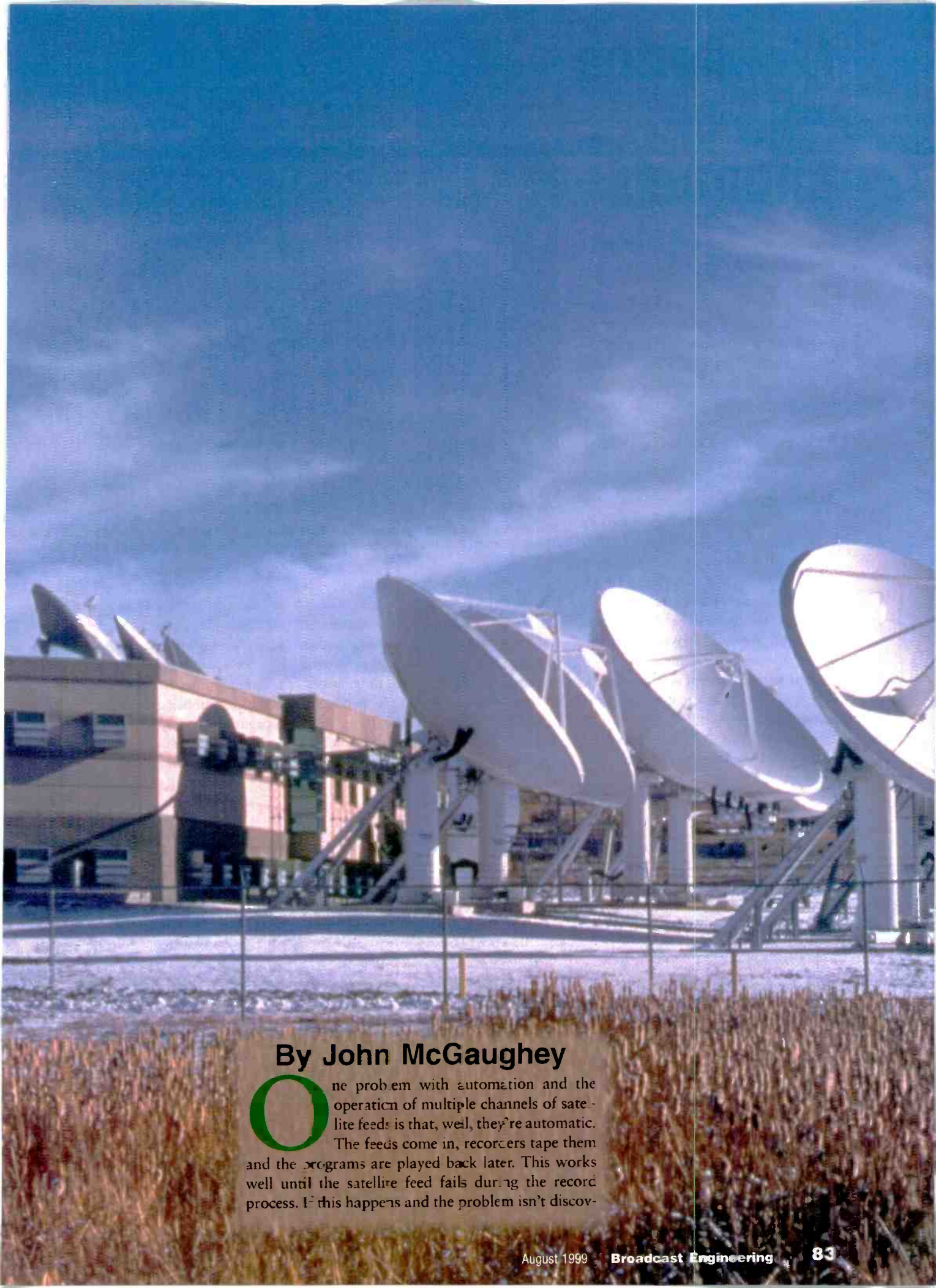
Table 2. Standard-definition digital video can be divided into four picture quality classes, each of which is used in a portion of the signal path from acquisition to the home viewer.

Michael Robin, former engineer with the Canadian Broadcasting Corporation engineering headquarters, is an independent broadcast consultant located in Montreal, Canada. He is co-author of Digital Television Fundamentals, published by McGraw-Hill.

Monitoring satellite channels



Depending upon multiple satellite feeds presents special monitoring challenges. Facilities like NDTC's Titan station near Denver must detect signal loss before it becomes content loss. Photo courtesy NDTC. ©1999 James Havey



By John McGaughey

One problem with automation and the operation of multiple channels of satellite feeds is that, well, they're automatic. The feeds come in, recorders tape them and the programs are played back later. This works well until the satellite feed fails during the record process. If this happens and the problem isn't discov-

Monitoring satellite channels

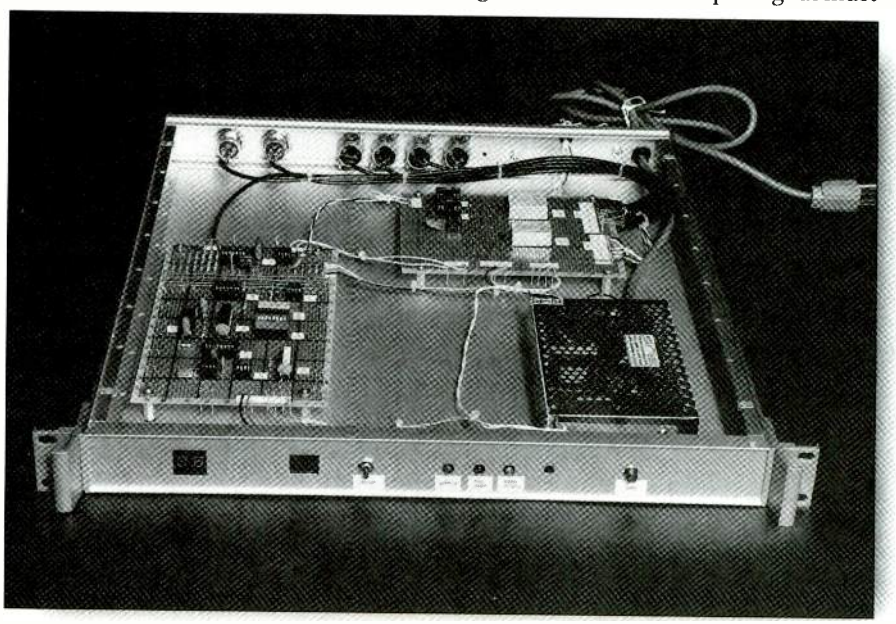
ered quickly, you could end up with a blank tape at air time — way too late to request a refeed.

We've come up with a nifty device at Georgia Public TV to monitor satellite feeds. While this system monitors the audio channel only, if a feed breaks, usually its both audio and video that fails, so it's *almost* foolproof. And, if you have a radio station at your facility, its perfect for monitoring its satellite feeds also.

System goals

The main requirement is to monitor a single balanced audio feed for activity using a time-out technique. The operator can adjust the time intervals for which the signal must be absent before initiating an alarm. The device relies on digital control, providing repeatability and easy adjustment.

Another requirement is that once the time-qualified absence of signal is detected, the error would be latched to close a relay. This indicates to external devices that a failure has occurred. The error latch can be cleared by a front panel pushbutton if the line presently has active signal. The contact closure output was chosen since it is universally used in the industry and can be used by a wide variety of devices.



The detection system fits neatly in a 1RU chassis. Along with the power supply, one board is used for the detection circuitry and another has the relays and external connections.

A block diagram of the design is shown in Figure 1. The balanced audio signal with a reference level of +4dBu is passed to a balanced to unbalanced convertor stage. A simple bandpass filter AC couples the signal and rolls off the frequency response above 5kHz. A subsequent amplifier gives control via potentiometer R13 for the sensitivity of the system to audio levels. The design lets any level from -2.3dBu to -12.3dBu be selected as a threshold of signal detection. The input signal must exceed this threshold before the system can determine if there is tone or active signal present. This should allow for setting the unit to respond to commonly encountered soft passages of dialog or music. The Schmitt trigger comparison block converts the analog audio signal into a digital form for use in the subsequent stage.

The digital signal is then used as a reference frequency for a phase lock loop. The phase lock loop is what gives the system the characteristic of treating any tone as the absence of signal. It does this by locking to any steady state periodic input — exactly what tone is. If any aperiodic input is applied to the loop then the phase lock loop attempts to track its frequency changes. In this way, the loop cannot maintain lock for actual program audio material that is presumably not periodic. The output required simply must indicate whether the loop is locked or not. If it is locked, the assumption is that tone exists, alternatively if the loop is unlocked then active audio is present.

The lock detector is shown in

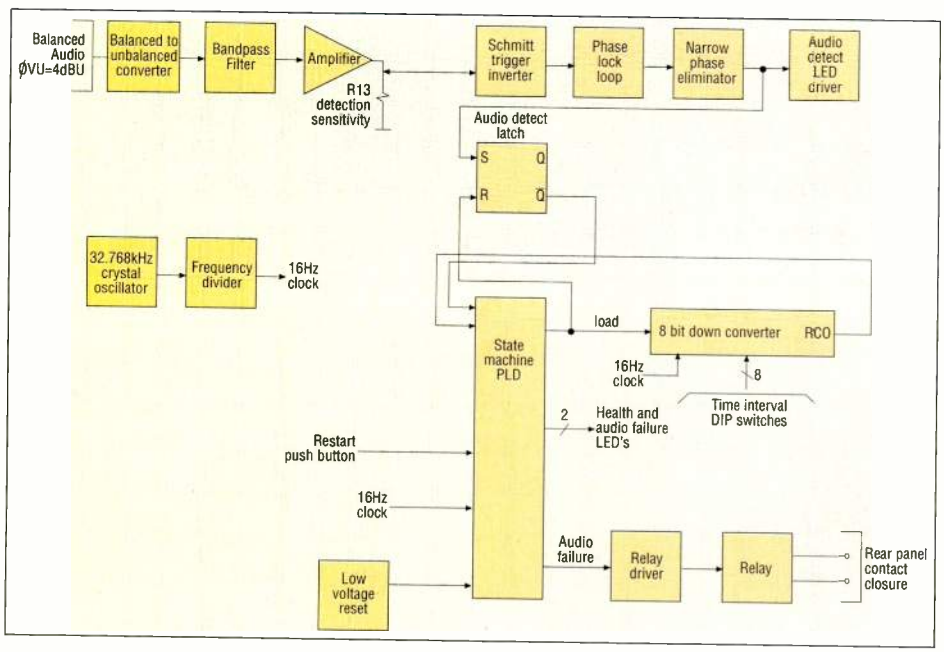


Figure 1. Block diagram of the detection system shows how the detection circuits, PLD and alarm relays are related.

Figure 1 as a narrow pulse eliminator. The circuit uses the phase pulse output of the 74HC4046 phase lock loop IC. The phase pulses consist of low-going pulses whose width is proportional to the degree of correction required to achieve lock. When tone is present there is no variation in the period of the signal, so the phase lock loop oscillator requires very little correction. In this case, the phase pulses are quite short, but for program audio large corrections are required and the duration of the phase pulses must increase. The narrow pulse eliminator circuit rejects the narrow pulses present in lock and allows through the much wider pulses present in the unlocked condition. This section can lock to any level of tone at any audio frequency above 100Hz. The narrow pulse eliminator output sets a simple latch made up of two cross-coupled NAND gates. The latch takes these audio detect pulses that vary in width and timing and remembers their occurrence until the state machine acknowledges their reception.

The rest of the system is the digital time qualification section that looks for the absence of audio for a preset time before indicating an error. The principle of its operation is essentially the same as a retriggerable one-shot multivibrator IC. That approach uses a fixed-time interval that is initiated by an event and if the event reoccurs before the end of the interval the timer is restarted. In this way the time out occurs at a fixed time interval from the last event.

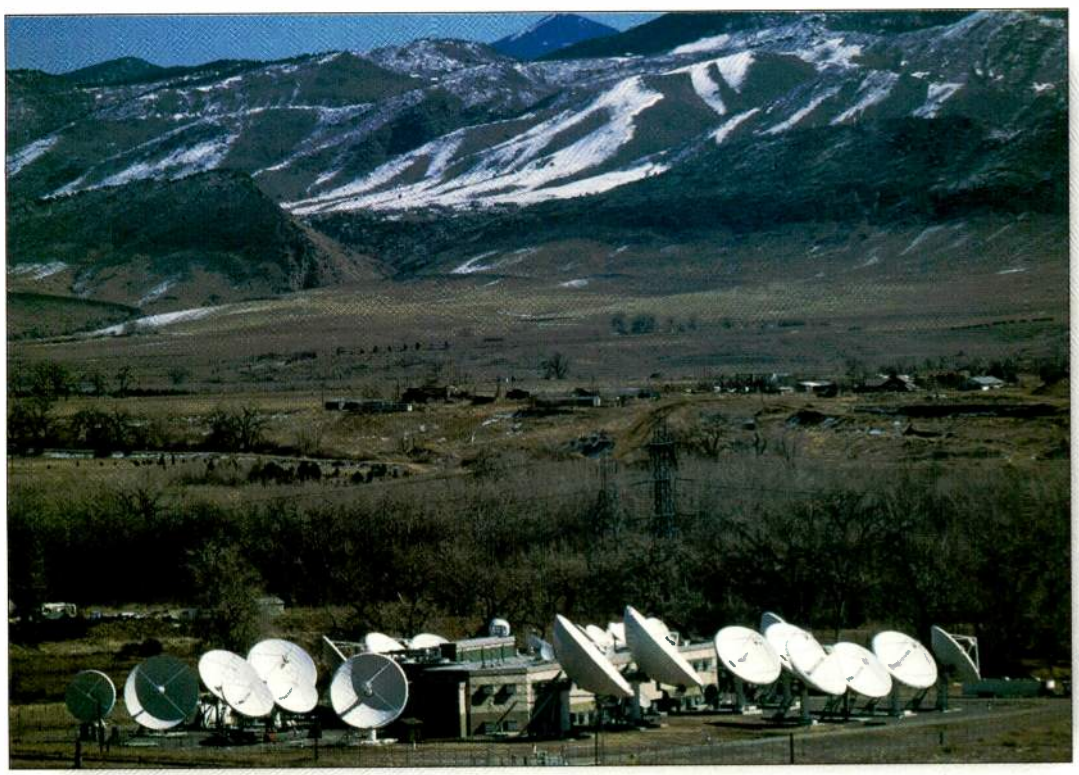
If power fails, the unit comes up looking for audio as opposed to indicating a failure.

The event in this case is the detection of audio. Unlike standard retriggerable one shot IC's that use resistor/capacitor set time intervals this system requires more precise timing and digital selection of the time interval. Because of these requirements the unit uses a crystal oscillator clock and a counting approach to emulate the retriggerable one-shot technique. The section is controlled using a well-known algorithmic state machine approach.

This allows for a compact, reliable and easily described method to be used for the system control. This state machine is contained entirely within one 20-pin PLD (programmable logic device). This IC is an EEPROM-based generic logic device that can be erased and reprogrammed to create custom logic functions chosen by the designer. Using a PLD to construct the control portion of the system reduced the number of IC packages that would otherwise have been needed if discrete logic components were used. To specify the logic needed for this IC, a software package is required to translate the text description of the state machine into a programming pattern that is used to configure the device. In order to accomplish the actual programming the IC is placed into a device programmer connected to a PC and then the JEDEC standard file is used to configure the cells within the IC.

The time reference for the unit is a 32.768kHz oscillator that is divided down to 16Hz as a clock for the state machine. Using a crystal instead of a simple relaxation oscillator gives a stable and repeatable time-out interval for the system. The time qualification is done using an eight-bit binary down counter that is loaded every time audio is detected. During periods in which no audio is detected the counter is allowed to count down towards zero at a precise rate. If audio is detected often enough, the counter is reloaded before it can reach zero. This is essentially what restarts the time-out interval as in a retriggerable one shot. In this way, the clock frequency and the number loaded into the counter set the time-out interval.

An eight-section DIP switch allows setting



Several commercial systems used in program distribution also monitor activity. A system that raises an alarm, reboots a computer, or switches to another active program feed would be of great utility for stations like Titan, which have a multitude of incoming feeds at any given time. Photo courtesy NDTC. ©1999 James Havey

Monitoring satellite channels

this interval with a one-second resolution for up to four minutes fifteen seconds. The RCO output of the down counter is a decode of the down counter state zero. It is simply fed back to the state machine section to indicate that the interval has been completed and that this should be treated as a time-qualified audio failure. This should provide flexibility in determining when audio really has dropped out as opposed to normal quiet intervals.

The unit has front panel indicators for three conditions. The first is an LED to indicate the presence of audio that is not time-qualified. Second is an indicator of a latched audio failure that occurred previously. Third is a health indicator that flashes while the system is actively examining the input for audio. The only front panel control is a restart button that clears a failure if audio is now present on the line being monitored. The PLD through a driver IC activates a relay the entire time that the failure is latched. This is a rear panel contact closure used for activating various responses to any latched failure.

Several commercial systems used in program distribution also monitor audio activity, no acceptable stand-alone units were found.

It is important that the system come up out of a power failure or brown-out condition in the proper state. This is handled by using a low-voltage inhibit IC to monitor the logic power supply. Any time the power supply voltage is below a given threshold it activates a reset of the control system to an initial state. This state is the one searching for audio to be present. If power fails, the unit comes up looking for audio as opposed to indicating a failure.

The entire system was wire-wrapped on a single PC board in one day and placed in an enclosure for rack mounting. The only unusual part needed was the PLD which is a Lattice Semiconductor GAL 18V10. ■

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The author will program any supplied devices from interested readers for return postage only. In addition, a complete schematic of the unit and a parts list will be included. The complete system cost approximately $300 and the parts are readily available through mail order distributors.

The author wishes to acknowledge the contributions of Sandy Mayfield and Glenda Smith toward the construction of the detection unit.

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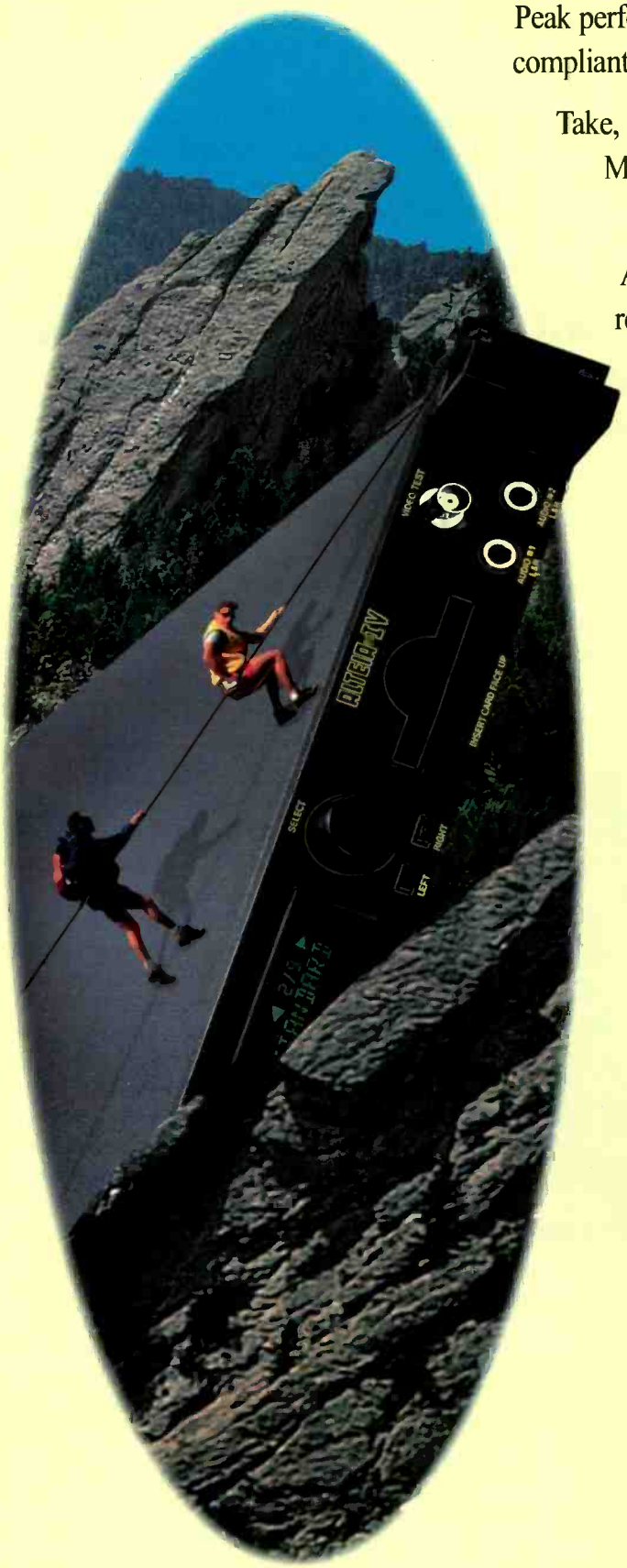

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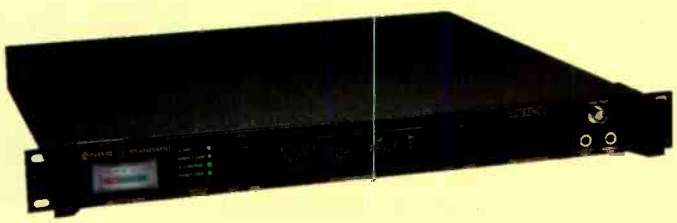

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Stories travel further and faster than facts

BY KARE ANDERSON

Here is a tip from July's column: *Be an author of your life story.* Start with what you know best: *you.* What do you want people to tell each other about you? How do you want to be most remembered when you leave the meeting, dinner party, family gathering, your life? It is never too late to at least co-create an engrossing living legacy, beginning with an interesting next chapter, starting now. How?

Consider conversations. Forget the qualifiers, historical background, jargon words and "how-to" before the "why listen" has been answered. What's the question or statement you know that will pull people into learning more of your story?

Isn't it wonderfully democratizing to know that now, more than ever, it takes more than money to get a message noticed? It takes a memorable message.

Say it better next time and your message may be the one most broadcast around the world. Get to the juicy center of the topic upfront so others are pulled into wanting to hear more. When someone says, "Tell me more about that," you know you have started your story by respecting their strongest interests rather than the usual habits of packing in extraneous preface details at the front of conversations.

Peel away the boring, up-front qualifiers and wandering background words. Drop the secondary detail until you have hooked the listener into wanting to know more. You are not acting like a robot but rather choosing to have a few seconds of forethought in respect to the listener's innate interests, world view and/or current situation. You not only tell the truth, you tell the best detail of that truth up front, to engage the person you most want to have hear you. Look for the heart-warming happening, contrasting facts or statistics, best/worst case scenario, extraordinary incident, flattering and genuine compliment, glittering opportunity or looming threat, cherished colleague's choice or respected opinion leader's actions to introduce your topic into conversation.

You can tattoo your word pictures into memory hooks. They can relate to your name, work, remarkable quality, skill or appearance, or can be a rhyme or word play. Ivan Misner, author of *Seven Second Marketing* offers many examples, including the following three which I've

Say it better next time and your message may be the one most broadcast around the world.

others, even beyond their conscious willing when you begin with the lead-in sentence to the story that most interests them. Why? Because your words are unforgettable. Remember that famous example where you can't help but picturing what you are admonished not to? Whatever you do now, don't think of big, pink elephants. Peel away the less immediately understandable or interesting parts of your topic to begin with the most interesting (to the listener) detail means others are more likely to want to learn or share more later. As Roger Ailes says, "See it and say it. If you can see a picture in your mind and describe it, others will stay tuned."

All of your stories don't have to be life-changing, but they can be engaging. Use paraphrased. "Let me take the world off your shoulders," offers Sharon Howard, massage therapist. Lance Mead of Lunar Travel Agency stands out from other agents when he says, "Ninety percent of all accidents happen in the home. So travel!" Photographer Robert Stewart writes, "My pictures say a thousand words so you don't have to."

Perhaps the best gift you can present to someone you respect or love is to tell many others about one of that person's most wonderful actions. Bonus: the halo effect of such third party endorsements can't help but rub off on you.

I feel this with all my heart, even if I am only intermittently good at it myself. If you want a more interesting, options-loaded, meaningful life, make the chapters more enticing, beginning with what you say, both in your comments and your questions. Raise the more interesting details to the top of the conversation and the most intriguing parts of others will emerge. They will like that experience and be drawn to you. Whether you want to have a more lively experience with loved ones during your play times, get the immediate attention of colleagues or strangers, attract more support for your project or initiate new friendships, begin with the specific detail that pulls them to your most interesting story. ■

Kare Anderson is a speaker and author.

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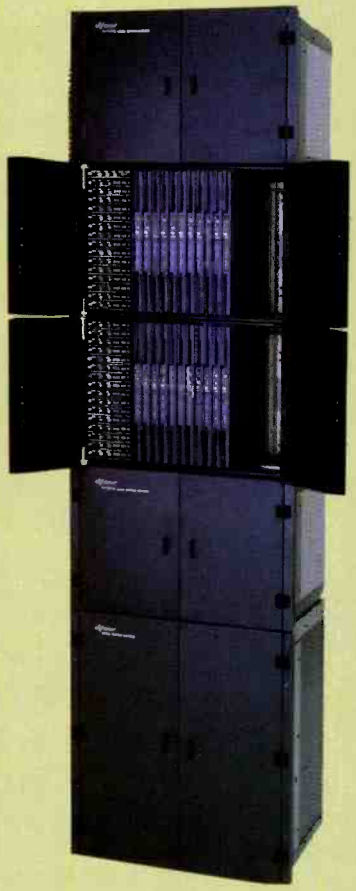
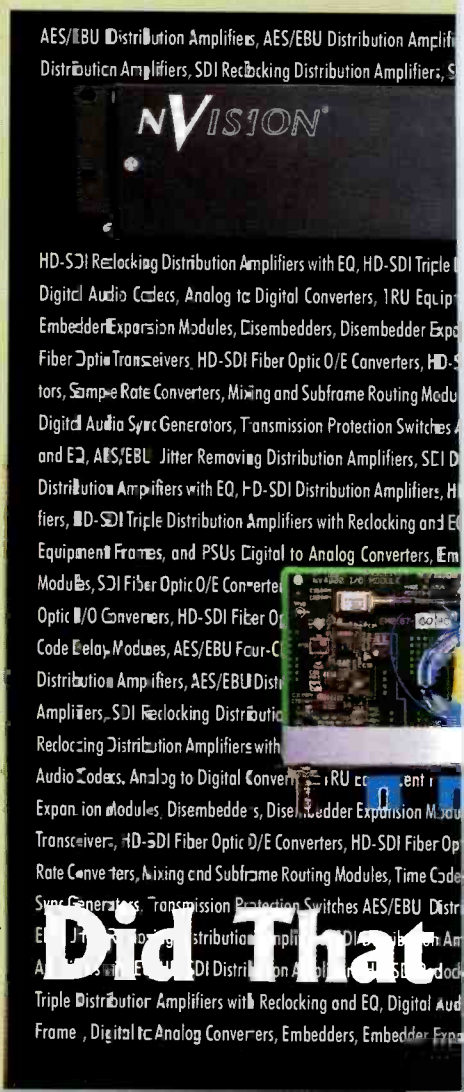


The NV3512, used by all of the major broadcasting networks and post houses, is a large-scale, expandable routing switch for synchronous and asynchronous switching of digital audio as well as time code. It can be controlled by most of the current router control systems, so it is easily integrated into existing as well as new facilities. It can be purchased in sizes of 8 x 32 all the way up to 2048 x 2048. (One customer has a synchronous NV3512 that is 2048 x 512.)

Higher NV3512 sales volume has resulted in recent increases in manufacturing efficiency, significantly reducing product cost. NVISION is able to pass on these substantial cost reductions to our customers, making our market-leading AES routing system not only the best but now the most affordable, with savings of up to 40%, depending on configuration.



Recently, customers have been heard to say, "Your products really work well, they solve engineering problems and fit easily into my budget. But I thought you only made routing switches!" Apparently, we manufacture more products than most people realize. Yes, we do build award-winning, trail-blazing and market-leading routing systems, but we also produce a huge range of modular products that are designed with the same exacting standards.

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Applied Technology

Aspect ratio conversion with Axon's ARC-2000

BY PETER SCHUT

The aspect ratio of the first cine films was 4:3. This became a logical format for the television industry when broadcasting began. To differentiate from the increasing popularity of broadcast featured movies, the film industry adopted a 16:9 aspect ratio (and 21:9 for an even wider Cinemascope). Although 16:9 television origination is not new, the population of 16:9 receivers will only rise to serious numbers with the advent of DTV broadcasting. One thing is evident: widescreen is going to happen and it is just a matter of time.

If we look at the current data formats widely in use in modern broadcast environments, D1 is the *de facto* standard. This 270Mb/s serial datastream can handle normal resolution video material in either 625 lines/50 field (576 active lines) or 525 lines /60 field (480 active lines). The horizontal resolution for both active video areas is 720 pixels. When 16:9 for television broadcasting became an issue, the first adaptation was done with higher data content. The active line in this proposal was 960 pixels and the datastream was increased from 270- to 360Mb/s. From a technical point of view (the wider line needed a higher amount of pixels), the high bit rate was a major disadvantage. Production facilities were just adopting 270Mb/s infrastructures and these expensive new technologies were not capable of handling 360Mb/s. A new proposal came along: Anamorphic widescreen. (See Figure1.)

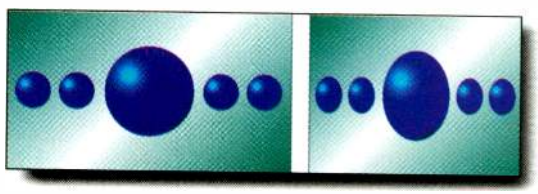

Figure 1. An anamorphic widescreen picture looks horizontally compressed.

This technology uses the same infrastructure as conventional 4:3 program material. The difference is that the widescreen information is optically converted to a 4:3 picture (some cameras use a widescreen CCD chip where the anamorphic output is created in the digital domain). The picture is horizontally cropped to fit the smaller screen. Although the widescreen version of this picture also has 720 pixels per line (displayed on a widescreen monitor, the pixels are stretched), this technology is visually not a significant tradeoff. This material, shown on a normal 4:3 monitor device, gives a distorted picture. Performers and scenery are stretched vertically.

How can you convert from one aspect ratio to the other and still preserve a high-quality image?

Conversions

If a 16:9 anamorphic picture is converted to, say, a letterbox in 4:3, you have to throw away 25 percent of the picture. This conversion loses picture resolution. One technique is to throw away every fourth line. Although this is great for the sharpness of the picture, it is a drastic way of getting the right aspect ratio. This technique is used in modern DVD players to give the customer a letterbox view of a 4:3 source. The drawback is that diagonal lines become edgy and some information is completely lost. The right way of doing this is called *interpolation*, where the information of several lines is used to create a new number of lines, either a higher or a lower amount. The same is applied in the horizontal domain if we have to drop or increase pixels. To get the optimum output, the interpolation filters are optimized for their given function and artifacts in moving material (like scrolling texts, a major issue in aspect ratio conversion). This is why fixed conversion scales give a better performance compared to variable scaling used in, for example, a DVE. The filters in the Axon ARC-2000 are optimized for the fixed output ratios like 4:3, 16:9 and 14:9.

Notation

To make the communication more reliable, we adapted a BBC notation to define a certain material in a certain environment. Example: a letterbox 16:9 source material that is shown in a 4:3 environment is called 16L12. This comes from a 16:9 source placed in a 12:9 (4:3) environment in a letterbox type of display. Normal 4:3 (12:9) material shown in a 4:3 (12:9) environment is called 12F12. The following notations are used:

P = pillarbox
L = letterbox
F = full field

With this notation we can define input and output formats within the normal and widescreen environments. Some examples include:

16F16 = 16:9 source in a 16:9 environment.

12F12 = 4:3 source in a 4:3 environment.

16L12 = 16:9 source letterbox in a 4:3 environment.

12P16 = 4:3 source pillarbox in a 16:9 environment.

14P16 = 14:9 source pillar box in a 16:9 environment.

14L12 = 14:9 source letter box in a 4:3 environment.

Using this notation is a nice way of defining the type of display and the way the original material is displayed in this

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environment. It is also used to define the conversion selected in the ARC-2000. If you want a 16:9 anamorphic source displayed in a 4:3 environment letterbox, select 16F16 > 16L12. This will be the standard procedure in editing the presets or patches. In Figure 2 you can see typical conversion scales used to display 16:9 material in a 4:3 environment. The first output is an anamorphic picture of a widescreen shot source. The picture is distorted. The second is a full letterbox display called 16L12. Then a 14:9 display where some parts of the picture are lost. And finally a pan-and-scan version of the original. This is called 12F12 again because you cannot see what the original was. In Figure 3 you can see typical conversion scales used to display 4:3 material in a 16:9 environment. The first output is again anamorphic. The picture is distorted. The second is a full pillarbox display called 12P16. The third is a 14:9 display where some parts of the picture are lost. Finally, there is an inverse pan-and-scan version of the original. This is called 16F16.

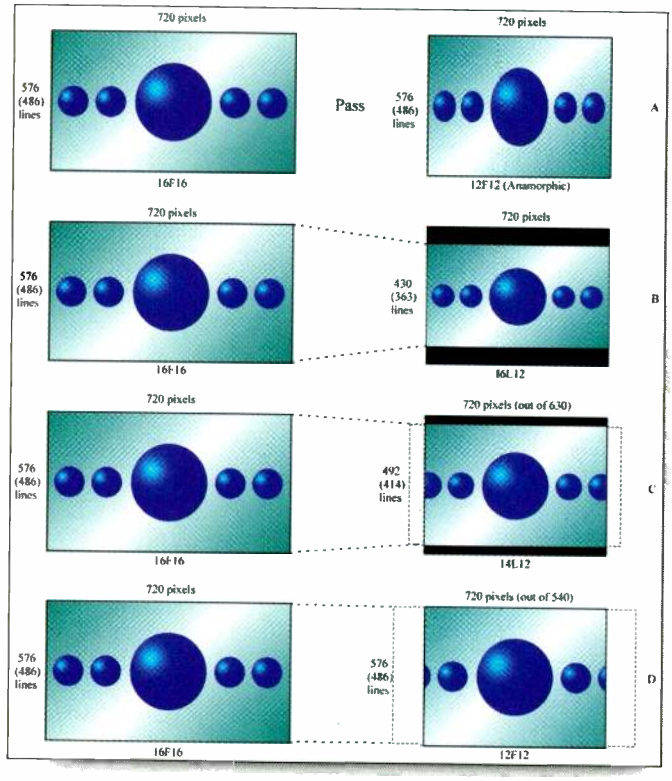

Figure 2. Converting from widescreen to normal screen.

System settings

An aspect ratio converter must have more features than just adjustable scaling. To make the unit user friendly and broadcast proof, several adjustments need to be made and or need to be selectable. The ARC-2000 has one frame delay. This delay is fixed and a genlock signal is not needed. To adapt the unit in a variety of applications, the delay can be adjusted up to seven lines less than a frame in one microsecond intervals. This gives the user the opportunity to correct for external propagation delays. Some other features include variable horizontal and vertical blanking. If the source is of analog origin, the blanking might be set incorrectly. In a 4:3 environment, this caused no big problems because the active picture was bigger than the screen display. If a pillarbox is selected to display a 4:3 picture in a 16:9 environment, the edges can be rough due to incorrect blanking. Widening the black bars left and right from the picture will solve this. The same applies to letterbox displays where two black lines can be added on top and bottom. Pan-and-scan is, of course, a possibility in both horizontal and vertical directions. The use of widescreen signaling and video line index is also supported.

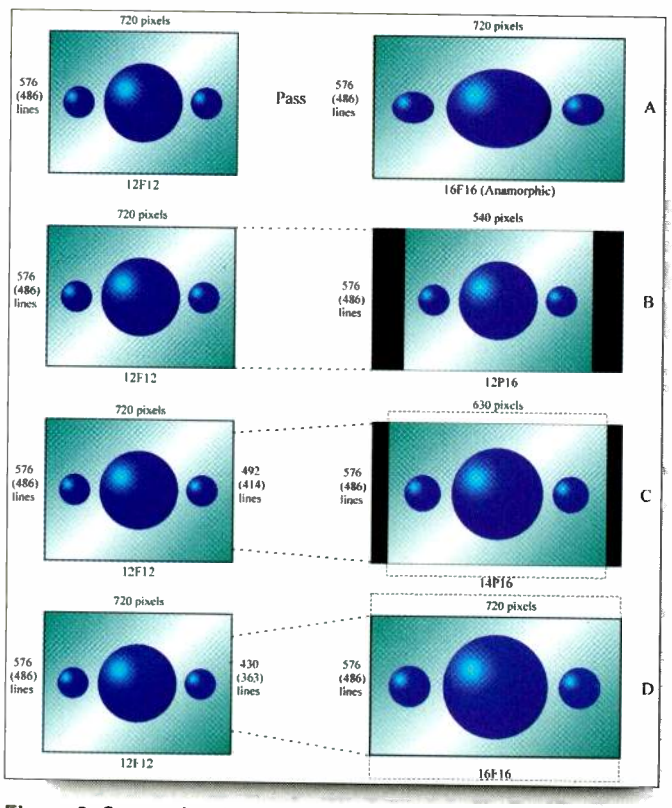

Figure 3. Converting from normal screen to widescreen.

Control

Several systems and topologies can control the ARC-2000. First it is possible to control the different presets by GPI-contacts. This enables the most straightforward control method: the unit switches cleanly from one setting to the other. Switching is performed in the blanking interval without disturbance. Transparent blanking is thus maintained. The GPI control modes are designed to handle several technical environments. One GPI per preset mode is the first method you can use. This will give the user the easiest GPI control mode, but with a parallel infrastructure. The second mode makes use of four GPI's in a binary counter way with four lines in parallel, this gives you the opportunity to handle 16 presets. The last mode can be enhanced by a fifth GPI that controls a take switch. The take switch gives a better timing of the actual transition. Although the use of 16 presets should not be a limitation in most environments, we decided to add a second bank of 16 that will be enabled by a GPI. This feature gives the user of dual environments (a transmission site with a 16:9 digital output and a 4:3 analog output) the option to store their preferred presets in a universal unit. The presence of this GPI input, triggers the analog or digital preset preference.

For more information on Axon's ARC-2000, circle (451) on the Free Info Card. ■

Peter Schut is product manager for Axon Digital Design.

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Circle (140) on Free Info Card

Applied Technology

Ross Video's Synergy Series switchers

BY DAVID ROSS AND JEFF MOORE

With the advent of DTV and widescreen formats, broadcasters now face the challenge of simultaneously supporting 4:3 and 16:9 aspect ratios. The 16:9 content must be compelling and offer DTV consumers additional enhancements to the viewing experience. This enhanced viewing experience must not come at the expense of the 4:3 (NTSC) production that is still in heavy competition with other NTSC channels.

The problem is really one of economics. The DTV channel must be added at minimum cost in equipment and no increase in operational cost. It must be done in a way that doesn't steal money from the NTSC transmission - the one everybody is watching and advertisers are supporting.

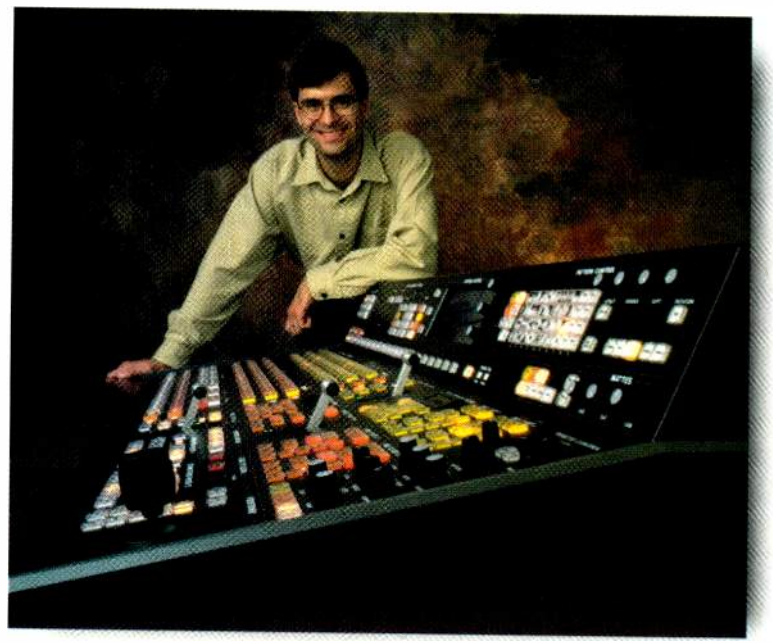
DTV vs. HD production

HD may well be a consumer success. No one knows for sure just yet. DAT, Digital Compact Cassette, Betamax, MiniDisk, and AM Stereo are all examples of compelling superior technologies that didn't catch on with consumers. If HD fails in the consumer market, broadcasters that chose to go straight to HD will be saddled with high debt and poor payback on equipment.

Full-blown HD production will not be practical for most broadcasters for many years to come due to its extremely high cost, scarcity of full HD equipment and lack of a single standard. Up and down conversion and conversions to and from interlaced formats are expensive. Up and down converters are expensive, big, consume lots of power and add artifacts, especially conversions between interlace and progressive scan formats.

The real difference between NTSC and DTV

Once a decision is made to use 601 as a springboard to DTV, the real difference between the two standards becomes apparent: screen real estate. Deciding to use 601 equipment is easy (relative to HD) and low risk, but it doesn't save you from having to get a widescreen show on the air.



David Ross with Ross Video's Synergy 3 DTV Switcher.

Remember, you can't directly mix a 4:3 source and a 16:9 source together. On a 4:3 set, the 16:9 will look unnaturally tall and skinny; on a 16:9 set, the 4:3 image will be stretched to look fat. Dealing with the differences in aspect requires extra hardware and careful production management. Converting NTSC to 601 was comparatively simple because the picture shape was unchanged – you set up the converters and forgot about them. Now, with different picture shapes and varying content within those pictures, you have to make real time decisions about the conversion during live production. For live productions such as news and sports, it all comes together in the production switcher.

A new type of production switcher designed for DTV production is needed to enable simultaneous 4:3 and 16:9 production. Such a switcher would have the following characteristics:

1. Allow easy intermixing of 4:3 and 16:9 input sources;
2. Deliver a 4:3 NTSC production and a 16:9 DTV production at the same time;
3. Make it possible to deliver both NTSC and DTV productions with the same or fewer operational people; and
4. Allow compelling use of the additional screen real estate offered by 16:9.

The Synergy Series Digital Production Switchers by Ross Video are switchers that meet these requirements.

The key to being able to handle simultaneous dual aspect ratio production is to be able to aspect ratio convert on the fly, inside the production switcher. Synergy features internal aspect ratio converters called Aspectizers. Internal Aspectizers make it possible to convert 4:3 to 16:9 or 16:9 to 4:3 on any input. To further enhance the conversion process, Aspectizers feature smooth pan-and-scan, squeeze effects, color background gen-

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erators, and more. The switcher operator easily controls the look of the format conversion either manually or by using quick presets. This makes it simple to handle sources that can quickly change aspect ratios such as those fed through VTRs, routing switchers or remote feeds.

When an Aspectizer is installed, both the original and the aspect ratio converted images are available within the switcher simultaneously, effectively doubling the number of switcher inputs. Both formats are available just like any other input on the switcher and can be separately assigned to a button, accessed through a shift function, or can be chosen automatically depending upon the current production format of an ME. Synergy's Aspectizers can also be placed on the switcher outputs. This provides several options for achieving a simultaneous dual aspect ratio production.

The key to being able to handle simultaneous dual aspect ratio production is to be able to aspect ratio convert on the fly, inside the production switcher.

Synergy employs other powerful technology to simplify dual aspect ratio production. Two of the most notable for this purpose are:

- Internal 2D DVEs built into every keyer. These can be used to add dynamic effects within expanded screen areas. They can also be used as additional aspect ratio converters and are particularly useful for quickly converting the aspect ratios of linear keys.
- Custom Control Macro Buttons. It is imperative to reduce the number of keystrokes required in delivering a typical newscast. These dedicated buttons, right on the switcher panel, can produce powerful effects at the touch of a single button. They can be used to trigger keystroke macros, run timelines, recall memories, cue and play video servers and VTRs, control external DVEs, run audio server sound effects, and more.

The cut over to DTV will require broadcasters to deliver a new 16:9 format DTV signal while continuing to deliver the current 4:3 NTSC signal for years to come. The live productions for these two transmitters must deal with a changing mix of 4:3 and 16:9 sources. A CCIR- 601 production switcher containing multiple program quality internal aspect ratio converters (Aspectizer) with integrated, flexible, on-the-fly control is required to make simultaneous dual aspect ratio production possible. The Synergy production switchers from Ross represent a new type of digital production switcher, one designed specifically for live dual aspect ratio DTV production.

For more information on Ross Video's Synergy Series switchers, circle (452) on the Free Info Card. ■

David Ross is Ross Video's executive vice president and director of product development. Jeff Moore is director of marketing and sales.

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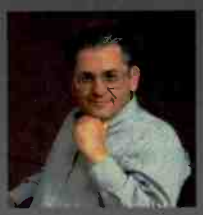
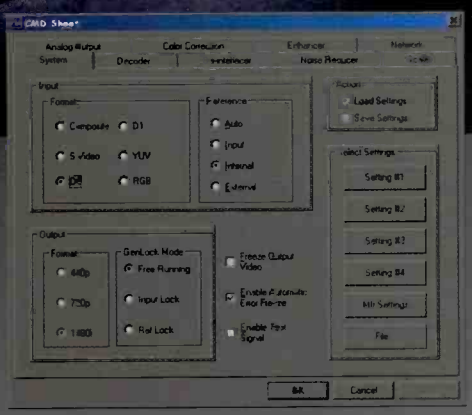


Yves Faroudja, founder of Faroudja Laboratories, was awarded the prestigious Charles F. Jenkins Lifetime Achievement Emmy Award for the development of key patents in the area of video processing.



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Circle (148) on Free Info Card

Applied Technology

Preventing color surprises

BY MARK EVERETT

The advent of digital television, both 601-based and HD, has brought a myriad of concerns and surprises to producers, editors and engineers. Not the least of these surprises results from transferring video from an original digital format to desktop or encoded formats. The colors have changed, and no one knows why. The basic truth comes from the fact that 601- and HD-based digital video is capable of producing a wider range of colors than RGB, NTSC or PAL formats. Therefore, when converting from 601or any HD digital formats, some colors may not be acceptable (legal) in RGB, NTSC or PAL formats and will not reproduce as expected.

The problem is the color gamut of the involved systems. Gamut problems have been around ever since the first paint systems were introduced into video. The basic problem has not changed. The originating system is capable of producing combinations of luminance and saturation that just do not reproduce in the defined NTSC or PAL gamut. Advances in imaging technology, expanded film color reproduction and the ability to get more of the original colors to video with improved imaging sensors, have opened the world of video to more gamut correction opportunities.

Broadcasters and production houses all over the world are replacing their analog plants with 601 and HD systems. However, much (if not most) of the product will be viewed in an encoded (NTSC, PAL or SECAM) format for many years to come. Color gamut is an issue that must be addressed.

There are at least three different variations of PAL legal chroma saturations, therefore at least three different definitions of PAL gamut. NTSC isn't much better. There are also at least three different definitions of gamut limits in the U.S., and they all have validity. Then there is the question of server- and PC-based video. Some of this equipment depends on computer-based RGB processing – another set of gamut limits.

Now, producers of commercials who are concerned with the presentation of certain colors take the time and energy to assure that all release copies are correct. This is not always the case and is not always possible given limited time and budgets. The next best solution is to find a method that will assure the colors will be limited.

The DL-810 Serial Digital Legalizer evaluates 601 video in real time on a pixel-by-pixel basis and provides an output guaranteed within NTSC or PAL encoded legal limits.

Videotek has produced a number of 601 processing products that address various aspects of the gamut issue. Color correctors – terms which colorists would just as soon never hear – have been around for some time. Both the SDC-101 and SDC-831 provide the operator, in a tape-to-tape editing situation, a means to either reduce gains and levels to meet gamut requirements, plus a means to simply clip the video to predetermined limits. Color correctors are traditionally complex and allow individual controls over gain, gamma, black level and offset of, at least, primary colors (RGB) and basic 601 (Y Cb Cr) components. Simpler solutions are similar to proc amps, and products such as the DPA-100 and DPA-90 have been produced to offer the operator the tools that are similar in operation to the traditional analog counterparts.

The color correctors have various amounts of automatic real time gamut-limiting features, depending on the model selected. One proc amp, the DPA-100, has an encoded legalization feature which is ideally suited for broadcast applications. We have found that a nice safety feature in a 601 plant is to put this proc amp in line just after master control and before the 601-to-NTSC encoder.

A further advantage offered by this line is the breadth of experience gained from real application by pioneers in the digital world. Recent additions to legalization added into products such as the SDC-831 and the new stand alone legalizer, DL-810, include the expansion of gamut limiting beyond strict definitions of RGB and encoded gamut. These include clip settings in one-unit increments plus vector limiting. Another issue is the vector circle. Encoded saturation is dependent on both luminance amplitude and chroma amplitude. There are a large number of legal combinations of luminance (around 50 IRE) and highly saturated chroma (up to 140 total units) where the vector is outside the graticule circle. However, there are many engineers and production customers who firmly believe that video should never go beyond the vector circle. Vector limiting has been added to satisfy those desires. Gamut legalization is a serious issue and will remain with broadcasters and producers as long as video is released in more than one format. ■

For more information on Videotek's DL-810, circle (453) on the Free Info Card.

Mark Everett is vice president of advanced technology at Videotek, Pottstown, PA.

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Circle (143) on Free Info Card

Production switchers

BY ED FRATICELLI

Since the early days of television broadcasting, there has always been a need to switch video signals from one source to another. Switching signal applications range from a master control operation that switches signals to a transmitter to a production switcher feeding a VTR, all the way to a simple "glitch" switcher connected to a monitor.

Production switchers are at the heart of almost any post-production operation. Traditionally, these systems have been behemoths with control panels full of buttons and lights and rack-sized chassis full of expensive electronics. The typical analog model of just a few years ago found in many edit suites was this type of unit, expensive and difficult to maintain. Processing electronics of these analog giants required endless tweaking of complicated signal path alignments.

Over the last 10 years or so, many post operations have begun the move toward systems that handle signal switching and processing in the digital domain. While many general purpose software-operated production systems have found their way into post systems, there are still many applications where the dedicated hardware-based units, especially production switchers, are still desirable or even necessary. The proprietary hardware and firmware in these systems generally run faster than their software-based counterparts. Many scenarios require separate units for various uses (switchers, DVEs, etc.), so multiple operators can each concentrate on their particular function. This is especially true in live production applications, where this type of operation is essential.

Today, there are many choices still available for dedicated production switchers. These systems span a range of sizes and capabilities, from the smallest single keyer "telecine switchers" to the largest of the live production monsters. The digital processing technology used in today's switchers has made even the smaller units powerful and much less expensive than the models available just a short time ago. Today's switcher buyers can expect faster, more powerful units in smaller, less power-hungry packages at a reasonable cost.

While there are still several manufacturers offering analog switcher models, the largest selection and advanced feature sets are available in the digital realm. The stability and reliability of digital processing systems makes them a good choice, even when switching analog signals. The addition of analog converters on the I/Os would be necessary in this situation. Then, as digital recorders and sources are added to this hybrid system, a gradual conversion to a fully digital system can be accomplished.

The digital processing technology used in today's switchers has made even the smaller units powerful and much less expensive than the models available just a short time ago.

Production switchers are usually ranked by size in two categories: number of inputs and number of effects banks. An effects bank normally consists of a set of input-selecting "bus rows" and one or more keyers. Each bank can perform any of several transition types, such as a fade, dissolve or wipes. Keys can be added to these to allow the superimposition of signals over the backgrounds. One effects bank can then be "re-entered" into another one, allowing the cascading of layers of these effects.

Switchers for live production generally are larger, meaning more simultaneous inputs and three or more effects banks. Switchers for post-production suites can, generally, stand to be smaller units, which cost less and take up a smaller "footprint" on the console. Many modern teleproduction suites tend to minimize the impact that the equipment has on rooms, and these small, but powerful units fit in perfectly. Digital recording allows for less effects to be required per pass as the generation loss typical in older analog systems becomes a thing of the past. So, these switchers can have less keyers and effects layers.

Feature sets can run the gamut. Digital technology again comes into play here, as VLSI (very large scale integration) circuits pack more production power into smaller electronic packages. A standard feature in most models is a memory function to store and recall switcher setups. Sets of switcher functions are stored in a number of different memory registers, which can later be recalled, restoring the switcher to the exact way it was when stored. Some models offer the ability to store these memory registers on internal hard disks and external floppy disks. An extension of this memory function is the timeline feature. Switcher operations can be "learned" into memory and then played back on cue, usually under computer editor control. Key frames are used to set up the timeline, or multiple timelines, with the ability to vary the duration to customize the effect.

Internal digital framestores are also a popular feature. Any number of full-frame memory stores can hold stills to then be selected as if they were an input feeding the switcher. Enhanced frame

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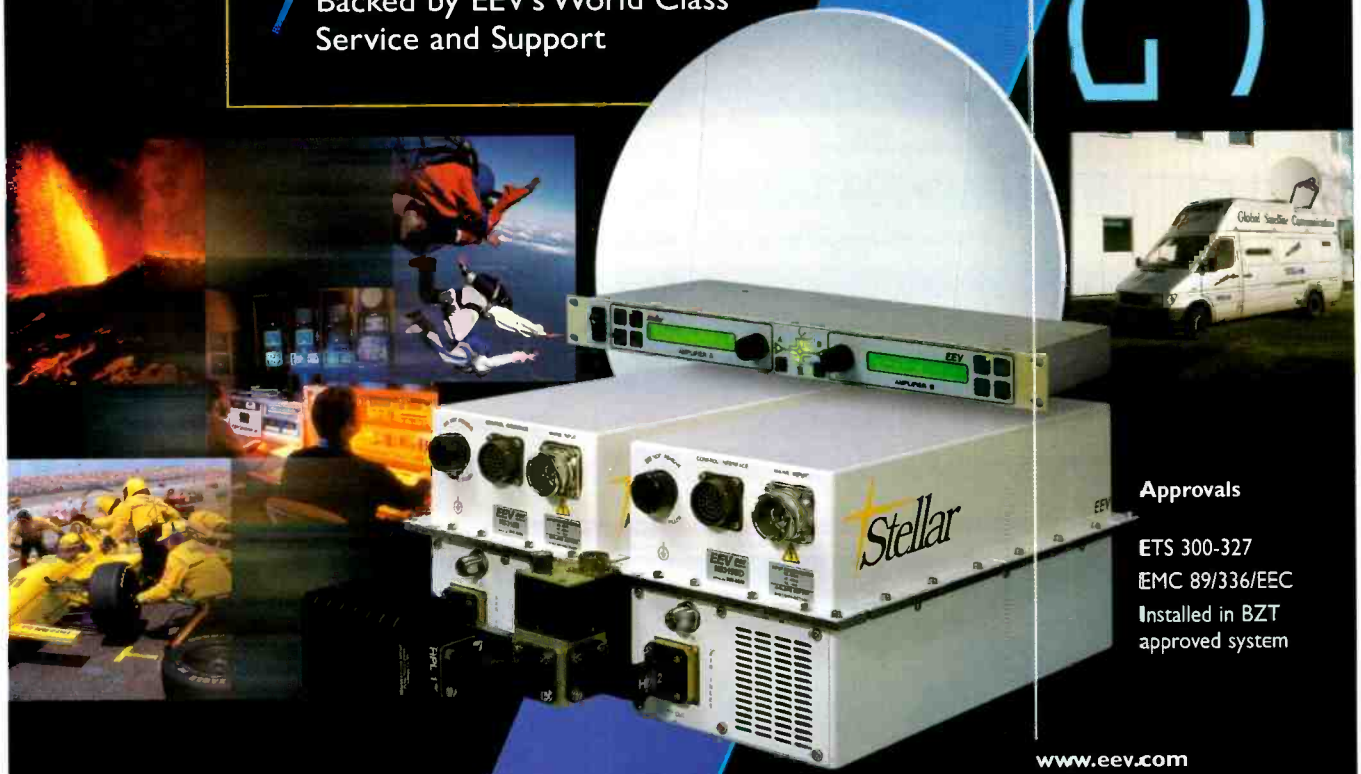

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stores allow painting into the stores, strobe effects and the downloading of graphic stills to and from disk. These stores are particularly useful for storing logos and still backgrounds and some also contain a register for holding a key matte or alpha signal.

Keyers do much more than the simple luminance keys of their predecessors. All types of keys can be accomplished, and chroma keyers are better than ever, since these keyers are already working in a component digital format. Keyer "accessories" such as extensive border and shadow generators, with soft edges, key blurring and various key-shaping parameters are also available. Tight DVE integration, or even built-in DVE capability, can be expected.

One complicating factor in choosing production switchers today concerns digital television's move toward high-definition. Which definition is high-definition? Several different combinations of resolution, frame rate and scanning methods are being used in production and getting one switcher that can handle all of these various combinations is problematic. Of course, most production is still being handled at standard 601 resolution and this equipment will be usable for many years to come. While some manufacturers may offer upgradable modes or units that can be switched between different standards, each facility's situation must be examined individually, since more and more production will be done at higher resolutions. ■

Ed Fraticelli is director of engineering and post production at Production Master Inc., Pittsburgh.

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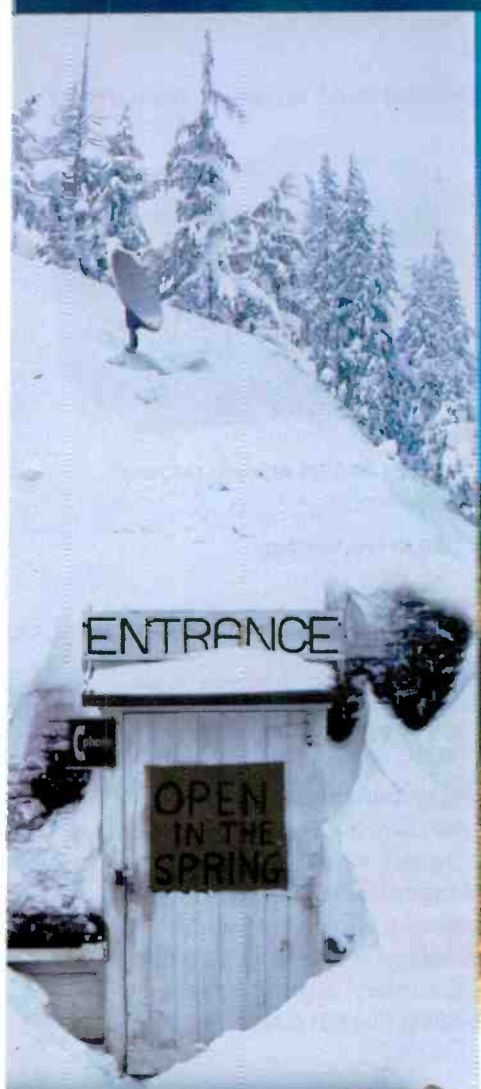

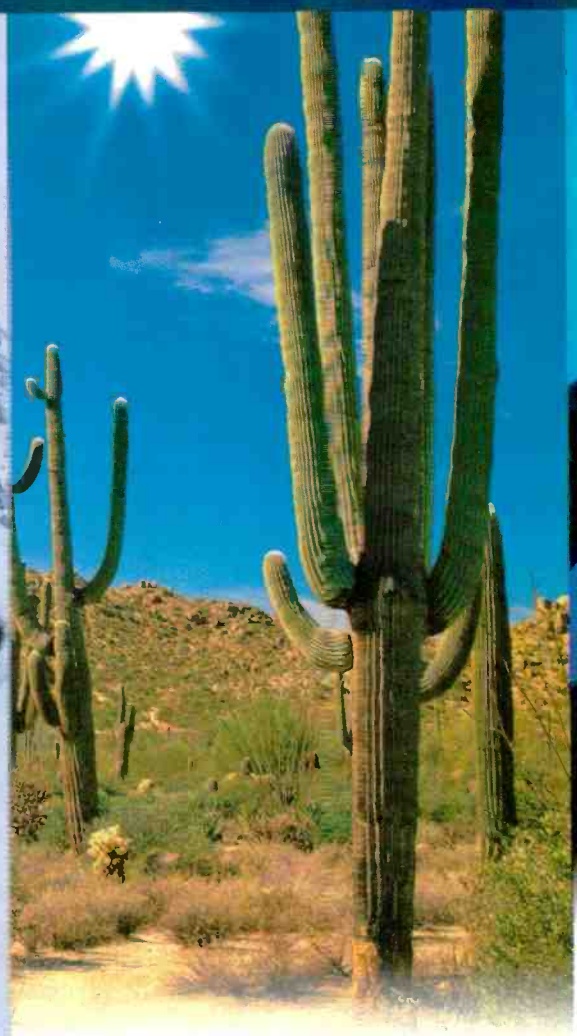

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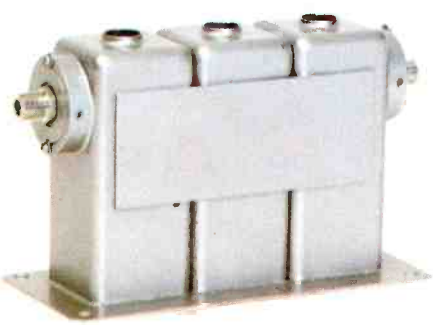

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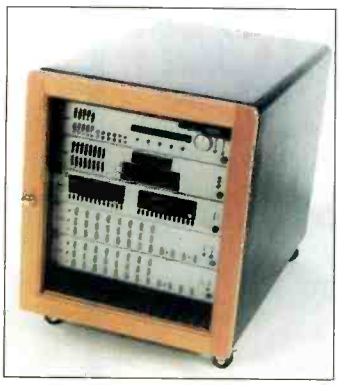

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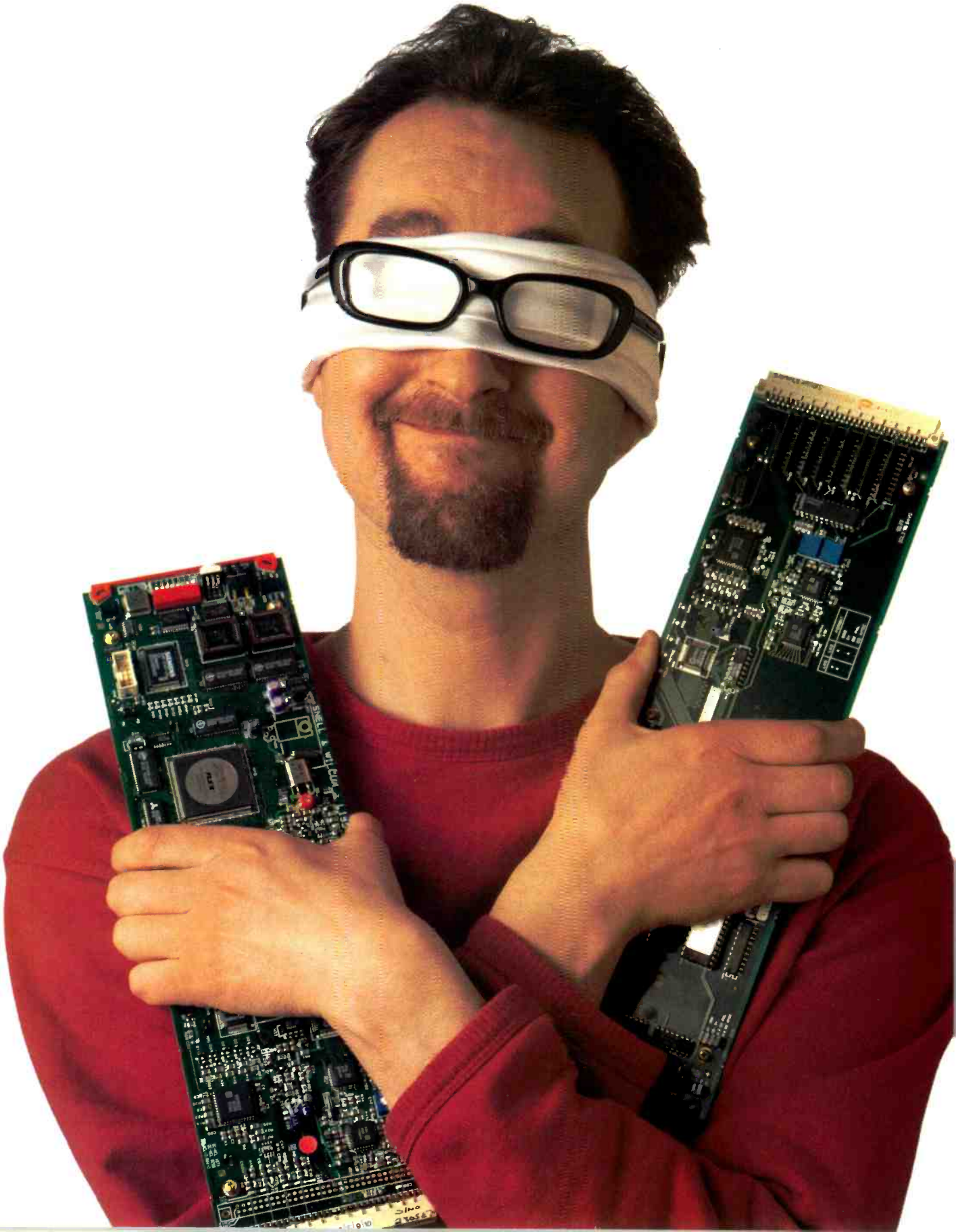

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Business Wire

BY SANDRA FERGUSON, EDITORIAL ASSISTANT

Sony is celebrating two 1999 engineering Emmy awards given by the Academy of Television Arts and Sciences. The first was presented to Charles Steinberg for lifetime achievement. Steinberg retired on June 30, 1999, as president of Sony's Broadcast and Professional Company. The second award was for the development of Sony's HDCAM high-definition VTR. Sony also announced that its Advanced Digital Systems Group signed a licensing agreement with Digidesign to permit support of plug-and-play compatibility with ProTools' DADR-5000 audio files. Northwestern University's Medill School of Journalism purchased 18 DSR-300 camcorders, nine DSR-80 studio VTRs and 14 DSR-20 half-rack VTRs for its graduate and undergraduate broadcast program. Western Illinois University purchased four ES-7 EditStationi systems, four DSR-85 4x spped recorder/players, five DSR-80 studio VTRs, six DSR-20 half-rack VTRs and six DSR-300 DSP camcorders.

Harris and Pacific Research and Engineering will announce the signing of a definitive agreement for Harris to acquire PR&E through a cash tender offer that values PR&E at approximately $9.5 million, including assumption of debt.

NBC awarded Belden a multi-year contract to be its primary supplier for wire and cable products.

Rainbow Network Communications purchased $2.5 million of equipment from Tektronix, including six 7500 Series synchronous AES/EBU digital audio routers, 16 M-2100 master control systems, 32 digital Performer routers and an assortment of digital systemization modular products. The Canadian Broadcast Corp. (CBC) purchased 18 Tektronix Profile video servers to replace regional delay and commercials/promotional play out facilities. The servers are being integrated into CBC's English Television Network regional facilities in Vancouver, Edmonton, Winnipeg, Regina, Halifax and St. Johns.

Acrodyne entered into an exclusive strategic equipment purchase agreement with the Christian Television Network (CTN) to provide TV transmitters and related equipment to CTN for use in its owned and operated stations.

RealNetworks and the Associated Press announced an agreement to provide AP audio and video packages using RealAudio and RealVideo to AP member newspaper and broadcaster websites. EMMIS Communications selected ENPS, the Associated Press' electronic news production system, as the newsroom system for its TV stations. Installation will begin at KHON-TV in Honolulu, with its other stations to follow in 1999 and 2000.

Otari announced Delicate Sound Studios' purchase of a new Otari Concept Elite console as the studio's primary audio post production console.

OpenTV purchased a Quantel Editbox online editor for its in-house creative department.

Cabletel Communications entered into an agreement with BARCO to market BARCO's digital broadcasting products to the broadcast industry.

Hollywood's CBS Television City selected Hitachi's SK-3000P HD cameras to begin HD production at its studio facility.

Telecast Fiber Systems successfully demonstrated that high-definition cameras may now be operated over standard fiber cables by testing a prototype of its new HDTV Cobra system through a mile of existing, nonmetallic fiber cable.

Columbine JDS announced that Broadcast Master, its integrated suite for Windows-based software modules for broadcast station management, has been installed by Nickelodeon International for Nickelodeon's new channels in Asia, Eastern Europe, the Baltics, and the Confederation of Independent States (CIS).

National Mobile Television will install Solid State Logic's Aysis Air console in its newly designed HD3 mobile unit.

Following its recent acquisition of Digipath routing switchers, Miranda chose INFOCOMM to demonstrate the company's new capabilities for signal processing and signal management in AV applications.

People

Sue Osier

Harris named Sue Osier to serve as executive in charge of its broadcast communications division's operation and manufacturing center in Quincy, IL. Jim Zaroda is television district sales manager for the northeastern U.S.

Bill D. Mouzakis

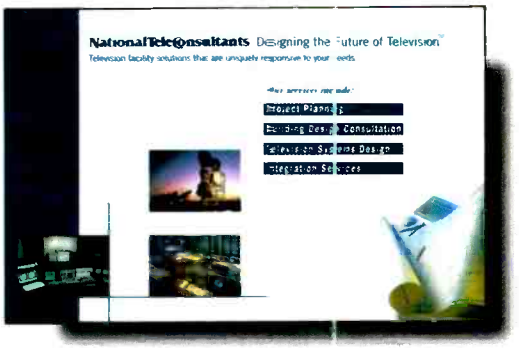
Digital System Technology named Bill D. Mouzakis as corporate director of engineering.

Yeshwant Kamath, a founder of Abekas, died July 11 of a heart attack.

Windows to the Web

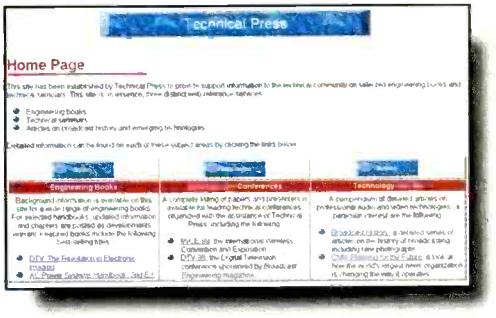
www.digibid.com

Upgrading equipment? Need to remarket the replaced equipment? Digibid provides a ready online marketplace of equipment buyers. Our online auction format makes it easy to sell your equipment.



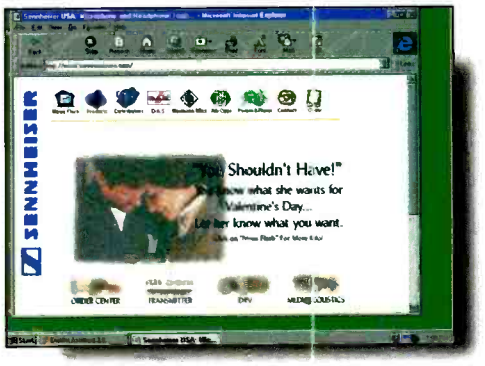
info@ntc.com

National TeleConsultants: National TeleConsultants is the largest independent television facility design and system integration company in the world. NTC is known for building creative and cost effective multichannel network facilities, production studios and television stations. Call us at 818-265-4400 and let us put our 19 years of experience to work for you.



www.technicalpress.com

Technical Press is a web-based reference site that supports more than a dozen video engineering books, including *DTV: The Revolution in Electronic Imaging*. Also available are articles on digital video technologies and applications, and a detailed series on the history of broadcast engineering.



www.sennheiserusa.com

Sennheiser: Established in 1945 in Wedemark, Germany, Sennheiser is an Oscar and Emmy award-winning leader in microphone technology, RF-wireless and infrared sound transmission, headphone transducer technology, and most recently in the development of active noise-cancellation. The company is driven by an innovative and pioneering spirit and is committed to ongoing research, precision engineering and meticulous manufacturing standards.

www.pinnaclesys.com

Pinnacle Systems: Pinnacle Systems' broadcast products give professionals the cutting edge tools needed to create dazzling productions faster and more affordably than ever before. These innovative digital video manipulation tools perform a variety of on-air, production, and post-production functions such as the addition of special effects, image management, capture, storage, and play-out, as well as graphics and title creation.

www.midasconsoles.com

Midas have been manufacturing high-quality, flexible and sonically superior audio mixing consoles for nearly 30 years. They also offer instant service backup and an amazing three year warranty on all products.

NEW FROM
Grass Valley

7500 NB SERIES
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AUDIO ROUTING SWITCHER

GRASS VALLEY IS PLEASED TO ANNOUNCE THE NEWEST MEMBER OF OUR SERIES 7000 FAMILY.

The 7500 NB has arrived, joining its Series 7000 siblings including the Classic Series, DV Series, and HD Series. This narrow-band addition blends strong features, compact size and exceptional value – making it the perfect solution for routing low-bandwidth signals throughout your facility. It's ideally suited for AES/EBU synchronous and asynchronous digital audio routing, and is a great companion to our Series 7000 analog/digital frames. This baby's ready to grow, with systems sized from 64 x 64 all the way to 1024 x 1024.

- *Synchronous audio routing with audio output monitoring*
- *Data rate of 50Mbits/sec, ensuring compatibility with all digital audio formats and compressed digital video signals*
- *Multichannel audio standards are supported, including all Dolby Surround Sound formats required for DTV*
- *Compact size-256 x 256 in only 12 RUs*
- *System growth of 64 x 64 granularity*

With the robust SMS 7000 Control System running through its crosspoints, it's a great addition to any family.

The 7500 NB. We're so proud of it, we just might start giving out cigars.

Call 1-800-TEK-VIDEO, ext. 9945
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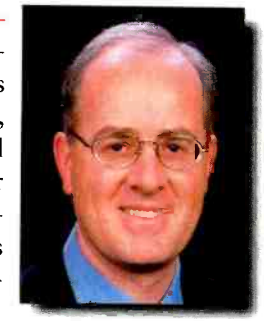
Michael Hession was promoted as Orban's general manager, assuming overall responsibility for managing Orban's operations and developments efforts.



Michael Hession

Fred Besnoff joined Neutrik as product applications manager. ■

Screen Shot

Avid's SOFTIMAGE/DS and Mad Dog Television Way Out in Front at U.S. Open

Avid's SOFTIMAGE/DS was one of the primary nonlinear video editing systems for NBC's three-day coverage of the U.S. Open in Pinehurst, NC, June 14-23. When asked to edit the U.S. Open from Pinehurst, Joe Brown, founder of Mad Dog Television and head editor for the event, said that SOFTIMAGE/DS was his first choice for an editing system. Brown said the system was great at matching the widely differing video footage shot by cameramen on the golf course with the pristinc images shot from the well-equipped NBC truck.

Sea Studios/National Geographic Television Adopt DVCPRO50 Progressive for Eight-Hour TV Series

Sea Studios Foundation, a production company that specializes in high-caliber natural history programming, has just begun shooting of a TV series titled "The Shape of Life" with Panasonic DVCPRO50 progressive equipment. The series of eight one-hour episodes will air nationally in 2001. Sea Studios will use AJ-PD900WA 2/3-inch 16:9/4:3 switchable 3-CCD DVCPRO50 progressive studio VTRs during the series' post production. The 480p footage obtained with the Panasonic cameras will be intercut with film-originated material for the final programs. ■

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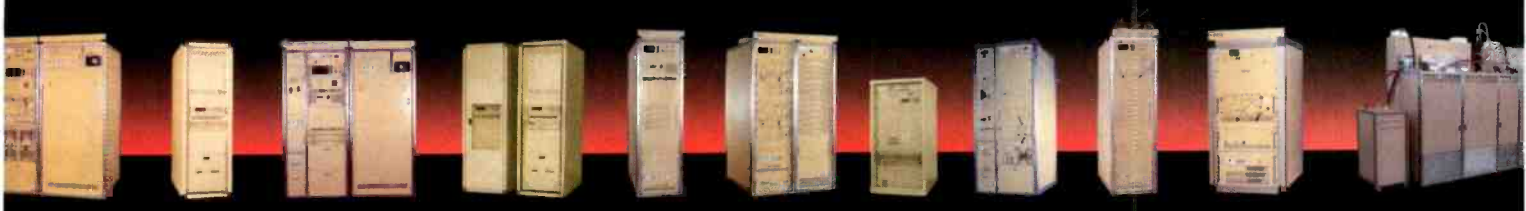

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QUICK DIAL 74

SONY

DSR-200A
3-CCD Digital (DVCAM) Camcorder

Combining a compact and lightweight body with the superior picture quality of DSP (Digital Signal Processing) and the DVCAM format, the DSR-200A is the ideal acquisition tool for video journalists, event and wedding videographers, stringers and production houses. 500 lines of horizontal resolution, 48kHz or 32kHz digital audio, three hour record time, and minimum illumination of 3 lux is only the beginning. Other features include 16:9/4:3 capability, Steady Shot, high resolution 1-inch viewfinder, time code operation, time/date superimposition and an IEEE-1394 interface for direct digital output. Offers full automatic as well as manual control of focus, iris, gain, white balance and shutter speed.

- Variable servo 10X optical power zoom lens goes from 5.9 to 59mm in 1.7 to 24 seconds. The manual zoom rocker is continuously variable right up to where the digital 20X zoom kicks in.
- Sony's Super Steady Shot reduces high frequency camera shake without compromising image quality. SteadyShot uses horizontal and vertical motion sensors that allow it to work accurately while zooming, moving (even shooting from a car), and shooting in low light conditions.
- Has digital effects including audio and video fade, overlap and Slow Shutter.
- Automatic and manual focus, iris, shutter, gain and white balance. Iris is adjustable in 12 levels from F1.6 to F11, shutter from 1/4 to 1/10,000 of a second in 12 steps, Gain from -3dB to +18dB in 8 steps.
- Zebra Pattern indicator, built-in ND filter.
- Custom Preset function lets you preset, store and recall custom settings for color intensity, white balance (bluish or reddish), sharpness and brightness.
- Stores Photo, Date/Time, Shutter Speed, Iris, Gain and F-stop for easy recall. So if you have to re-shoot, you know your original settings for every scene and frame.
- Records Drop/Non-Drop Frame time code. Time code can be read either as RC time code or as SMPTE time code.
- Has a large 1-inch B&W viewfinder with 550 lines of resolution for easy focusing even in low contrast lighting situations. Separate information sub panel displays time code, battery time, tape remaining and other camcorder functions without cluttering up the viewfinder.
- Records 16-bit/48kHz audio on one stereo track or 12-bit/32kHz with two pairs of stereo tracks (L1/R 1, L2/R2), so you can add stereo music or narration.
- One-point stereo electret condenser mic for clear stereo separation. Directivity can be selected from 0°, 90° & 120°.
- Automatic & manual (20-step) audio level record controls. Monitor audio with headphones or from the LCD panel which has an active VU meter.
- XLR input connectors for mics and audio equipment.

DSR-200A Field Package:
- DSR-200A Camcorder • NPA-1000/B Battery Case Adapter
- 3 NP-F930/B 7.2v 4000 mAH Batteries
- AC-V900/B AC Adapter, Triple Battery Charger
- VCT-U14 Tripod Adapter • LC-2000CP System Case

DSR-20
DVCAM Player/Recorder

The DSR-20 is a versatile DVCAM VCR with a very compact chassis and a variety of convenient functions for recording, playback and simple editing. It features auto repeat playback, power-on recording/playback, multiple machine control interfaces, AC/DC capability and i.Link (IEEE1394) input and output. And of course, it offers the stunning image and sound quality inherent to the DVCAM format.

DVCAM Quality
- Utilizing the DVCAM format, the DSR-V10 provides the recording/playback quality and reliability required for professional use. It can also play back consumer DV format tapes without any special adapter.
- Provides two selectable audio modes; a two channel mode with 48 kHz/16-bit recording and a four channel mode with 32 kHz/12-bit recording.
- Dual-size cassette mechanism accepts both mini size (up to 40 minutes) and standard size DVCAM tapes (up to 184 minutes) without an adapter.

Editing Capability
- Equipped with Control L interface, the DSR-20 can perform simple time code-based editing when connected to another DSR-20 or other similarly equipped VCRs/cameras like the DSR-30, DSR-200A or DSR-PD1. When using the FXE-120 or ES-3 EditStation System, the DSR-20 can serve as a feeder player.
- Has DV (IEEE1394) input and output. When connected to other DV equipped machines, the DSR-20 offers digital dubbing of video, audio and data, without any deterioration of image and sound quality. In addition, in the "Digital dubbing including TC copy" mode, full information of video, audio and time code of the original tape can be copied to another tape. Especially useful when making working copies of the original.

Record/Playback Functions
- Automatic repeat function for repeated playback. After reaching either the end of the tape, the first blank portion or the first index point, the DSR-20 automatically rewinds the tape then starts playing back the segment again.
- Power-on recording/playback capability for unattended automatic VCR operation. When connected to an external timer and the VCR's TIMER switch is set to REC, the DSR-20 starts recording as soon as power is turned on. Likewise, when the TIMER is set to REPEAT, the VCR goes into Auto Repeat mode and starts playing back the moment power is turned on.
- In addition to Control L, the DSR-20 also incorporates a Control S and RS-232 interface for remote control operation. Basic VCR functions can be controlled from a PC via RS-232, while Control S allows control via the optional DSRM-10 Remote Control. In addition, with the Control S input/output connector, two or more (up to 50) DSR-20's can be daisy-chained and controlled from one DSRM-10 Remote Control.
- External sync input enables synchronized playback with other VCRs. Especially important in A/B roll configurations.

Conveniences
- The DSR-20 be powered by AC or DC. Ideal for mobile applications, the DSR-20 can be connected to a 12V power supply like a car battery or battery belt & powered via the 4-pin XLR DC input.
- Can perform searches for Index Points, which are recorded on the tape as "in-point" marks everytime a recording starts. The DSR-20 can also search for photo data recorded on a DVCAM cassette by the DSR-PD100/200A/300, or where the recording date has been changed.
- Supplied with the RMT-DS20 Wireless Remote for control of basic VCR functions. And again, when two or more VCRs are connected via Control S, they can be simultaneously controlled from one wireless remote by simply sending one command to the master deck.

DSR-30
DVCAM Digital VCR

The DSR-30 is an industrial grade DVCAM VCR that can be used for recording, playback and editing. DV standard 4:1:1 sampling digital component recording with a 5:1 compression ratio provides spectacular picture quality and multi-generation performance. It has a Control L interface for editing with other Control L based recorders such as the DSR-200A DVCAM Camcorder or another DSR-30. It also has a continuous auto repeat playback function making it ideal for kiosks and other point of information displays. Other features include high quality digital audio, IEEE-1394 Digital interface and external timer recording. The DSR-30 can accept both Mini and Standard DVCAM cassettes for up to 184 minutes of recording time, and can playback consumer DV tapes as well.

- Records PCM digital audio at either 48kHz (16-bit 2 channel) or at 32kHz (12-bit 4 channel).
- Equipped with Control L, the DSR-30 is capable of SMPTE Time Code based accurate editing even without an edit controller. Built in editing functions include assemble and separate video and audio insert.
- By searching for either an Index point or Photo Data recorded by the DSR-200A camcorder, the DSR-30 drastically cuts the time usually required for editing. The DSR-30 can record up to 135 Index points on the Cassette Memory thanks to its 16K bits capability.
- Audio lock ensures audio is fully synchronized with the video for absolute precision when doing an insert edit.
- Built-in control tray has a jog/shuttle dial, VCR and edit function buttons. The jog/shuttle dial allows picture search at ±1/5 to 15X normal speed and controls not only the DSR-30 but also a player hooked up through its LANC interface.
- DV In/Out (IEEE 1394) for digital dubbing of video, audio and data ID with no loss in quality.
- Analog audio and video input/outputs make it fully compatible with non-digital equipment. Playback compatibility with consumer DV tapes allows you to work with footage recorded on consumer-grade equipment. Tapes recorded in the DSR-30 are also compatible with Sony's high-end DVCAM VCR's.

QUICK DIAL 74

Panasonic
Broadcast & Television Systems

AG-EZ1 3-CCD Digital Video Camcorder

- Digital recording delivers 500 lines of horizontal resolution with no noise. (S/N ratio is 54dB)
- 10:1 power and 20:1 digital zoom lens. Both zooms are adjustable in four speeds (3.5-15 sec.) For extreme close-ups the lens can focus up to 1/4" from the subject.
- Two digital audio modes, choose between two-channel 16-bit stereo recording or two sets of 12-bit stereo.
- Huge 1.5" 180,000 pixel color viewfinder with 400 lines of resolution displays all functions on demand.
- Digital Electronic Image Stabilizer (DEIS) compensates for jittery video. Particularly effective when the digital zoom is employed.
- Variable speed shutter from 1/60---1/8000 of a second.
- Built-in SMPTE time code generator.
- Digital Photo-Shot lets you record a still-frame for six seconds, while audio continues as normal. 290 still pictures can be recorded on a single 30-minute tape. TopScan function finds any shot easily.

$1995

AG-EZ30 World's Smallest 3-CCD Camcorder w/IEEE1394 Interface

The AG-EZ30 combines 3-CCDs and the DV format to deliver a level of picture and sound quality that makes it one of the most advanced camcorders of its kind. Weighing just 1.5 lbs. this incredibly lightweight camcorder also incorporates a large 2.5-inch color LCD monitor and has a host of sophisticated auto functions as well full manual control when required.

- 3-CCDs (270,000 pixels each) with a large light-collecting area give the camera high sensitivity and wide dynamic range. Double-density pixel distribution and a gapless dichroic prism further ensure razor-sharp images and extremely faithful color reproduction.
- Selectable 2-channe 48 kHz/16-bit or 4-channel 32 kHz/12-bit PCM audio recording.
- Built-in stereo mic and external mic input as well.
- 180,000 pixel, 2.5-inch color LCD monitor. Also has a 0.5-inch color viewfinder.
- Digital Image Stabilizer for clear, shake and jitter free shots.
- 12X optical zoom as well as 30X and 120X digital zoom functions. Move from wide-angle to full zoom in 1.3 seconds allowing quick framing while in REC pause.
- Offers six digital effects: Wipe, Mix, Strobe, Gain-Up, B&W and still mode.
- Large-diameter focus ring enables a high level of focusing precision. A Multi-Function Push Dial allows easy setting of the 16-step iris, 3-step gain control (+12dB maximum) and 14-step shutter (up to 1/8000 second). Mic input level can also be set in steps (-20/-10/0/+3/+6 dB).
- Five program AE modes for shooting in a variety of different conditions. There is also a five-mode white balance: Set, Fluroescent, Auto, Indoor and Outdoor.

SONY

UVW-1600/UVW-1800
Betacam SP Editing Player • Betacam SP Editing Recorder

The UVW-1600 and UVW-1800 are the other half of the JVW series. They offer the superiority of Betacam SP with sophisticated editing features. They feature an RS-422 9-pin interface, built-in TBCs and Time Code operation. Inputs/outputs include component, composite and S-Video.

All the features of the UVW-1200/1400A *PLUS*—
- Optional BVR-50 allows remote TBC adjustment.
- RS-422 interface for editing system expansion.
- Two types of component output; via three BNC connectors or a Betacam 12-pin dub connector.
- Frame accurate editing is assured, thanks to sophisticated servo control and built-in time code operation. In the insert mode of the UVW-1800, video, audio Ch-1/2 and time code can be inserted independently or in any combination.

PVW-2600/PVW-2650/PVW-2800
Betacam SP Pro Series

Whenever versatility and no compromise performance is needed, there is only one choice. Legendary reliability and comprehensive support for its many users has established the PVW series as the standard in broadcast and post production. The PVW Series includes the PVW-2600 Player, PVW-2650 Player with Dynamic Tracking and the PVW-2800 Editing Recorder. They feature built-in TBCs, LTC/VITC time code operation and RS-422 serial interface. They also offer composite, S-Video and component video inputs and outputs. Most important they are built for heavy, every day duty.

- Built-in TBC's and digital dropout compensation assure consistent picture performance. Remote TBC adjustment can be done using the optional BVR-50 TBC Remote Control.
- The PVW-2600, PVW-2650 and PVW-2800 (generates as well) read VITC/ LTC time code as well as User Bits. Ext/Int time code, Regen/Preset, or Rec-Run/ Free-Run selections.
- Built-in character generator displays time code or CTL data.
- Set-up menu for presetting many functional parameters.
- Two longitudinal audio channels with Dolby C- type NR.
- Recognizable monochrome pictures at up to 24X normal speed in forward and reverse. Color at speeds up to 10X.
- Two types of component connection; three BNC connectors or a Betacam 12-pin dub connector. They have composite and S-Video signals as well.

PVW-2650 Only
- Dynamic Tracking (DT) playback from -1 to +3 times normal speed.

PVW-2800 Only
- Built-in comprehensive editing facilities.
- Dynamic Motion Control with memory provides slow motion editing capability.

800 SERIES UHF WIRELESS MICROPHONE SYSTEMS

Consisting of 5 handheld and bodypack transmitters and 6 different receivers, Sony's UHF is recognized as the outstanding wireless mic system for professional applications. Operating in the 800 MHz band range, they are barely affected by external noise and interference. They incorporate a PLL (Phase Locked Loop) synthesized control system that makes it easy to choose from up to 282 operating frequencies, and with the use of Sony's pre-programmed channel plan, it is simple to choose the correct operating frequencies for simultaneous multi-channel operation. Additional features, like space diversity reception, LCD indicators, reliable anc sophisticated circuit technology ensure low noise, wide dyramic range, and extremely stable signal transmission and reception. Ideal for broadcasting stations, film production facilities, and ENG work.

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HyTRON 50 Battery

Weighing a mere 31oz (880 grams) and packing 50 Watt-hours of energy - enough to operate a typical ENG camcorder for two hours, the HyTRON 50 is the most advanced lightweight battery in the industry.

- Made possible by recent advancements in a cell technology originally designed for the mobile computing industry, it incorporates nickel metal hydride cells that provide the highest energy density of any rechargeable cylindrical cell available. High performance is further assured through the integration of Anton/Bauer InterActive digital technology.
- Equipped with an on-board "fuel computer" which monitors energy input and output as well as critical operating characteristics and conditions. This data is communicated to the InterActive charger to ensure safety and optimize reliability.
- In addition, remaining battery capacity information is available by means of an LCD display on each battery and in the view-finder of the most popular broadcast & professional camcorders.
- Special low voltage limiter prevents potentially damaging overdischarge.

Specifications: 14.4 V, 50 WH (Watt Hours)
5-3/4" x 3-1/2" x 2-1/4", 1.9 lbs (88kg)
Typical runtime: 2 hours @ 25 Watts 3 hours @ 17 Watts

QUAD 2702/2401

Four-Position Power/Chargers

The lightest and slimmest full featured four position chargers ever, they can fast charge four Gold Mount batteries and can be expanded to charge up to eight. They also offer power from any AC mains in a package the size of a notebook computer and weighing a mere four lbs! The 40 watt 2401 can charge ProPacs in two hours and TrimPacs in one. Add the Diagnostic/ Discharge module and the QUAD 2401 becomes an all purpose power and test system. The 70 watt QUAD 2702 has the module and is the ultimate professional power system.

FUJINON

ENG LENSES

While ENG camera technology evolves faster and faster, delivering ever higher performance in ever small bodies, it has been increasingly difficult for lens manufacturers to improve quality while keeping size and weight to a minimum until recently. With Aspheric Technology (Ar2) Fujinon has succeeded in manufacturing superior quality lenses that are both smaller and lighter than lenses of conventional spherical design. From the widest angle to the highest telephoto, Fujinon's broadcast hand-held style lenses offer unparalleled features and performance. In fact, they are so advanced and so optically superb they will reshape your thinking about how well a lens can perform.

Fujinon's broadcast hand-held lenses feature the very latest in optical and mechanical design, and manufacturing techniques. New EBC (Electron Beam Coating) reduces flare and improves contrast, while AT2 Aspheric Technology improves corner resolution and reduces chromatic abberation. And all except the 36:1 Super Telephoto offer the exclusive "V-Grip" and Quick Zoom.

A15X8EVM Standard Zoom Lens

A versatile performer in a compact package, offers AT2, inner focus, Quick Zoom and the "V-Grip".

A20X8EVM

Standard /Telephoto Zoom Lens

Combines additional focal length with AT2, inner focus, Quick Zoom and the "V-Grip".

A36X14.5ERD

Super Telephoto Zoom Lens

The longest focal length hand-held style lens to offer AT2 and inner focus.

GLIDECAM INDUSTRIES

V-16 AND V-20

Camera Stabilization Systems

The V-16 and V-20 allow you to walk, run, go up and down stairs, shoot from moving vehicles and travel over uneven terrain without any camera instability or shake. The V-16 stabilizes cameras weighing from 10 to 20 pounds and the V-20 from 15 to 26 pounds. They are both perfect for shooting the type of ultra-smooth tracking shots that take your audience's and client's breath away,– instantly adding high production value to every scene. Whether you are shooting commercials, industrials, documentaries, music videos, news, or full length motion pictures, the Glidecam "V" series will take you where few others have traveled.

QUICK DIAL 74

sachtler

Tripods & Fluid Heads

DV Systems—Digital Support for Every Budget

Today's compact digital cameras require light, fast and highly versatile camera support systems. Starting from the DV2 all the way up to the DV12, Sachtler has a solution tailored for just about every conceivable digital camera package available today. All feature Sachtler's patented counterbalance system and Touch and Go wedge plates. And all except the DV2 feature sliding camera platform to ease in the balancing of your camera.

DV2 System

- The smallest head of the Sachtler's line.
- Sachtler Touch and Go quick release with automatic camera lock and safety lever/drop protection
- One step of dynamic counterbalance
- Frictionless leak proof fluid damping with one levels of drag
- Vibrationless vertical /horizontal brakes
- Built in bubble for horizontal leveling
- Single Stage 75mm tripod DA 75 Long
- Lightweight floor spreader SP 75

This system (0210) consists of:
Fluid Head (DV-2), Long Tripod (DA 75), floor spreader (SP 75)

DV4 System

- Sliding balance plate
- Touch and Go quick release with automatic camera lock and safety lever/drop protection
- One step of dynamic counterbalance
- Frictionless leak proof fluid damping with one levels of drag
- Vibrationless vertical /horizontal brakes
- Built in bubble for horizontal leveling
- Single stage 75mm long tripod DA 75
- Lightweight floor spreader SP 75

DV4 System (0410) consists of:
Fluid Head (DV-4), Long Tripod (DA 75), floor spreader (SP 75)

DV6 System

Same as the DV4 PLUS —

- Five step of dynamic counterbalance
- Five step of vertical and horizional drag

DV6 System (0610) consists of:
Fluid Head (DV-6), Long Tripod (DA 75), floor spreader (SP 75)

DV8 System

Same as DV6 PLUS —

- Greater load capactiy

DV8 System (0810) consists of:
Fluid Head (DV-8), Long Tripod (DA 75), floor spreader (SP 75)

DV12 *Same as DV8 PLUS* — • Great Load Capacity • Fits 100mm tripods

Vinten

PRO-130 SYSTEMS

The Pro-130 tripod systems are perfect for today's on the move ENG cameramen. Lightweight, these systems have been specifically designed to provide a wider balance range to suit the latest DV, DVCPRO, DVCAM camcorder and camera/recorder combinations. All systems come complete with the PH-130 fluid pan & tilt head, choice of single or 2-stage ENG tripod, floor spreader and soft carrying case for easy transportation.
The PH-130 pan & tilt head incorporates Vinten's continuously variable LF drag system to provide smooth movement and easy transition into whip pan, together with a factory set balancing mechanism. Both the single-stage and two-stage legs are toggle clamp tripods are made from strong, durable aluminum with excellent height range capabilities.

VISION 8 AND 11 Lightweight Heads For the Future

Superbly engineered and designed for use in professional broadcast, educational and corporate productions, the Vision 8 and Vision 11 simultaneously provide the ultimate in lightweight support with exceptional robustness— even in the toughest shooting conditions.

Vision 8 Pan & Tilt Head

The incredibly lightweight Vision 8 provides smooth shots, whip pan action and quick set-up while supporting up to 23 lbs. Add the single-stage carbon fiber tripod and you have the lightest combination possible for that all important event— without sacrificing the reliability and robustness that you require.

- Simple external adjustment for perfect balance over the full 180° of tilt
- Infinitely variable drag with proven LF technology
- Calibrated drag knobs
- Flick on/flick off Pan and Tilt brakes
- Single rotation counterbalance
- Leveling bubble standard
- Standard 100mm leveling ball • Lightweight, only 5.9 lbs.

Vision 11 Pan & Tilt Head

Slightly heavier the Vision 11 offers additional capacity (up to 29 lbs.) plus it has illuminated controls to allow fast camera balancing and leveling even in poor lighting. Combine with a two-stage carbon fiber or aluminum tripod and you have a package with the biggest height adjustment yet the smallest to carry. Ideal for all ENG assignments.

- Simple external adjustment for perfect balance over the full 180° of tilt
- Infinitely variable drag with proven LF technology
- Back-lit and calibrated drag knobs
- Flick on/flick off Pan and Tilt brakes
- Digital counterbalance readout
- Illuminated leveling bubble • Standard 100mm leveling ball
- High load to weight ratio • Lightweight — only 6.2 lbs.

QTV

15" and 17" On Camera Prompters

The 15" and 17" On Camera prompter is the industry standard and designed for use with any camera, for any application. The high contrast, high resolution monitor, created by QTV, is the result of state of the art components and design. The monitor permits a much greater degree of tilt because of its cutaway feature. Its VPS Eyeline feature superimposes copy over the camera lens, enabling the reader to maintain maximum eye-to-eye contact. It's easy and comfortable to read. QTV's On Camera prompter will make sure the talent has clear access to the prompter. The 17" model has a viewing area of 123 sq. inches, 39% more than the 15" model. The 15" On Camera prompter is also available in a free standing pedestal model, which can be utilized both in the studio and in remote situations.

MVP-11

The MVP-11 incorporates QTV's latest design technology for studio and EFP prompting. The MVP-11 features the most advanced circuitry for a prompter of this size. Fully self-contained, it offers high brightness and high resolution that ensures unmatched ease of readability for the speaker. The MVP-11 is powered by AC or DC current utilizing the Sony type NP-1 or Anton Bauer 13-14 volt batteries, allowing on-location as well as studio prompting. It weighs only 19 lbs. including the quick release roller plate for fast mounting and balancing. Below the lens mounting is utilized resulting ideal counter balancing for ease of operation.

MVP-9 Mini Videoprompter

The MVP-9 mini videoprompter is designed for use with smaller cameras and small spaces. The same level of performance is achieved as the larger CRT based units but in a smaller configuration that is powered by AC or DC current (as above). Created for the new generation of smaller, lighter cameras, the MVP-9 weighs only 17 1/2lbs and both the monitor and camera mount set up quickly and easily. As with the other units the VPS Eyeline feature assures maximum eye contact with lens while easily raeding the script. It packs up very tightly, making it easy to take anywhere

PROFESSIONAL VIDEO TAPES

QUICK DIAL 71

FUJI

Professional Grade VHS

PG-30	2.39	PG-60	2.59	PG-120	2.79

Broadcast Grade VHS Box

BGR-30	3.49	BGR-60	4.19	BGR-120	4.69

H471S S-VHS Double Coated

ST-30	6.89	ST-60	7.69	ST-120	7.99

M221 Hi 8 Double Coated

Metal Particles		Metal Evaporated	
P630HMP	4.99	E630HME	7.69
P660HMP	6.29	E660HME	10.69
P6120HMP	8.29	E6120HME	14.19

M321SP Metal Betacam (Box)

05S	12.39	10S	12.99	20S	13.39
30S	15.49	60L	25.49	90L	40.95

DP121 DVC PRO

12M (Med.)	7.49	23M	8.79	33M	10.99
63M	19.99	64L (Lg.)			22.50
94L	31.99	123L			39.99

maxell

Hi8 Metal Particle (XRM)

P6-120 XRM	6.99

Broadcast Quality Hi8 Metal Particle

P6-30 HM BQ	5.39	P6-60 HM BQ	6.09
P6-120 HM BQ			7.99

P/I PLUS VHS

T-30 Plus	1.69	T-60 Plus	1.99	T-90 Plus	2.09
T-120 Plus	2.19	T-160 Plus			2.69

HGX-PLUS VHS (Box)

HGXT-60 Plus	2.69	HGXT-120 Plus			2.99
HGXT-160 Plus					3.99

BQ Broadcast Quality VHS (Box)

T-30 BQ	3.89	T-60 BQ	3.99	T-120 BQ	5.99

BQ Professional S-VHS (In Box)

ST-31 BQ	6.79	ST-62 BQ			6.99
ST-126 BQ	7.45	ST-182 BQ			13.99

Betacam SP

B30MSP	13.49	B60MLSP	19.99	B90MLSP	29.95

Panasonic

Mini DV Tape

AY DVM-30	6.49	AY DVM-30 (10 Pack)	ea. 5.99
AY DVM-60	7.99	AY DVM-60 (10 Pack)	ea. 7.49
AY-DVM80	16.99	AY-DVM120	21.95

DVCPRO

AJ-P12M (Medium)	6.99	AJ-P23M	9.99
AJ-P33M	11.19	AJ-P66M	19.49
AJ-P64L (Large)	20.99	AJ-P94L	30.99
AJ-P126L			44.99

SONY

Hi-8 Professional Metal Video Cassettes

P6-30 HMPX	4.59	P6-30 HMEX	7.99
P6-60 HMPX	6.49	P6-60 HMEX	10.99
P6-120HMPX	8.49	P6-120HMEX	14.99

PR Series Professional Grade VHS

T-30PR	2.39	T-60PR	2.59	T-120PR	2.79

PM Series Premier Grade Professional VHS

T-60PM	3.99

BA Series Premier Hi-Grade Broadcast VHS (In Box)

T-30BA	3.59	T-60BA	3.99	T-120BA	4.79

MQ Master Quality S-VHS (In Box)

MQST-30	7.49	MQST-60	7.79	MQST-120	7.99

BRS 3/4" U-matic Broadcast Standard (In Box)

KCS-10 BRS (mini)	8.69	KCS-20 BRS (mini)	8.99
KCA-10 BRS	8.19	KCA-20 BRS	8.69
KCA-30 BRS	9.60	KCA-60 BRS	13.39

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

KCS-10 XBR (mini)	8.79	KCS-20 XBR (mini)	10.59
KCA-10 XBR	9.29	KCA-20 XBR	10.69
KCA-30 XBR	11.99	KCA-60 XBR	15.69

KSP 3/4" U-matic SP Broadcast (In Box)

KSP-S10 (mini)	9.59	KSP-S20 (mini)	11.09
KSP-10	10.09	KSP-20	11.59
KSP-30	12.99	KSP-60	16.99

BCT Metal Betacam SP Broadcast Master (Box)

BCT-5M (small)	12.29	BCT-10M (small)	13.09
BCT-20M (small)	13.29	BCT-30M (small)	14.49
BCT-30M (small) (50 Pack)			ea. 13.49
BCT-30ML	18.99	BCT-60ML	23.49
BCT-90ML			34.99

Mini DV Tape

DVM-30EXM w/Chip	14.99	DVM-60EXM w/Chip	17.99
DVM-30EX "No Chip"	12.99	DVM-60EX "No Chip"	13.99
DVM-30PR "No Chip"	9.99	DVM-60PR "No Chip"	10.49

Full Size DV Tape with Memory Chip

DV-120MEM	25.89	DV-180MEM	29.99

PDV Series Professional DVCAM Tape

PDVM-12ME (Mini)	15.25	PDVM-22ME (Mini)	16.25
PDVM-32ME (Mini)	16.99	PDVM-40ME (Mini)	18.49
PDV-94ME (Standard)	33.49	PDV-124ME (Standard)	37.99
PDV-184ME (Standard)	44.95	PDVN-64N	24.95
PDVN-124N	31.95	PDVN-184N	39.95

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QUICK DIAL 731

NewTek

Calibar 3-Oz. Pocket-Sized Test Generator

The size of a ball point pen and running on a single battery, Calibar is an NTSC test signal generator that packs a rack mount's worth of test equipment into a battery operated instrument. Calibar is the fastest, easiest and most portable way ever to calibrate video equipment. No patch bay racks. Just one cable. So besides giving you fast accurate readings in the studio, it's perfect for off-site events or trouble-shooting in the field.

$349

- Designed for studio and field operation, it produces 24 test pattern functions at the touch of a button. 10-bit precision digital-to-analog conversion assures highly accurate signals.
- Calibar's combination of low cost, portability and full-featured operation makes it ideal for broadcast engineers, television production facilities and video post houses.
- Tuck Calibar in your pocket and you're ready to go. Touch the button to generate SMPTE color bars, touch it again to calibrate convergence and so on.
- With the supplied AC adapter, it also functions as a black burst generator.

CHYRON PC-CODI & PC Scribe

Text and Graphics Generator and Video Titling Software

PC-CODI incorporates a broadcast quality encoder and a wide bandwidth linear keyer for the highest quality, realtime video character generation and graphics display. A video graphics software engine running under Windows 95/NT, PC Scribe offers a new approach and cost effective solution for composing titles and graphics that is ideal for video production and display applications. Combined, their a total solution for real-time character generation with the quality you expect from Chyron.

PC-CODI Hardware:

- Fully-antialiased displays • Display and non-display buffers
- Less than 10 nanosecond effective pixel resolution
- 16.7 million color selections • Fast, realtime operations
- Character, Logo and PCX Image transparency
- Variable edges: border, drop shadow and offset
- Full position and justify control of character and row
- User definable intercharacter spacing (squeeze & expand)
- Multiple roll/crawl speeds • Automatic character kerning
- User definable tab/template fields
- Shaded backgrounds of variable sizes and transparency
- Software controlled video timing
- User definable read effects playback: wipes, pushes, fades
- NTSC or PAL sync generator with genlock
- Board addressability for multi-channel applications
- Auto display sequencing • Local message/page memory
- Preview output with safe-title/cursor/menu overlay
- Composite and S-video input with auto-genlock select

PC-Scribe Software:

- Number of fonts is virtually unlimited. Also supports most international language character sets. Fonts load instantly and the level of anti-aliasing applied is selectable.
- Adjust a wide range of character attributes. Wide choice of composition tools.
- Characters, words, rows and fields can color flash
- Character rolls, crawls and reveal modes. Speed is selectable and can be auto timed with pauses. Messages can be manually advanced or put into sequences along with page transitions.
- Multiple preview windows can be displayed simultaneously.
- Transitions effects include: cut, fade, push, wipe, reveal, peel, zoom, matrix, wipe, spiral, split, weave and jitter.
- Import elements to build graphics. This includes OLE objects, iNiNiT! RGBA and TGA with alpha channel. Scribe also imports and exports TIFF, JPEG, PCX, TGA, BMP, GIF, CLP, ASCII, IMG, SGI, PICT and EPS formats.

PC-CODI and PC-Scribe Bundle 2995.00

TRUEVISION/Avid

TARGA 1000/MCXpress NT

Professional Video Production Workstation

Incorporating the award-winning TARGA 1000 video card and Avid MCXpress NT non-linear editing software, this fully-configured workstation meets the needs of production professionals, corporate communicators, educators and Internet authors.

TARGA 1000 Features:

The TARGA 1000 delivers high processing speed for video and audio effects, titling and compositing. Capture, edit and play-back full-motion, full-resolution 60 fields per second digital video with fully synchronized CD-quality audio.

- Compression can be adjusted on the fly to optimize for image quality and/or minimum storage space. Has composite and S-video inputs/outputs. Also available with component input/output (TARGA 1000 PRO).
- Genlock using separate sync input for working in professional video suites
- Audio is digitized at 44.1KHz or 48KHz sampling rates, for professional quality stereo sound. Delivers perfectly synchronized audio and video.

MCXpress Features:

The ideal tool for video and multimedia producers who require predictable project throughput and high-quality results when creating video and digital media for training, promotional/marketing material, local television and cable commercials, CD-ROM and internet/intranet distribution. Based on Avid's industry-leading technology, it combines a robust editing functionality with a streamlined interface. Offers integration with third-party Windows applications, professional editing features, powerful media management, title tool and a plug-in effects architecture. It also features multiple output options including so you save time and money by reusing media assets across a range of video and multimedia projects.

TARGA 1000/MCXpress Turnkey Systems:

- 300-watt, 6-Bay Full Tower ATX Chassis
- Pentium ATX Motherboard with 512K Cache
- Pentium II- 300 MHz Processor
- Matrox Millenium II AGP 4MB WRAM Display Card
- 64MB 10ns 168-Pin (DIMM) S-DRAM
- Quantum Fireball 6.4GB IDE System Drive
- Seagate Barracuda External 9.1GB SCSI-3 Ultra Wide Capture Drive
- Adaptec AHA-2940UW Ultra Wide SCSI-3 Controller Card
- Teac CD-532e 32X EIDE Internal CD-ROM Drive • 3.5" Floppy Drive
- Altec-Lansing ACS-48 3-Piece Deluxe Speaker System
- Viewsonic G771 17-inch (1280 x 1024) Monitor (0.27mm dot pitch)
- Focus 2001A Keyboard • Microsoft MS Mouse
- Windows NT 4.0 Operating System Software
- Avid MCXpress for Windows NT
- Truevision TARGA 1000 or 1000 Pro Video Capture Card

With TARGA 1000 ..... $5995.00
With TARGA 1000 Pro (component input/output) $6495.00

KNOX VIDEO

RS4x4/8x8/16x16/16x8/12x2

Video/Audio Matrix Routing Switchers

Knox's family of high performance, 3-channel routing switchers are extremely versatile, easy-to-use and very affordable. Housed in an ultra-thin rackmount chassis they accept and route (on the vertical interval) virtually any video signal, including off-the-air and non-timebase corrected video. They also route balanced or unbalanced stereo audio. The audio follows the video or you can route the audio separately (breakaway audio). Each of the switchers offers manual control via front panel operation. They can also be controlled remotely by a PC, a Knox RS Remote Controller, or by a Knox Remote Keypad via their RS-232 port. Front panel LEDs indicate the current routed pattern at all times. Knox switchers are ideal for applications such as studio-feed control and switcher input control, plus they have an internal timer allowing timed sequence of patterns for surveillance applications as well.

- Accept and routes virtually any one-volt NTSC or PAL video signal input to any or all video outputs.
- Accept and route two-volt mono or stereo unbalanced audio inputs to any or all audio outputs.
- Video and audio inputs can be routed independently , they don't need to have the same destination.
- Can store and recall preset cross-point patterns. (Not available on RS12x2.)
- Front panel key-pac operation for easy manual operation.
- Can also be controlled via RS-232 interface with optional RS Remote Controller or Remote Keypad.
- Front panel LED indicators display the present routing patterns at all times.
- An internal battery remembers and restores the current pattern in case of power failure.
- Internal vertical interval switching firmware allows on-air switching.
- Housed in a thin profile rackmount 1" chassis.
- Also except the RS12x2 are available in S-Video versions with/without audio.
- Models RS16x8 and RS16x16 are also available in RGB/component version.
- With optional Remote Video Readout, the RS16x8 and RS16x16 can display active routes on a monitor at remote locations, via a composite signal from a BNC connector on the rear panel.
- The RS4x4, RS8x8 and RS16x16 are also available with balanced stereo audio. They operate at 660 ohms and handle the full range of balanced audio up to +4 dB with professional quick-connect, self-locking, bare-wire connectors.

LEADER

Manufacturing test and measurement equipment for over 40 years, Leader Instruments is the standard which others are measured against for reliability, performance, and most important—cost effectiveness.

5860C WAVEFORM MONITOR

A two-input waveform monitor, the 5860C features 1H, 1V, 2H, 2V, 1 s/div and 2V mag time bases as well as vertical amplifier response choices of flat, IRE (low pass), chroma and DIF-STEP. The latter facilitates easy checks of luminance linearity using the staircase signal. A PIX MON output jack feeds observed (A or B) signals to a picture monitor, and the unit accepts an external sync reference. Built-in calibrator and on-off control of the DC restorer is also provided.

5850C VECTORSCOPE

The ideal companion for the 5860C, the 5850C adds simultaneous side-by-side waveform and vector monitoring. Featured is an electronically-generated vector scale that precludes the need for fussy centering adjustments and eases phase adjustments from relatively long viewing distances. Provision is made for selecting the phase reference from either A or B inputs or a separate external timing reference.

5100 4-Channel Component / Composite WAVEFORM

The 5100 handles three channels of component signals, plus a fourth channel for composite signals, in mixed component / composite facilities. Features are overlaid and parade waveform displays, component vector displays, and automatic bow-tie or "shark fin" displays for timing checks. Menu-driven options select format (525/60, 625/50, and 1125/60 HDTV), full line-select, vector calibration, preset front-panel setups and more. On-screen readout of scan rates, line-select, preset numbers, trigger source, cursor time and volts.

5100D Digital Waveform/Vectorscope

The 5100D can work in component digital as well as component analog facilities (and mixed operations). It provides comprehensive waveform, vector, timing and picture monitoring capabilities. Menu driven control functions extend familiar waveform observations into highly specialized areas and include local calibration control, the ability to show or blank SAV/EAV signals in both the waveform and picture, the ability to monitor digital signals in GBR or YCbCr form, line select (with an adjustable window), memory storage of test setups with the ability to provide on-screen labels, flexible cursor measurements, automatic 525/60 and 625/50 operation and much much more.

5870 Waveform/Vectorscope w/SCH and Line Select

A two-channel Waveform/Vector monitor, the microprocessor-run 5870 permits overlaid waveform and vector displays, as well as overlaid A and B inputs for precision amplitude and timing/phase matching. Use of decoded R-Y allows relatively high-resolution DG and DP measurements. The 5870 adds a precision SCH measurement with on-screen numerical readout of error with an analog display of SCH error over field and line times. Full-raster line select is also featured with on-screen readout of selected lines, a strobe on the PIX MON output signal to highlight the selected line, and presets for up to nine lines for routine checks.

5872A Combination Waveform/Vectorscope

All the operating advantages of the 5870, except SCH is deleted (line select retained), making it ideal for satellite work.

5864A Waveform Monitor

A two-input waveform monitor that offers full monitoring facilities for cameras, VCRs and video transmission links. The 5864A offers front panel selection of A or B inputs, the choice of 2H or 2V display with sweep magnification, and flat frequency response or the insertion of an IRE filter. In addition, a switchable gain boost of X4 magnifies setup to 30 IRE units, and a dashed graticule line at 30 units on screen facilitates easy setting of master pedestal. Intensity and focus are fixed and automatic for optimum display. Supplied with an instruction manual and DC power cable.

5854 Vectorscope

A dual channel compact vectorscope, the 5854 provides precision checkout of camera encoders and camera balance, as well as the means for precise genlock adjustments for two or more video sources. Front panel controls choose between A and B inputs for display and between A and B for decoder reference. Gain is fixed or variable, with front panel controls for gain and phase adjustments. A gain boost of 5X facilitates precise camera balance adjustments in the field. Supplied with a DC power cable.

Designed for EFP and ENG (electronic field production and electronic news gathering) operations, they feature compact size, light weight and 12 V DC power operation. Thus full monitoring facilities can be carried into the field and powered from NP-1 batteries, battery belts and vehicle power. Careful thought has been given to the reduction of operating controls to facilitate the maximum in monitoring options with the operating simplicity demanded in field work.

CORPORATE ACCOUNTS WELCOME

Circle (159) on Free Info Card

The GALLERY

The Perfect Digital Audio Interface

Interfacing an analog VTR to a digital plant or a new digital recorder to an analog plant? The low cost ADA2008 *is* the perfect choice!

It features the award winning AD2004 A-to-D converter and the 20-bit brother, the DAC2004. Performance is uncompromising with THD+N of -107 dB. Power the system from the internal international supply or power up to 9 of the ADA2008s from the cost effective PS-202D external redundant supply. Call Rory Rall today.

- *Affordable - No Compromise Performance*
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- *9 pSec intrinsic jitter*
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- *9 segment true digital level meters*
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Circle (160) on Free Info Card

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When you "can't get there from here..."

Use LOGICONVERTER to convert control signals to "dry" relay contacts. Ideal for remote control of studio gear...isolate control circuits, "marry" incompatible logic. Four opto-isolated inputs, 4 relay outputs, with user-programmable logic. Keep one on hand for emergencies!

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Circle (162) on Free Info Card

The GALLERY

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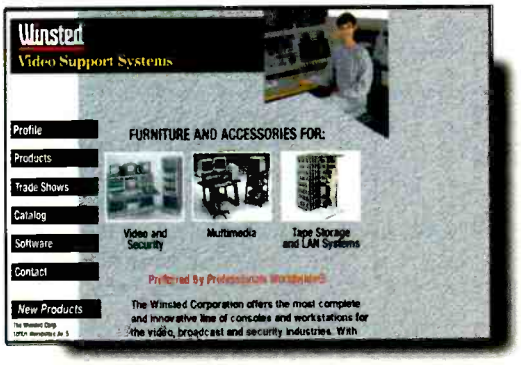

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Winsted Corporation: Winsted offers a full line of modular consoles, rack cabinets, file server workstations, tape storage, and editing desks. The most complete line of accessories in the industry complement this extensive offering. Winsted's 164-page fully illustrated catalog includes an easy-to-understand modular components section that allows you to design your own console, or you can receive a free consultation with a Winsted's system design engineer. To receive a free catalog or learn more about Winsted at their website www.winsted.com or call toll free at 800-447-2257.

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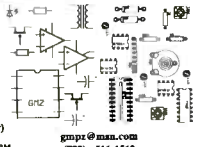

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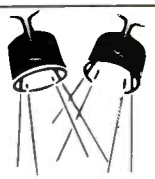

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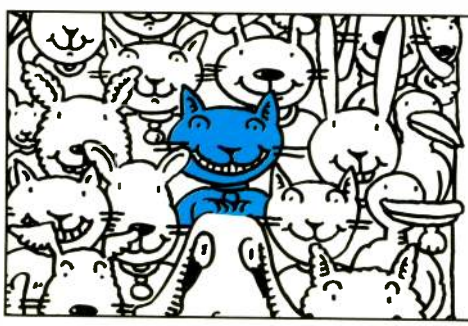

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EOM

Broadcast entrepreneurs: Awake!

BY PAUL MCGOLDRICK

Flying home from a West Coast business trip I got into a conversation with a charming lady who turned out to be the general manager of a smaller PBS station. It became clear, even at this level in our industry, that the lack of DTV rules — and the FCC's unwillingness to make any kind of controversial decisions — has had a telling effect in our not knowing the future of the industry, the "Will it be 720p or 1080i" questions, and the like. Technology problems that are misunderstood lead to expensive solutions. With the major manufacturers now seemingly locked up in one HD camp or another, we seem to be in for the long haul with the full smorgasbord of Table 1.

When I was involved in the sale of broadcast equipment it was always more pleasurable to deal with overseas stations. They generally knew what they wanted and were fairly self-sufficient in dealing with their problems (because they had to be). In the U.S., over the last two decades, the self-sufficiency of the hardcore engineering groups in the major networks has been falling fast. For many companies, those customers often account for 80 percent of a sales team's time and 20 percent of its sales. It's easy to justify that use of time, arguing that once the majors are sold, everybody else will copy their smart decisions. And maybe that was partly true.

Even if it was true, DTV will finally put it to rest.

It's all over for Mom and Pop

I have probably made it clear by now, to regular readers, that I believe the Mom-and-Pop TV station is on its way out. Stations with a market valuation of less than $500,000 (there are far more than you might think) cannot possibly hope to convert to DTV except through a purely philanthropic gesture by a millionaire owner. These stations cannot afford the equipment. Nor will they gain any additional revenues from the conversion to pay for it in the long term. Consolidation, as has happened and continues to happen in radio, will take place with licenses changing hands for, maybe, a quarter of the market value. The saviors from the big cities will put in a satellite dish, a solid-state transmitter and some smarts to make signals look "local" and will originate all programs from their head offices.

I believe the Mom and Pop TV station is on its way out.

For larger stations, with market valuations up to, say, $5 million, that could also be their destiny in the second stage of consolidation. (I think there have been three recognizable levels of consolidation in radio.) It is really up to us to prevent that from happening.

How? My seating companion has a budget of $5 million to get her station up on a UHF channel. Raising that kind of money is not easy for a PBS station, but it will probably be found. Comparably valued commercial stations would not be able to raise that kind of money. However, amortizing the normal equipment renewals that would take place anyway, it is probable these stations could raise a loan of $1 million, repayable over a five-year period.

That kind of money would not go far with today's equipment costs. Something would have to give. Building a fifth of a station in DTV is obviously not an option. But this is a remarkable opportunity for entrepreneurial manufacturers to get into this large dollar market with gear that is good but not built to look like a Cadillac. I recently priced the component costs for a full-bandwidth 16x16 switcher with cable equalization and re-clocking on the inputs. With an industry-available enclosure, a bought-in power supply and a reasonable set of switches, the total cost for a DIY switcher was just a little shy of $1200...the BNC connectors representing by far the largest single item.

The same kind of price savings can be made on just about everything in the DTV chain, including using standard computer products to build your own program server. I am not suggesting that individual stations will get into making their own equipment, but small companies could and should take note of the market momentum while the larger suppliers are focusing on the higher status installations. If companies in the U.S. don't take notice, there are extremely enterprising operations in countries such as Australia that will swing in and happily take advantage of the situation.

Another item that came up in my conversation was the subject of UHF translators and their lack of availability. That really surprised me, because we were making such products at EMI twenty years ago. Doing a UHF-to-UHF conversion (with a reasonable channel separation specified) and producing, say, a 60W output is hardly rocket science and is inexpensive today.

Let's save some TV stations from consolidation and get reasonably priced DTV equipment out there. ■

Paul McGoldrick is an industry consultant based on the West Coast.

SEND Send questions and comments to: paul_mcgoldrick@intertec.com

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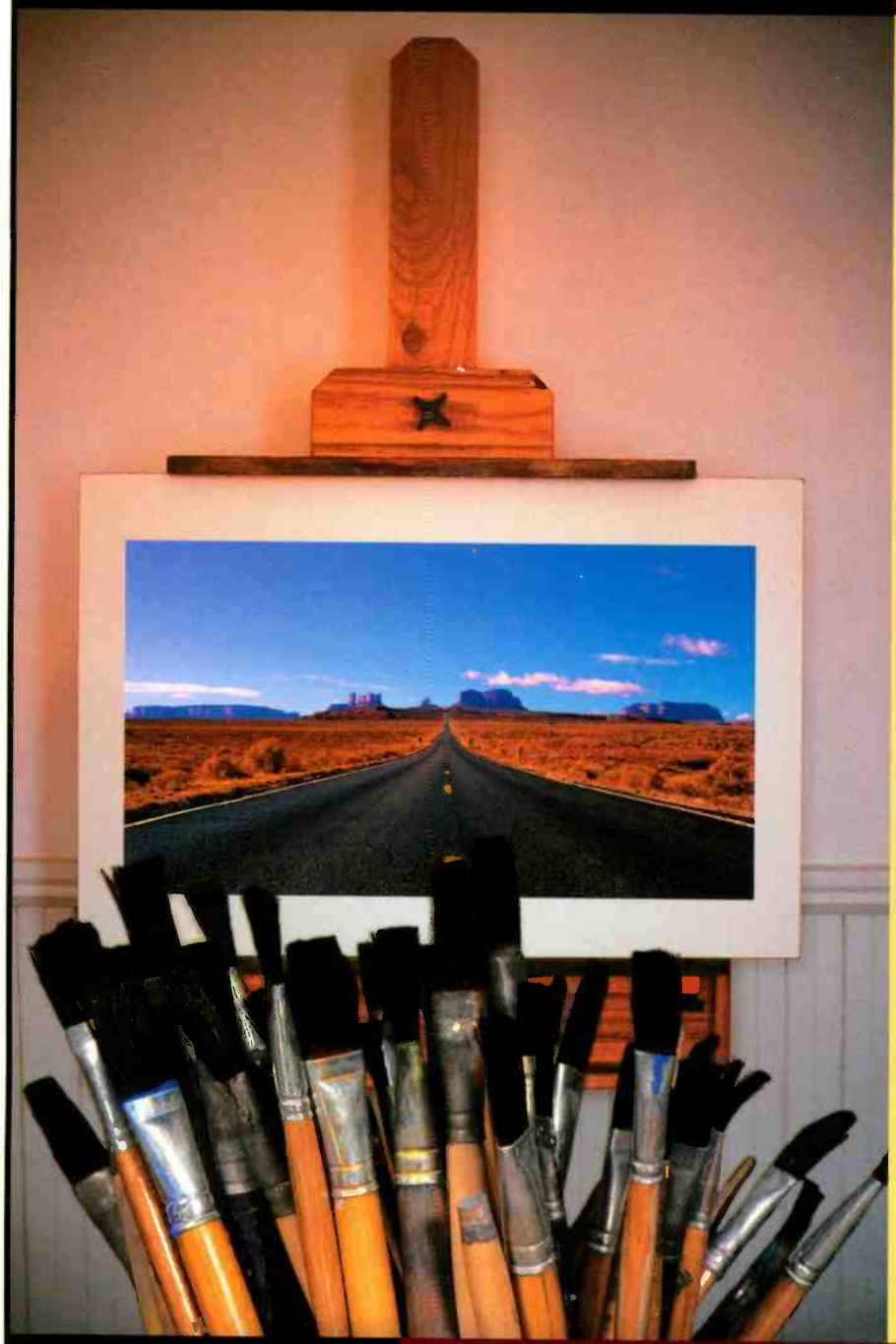

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