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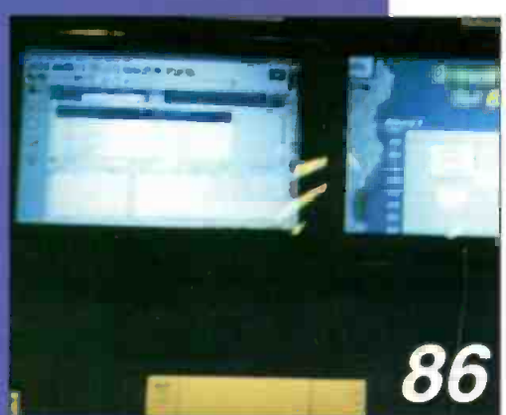

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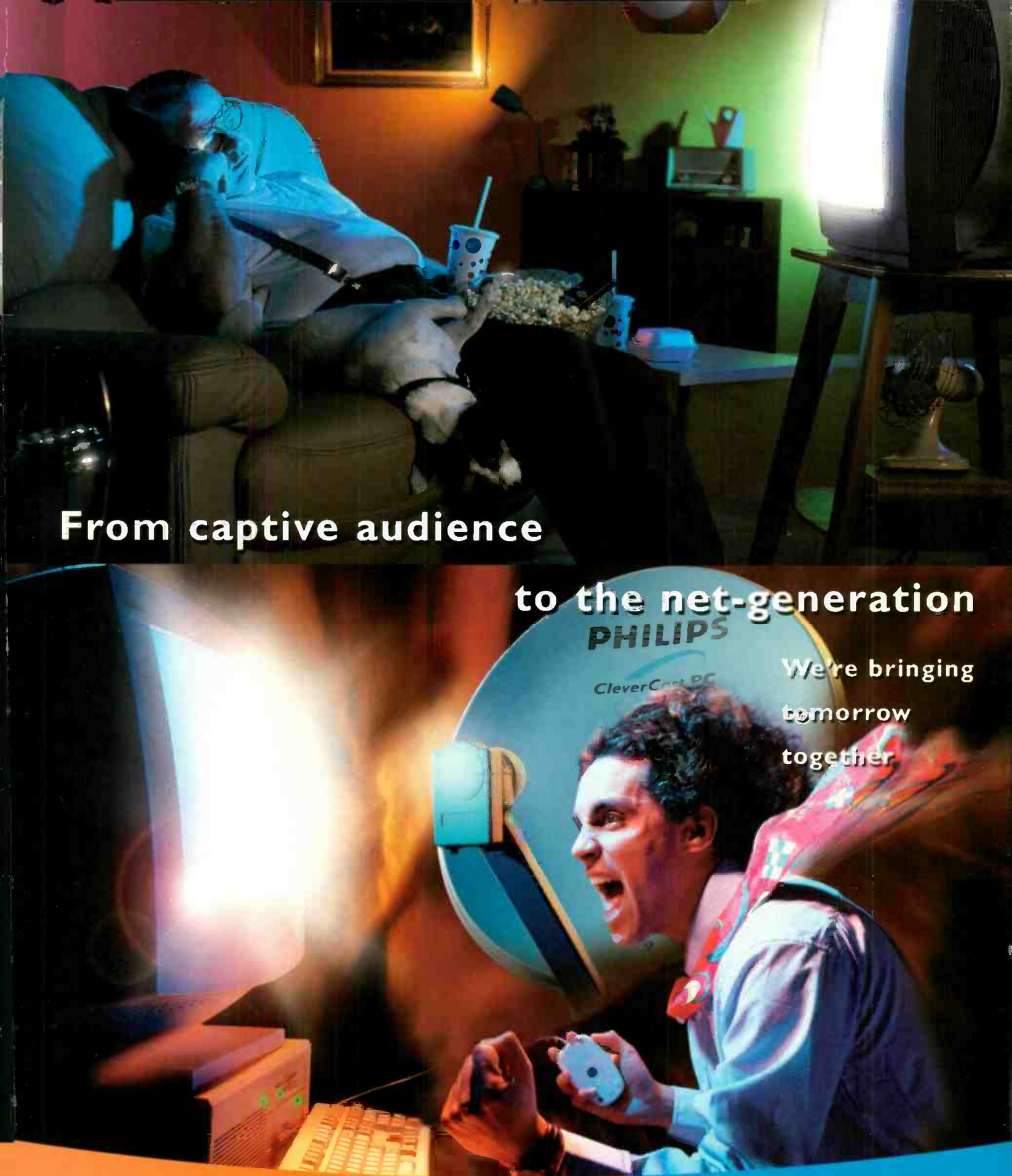

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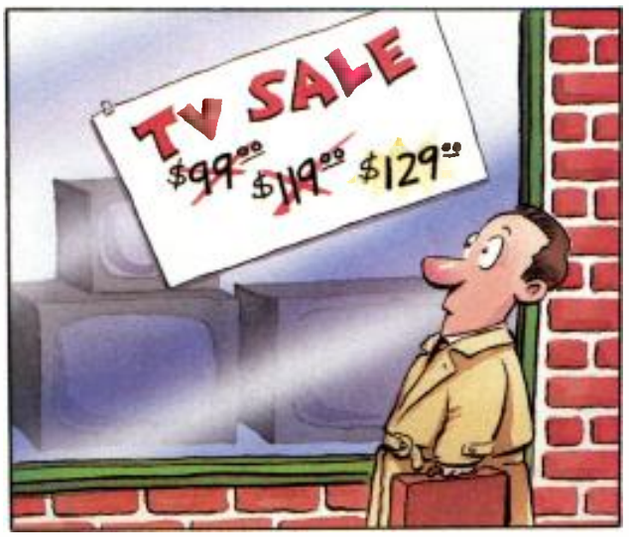
Editorial

Bargain hunting

Even with today's digital technology, getting a bargain TV set isn't always easy. Around Thanksgiving I decided to replace a little 5-inch B/W TV set I'd used in my bedroom with a new 13-inch model. What I thought would be easy and cheap was both harder and more expensive than expected.

First, I discovered 13-inch TV sets come in three flavors; $129, $149 and $189. That's about it. It didn't matter where I looked or what brand I looked at. That was the price.

However, the Friday after Thanksgiving has great sale prices. I almost hate to admit that the call of a bargain had me standing in line at a Wards store at 5:30 a.m. It's cold, dark and windy, but hey, I'm getting a bargain. Little did I know how I'd soon blow the whole process it big time.



When 6 a.m. arrives, the doors open, and pandemonium explodes. Unprepared for the carnage, I watch as people push and shove me out of the way to get into the store. Once they got into the store, they begin *running* for their buys. Never having been in the store, I wander around, clueless as to protocol.

Once I find the electronics section, I quickly look for the sales items. The reason behind my 6 a.m. insanity was the store's ad for a $99 13-inch TV. Remember, I knew what these sets cost and, and I was going to save $30.

About 50 people reached the electronics section before me and they're scarfing up sale items like crazy. As I looked for my TV, I notice a stack of about 30 new stereo VCRs on sale for $99. People were snapping up them two at time. You'd have thought they were loaves of bread and these folks were starving.

Finally, after almost 45 minutes, I managed to locate and buy my $99 TV set. I was about to learn just what a bargain can cost.

Once home, I discover that the TV's speaker was mounted on the side, not the front. It's a small point, but the darn thing drove me batty. The volume had to be really cranked just to hear anything. This would never do. So I returned the set and began hunting for one with a *front-mounted* speaker.

I searched store after store, after store. No acceptable sets for $99. Sales were over and besides, the cheap ones had their speakers on the side.

At this point, my desire for cheap lost out to expediency and functionality. Besides, I'd spent more time looking for that darn TV than I had my last car! So, I decided to just spend the extra $30 and buy a $129 TV because it had two important features. First, the speaker was mounted in the front—where it's supposed to be. And second, the set had channel and volume controls on the front panel. Very useful, especially when you're at the TV and the remote is across the room, or worse—lost?

But that's not the end of my bargain hunting story. Remember my early morning trip to Wards? Just before they opened the doors, the first 200 people in line got a coupon to buy up to two Furbys for $29 each. I got my coupon, looked at it, and thought, "Why would I want a Furby?" Sticking the coupon in my pocket, I never gave it another thought.

Just before Christmas, Furbys were selling for $200 apiece in local papers. Let's see now, $400-$60 = a $340 profit. I wonder what size TV could I have gotten for that?

Brad Dick

Brad Dick, editor

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Reader Feedback

Fixing lip sync

David Pickett's question on lip sync problems and your response were quite interesting to me. Pixel sells tracking audio delays to correct lip sync problems, and I have some knowledge of the problem. Generally, the problem has been quite bad on the West Coast for several years, but nobody really paid attention until advertisers started demanding compensation for commercials which aired with bad lip sync problems. Nothing like a little lost revenue to bring a problem to the forefront of technology.

The problem, in simple terms, is easy to correct — just add a compensating audio delay everywhere the video gets delayed. Unfortunately, this is an expensive problem since the video gets delayed by a significant amount in virtually every video device from the camera (frame memory based digital processing) to the consumer TV (digital special effects and full-time frame-based video noise reduction). With the addition of some heavy-duty video processing for compression encoding and decoding, the problem gets really bad.

The added headache is that most of the video delays have a habit of changing very quickly by large amounts. This is caused by frame synchronizer pointer crossings and compression equipment catching up or falling behind, depending on instant changes in the video content. Tracking audio delays can be made to keep up with the quickly changing video delay, but since audio is more or less continuous, making large audio delay changes quickly without introducing artifacts is very difficult. Many MPEG equipment designers have built-in audio delays, but they usually suffer from one of four deficiencies:

•The delay is set to the average video delay of the video and left unchanged (this guarantees the lip sync will be bad all the time but rarely really bad).

•The delay is changed by stealing or repeating audio samples, which often results in clicks, pops and severe distortion in the audio.

•The delay is changed by using a FIFO memory and reading audio out of the memory slower or faster than it is written into the memory (this causes a pitch change).

•Using a FIFO memory but limiting the rate of change to around 1 percent so the pitch change is not very noticeable. The audio delay correction will lag video delay changes by a considerable time — around 30 seconds for an MPEG encoder, usually occurring during commercial time.

We have found that the FIFO approach with DSP processing to correct the pitch error works well, and we can change audio delay at a 20 percent rate without any pitch error and with minimum tempo error. Very few professionals can detect a one-second delay change made at the 20 percent rate with typical speech and background music found in commercials.

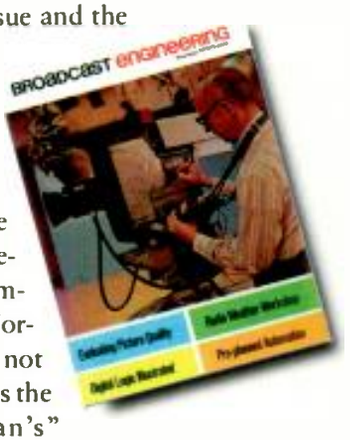
The audio delay problem can be solved, but in order to keep the cost down, video equipment manufacturers need to add a digital delay signal output (DDO) to their equipment. This is basically a 2V p-p (TTL level source terminated in 75Ω) square wave output on a BNC connector. This signal has a positive duration matching the video delay. The signal needs to be repeated constantly at a rate that guarantees approximately a 50 percent duty cycle when the video device is at maximum delay with a minimum positive period matching the minimum video delay, or at least 20µs so the receiving device knows it is there at minimum delay. For example, a four-field video synchronizer would output a positive pulse matching the current video delay every eight fields, with the minimum positive duration being 63.5µs assuming the synchronizer has a minimum delay of 1H. If every video processing device had this output then it would be a simple matter for facilities to add a companion audio delay to keep lip sync in alignment.

For more information on these problems, we have published several application notes on our website: pixelinstruments.com.

CARL COOPER
PIXEL INSTRUMENTS

Poor man's PC70

The camera on Page 12 of the November issue and the response from Rick Pitchford caught my eye. There must have been a typo because the camera was the Norleco LDH-1, not LHD-1. It was the "poor man's" PC70. I had three of them in a corporate studio and remember well the reasons they were $75K less than a PC70.



The photo shows the side door open, which was necessary to do registration. You had to insert a screwdriver in the pots for each channel and do the subtractive registration process while leaning sideways to see the grid in the viewfinder. The Plumbicons were Grades B & C and virtually could never be registered in the corners. Their CCUs were also limited and color balancing between studio cameras was almost impossible. To top it all off, the CCUs only had composite out so chromakeyers had to be composite, not RGB, and keying was always less than perfect.

They were sort of "state-of-the-art" for the price and we produced several hundred programs with them over their lifetime.

Regards,

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News

EchoStar and News Corporation strike a deal

BY LARRY BLOOMFIELD

EchoStar Communications Corp. announced that it would acquire assets from Rupert Murdoch News Corp. The deal would give EchoStar a license to operate a high-powered DBS business at 110° W. If managed properly, these newly acquired assets could adversely affect the viewer projections of DirecTV and PrimeStar.

Under terms of the agreement, EchoStar will get two new, Loral-built satellites that are expected to be launched sometime this year. The deal for the two new birds includes construction, launch and insurance at the expense of the seller, News Corp. Also included in the deal is a recently constructed, suburban-Phoenix DBS uplink center with an initial capacity of about 500 program channels. EchoStar also gets a worldwide licensing agreement to manufacture and distribute set-top boxes internationally using NDS encryption/decoding technology with no less than a 500,000-unit purchase commitment by an affiliated entity of News Corp.

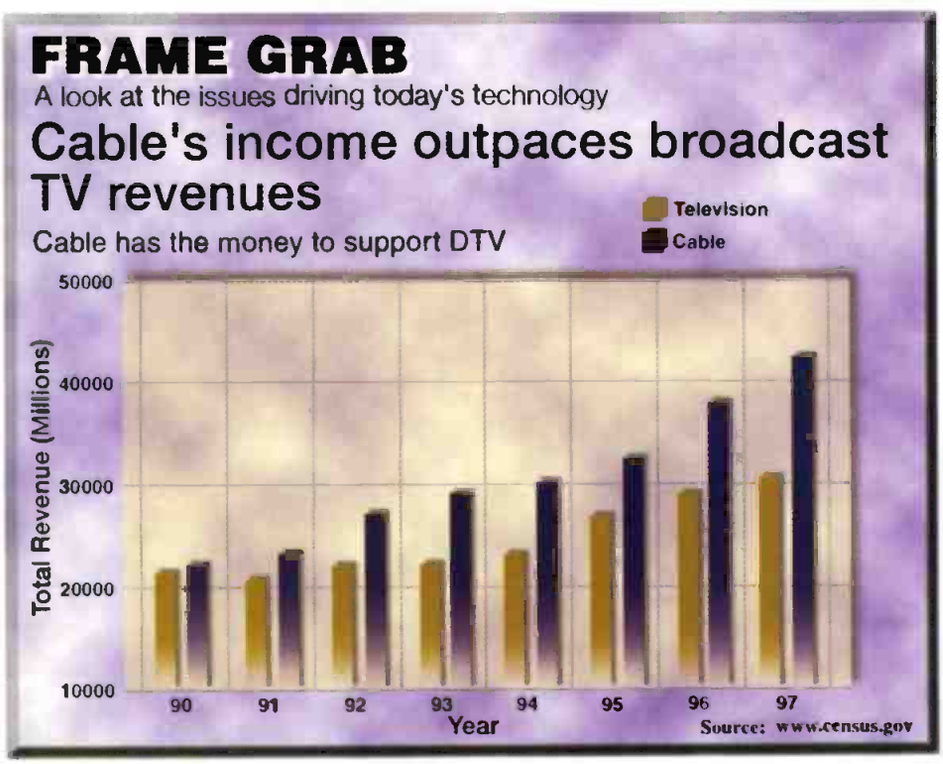
Ecgostarll with solar panels being readied for launch.

In addition to the already impressive program packages EchoStar offers its subscribers, this deal comes with a three-year retransmission consent agreement for DISH Network to rebroadcast Fox Network owned-and-operated local station signals to its respective markets. In addition, EchoStar will enter into an agreement to carry the Fox News Channel on DISH Network.

With this deal, EchoStar and long distance telephone company MCI also get a nonexclusive right to bundle EchoStar's DBS service with MCI's telephone services on a mutually acceptable basis.

The combination of EchoStar's newly acquired satellites at the 110° W orbital slot and its current satellites at 119° (DISH Network) will provide over 500 channels of programming, Internet/data delivery and HDTV, along with the capability of broadcasting to the continental U.S., Alaska, Hawaii, and the territories in the Caribbean. A company statement says that EchoStar is "positioned to become a one-dish solution for local-to-local channels."

Litigation between EchoStar and News Corp. will be withdrawn upon closing. There is little doubt that this deal will have the consent of EchoStar's shareholders, and its board of directors has already approved the agreement. The transaction's last hurdle is that it is



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subject to appropriate regulatory approvals.

With the government looking for ways to create competition in the marketplace for program distributors, this move should turn up the heat. EchoStar's CEO and chairman, Charlie Ergen, has been at the head of the line at attempting to give the viewers what they want. Commenting on this deal, Ergen said, "This agreement provides EchoStar with an opportunity to offer consumers an alternative to rising cable prices and poor cable service. It also strengthens EchoStar's efforts to provide local network channels for consumers who live in areas that don't get a reliable picture from a conventional off-air antenna."

For additional information, see www.dishnetwork.com.

NABET lockout ends

The National Association of Broadcast Employees and Technicians (NABET), an affiliate of the Communications Workers of America, called off a boycott of ABC/Disney by 2600 of its workers after two and a half months. The lockout, which began on Nov. 2 as a one day strike by workers over changes in medical benefits and then escalated when the network locked workers out, ended with NABET agreeing to submit the network's contract offer to members for a ratification vote.

Over the course of the lockout, many of ABC's broadcasts were affected by the inexperienced staff behind the scenes, as well as the network's difficulty in booking guests for its news interviews. Camera crews were excluded from several news conferences during the network's critical election night coverage, and politicians, particularly Democrats, were loath to cross picket lines to appear on such staples as "Nightline," "Good Morning America," and "This Week." Several notable entertainers also refused to cross lines, including Tony Bennett and comedian Adam Sandler. Even the network's sports coverage was notably affected. "Monday Night Football," usually a showplace for technical excellence, drew the ire of media and viewers alike for repeated production glitches and poor camera work.

According to NABET/CWA president John Clark, "Disney/ABC was willing to keep presenting its viewers inferior news, public affairs and sports coverage indefinitely, it appears, in order to dictate contract terms."

Though they are recommending that the contract be ratified by a member vote, the union may not be wholly satisfied with the offer. The union membership "deserves a better contract than this one," said CWA president Morton Bahr, "but I am recommending ratification on the basis that it's the best settlement that can be reached at this time without unduly prolonging the hardship that Disney/ABC has inflicted."

John Clark
NABET/CWA president

Bahr also hinted that NABET/CWA would take a different approach to resolving its differences with the network. "It became very clear to us that ABC's labor policies are now totally dominated by the parent company. We're going to have to develop a unified, multi-union approach to dealing with the Disney empire and the contemptuous attitude that Disney management takes toward its workers and the collective bargaining process."

Ballots for the ratification of Disney/ABC's offer were mailed to the union's membership near the end of January and were due back by February 5. Results will be announced shortly thereafter.

Study spotlights EAS noncompliance

The Federal Communications Commission urged broadcasters to come into 100 percent compliance with the Emergency Alert System (EAS). Upon the recent release of a survey of 653 AM, FM and TV broadcast stations, the Commission said stations have improved compliance with EAS mandates but must increase their efforts.

One of the most disturbing results of the survey indicated that 85 stations either had not installed EAS equipment or had equipment that wasn't working. The FCC mandates that all stations have an EAS encoder and decoder in operating condition. The survey indi-

KATU-TV goes online

KATU-TV has partnered with Transport Logic to put its analog broadcasts on the Web. The world can now view KATU's local shows at www.katu.com. For those who don't know, KATU is Fisher Broadcasting's ABC affiliate on Channel 2 serving Portland, OR.

"The addition of Web-based broadcasting continues our technology push. KATU is the first commercial TV station in Portland with HDTV and we plan to continue to be a technology leader," said Jim Crownover, customer services manager of KATU-TV.

Viewers can watch KATU's local programming with a browser and a Real Player. Those who do not have Real Player can download one by going to KATU's website.

"Our commitment to offering our viewers the ability to see local news on the Internet is significant. We think that viewers will begin to check our site while traveling to see what is happening at home," said Jim Boyer, KATU-TV general manager.

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cates only 87 percent compliance.

Only 83 percent of surveyed stations were monitoring the correct stations. Every area has a primary station, and there's also the National Weather Service, sometimes called the NOAA weather radio station. Since all states, territories, etc., have plans in operation as we speak, it wouldn't be hard to find out what you should be monitoring.

One hundred fifty stations reported they had failed to save EAS monitor printouts along with a copy of the station log. The FCC requires that stations log the weekly and monthly test and any equipment malfunction.

EAS Handbooks are required and can be downloaded from the Commission's website for free, but there were 98 stations that didn't have a copy. If you are one of those who need a copy of the handbook, getting EAS information is simple. Go to the FCC website: www.fcc.gov. Once there, click on "search" and enter "EAS." You'll get a whole list of things on EAS, including how to download the handbook.

The final area mentioned in the FCC report was about stations sending and receiving the weekly EAS tests. Stations must also retransmit a monthly test. According to the FCC, "This reflects on how well stations may handle messages during an emergency." One hundred fifty-six stations apparently did not comply.

EAS is a life-saving tool. In 1998, the FCC received over 500 reports from broadcasters who have activated EAS locally to broadcast public notices about events such as tornadoes, flash floods and evacuations. No one can count how many lives may have been saved.

Because EAS compliance is not at 100 percent, the FCC's field offices will conduct inspections of AM, FM and TV stations to ensure that the stations are meeting the EAS requirements. Furthermore, the Commission may issue forfeitures to stations that do not meet the EAS requirements. The FCC says it is stepping up its inspection program this month.

For more information, see www.fcc.gov/cib/News_Releases/easenf.html. ■

SEND Questions? Contact our authors with e-mail, page 26.

Unlit tower involved in near miss

According to FCC Report No. CI 98-27, a helicopter on an urgent emergency call near Muleshoe, TX, which is about half way between Amarillo and Lubbock, was forced to "alter its approach pattern" when the pilot unexpectedly encountered a nearby unlit antenna structure. The pilot notified the local police, who, in turn, notified the FCC. The FCC's Dallas Office investigated and took steps to ensure that the tower was promptly lit and that the FAA was notified of the outage.

The event underscores the necessity of properly lit towers.

A recent FCC audit of existing antenna structures found 368 structures out of 1331 (28 percent) were not registered as required by FCC rules. Owners of those structures requiring an FCC registration whom have not done so must register their structures immediately.

The FCC's Compliance and Information Bureau (CIB) is continuing its investigation of the Texas near miss. CIB Bureau Chief Richard D. Lee said, "Unlit antenna structures present a special hazard to law enforcement and emergency medical personnel. I cannot stress too strongly the need for complete compliance with FCC rules. Violations in this area can place life and safety at risk. Enforcement of these requirements is a top priority."

The FCC rules are very simple and

Analysts say analog until 2025

Without the adoption of an alternate system, the government might miss its goal of switching off analog broadcasts in 2006 by nearly 20 years, or so say findings published in a report entitled "Selling off the airwaves — Strategies for the transition to digital broadcasting," from Strategy Analytics Inc.'s Interactive Home Service. According to the report, the "universal broadband" strategy will not allow analog to be switched off by 2013. That strategy requires "recognition and promotion of cable and DBS satellite networks as official public service TV distributors and support for mass adoption of in-home networking technologies." Such recognition has not occurred.

Strategy Analytics predicts consumers will not warm to HDTV receivers and set-top boxes, with only 190,000 receivers purchased by the end of 1999. While this will provide a revenue stream worth $700 million to manufacturers during the first 12 months, it is only a fraction of the audience broadcasters need to make a transition worthwhile. While Strategy Analytics predicts the demand will rise steadily, only nine percent of U.S. households will be watching DTV by 2006. A switch-off at that point would not only leave millions of homes without TV and render tens of millions of TV sets useless but would be suicide for the TV broadcast industry.

"Unless regulators adopt a new approach to the analog switch-off, there is a risk that these frequencies could still be occupied by NTSC until the year 2025," comments David Mercer, interactive home service director at Strategy Analytics.

Many have ignored the fact that most homes have multiple TV sets. Even in households with cable and/or satellite TV, at least one unit, if not all, relies on terrestrial transmissions for part of its reception. Strategy Analytics says, "Regulators should encourage or enforce multiroom distribution of video signals to ensure the benefits of broadband are available to all devices in the home."

"The airwaves are a valuable asset. Analog TV makes inefficient use of them," says Mercer. "Getting from today's analog environment to a completely digital world will be much tougher than people realize."

For additional information, see Strategy Analytics Inc.'s website at www.strategyanalytics.com. ■

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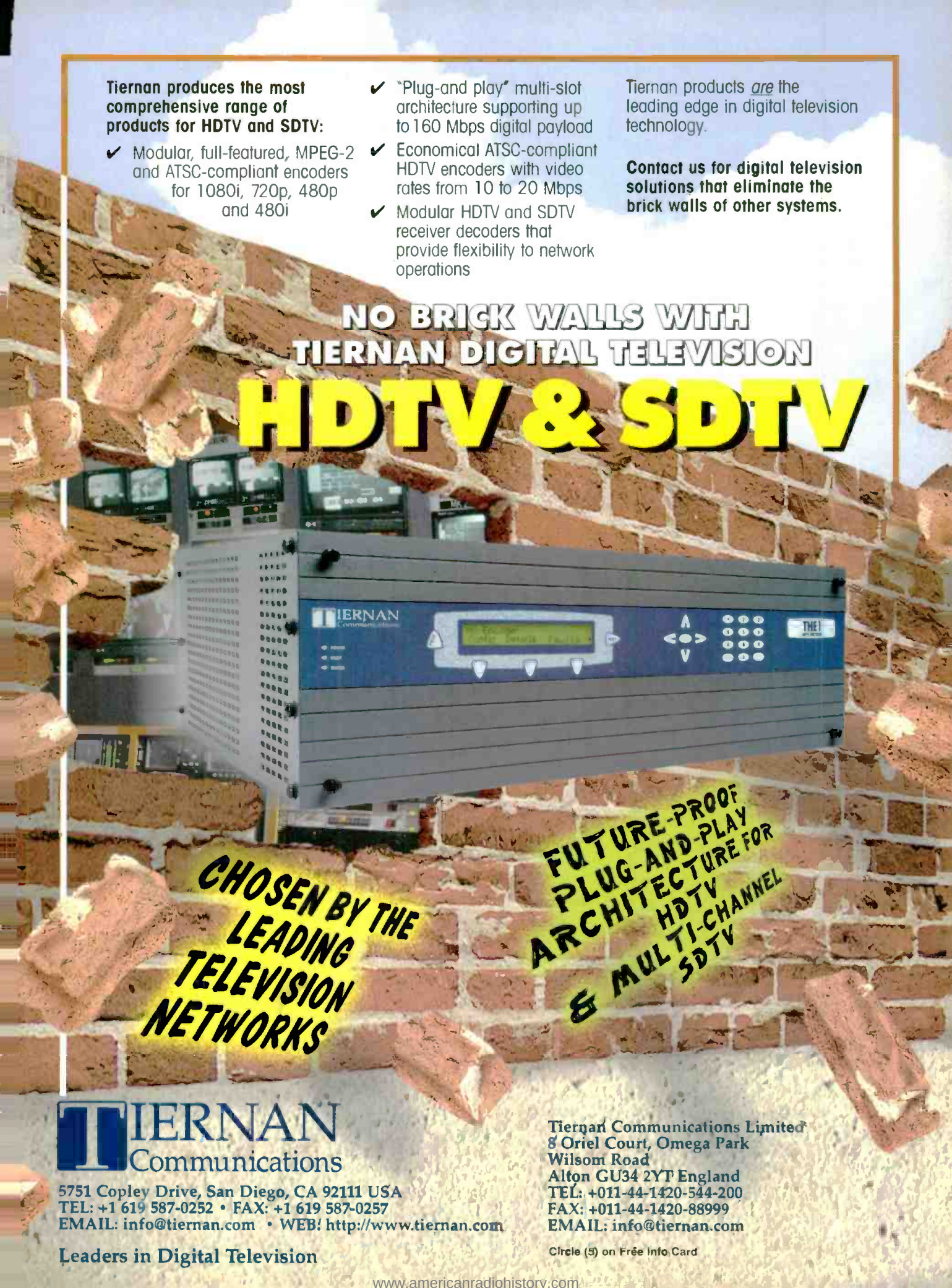

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clear. Antenna structures over 200-feet high, or in certain areas designated by the Federal Aviation Administration (FAA), must be lit from dusk until dawn. If a top tower light is extinguished for more than 30 minutes, the FAA must be notified so that a Notice to Airman (NOTAM) can be issued.

FCC rules also require, with certain limited exceptions, that broadcast tower structures be registered. "These registration rules are as essential and sensible as the need for automobiles to have license plates. There are no good reasons for failing to comply with this basic requirement," Lee said.

The FCC welcomes public input about unlit radio towers. If you do call about an unlit tower, you may be saving someone's life.

The Commission can be reached at 1-888-CALLFCC (1-888-225-5322). To see a copy of the FCC Report No. CI 98-27, go to www.fcc.gov/Daily_Releases/Daily_Business/1998/db981130/nrci8027.txt. ■

SBE calls for candidates

The Society of Broadcast Engineers is looking for candidates for its upcoming national elections. Interested parties must be members of the Society in good standing and must hold SBE certification at any level.

The upcoming election will decide six two-year seats on the Board of Directors. Board postions are strictly at-large. In addition, the Society will be filling all four officer's seats. Officers serve only one-year terms. The current president, Edward J. Miller, and vice president, Troy Pennington, are prohibited from holding their offices again by the Society's bylaws.

The deadline for nomination is July 5. A candidate must have 10 member nominations to be included on the final ballot. Ballots will be mailed to the SBE general membership at the beginning of August. Those elected by the membership will be installed in October of this year at the SBE's national meeting in Madison, WI.

Anyone interested in running for office should contact Joe Snelson at jsnelson@mdp.com, Larry Wilkins at wilkins@wlwi.com, or Richard Farquhar, the committee chaiman, at rick@rafassociates.com (800-632-2367). ■

DTV Momentum builds

The Consumer Electronic Show was evidence of continuing growth for DTV equipment. According to the president of the Consumer Electronics Manufacturers Association (CEMA), Gary Shapiro, more than 13,000 DTV sets were sold within weeks after the launch of digital broadcasting.

Gary Shapiro, president CEMA

He reported that all major manufacturers are involved in development of DTV products and early consumer reception has been enthusiastic. At the association's January electronics show, set manufacturers were asked what percentage of digital sets sold in 1999 would be high definition sets. The panelists at the set-makers session were unanimous; at least two thirds of all sets sold would be HDTV.

CEMA estimates digital television sales of 150,000 sets by the end of 1999, and sales of 600,000 in the year 2000. CEMA projects that the first 10 million sets will be sold by 2003, the next 10 million in 2004 and 2005, and 10.8 million to be sold in 2006.

Home theatre sales exceed $10 billion

Echoing the success of DTV sets, home theater is a rapidly growing segment of consumer sales. New home theater sales reached $10.64 billion in 1998 according to industry analysis. "Home theater is a growing trend with American families. Already 20 percent of US households own a home theater as compared to 4 percent just five years ago," said Shapiro.

CEMA research also confirmed the support of home theater by custom installers. Roughly 40 percent of home theater sales are through custom installations. More than 80 percent of set manufacturers support custom installers either through technical support, dedicated product lines or marketing assistance. Sales of home theaters are shown below:

Retail sales without installation: 60 percent

Custom installation through retail stores 26 percent

Custom installation sales (non retail store) 14 percent.

The survey results were supported through a wide cross-section of the home theater industry. For more information on CEMA and home theaters see www.cemacity.org

CEMA rejects Forrester results

In a fiery response to recently released research from Forrester Research, Shapiro issued the following statement: "The Forrester research results are wrong. Forrester makes predictions in its report about what consumers want *without talking to consumers*. Our HDTV research is based on consumer opinion surveys and consumer focus groups that included HDTV demonstrations. The results of our research are clear: Consumers want high definition TV and, in demonstration after demonstration, they express a strong preference for HDTV over standard definition TV.

"HDTV is like ice cream. You can read about ice cream. But until you taste it, you don't know how good it is. Our research tells us that when consumers see HDTV, they are excited about the technology and willing to pay for it," Shapiro said.

Shapiro was responding to a recent statement from Forrester that consumers will not support HDTV. (Editor's note: For a summary of the Forrester data on predicted TV set sales, see the Framegrab on page 68 of the January 1999 issue.) ■

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WETA goes live from the White House

WETA-TV and Worcester, MA-based Telecast Fiber Systems Inc. (TFSI) teamed up for the first PBS/HDTV transmission of "In Performance at the White House."

The broadcast was the first live origination of an uncompressed HDTV program to a network and on to an affiliate for digital broadcast. The uncompressed 1080i signal from the HD remote truck at the White House was fed to TFSI's Digital Viper unit beside the truck so it could be then transmitted at 1.5Gb/s over 14 miles of Bell Atlantic glass to the PBS's Master Control in Alexandria, VA.

Once the signal got to Alexandria, PBS used its new HD encoder to compress and encode the program in real time down to 19.39Mb/s. The bitstream was then transmitted over a second fiber circuit to WETA-TV for live broadcast by a new Harris Sigma-series, full-power digital transmitter.

By bringing fiber to the truck, the Digital Viper moves the transmission DEMARC to the closest possible point to the broadcaster. This substantially reduces the possibility of interference or distance limitations between the truck and the transmission path. A distinct advantage to this approach is that the uncompressed signal can be optically split to multiple users with compression or conversion to different formats done at the last stage.

For additional information, see TFSI's website at www.telecast-fiber.com. ■

Telecast digital Viper 442 at PBS master control.

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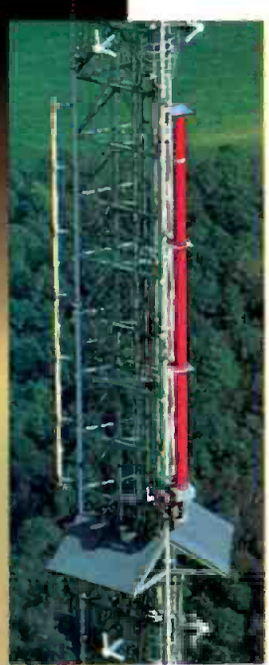

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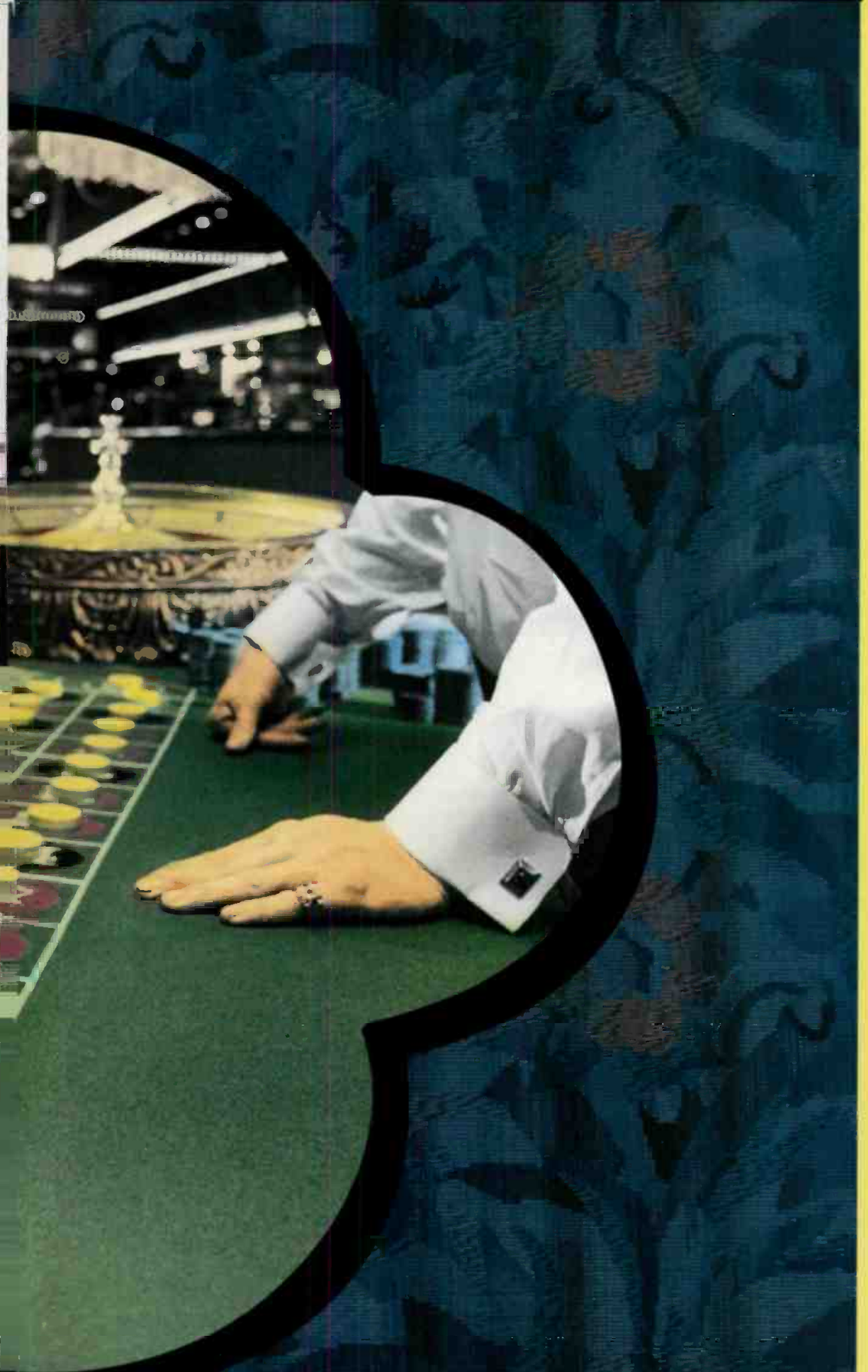

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Centralization: Local vs. regional

On several of the professional TV-related Internet forums, the subject of "group ownership" and centralization has been, and probably still is, a hot topic. In light of Congress' growing interests in this area and the recent acquisitions and mergers in the DBS part of the industry, this buzz isn't confined to the Internet.

In case you are one of the few who haven't heard, DirecTV has acquired United States Satellite Broadcasting (USSB) from Huber Communications. USSB has shared satellites with DirecTV for some time. In addition, a much larger deal, DirecTV's bid for PrimeStar, will apparently go through. Furthermore, EchoStar acquired News Corporation's space assets over the U.S. as well as the ultramodern Gilbert, AZ, operations, control and uplink center. That boils down to only two DBS players for the U.S.

Many are concerned about local-into-local and others about the lack of grassroots access as the result of this swing toward centralization. The FCC's policies concerning group ownership are currently under review because of the number of stations some interests have amassed under current policies.

There are probably thousands of rural support-type operations that are being hard hit by this centralization trend. One such entrepreneur, Robin Adair, CET, owns DULCA SCENES, a video and post-production business in Columbia, KY. Many of these "local" houses received their start as allied business. Adair said, "We started out as an electronics repair, off-air antenna installation and service business that grew with technology to include both big dishes and the newer small DBS dishes."

Typical of this kind of rural operation, the owners have backgrounds in differing aspects of radio and TV broadcast. Many have college training in addition to practical experience and several are quite accomplished. As an example, Adair has written a chapter in the Electronics' Technician Antenna Handbook on Interference.

When speaking with Adair about the centralization issue, she said, "My guess is that if ownership caps were lifted, we would see rapid consolidation of over-the-air broadcast television with a move to regionalized operations centers and smaller local studio/sales offices." This would have a definite impact on not only her business, but all the small independent production and post-production facilities whose bread and butter is supplemented by doing an occasional local shoot for "the TV station."

Adair pointed out that there is one factor often overlooked; the production resources in a community that could be used to produce content. Many high schools have the required equipment (and plenty of free labor) to produce and air a football or basketball game. There is plenty of local content that could make it to air in smaller markets if that market had the additional capacity. DTV will help in that area with multicasting.

Not every post production facility needs million-dollar equipment to produce programming. This studio at DULCA, located in Columbia, KY, relies on cost-effective solutions to produce local programming.

The future holds in store more centralization, with small local facilities available for local-interest content insertion. Even this can be run from a major control point. You can't, in some ways, blame the broadcaster, as it saves them money.

Software is currently available that will permit a single point of remote control and centralization of all operations, plant configuration, scheduling, programming, billing and all other aspects of the broadcast station for any group owner or broadcaster irrespective of the size or number of program channels or the station's geographical location. With the dramatic increase in group ownership and the many regional networks already formed with their corresponding centralized broadcast centers, this should come as no surprise.

The concept of the local station serving its community has given way, in many cases, to bottom-line concerns. Despite the local cable-access channels, and with the relaxing of the FCC rules on required local public-service and public-events programming, small communities are increasingly at a loss for the dissemination of local information.

It is possible that the days of the small businessperson are numbered. There will probably never be another "Mom-and-Pop" broadcast facility unless the family name is linked to a multimillion-dollar bank account. Even the smallest of radio stations sells today for a million plus. Imagine what it will be like to bid against the larger corporations when the auctioning of TV spectrum is a part of our daily lives after 2006.

The "local information source" position is still up for grabs in most communities. In a few markets broadcasters are moving to capitalize on the opportunity. The big problem for most of these services today is accessibility and lack of promotion. As the lines between the computer market and broadcasting become more obscure and information is cached in home media servers for demand-based consumption, the market for these kinds of services should grow dramatically. ■

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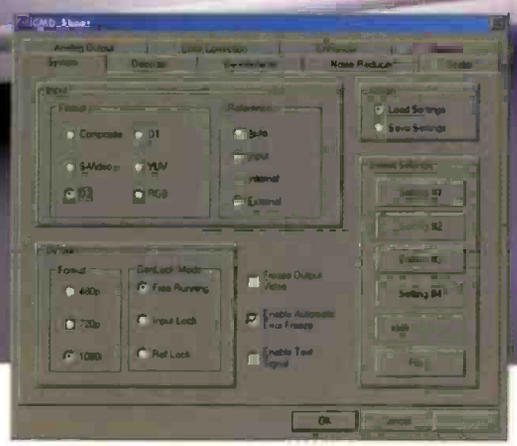

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FCC Update

FCC adopts online call sign system

BY HARRY MARTIN

The FCC has adopted a new streamlined system whereby broadcast licensees can reserve new and changed call signs for their stations via the Internet.

This new online electronic call sign system will enable users to determine the availability and licensing status of call signs; to request an initial call sign or change an existing call sign; and to determine more easily the appropriate fee. The system will allow applicants to effectively reserve a selected call sign as soon as the user has submitted its call sign request. In addition, because all the steps and instructions to reserve call signs are included within the online system, it will prevent users from filing defective or incomplete call sign requests. The Mass Media Bureau will announce by public notice how and when the transition to the new call sign system will be effectuated, and it expects to implement the new system following the Bureau's relocation to the Portals Building in early 1999.

Licensees or permittees requesting an initial or changed call sign must provide their e-mail address, and the Commission will then e-mail to them a unique validation code for the transaction. This procedure will allow the tracing of inappropriate call sign requests and discourage unauthorized entries into the reservation system.

Dateline

TV stations in Delaware and Pennsylvania must file renewal applications on or before April 1, 1999. Stations in the following states must file ownership reports by April 1, 1999: Delaware, Indiana, Kentucky, Pennsylvania, Tennessee and Texas.

DTV rules further refined

In dealing with petitions for reconsideration of its earlier Report and Orders in its DTV proceeding, the Commission resolved the following remaining issues:

- DTV power increases. The Commission will permit parties to submit applications requesting DTV power increases above the former 200kW limit, up to a maximum of 1000kW. Requests to increase power above 200kW must include engineering documentation demonstrating compliance with the *de minimis* interference standard with respect to all affected stations assumed to be operating at the DTV power level specified for their allotments or at 200kW, whichever is greater.
- Hours of Operation. All DTV stations which voluntarily commence DTV service prior to their applicable construction deadlines have complete discretion with respect to their operation schedules. Once their DTV construction deadlines have passed, licensees must operate their DTV stations during the same time periods that they operate their existing analog facilities.
- Eligibility. The Commission reaffirmed its DTV eligibility standards. Only those parties who held a license or a construction permit for a full-power TV station as of April 3, 1997 are entitled to receive a DTV license. Accordingly, the Commission denied reconsideration petitions arguing that certain NTSC applicants whose applications were pending as that date, should be awarded a DTV channel. However, the Commission will afford new NTSC permittees, whose applications were not granted on or before the April 3 cutoff and, thus, were not eligible to receive an initial DTV paired license, the choice of immediately constructing either an analog or DTV station on their existing channel. If these permittees initially choose to construct an NTSC facility, they may request Commission authorization to convert to DTV on their existing channel at any point during the transition period.

At the end of the transition period, the Commission will reassign all out-of-core DTV broadcasters, including pending applicants, to channels within the core. The Commission is confident that sufficient channels will be available to provide all out-of-core stations with a new channel.

- Modification applications. The Commission denied petitioners' requests that they be granted full DTV service replication for modified facilities, even for those reflected in modification applications filed prior to the April 3, 1997 DTV eligibility deadline. The Commission determined that spectrum conservation issues made it impossible to provide DTV allotments that would match the service areas requested in all pre-cutoff NTSC modification applications.

While the Commission will continue to process modification applications for NTSC stations, where such a proposed modification would result in interference to the predicted service of a DTV station, the application will be dismissed.

In the event an application seeking modification of NTSC facilities is granted, the Commission will not automatically increase the facilities of the associated DTV allotment to replicate the new NTSC service area. If parties with pending NTSC modification applications wish to have their DTV facilities modified, they must file a separate application for modification of the DTV station. ■

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

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HDTV — Is it worth the trouble?

BY JERRY WHITAKER, BE CONFERENCE CONSULTANT

New technologies — digital systems in general, and computers in particular — promise to radically change the TV industry as we know it. Indeed, they are already remaking the entertainment, information, and commercial landscape. The ongoing implementation of DTV in general, and HDTV in particular, represents the culmination of these trends. DTV — developed as much for hybrid computer/TV systems as for broadcasters — represents a significant challenge to video professionals, but it also offers unprecedented opportunities to those willing to take some risks.

Consumers in the U.S. have demonstrated an insatiable appetite for new electronic gadgets. TV broadcasters have, in the past, been the benefactors of this growth market. Now, as consumers branch out from traditional over-the-air entertainment sources to other media, broadcasters have a whole new ball game with which to deal. The continuing decline in network viewership is just one indicator of this trend. While it is certainly true that one reason for lower viewership at the flagship networks is the plethora of choices, thanks in large part to cable and DBS, it is also true that many people are simply turning off their TVs and turning on their computers for information, entertainment, and shopping. The genie is out of the bottle and it will never go back in. To compete in today's environment requires some dramatic and, in some cases, difficult choices.

The questions now looming over the TV industry with regard to HDTV are essentially a repeat of previous major consumer appliance "upgrades" (i.e., color, the compact disc, and computers — in all their many variations). It is fair to point out, however, that in the case of DTV, there are a few new twists over the previous upgrade examples. Prime among them is that the FCC plans to shut down NTSC within the next decade. We can debate at length over when that will really happen, but rest assurred that it will happen.

The next significant issue, of course, is whether to take full advantage of the DTV system and transmit the highest-quality HDTV signal, or multiple streams of SDTV. This important, and immediate, issue is addressed this month: HDTV: Is it worth the trouble? Our two commentators have extensive experience in what HDTV is capable of and what is at stake for TV. ■

Bruce F. Miller

From the broadcaster's perspective, who needs the aggravation of another channel to drain significant dollars away from an established station? Sure, the FCC has loaned you the spectrum space but not the significant capital to place it on the air, the sponsors who are willing to pay premiums for advertising on that channel, the source of attractive HDTV programs and any guarantee that anyone will see that new digital channel. So why bother? Besides, standard DTV has been accepted by the buying public that has purchased satellite service, and it doesn't seem to be clamoring for HDTV.

Maybe, you think, "If I wait a year or two, the FCC will rescind the Sixth Report and Order, the Fifth, etc., and the industry will return to the comfort zone of NTSC. And even if ATSC is not banished, certainly in a year or two the cost of conversion will be lower than it is today. I'll have a choice of vendors for everything I need and will be able to obtain competitive quotes. If I wait until closer to the deadline for my station's market to get on the air digitally, someone will have resolved all the tower and reception issues and I can simply copy what they have learned."

If your current line of thinking mirrors the previous paragraphs, then you do not need a business plan — a going-out-of-business plan would be more in order. HDTV is catching on and you need to be a part of it. Vendors are actively seeking input from potential users by asking how they can craft their products to meet your needs. If you haven't assessed your needs yet, the products that come to market at theis year's NAB Show will be designed without your suggestions.

HDTV will ultimately replace standard-definition TV, just as CDs have replaced LPs. As the program content improves, the public will demand the quality. The public will probably not remember if your station was the first in your market with HDTV, but it will certainly pass you by if you offer no HDTV. Remember that this is the public that is funding the resurgence of the theaters that offer frequent new material, mind-boggling visual experiences and ear-catching surround sound. With HDTV, your station can offer that experience in the comfort of the viewer's home.

Start your business plan today to phase-in HDTV earlier rather than later. The spectacular video and audio will be your initial reward, but don't stop there. Determine how best to use the significant data carrying capacity that resides in the 19.4Mb/s stream you send to every one of your viewers. Even if you use only 600kb/s, that's 10 times more than most high-end modems deliver. There's a revenue stream in data to reward you for innovation. When you finally give birth to the new kid on the block, you will forget the pain and revel in the experience. ■

President, Model Station Project, Inc., Washington, DC.

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Robert Hopkins, Ph.D

Is HDTV worth the trouble? Absolutely.

Since 1995, the Sony Pictures High Definition Center has been transferring movies to high-definition digital tape. These master tapes have been placed in our vault in anticipation of future HD demands, whether that is for prerecorded media or broadcasting. In the meantime, the HD master is downconverted for all current needs. This includes PAL and NTSC, pay-per-view, broadcasting, VHS, laser disc, DVD, etc. The downconverted copy is demonstrably superior to a 525-line or 625-line transfer.

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In our transfers, we are careful to maintain proper 3:2 pulldown. This is important because digital broadcasting will be more efficient if the proper 24Hz characteristic of the movie is maintained. It is also important because of our downconversions to PAL.

We believe that HD broadcasting will come about. But, we also believe that standard definition broadcasting will continue. Our objective is to transfer movies one time only, and have that one master serve all needs. Clearly, for this strategy to work, we must transfer at the highest resolution. We use the 1080 format. Our resulting product can then be supplied as a 1080 product, or downconverted to the 720 or 480 formats.

What about other television programming? About 75 percent of prime time programming is captured on film at 24 frames per second. In the old days, the film would be cut to put together the program. Then the resulting film would be transferred to NTSC video. If a PAL version was needed, it would come from a second transfer. In this case, a true "master" — the 35mm film — was made. Today, each shot is separately transferred to video, and then treated as if it were 60Hz interlaced video rather than 24fps film. Edit timing is based on 60Hz fields, not 24Hz frames. In this case, the "master" is the NTSC video. The 24fps character of the film is broken. The temporal flow of the program is uneven.

HD, at 24fps 1080p scan, offers a solution to this problem. If the shots are transferred to 24fps video, and edit timing is based on 24fps, we will have "recreated" the master from the old days, except it is already electronic. It can be broadcast at 24fps, or downconverted to the 720 or 480 formats. It can easily be made into a 60 Hz signal, interlaced or progressive, by "inserting" a 3:2 pulldown. It can easily be made into a 50Hz signal by playing the 24Hz tape at 25Hz. By posting the show in this manner, this single master can be used to satisfy all needs, 50Hz or 60Hz, high-definition or standard-definition. The HD Center is interested in 24Hz electronic shooting also. We want to be able to seamlessly mix material shot on film and material shot electronically. This is for material that will end up as video, and for material which will end up as film. We believe the easiest way to accomplish this is to shoot video at 24fps. ■

Vice president and general manager of the Sony Pictures High-Definition Center, Culver City, CA

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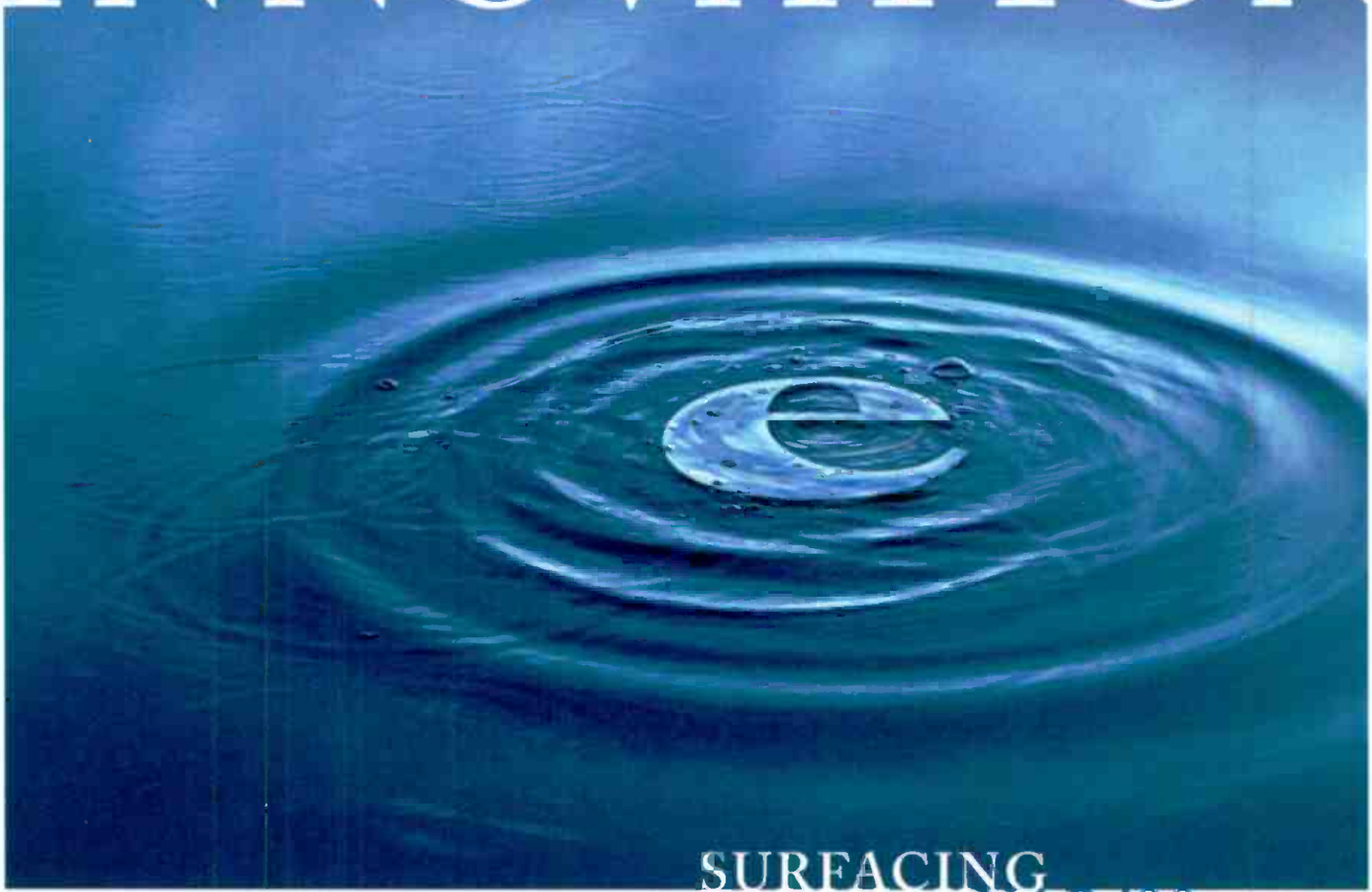

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Transition to Digital

The concept of resolution

BY MICHAEL ROBIN

Televison resolution specifications are sometimes quoted and often misrepresented. Picture resolution may be described using several different numbers, all of which claim to be accurate. The basics of analog and digital resolution were covered in past columns (see March and April 1998), therefore, this article will provide another viewpoint on the subject.

Spatial resolution

Photographs are essentially two-dimensional representations of events frozen in time. The difference between a photograph and *motion pictures* is the latter is typically a sequence of successive, related pictures. The ability of photographs to reproduce fine detail is typically expressed as the number of lines per millimeter that can be separately recognized. Values range from below 50 to around 1000 and depend on the emulsion, the contrast of the subject, and the color of the light, as well as other factors. The resolution of a photograph is the same in all directions.

Television pictures

Video pictures are scanned horizontally and vertically. The result is an electrical representation (in volts) of picture brightness values (in candelas per square meter) at specific locations on the scanned image at a given moment in time. The electrical representation may be analog or digital.

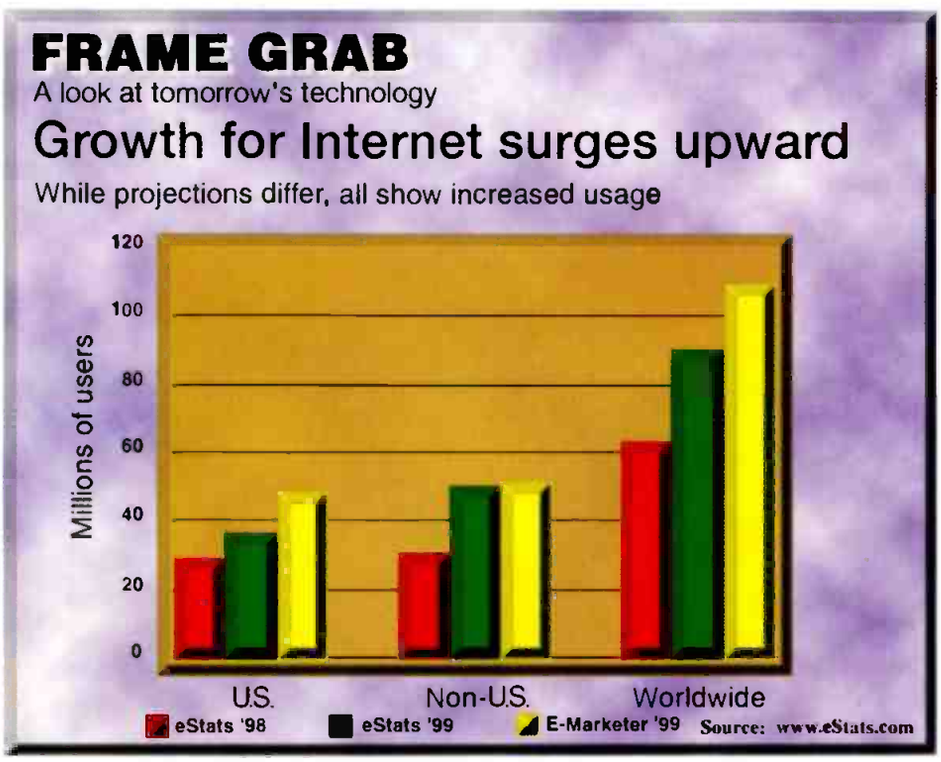
Television pictures are made up of a given number of lines per picture, specific to the scanning format. Conventional standard definition formats (525/60 or 625/50) use interlaced scanning. Due to the horizontal and vertical scanning process, television pictures exhibit two types of spatial resolution — vertical and horizontal.

•**Vertical resolution:** In interlaced video, the vertical resolution is equal to the number of active lines multiplied by the Kell factor, (usually taken as 0.7). Vertical resolution is expressed in lines per picture height (LPH). It is independent of the transmission bandwidth. In the 525/60 scanning standard, the vertical resolution is equal to 0.7 x 485, or 339LPH.

•**Horizontal resolution:** The number of picture elements per active line duration that the television picture needs to resolve horizontally is equal to the aspect ratio (e.g. 4:3 or 16:9) multiplied by the vertical resolution. This results in a characteristic optimal (minimum) bandwidth that the transmission medium, from the camera output to the receiver's CRT, needs to handle. Horizontal resolution is expressed in LPH and in an optimized system is equal to the vertical resolution. Each scanning standard is characterized by a resolution factor expressed in lines/MHz. The resolution of a given system is equal to the resolution factor multiplied by the system bandwidth (in MHz). In standard-definition systems (SDTV) the resolution factor is about 80 lines/MHz. In the slightly suboptimal NTSC system, with a nominal bandwidth of 4.2MHz, the horizontal resolution is about 80 x 4.2 = 336LPH. For equal horizontal/vertical resolution (339LPH) the system bandwidth should

Picture source	Flicker frequency	Frames per second	Flicker threshold
Movies	48Hz	24	68.5 cd/m²
50Hz television	50Hz	25	99.4 cd/m²
60Hz television	60Hz (nominal)	30 (nominal)	616.7 cd/m²

Table 1. The CFF for commonly encountered flicker frequencies.



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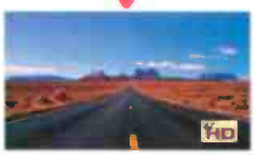

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be slightly higher (4.28MHz). It is important to note that the horizontal resolution is numerically smaller than the number of resolved picture elements per active line. In the same 4.2MHz system, the number of resolved picture elements per active line would be 4/3 x 333 = 444. The two numbers, 333 and 444, are occasionally used to describe the horizontal resolution.

Temporal resolution

An important property of the human visual system (HVS) is persistence of vision. Once an image has been formed on the retina, the eye acts as a storage device. The visual sensation of the image is retained for a finite length of time. As a consequence, we can be fooled into believing that a sequence of static pictures represents motion whenever the display rate exceeds 10 pictures per second. However, eliminating the flicker phenomenon requires still higher picture rates. The display rate is chosen to provide a sufficiently rapid succession to avoid display flicker at levels of image brightness appropriate for given viewing environments. The *critical flicker frequency* (CFF) depends on the display brightness and is the minimum rate of display, at a given picture brightness, at which the HVS does not perceive flicker.

Early movies used 17 pictures per second. Contemporary movies use 24 pictures per second, with each picture projected twice. This results in a display rate of 48 pictures per second. The TV picture (frame) has a refresh rate of 30Hz (525/60 scanning standard) or 25Hz (625/50 scanning standard). Each frame is made up of two successive interlaced fields with a refresh rate of 60Hz or 50Hz. Historically, the values for the field repetition frequency were chosen to be equal to the power line frequency, 60Hz in the U.S., Canada and Mexico, and 50Hz in other parts of the world. Today they are only nominally related to the power line frequency.

Interlaced scanning is used to reduce the transmitted bandwidth. It causes large picture areas of uniform color and brightness to flicker at the field rate (large area flicker) and is an acceptable compromise. When two adjacent lines in two consecutive fields have different luminance values, the result is small area flicker, at the frame rate, and is highly objectionable. To avoid these problems, computers, which have no wide bandwidth signal distribution constraints, use progressive scanning, a high number of scanning lines and picture refresh rates in excess of 60Hz. ATSC recommendations, included in the DTV standard, allow for a choice of interlaced or progressive scanning formats. It is predictable that in the future there will be a trend towards the use of progressive scanning.

Digital system considerations

There are several considerations unique to resolution in digital systems, among them:

•Quantizing or amplitude resolution. In digital systems the term *resolution* is often used to represent the number of unique analog signal voltage levels the system is capable of recognizing. For example a system with a resolution of 10bits/sample is capable of producing $2^{10} = 1024$ different voltage levels at the output.

•Vertical resolution. In digital systems the vertical resolution can be expressed in two ways:

•Analog-related resolution: In an interlaced system the analog vertical resolution is equal to the number of active lines per field multiplied by the Kell factor usually taken as 0.7. Ideally in a noninterlaced system the vertical resolution would be more near to the actual number of active lines.

•Digital-related resolution: The digital related resolution is usually expressed as a number equal to the number of active lines per picture. Due to the interlace ambiguity, the actual vertical resolution is lower because the Kell factor plays a limiting role. In a noninterlaced display, such as a computer, the vertical resolution equals the number of active lines.

•Horizontal resolution. In digital systems the horizontal resolution can be expressed in two ways:

•Analog-related resolution: In a "black-box" consisting of an A/D, a processor and a D/A the analog-related resolution depends on the sampling frequency and the combined effects of the anti-aliasing and reconstruction filters. In an SDTV scanning system the resolution factor is about 80 lines/MHz. Other scanning systems have different resolution factors.

•Digital related resolution: In a 4:2:2-type digital system, the digital-related resolution is expressed as the number of pixels per active line, i.e. 720 Y pixels, 360 B-Y pixels and 360 R-Y pixels. These numbers are sometimes called pixel densities. The pixel numbers do not define the resolution and their indiscriminate use may create confusion. Figure 1 presents the case of the 4:2:2 luminance signal. It shows the relationship between the idealized response of four typical luminance bandwidth-limiting filters, the number of samples per picture width (active line) and the horizontal resolution in LPH. The quoted figures are calculated using a figure of 80 lines/MHz of bandwidth for both SDTV scanning standards. If the anti-aliasing and reconstruction filters are neglected, a 4:2:2 component digital black box would be capable of producing pictures with an equivalent bandwidth of 6.75MHz (the Nyquist frequency), resulting in 720 samples (pixels) per active line or a horizontal resolution of 540LPH. To avoid aliasing and beat phenomena, pre- and post-filters with a cutoff frequency of 5.75MHz are being used. An idealized *brickwall* filter with a cutoff frequency of 5.75MHz would result in horizontal resolution of

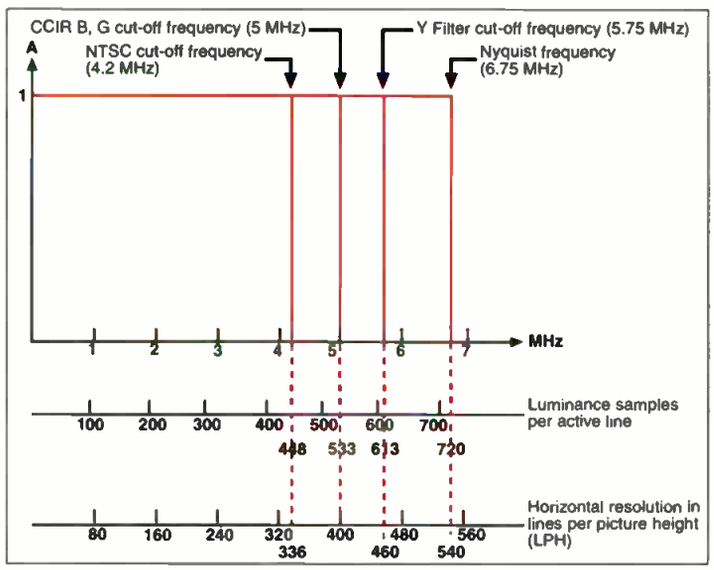

Figure 1. The relationship between idealized luminance bandwidth, the resulting number of samples/active line and the horizontal resolution.

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460LPH and 613 analog pixels per active line. By comparison, an idealized 5MHz brickwall filter (CCIR B,G) would result in a horizontal resolution of 400 LPH and 533 analog pixels per active line and a similar 4.2MHz filter (NTSC) would result in a horizontal resolution of 336 LPH and 488 analog pixels per active line. Practical low-pass filters result in reduced performance and related horizontal resolution. It is important to remember that although the 13.5MHz luminance sampling frequency results in 720 digital samples per active line, the actual horizontal resolution depends on the analog low-pass filter characteristics. Unfortunately, technical literature and equipment specifications often quote unrealistic figures. It is up to users to draw the proper conclusions. Computer displays use digitally generated pixels and, thus, have no analog bandwidth-related limitations other than the CRT display resolution and the characteristics of the analog drive (red, green, blue) circuits.

With digital TV concepts and implementations, the trend is towards expressing the picture resolution as the number of pixels per active line multiplied by the number of active lines per field. The 4:2:2 signal resolution is thus expressed as 720x480 and the two ATSC recommended HDTV signals are specified as having a resolution of 1280x720 and 1920x1080 respectively. This trend tends to ignore the original definitions of horizontal and vertical resolution and is gradually replacing them in equipment and system specifications. ■

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.

Send questions and comments to:
michael_robin@intertec.com

Computers & Networks

The EBU/SMPTE Task Force – Part II, Systems

BY BRAD GILMER

At the 1998 International Broadcasting Convention in Amsterdam, the EBU/SMPTE Task Force published a report on the future of television technology. This is the second article in a series that explores the report and its impact on the industry at large. The Task Force report is divided into four sections–Systems, Compression, Wrappers and Metadata, and Networks and Transfer Protocols. This month we focus on Systems.

The Systems model

The Systems group developed a model that was used as the basis for its work (see Figure 1). Pre-production, acquisition and production, post-production, distribution, storage, transmission and emission and archiving were identified as operational areas, also called activities. These activities are shown along one plane of the model. Both the activities and user requirements differ for each of these areas. Equipment, standards and processes must be designed to fit the particular needs of each area. From a different viewpoint, the activities can be divided according to type or planes. Typical planes within a broadcast facility include video essence, audio essence, data essence and metadata. Essentially, all types of program content can be placed into one (or more) of these categories.

Communications

The model also describes how system communications should be structured. A layered approach has a number of benefits, including the ability to make changes on one layer without affecting other layers.—Broadcasters will likely use a four-layer model that closely follows the International Organization for Standardization (ISO) Open Systems Interconnect (OSI) model. The layers within the Task Force model are application, network, data link and physical.

At the base of the model is a critical element — control and monitoring. Control and monitoring will be increasingly important as systems migrate from conventional media on tape machines to disks and other media under the control of computer systems. As a consequence, the Task Force strongly recommends that a common control and monitoring architecture be standardized so that this primary user requirement can be satisfied. Beyond that, an open-protocol, object-based approach is recommended.

The following list of essential characteristics were identified by the Task Force as critical for building large, integrated systems:

•Extensibility: devices need to be added and removed without upsetting existing networked devices. Likewise, new features need to be smoothly integrated.

•Scalability: the addition of a large number of devices must be possible without the need for major reconfiguration.

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Table 1. Extra data space available on today's digital VTRs.

•Resource allocation: dynamic allocation of resources between activities must be supported.

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retrieving program content and resources should be possible with a minimum of human interaction.

•Fault tolerance: the system should be fault tolerant and provide failure recovery to ensure service continuity.

•Security: if multiple users use distributed resources, security mechanisms are required.

•Interoperability: the system should allow the use and exchange of devices from different manufacturers in a common system.

Furthermore, as broadcasters begin to employ networking technologies in addition to conventional routing, issues of latency and Quality of Service (QoS) will become critical. QoS and bandwidth need to be controllable by the requirements of resources and applications. For example, video streaming may require a particular bandwidth to operate effectively and this must be satisfied by the control interface. In addition, command latency (the time between command and action) needs to be deterministic for many real-time applications; certain system commands must get through no matter what. For instance, it would be unacceptable to wait until a file transfer is complete before a command to stop the transfer would be processed.

As broadcasters and equipment manufacturers, we need to start thinking about the concept of a *contract* for a particular QoS. In broadcast facilities, there is an expectation, or contract, when a source is routed to a destination using an analog or digital router. The signal is expected to be there 100 percent of the time, and the command to perform the switch will be interpreted by the router control logic and executed at the next vertical interval. With computer networks, even high-speed networks, there is no such guarantee. If you want to send a file from one system to another, it may get there immediately or it may take some time depending on network traffic. Further, unless ATM is being used, there is no way to prioritize the traffic, no way to specify the transfer time and no pre-determined amount of time for control execution. The Task Force recognized that these features are critical to operations, and that they must be standardized and incorporated into products to build large integrated systems in the future. This subject will be covered more thoroughly in Part 5 of this series.

Object models and device abstraction

The Task Force strongly recommended that standards be developed, and that manufacturers employ an object-oriented approach to future control systems (see Figure 2). There are three layers that are conceptually like layers of an onion. At the center of the model is the device to be controlled. Surrounding it is a transaction-based control protocol. Next is a functional API (application programming interface), and finally an object wrapper.

Transaction-based control protocols are low-level protocols such as RS-422. Functional APIs define the device control in terms of a set of procedure (subroutine) calls. APIs can encapsulate a whole sequence of messages into a single call. This is a key point in support of using an object-based approach to control. Each layer of abstraction simplifies communication with the device. It reduces the amount of information a common control system must have about the specific characteristics of a particular device, which allows the control system to focus on complex issues of resource allocation without having to perform low-level command translation for each device type.

The object wrapper encapsulates the API for a device or service and acts as a proxy. For example, a video server object wrapper can be written that serves as a generic interface for the control system. The same object wrapper can be used to control devices from multiple manufacturers. Ultimately, this should translate into control systems that are more flexible and less costly.

In an object-based system it would be convenient to have an object registry wrapper. This wrapper encapsulates a system entity that keeps track of objects within the system. As devices and software modules are loaded and unloaded, they register with the object registry. The module's presence and characteristics are then made known to other objects in the system. The registry is essentially a database with a complete description of devices and services available on the network. Through registry queries, objects can learn about the network and devices that are connected

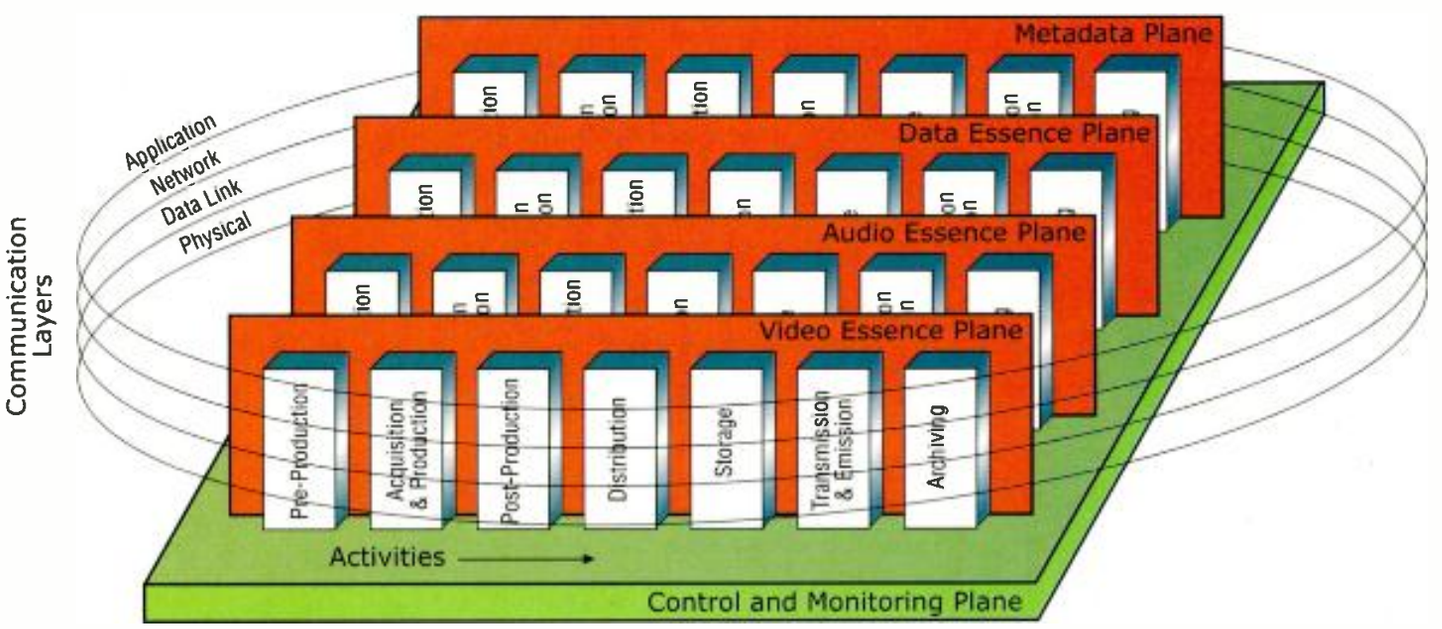

Figure 1. The Task Force's system model

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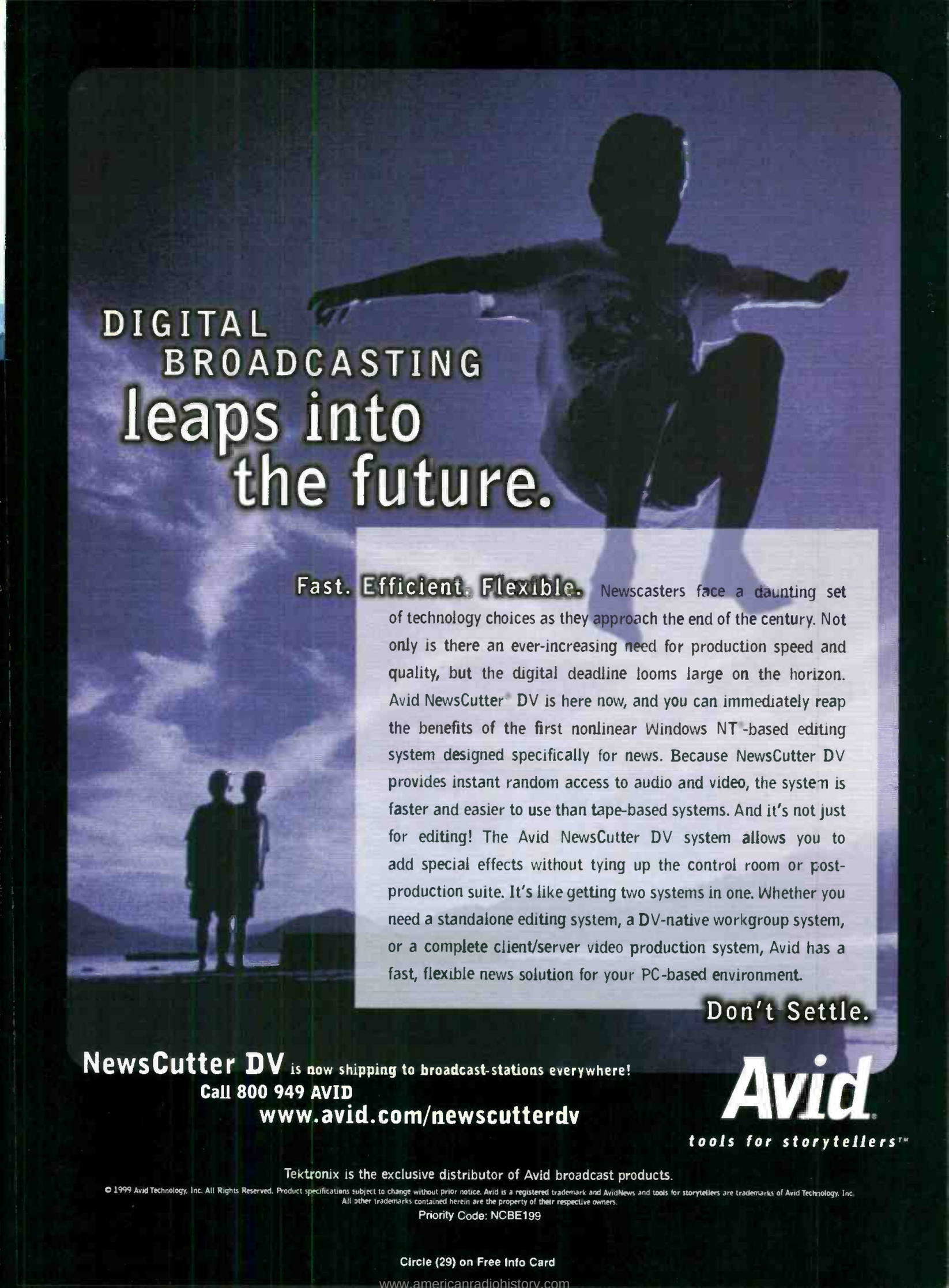

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to it. The registry is an abstraction of the system itself. How is this useful? Lets assume someone wants to design a device that will gang-roll a number of VTRs when a sporting event is about to start. A client on the system retrieves objects of type VTR that have been assigned to a particular group. When the client detects an incoming record command, it then sends the appropriate command to all the VTRs in this group. With distributed object systems, one or more objects can live in the same device, or a single object can be spread over several devices, which allows object-based systems to attain high levels of extensibility and reliability through distributed implementations.

Using an object registry also allows the network to be reconfigured on the fly. When a new device is brought on line, a simple entry in the database advertises its availability. This is a very economical way to make control systems extensible.

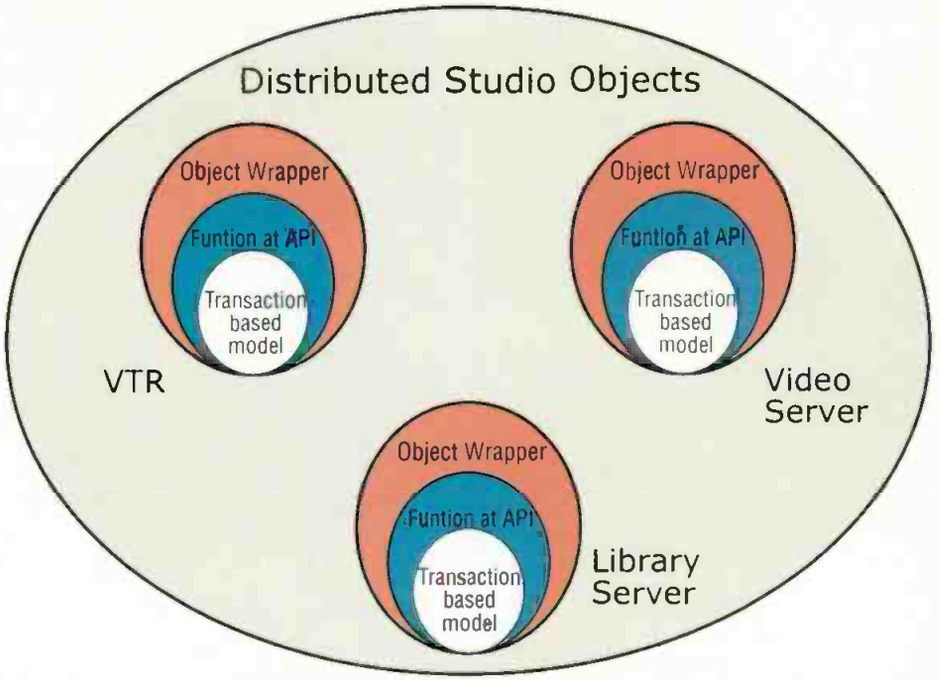

Figure 2. The Task Force has proposed on object-oriented approach to controlling devices which simplifies communications.

Data essence and metadata

Data essence is information other than video essence or audio essence, which has inherent stand-alone value. This is unlike metadata, which is contextual. Examples of data essence include subtitle text, scripts, HTML and still images. Data essence also includes program logs, playlists, and as-run logs.

Metadata is information other than video essence or audio essence that must be linked to have any value. Examples include sync, timecode, GPS coordinate data, and MPEG presentation time stamps.

System users will want to transfer data essence without having to think about it. To accommodate such a requirement, it is highly desirable that standardized formats be employed for these essence types whenever possible. The use of proprietary coding inhibits the user from designing an efficient system. Standards exist for many of the data essence types listed above, but there are no standards for program logs, playlists or as-run logs. A key recommendation of the Task Force is that such standards be developed.

Another issue considered by the group was the question of repetition rates for data essence and metadata. In some environments such as distribution, this is critical. In the distribution or transmission chain there is only one transportation mechanism or pipe available to send data from one place to another. Of course, data essence and metadata are also competing with video and audio essence for a share of the bandwidth. Because communications in these pipes is serial, it is critical to establish the metadata time slice. Some data will be critical and must be repeated frequently to ensure proper reception. For example, MPEG transmissions cannot be properly decoded without much of the header info, therefore a high repetition rate is required. Other data may not be as essential, so a lower repetition rate may be acceptable. If the transfer is accomplished using file transfer, repetition may not be required at all.

Further information on object-oriented technologies & Java

"Object-oriented Analysis and Design with Applications" by Grady Booch, 2nd edition, February 1994
Addison Wesley Object Technology Series

"The Common Object Request Broker (CORBA): Architecture and Specification", Revision 2.2 Feb. 1998 Object Management Group, Framingham, MA 01701, USA

"Architecture of the Virtual Broadcast Studio" by Ken Guzik: SMPTE Journal Vol. 106, December, 1997
www.smpte.org/publ/abs9712.html

"Discovering OPENSTEP: A Developer Tutorial – Appendix A, Object Oriented Programming":
www.developer.apple.com/techpubs/rhapsody/DeveloperTutorial_NT/Apdx_OOP.pdf

OPENSTEP White papers:
www. enterprise.apple.com/openstep/whitepapers.html

"CORBA Overview":
www.infosys.tuwien.ac.at/Research/Corba/OMB/arch2.htm#446864

"Java Programming Language", 2nd. Edition, by Ken Arnold and James Gosling: Addison Wesley

Java home page: www.java.sun.com

Java 8-page overview: java.sun.com/docs/overviews/java/java-overview-1.html

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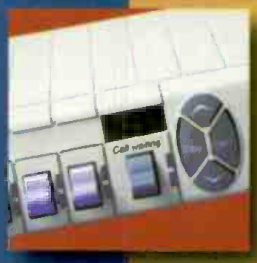

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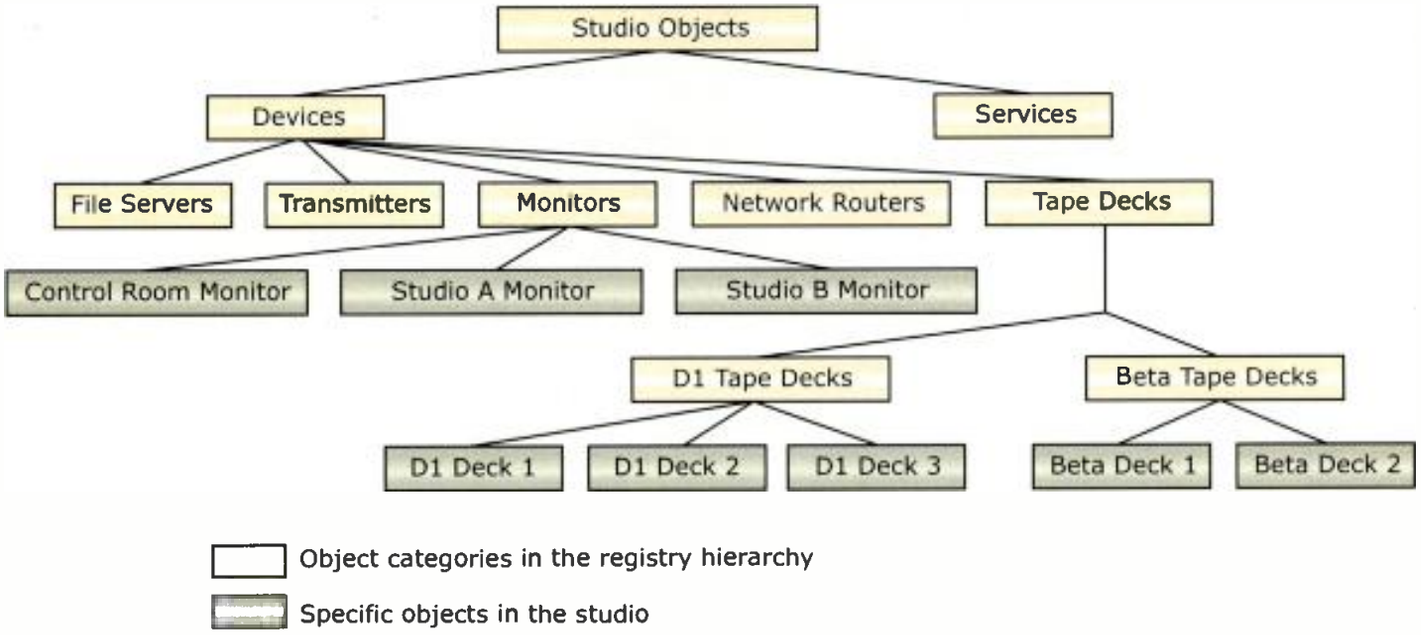

Figure 3. A network object registry tracks network objects and their properties.

Users of data essence and metadata may wish to store these materials for later use. Today, this information is typically stored either on the tape itself, or in a separate file on disk (e.g. closed-caption information). To date, this has not been much of a problem. However, as the use of HTML and other web-based data increases, and as the association of this data with program content becomes more common, other storage media may be required. The Task Force report contains an interesting table listing tape formats along with any additional data space (see Table 1).

Linking metadata to its original content essence is easy when the material is stored on videotape with the content. However, the problem becomes more complex when metadata is separated from content essence for storage. Linking the two is critical, and work is ongoing at SMPTE on how to do this. One issue is whether the link must be unique. However, the amount of content generated daily, combined with the prospect of increased metadata in the future, means guaranteeing uniqueness is difficult. Other issues relate to whether the link contains any information itself, or whether it is just a random number that allows systems to link content essence and metadata together. In many facilities, house or show numbers convey information about the media they refer to. For example, tape number BB343 might be Brady Bunch show number 343. Conveying information in a link or identifier might be useful for humans, but it is very difficult to guarantee uniqueness in such systems when the number of items becomes large.

For further information see the Broadcast Engineering website at: www.broadcastengineering.com. Next month we will take a detailed look at the Task Force's views on compression. ■

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

Send questions and comments to: brad_gilmer@intertec.com

Ask Dr. Digital

Found: filter specs

BY STEVE EPSTEIN, TECHNICAL EDITOR

I would like to put a filter in my Sony BVP500 studio cameras. The lenses are Canon J20xSUPERs. I am looking for a promist and a fog, and I do not know what size I need. Any help would be most appreciated.

Fernando Bellido
Peru

I checked with Sony about putting filters in the filter wheel. That camera comes with several different imagers. Depending on the imager, the camera has 1 or 2 filter wheels. In either case, the filter wheels are full. It is possible to replace an unused filter(s) with the promist and/or the fog. Sony supplies the filter specs to Tiffen as to the exact size requirements. Tiffen makes both a promist ($174.75) and a fog filter ($153.75) that fit that camera.

You can contact Tiffen at 800-645-2522 or www.tiffen.com. Be aware that those filters are installed in a critical portion of the optical path. Only high quality filters should be used and they need to be installed with the utmost care.

I also checked with Canon concerning a front of the lens filter. The thread size on the frontmost lens element is 182P1mm. The glass portion of the filter is 178mm in diameter with a thick-

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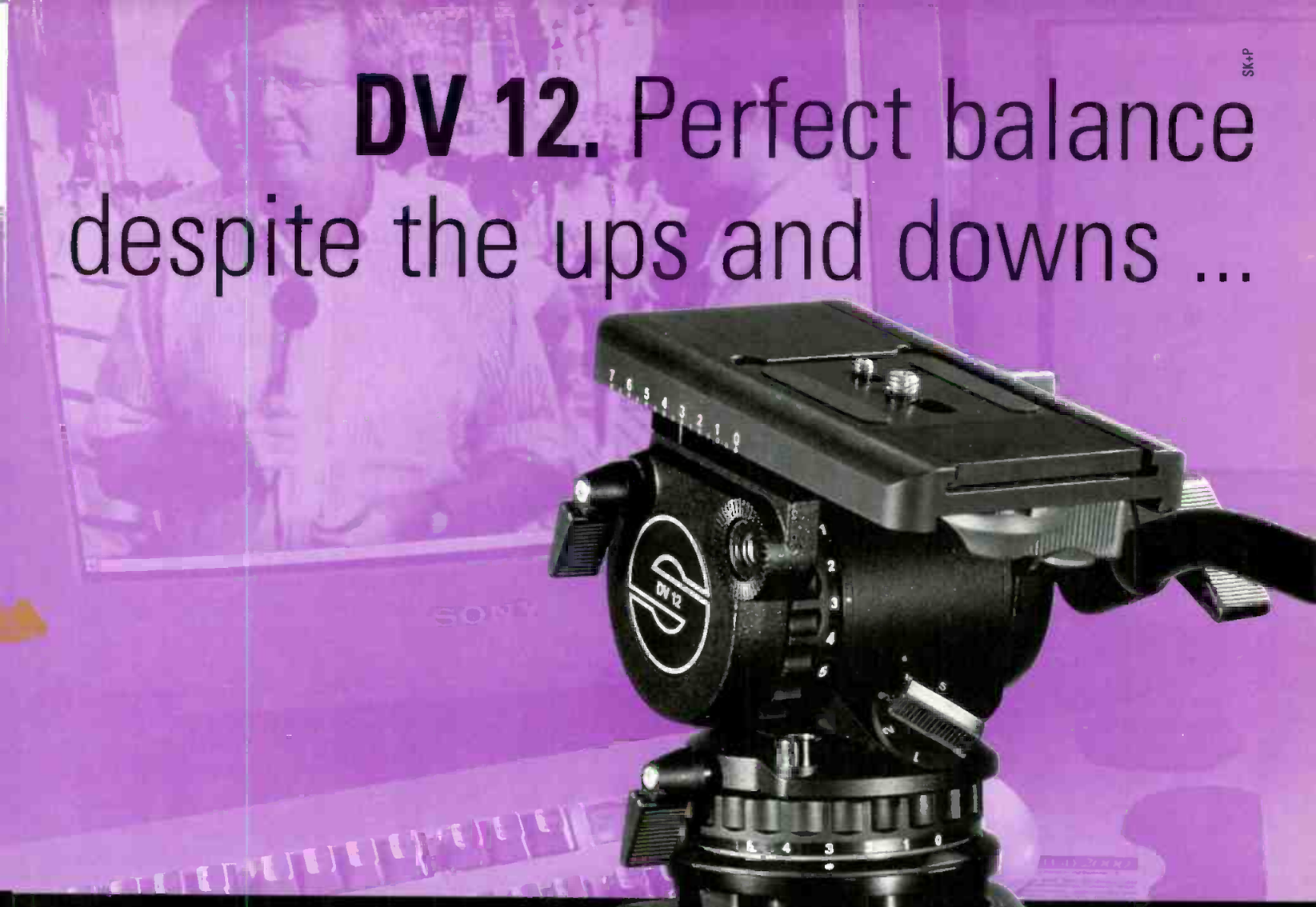

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ness of 5mm. A larger, less critical filter can be screwed on the front of the lens. Canon offers a clear filter (PFJ-201) that fits that lens, but does not have a promist or fog. You can reach Canon at 201-816-2900 or www.usa.canon.com.

In the October issue, a reader asked a question concerning the use of twisted pair or coax for digital audio. It was my opinion that either one worked, and the choice boiled down to personal preferences—would you rather install XLRs or BNCs? Here is some additional information concerning that particular choice from a reader:

Under certain circumstances, AES audio may need to be patched. When a patch cord is inserted into a destination, the source impedance is no longer 110W or 75Ws. In coaxial patches, there is adequate separation of the coax center conductor from nearby signals to prevent crosstalk. In a leaf-type patch, such as those used for twisted pair, there is not. There are components at 6MHz or so, and these behave like RF. We have encountered crosstalk to an open circuited 110Ohm channel, and have not encountered with coax channels.

Interconnection to source and destination equipment is commonly 110Ω, where you need to use transformers. Interconnection to terminal equipment (distribution amps, routers, etc.) is commonly available in either format. There are few connections that require transformers on both ends of a coaxial run, within a given facility. In cases where both ends are 110Ω and patching is not necessary, there is no advantage to using coax. Many facilities will have a few locations like this, and the rest of the facility can be wired easily with coax.

If you intend to use Video DA's for AES, there are a few cautions:

1. Assure that the bandwidth is adequate. There can be slew rate distortion if the amp isn't good to 40MHz or so. This significantly reduces the length of cable runs, possibly disabling the system entirely.

2. Ensure the DC component on the amp's output is zero volts. DC offsets can create problems in downstream equipment.

3. Make certain that the amplifier gain is exactly unity. This can be done by looping a square wave through the input to a termination at the A input of an oscilloscope, then taking the output to a termination at the B input of the scope. Invert one of the signals and superimpose them so that the trailing edge of a negative transition lines up with the leading edge of a positive transition. Ideally, there will be two unbroken horizontal lines on the scope. Adjust for zero offset, adjust for unity gain, and check for nonlinear gain. Adjusting the square wave's frequency will allow you to check for bandwidth and other problems.

Based on these potential problems—including screwdriver drift—video DA's are not really a good solution.

NVision has published a book called THE BOOK that details this information. See page 43. You can obtain a copy by contacting NVision's Tom Crabb at tomcrabb@nvision1.com, or at 1-800-719-1900.

Tom Norman, CPBE
Systems Engineer
Harris Broadcast Systems

Dr. Digital responds

Thanks for the info Tom. Personally I'd use coax, I like working with it and sometimes I think I could install BNCs in my sleep. Now that I think about it, some of my former employers would probably swear I've done just that. However, checking with friends who work in radio (you know—TV without pictures); they prefer twisted pair. In any event, it is always a good idea to pick one or the other as the house standard and use adapters accordingly.

By the way, anyone interested in a copy of THE BOOK can circle (297) on the Free info card and we'll get that info to Tom Crabb at NVision.

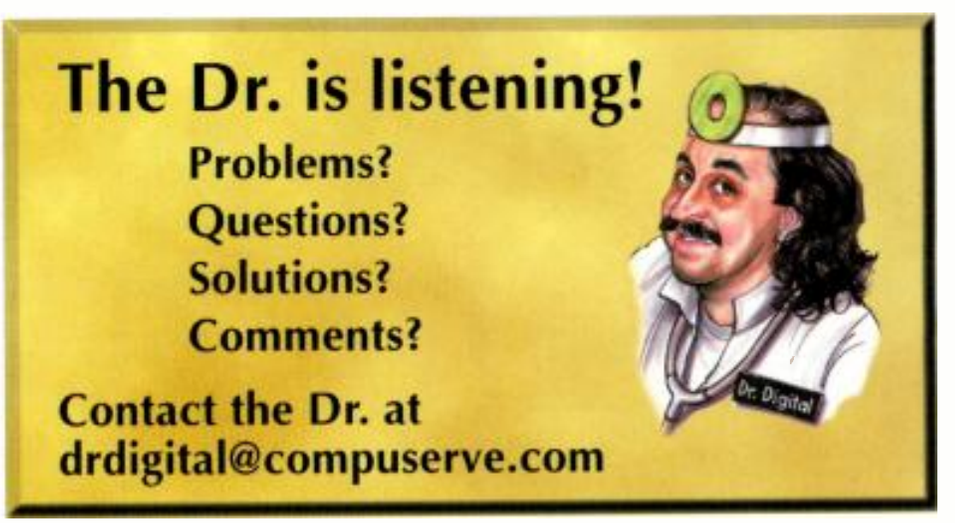
Anyone charged with the responsibility of keeping equipment operating knows the value of service literature and spare parts. Over the last few months I have received several requests for those particular items. Two of which have proven to be extremely elusive.

The first request comes from the not-so-happy owner of a Toshiba transmitter. It seems the finals in this 24kW solid state transmitter are getting scarce. I have checked with Toshiba (both the US and Japanese offices) as well as some domestic semiconductor manufacturers and come up empty handed. Does anyone know where I can get replacements for a 2SK1310F FET?

The second request is for service manuals. A local cameraman is looking for a service manual(s) for an old (read tube) Thomson camcorder. The unit looks like it was OEMed from Sony and has Thomson CSF labels. The model number of the camera is MC-613, and the dockable Betacam (not SP) recorder is model number VR-611. Let me know of you would be willing to lend or sell me a copy of these service manuals (or their Sony equivalents).

As usual, if you need some help or have a comment, drop me a note. ■

Send questions and comments to: drdigital@compuserve.com.



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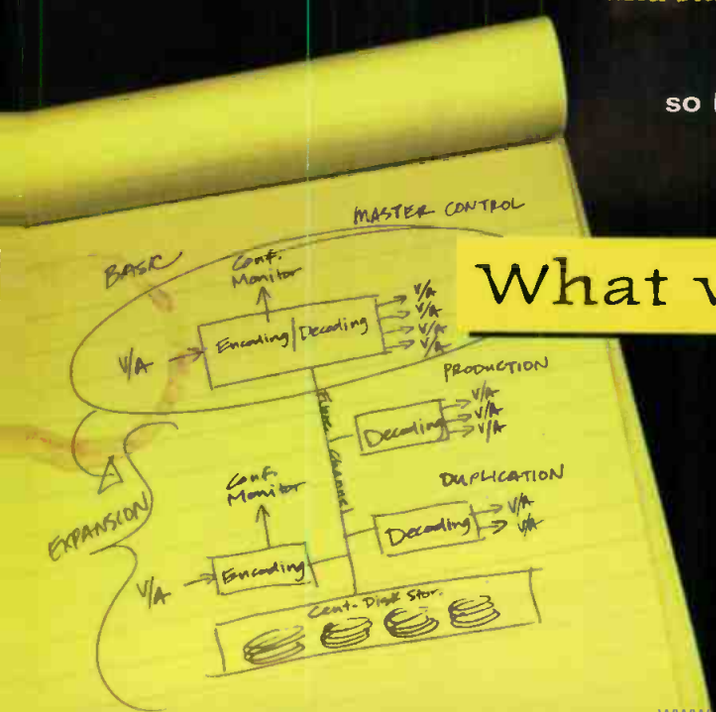

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SYSTEMS DESIGN SHOWCASE

Florida's News Channel:

The new world of local TV news

By George Thorry

"Cybersets," "ATM switched broadband Intranet," and "local branding" are phrases that are common currency when Bob Brillante talks about Florida's News Channel. Brillante is the founder and managing partner of Florida's News Channel (FNC), an all-digital news network that employs break throughs in virtual sets and fiber-optic transmision.

Florida's News Channel's assignment desk supports news bureaus across the state with an ATM-switched broadband intranet.

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The launch of FNC last September represents the culmination of five years of planning for what is being called "the new world of television news." This new world combines several new technologies for the first time, including virtual news environments, digital servers and a high-speed, fiber-optic network.

The news network will deliver original and exclusive news programming to seven major market areas in the state: Jacksonville, Orlando, West Palm, Broward/Dade County, Naples/Fort Myers, Tampa/St. Petersburg, and Tallahassee/Panama City. Each will receive fully customized local newscasts from FNC's network operations center in Tallahassee.

Producing the news at FNC is a continuous process. Throughout the day the network's nine field news bureaus and seven broadcast partners send local news coverage from around the state via fiber-optic transmission to producers in Tallahassee assigned to each affiliated market. These field packages and each in-studio shot are pre-taped for merging with the virtual sets. During production, producers can switch from shot to shot, just as they would in a hard set studio setting.

The stories are then digitized onto ASC servers and sent back out to cable subscribers over the fiber network. The network operates ASC VR325-2 broadcast video servers with RAID storage systems. The network chose ASC because it offered the flexibility to add as few as two server channels at a time, affording FNC the ability to add capacity in gradual increments. These servers act as a jukebox, playing back all of the elements that comprise the network's 30-minute newscasts through the control room, including intros, graphics and the virtual news environments.

These cybersets create virtual reality environments customized to each market. This technology affords FNC considerable economies of scale vs. constructing, maintaining and staffing seven separate customized hard sets. FNC's news director likens the network's concept to a video wire service, whereby prerecorded elements can be modularized into any of the network's feeds.

FNC's master control facility is capable of sending up to 20 local news feeds.

FNC feels that because its typical news wheel is pre-recorded as several video modules, its news is more timely and gets to the viewer more quickly. Rather than having to tear down and then rebuild an entire feed to update its news, the station uses a nonlinear approach and simply plugs in the necessary number of new content modules.

In addition to cablecasting originally produced news wheels throughout the day, the network prides itself on its live coverage capabilities. For example, FNC's affiliate in the Tampa/St. Petersburg market, GTE Media Ventures, established 48 fiber terminals throughout the region to provide news crews with instant access for feeding live news events to cable subscribers. When a story breaks at the Tampa courthouse or the new Buccaneers stadium, FNC can simply plug into one of these fiber terminals and go live. There's no need to set up ENG or satellite trucks. FNC's statewide ATM network has the flexibility to distribute breaking news to any single market or open up the entire network and send its live pictures to cable homes throughout the state.

Creating the news wheel begins with FNC's news anchors sitting in a completely empty brightly lit blue room introducing each story. The server adds digital quality news environments complete with local scenes and branding elements to promote the local cable affiliate.

The network realizes further economies by running its seven local newscasts from two virtual studios. ORAD is providing Softset, a cyberset solution running an original set design by Devlin Design Group through a Silicon Graphics Onyx2 engine. Each virtual studio has an identical control room equipped with Tektronix/Grass Valley switchers, Chyron Max CGs, Wheatstone SP8 audio boards, and Pinnacle's DV Extreme and Lightning for effects and still-store graphics. The two virtual studios and hard set studio feature Sony BVP-550 cameras with Vinten robotic camera systems in the virtual sets.

FNC will use Panasonic DVCPRO equipment for its digital ENG activity. Field bureaus are equipped with AJ-LT75 laptop editing systems for rapid turnaround and AJ-D700 cameras. The field equipment packages also include Lowel lighting kits, Anton Bauer battery systems, Sennheiser shotguns, and Sony wireless microphones. All ENG traffic will be received and transmitted on an OS-3 or DS-3 circuit in an ATM format, then via ATM through FNC's fiber, and then compressed and decompressed using MPEG 4:2:2 by Tektronix codecs.

NewsMaker Systems' StarDrive newsroom automation and production system manages the newsroom's computer needs and controls the recording of all FNC feeds directly into ASC VR300 video servers. The system accurately controls the operation of the ASC servers and the playout of the news and commercial product to the network's individual zones. These servers feed nearly 100 terminals on the StarDrive system and 48 separate production devices. The

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StarDrive automation system controls the ASC VR channels, the Link-AVS 16x1 routing switchers, ChannelMatic audio signal tone generators, and 360 Systems DigiCarts. Under StarDrive's control, individual clips are scheduled independently for playback to any or all of the regional newscasts.

Tampa-based Professional Communications Systems, a division of Media General of Richmond, is performing the integration process for FNC at its serial digital 601-based facility. The integration requires a number of conversions for the move from analog to digital 601 to ATM.

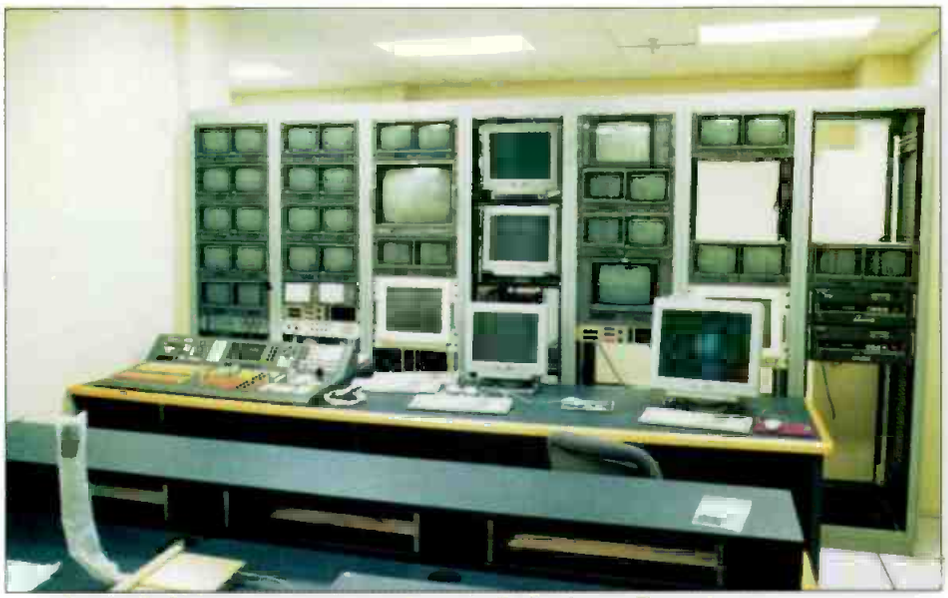
Florida's News Channel also maintains several satellite uplinks and downlinks. Editing is performed on Scitex StrataSpheres. StrataSphere was chosen for its capability to perform real-time nonlinear editing. The system also allows multiple video layering without degradation, thereby saving FNC rendering steps.

To carry its innovative blend of next-century technology and up-to-the-minute local information, FNC has built an ATM-switched broadband intranet. This high-speed, fiber-optic transmission system links Florida's telecommunications companies and public venues with a high-capacity path capable of transporting vast amounts of video, voice and data simultaneously. The news network is one of the first networks in the world to deploy a digital statewide ATM-switched video transport system.

With an ATM switched network, FNC can generate a broadcast-quality signal using relatively little bandwidth: approximately 10Mb as compared to the much larger allocations required by proprietary networks. The Tektronix receivers positioned throughout the network are totally controllable from Tallahassee, allowing FNC to easily change parameters via a web GUI.

With its massive infrastructure for information delivery, cutting-edge news-gathering technology and commitment to the communities it serves, FNC will revolutionize the way news is reported, produced and delivered. This revolution is well under way and, for the people of Florida, will bring a new world of TV news. ■

George Thorry is vice president of marketing for Florida's News Channel.



One of two identical digital production suites at FNC's Tallahassee network operations center.

Equipment List

- 360 Systems Digicart II
- ADC video patch bays
- Angenieux 16x8.3 AIF EPF lenses
- Anton Bauer battery/charger system
- Best 60kW UPS
- BVS MK6 chromakeyer
- Canon IF Pro 18x zoom ENG lens
- Cantoni G107 camera support system
- Chyron Codi
- Chyron MAX!PLUS
- Clearcom intercom
- Wheatstone TV-600 console
- Crown D-75A speaker amps
- DPS-465 frame sync
- ESE master clock system
- Fluke 79 multimeter
- Hitachi V-1565 dual-channel scope
- Ikegami color picture monitors
- Kohler 350kW generator
- Leitch CES-3501FS timing system
- Leitch SPG-2612N sync generator
- Leitch VES-6800 logo generator
- Link AVS-16/B/C 16x1 routing switcher
- Link A/D, D/A converters
- Link PDE-890 closed-caption decoder
- Link video DAs
- Lowell VP-98 lighting kit
- Panasonic AJ-D640 DVCPRO recorders
- Panasonic AJ-D700 DVCPRO camcorders
- Panasonic AJ-D750 DVCPRO recorders
- Panasonic AJ-LT75 DVCPRO laptop editing system
- Parker Vision CameraMan system
- Philips 25-inch color monitors
- Pinnacle DVEXtreme
- Pinnacle lightning
- ProBel 64x64 DV routing switcher
- QTV On-Camera15 teleprompter
- Rane AVA-22 dual-channel A/V delay
- Scitex DVeousFX
- Scitex StrataSphere NLE system
- SGI IRIX workstation
- Shure ECD14/84 wireless microphone system
- Sony B/W monitors
- Sony color monitors
- Sony BVP-550 cameras
- Sony PVW-2800 Betacam SP recorders
- Stantron racks
- Tekniche A/D converters
- Tektronix 1720-SCH vectorscopes
- Tektronix 1730-D digital waveform monitors
- Tektronix 2200-Plus production switcher
- Tektronix 601 waveform monitors
- Tektronix 740 audio monitors
- Tektronix TDS-430A digital scope
- Tektronix TSG-170D test generator
- Truevision Targa 2000RTX video boards
- Ultimatte-8 digital compositing system
- Ultimatte 300 keyer
- Vertex 3.8m TVRO system
- Videotek DM-141A stereo demods
- Vinten tripods and studio dollies
- Vinten Multicontroller II
- Vinten Osprey studio pedestals
- Vinten Petrel pan & tilt heads
- Winsted edit suite console
- Winsted frames
- Wohler rack audio monitors

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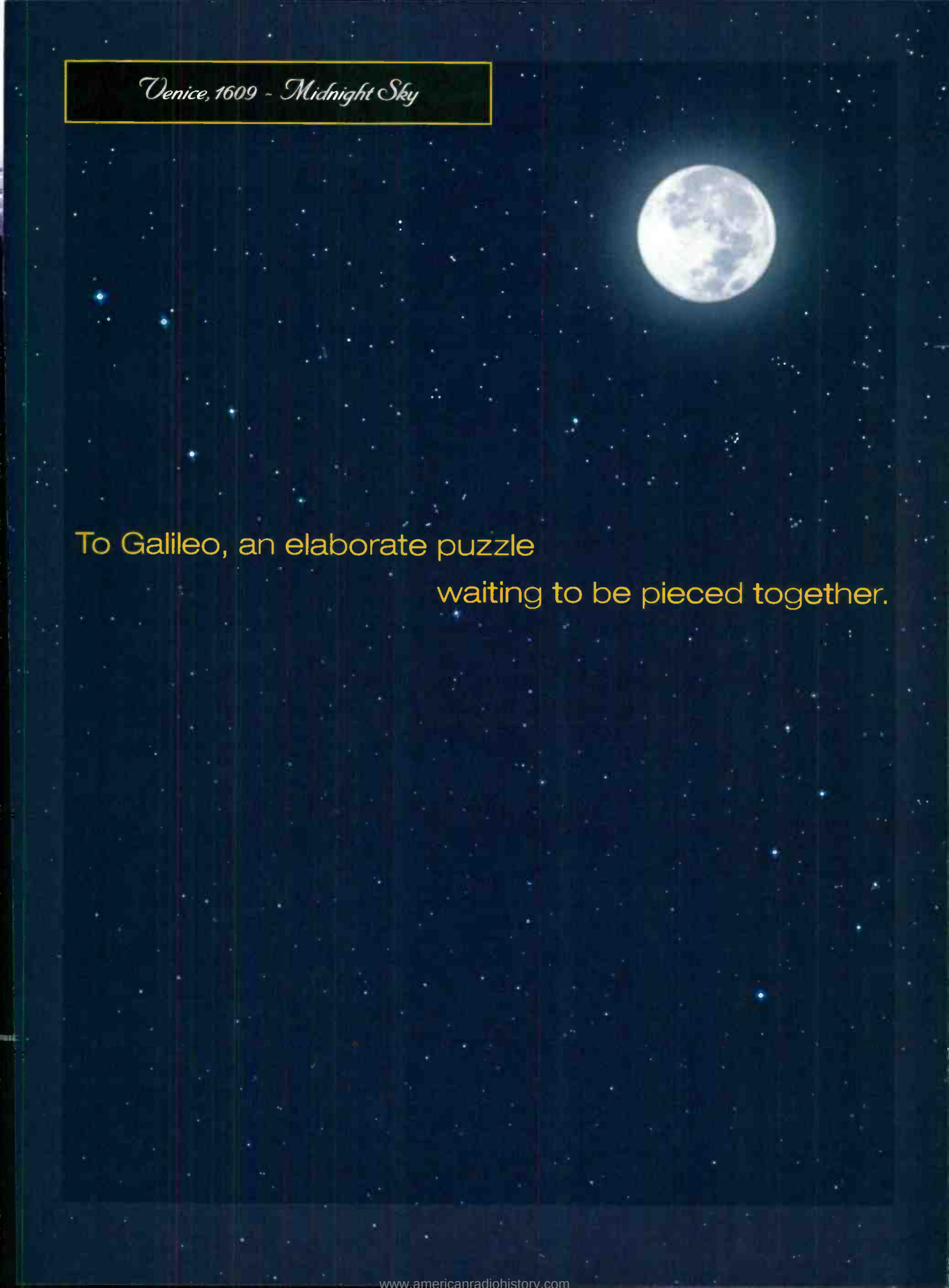

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DNE-1000 Editor

NewsBase MAV-1000 Server
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- RAID-3 reliability
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- Faster than real-time video transfer

ClipEdit Workstation
- Desktop video editor
- Compatible with any Windows NT® based news text system

Betacam SX DNW-A75 VTR
- Betacam SP playback compatible
- MPEG-2 4:2:2 P@ML
- Preread for A/B roll editing

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Transmission & Distribution

Workplace hazards

BY DON MARKLEY

While those in the industry don't often give it much thought, we work in areas the general public would consider risky. For example, we work around towers and rarely consider the possibility of falling objects (except ice). We routinely work around voltages capable of turning one into a crispy critter and around electromagnetic fields capable of inducing ailments not curable by Viagra (so they say). Maybe it's time to give such problems a little more thought and get into the game of CYA (an old parlor game otherwise known as "contemplate your ancestors").

Most engineers are mindful of the FCC and its inspections. Efforts are normally made to comply with all applicable FCC regulations and to operate stations in a legal and responsible manner. However, this tends to induce a case of tunnel vision in which other controlling agencies are ignored. Such seems to be the case with regard to the Occupational Safety and Health Administration (OSHA). The general approach by stations seems to be keeping a very low profile in the sincere hope that: A) nothing will go wrong for which the station can be blamed; and B) maybe we just won't be noticed. Not only is such an approach shortsighted, but it eliminates a potentially useful tool for the station's staff.

OSHA concerns

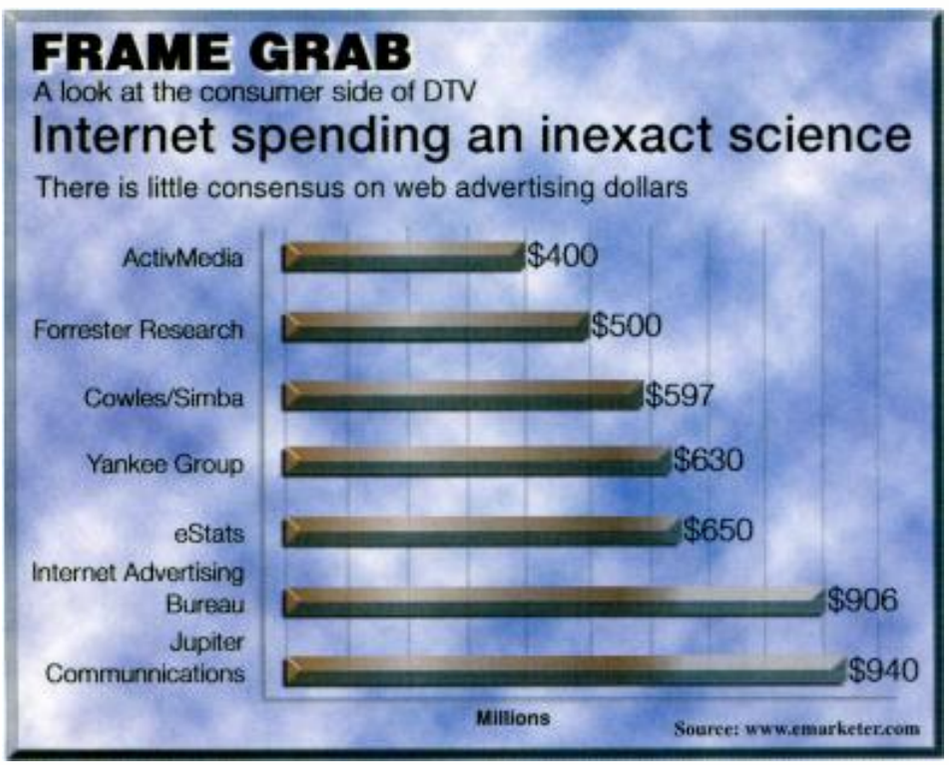
The first step is to accept the fact that OSHA isn't out to get you. Instead, it is concerned with making the workplace as safe as possible for everyone – a goal that should be shared by all. As the person responsible for the station's technical operation, it would be a good idea to stop by the local OSHA office. For starters, it has a great deal of information available to help you avoid future problems and to explain its regulatory requirements. Secondly, this is a chance to meet the local staff and explain the types of projects currently underway at your facility. They can provide some good advice on areas of concern. At this stage of the project they really are there to help. In fact, if there are concerns regarding some aspect of your facility or construction project, OSHA can have someone check it out and advise you of the steps needed to comply with regulations. There won't be any fine – just help.

As a station engineer, be aware that staff safety training is a necessity. In addition, increase your awareness of how hazards are be evaluated and treated. As a fairly obvious example, let's look at ENG trucks. The hazards involved in its operation include mast extension problems relative to overhead wires and non-ionizing radiation levels near the microwave link. Unless you are using a home-brew microwave system, the radiation levels around the dish are simply not significant. However, the staff should be advised of the radiation risks and certainly must be trained concerning the mast.

As part of the safety training, a written hazard assessment should be prepared which identifies all hazards involved with the truck. The hazard assessment should be posted for all operators to read. Next, a safety meeting should be held to discuss the hazards and how they are to be treated or eliminated. All operators should be trained concerning proper procedure in the event an accident occurs. Training should include establishing a proper procedure for getting help, removing the vehicle from the danger, if possible, and reporting the incident to the proper authorities. Make sure that everyone understands the hazards. Record the name and date that each operator received the safety training. Keeping training records is a legal necessity.

Dealing with outside contractors

With regard to projects being carried out by others, the procedure changes



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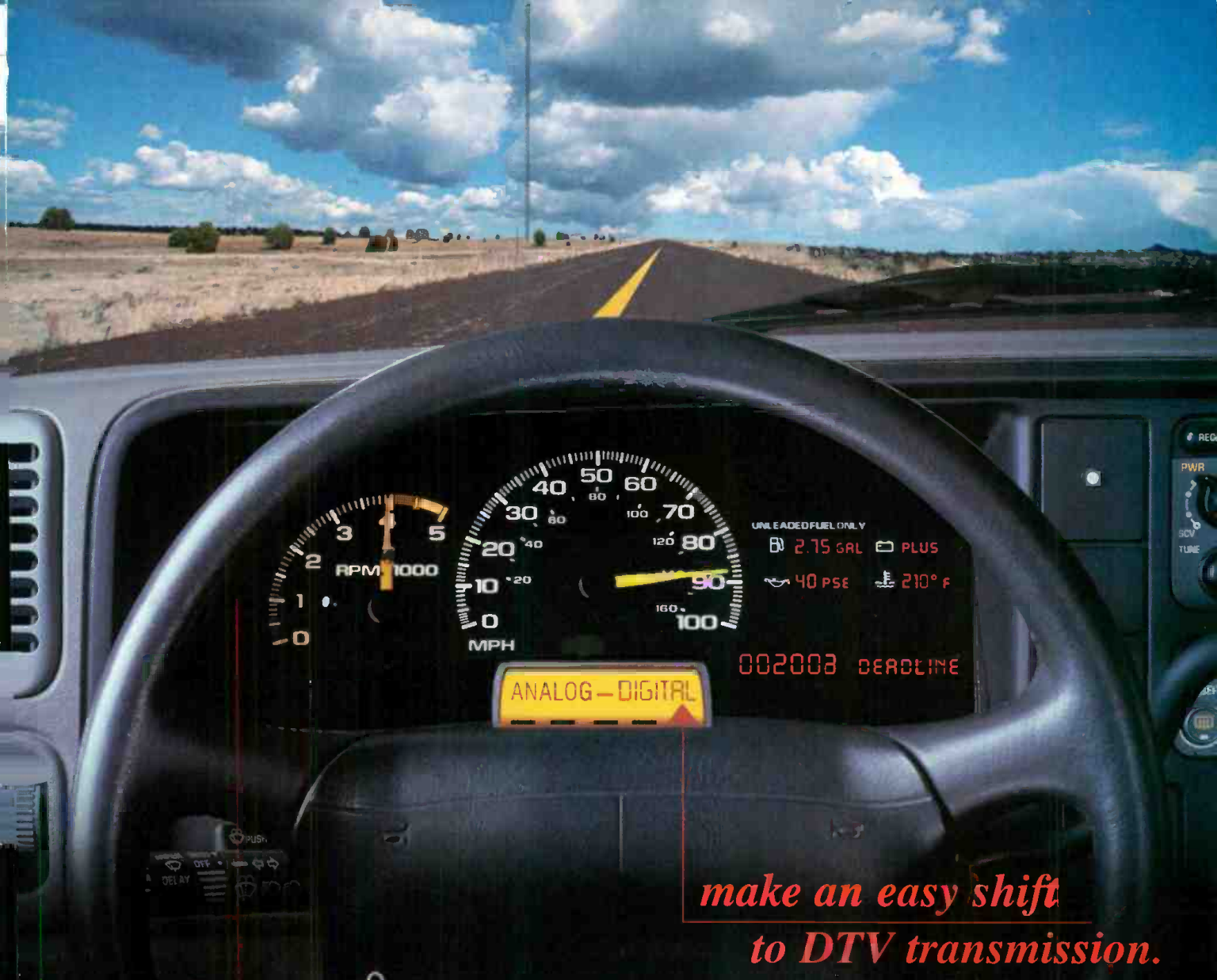
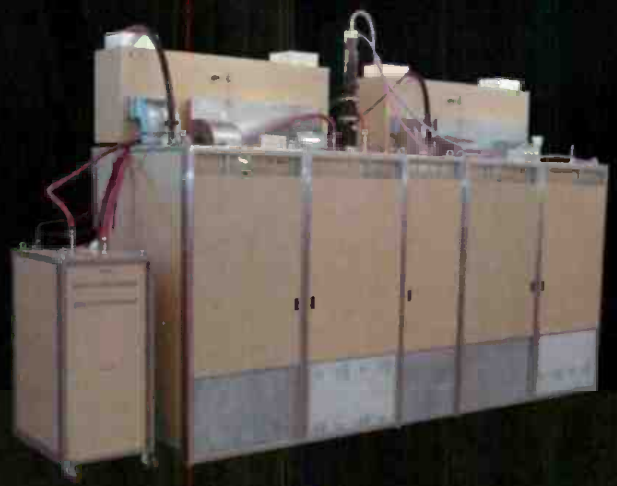


make an easy shift to DTV transmission.



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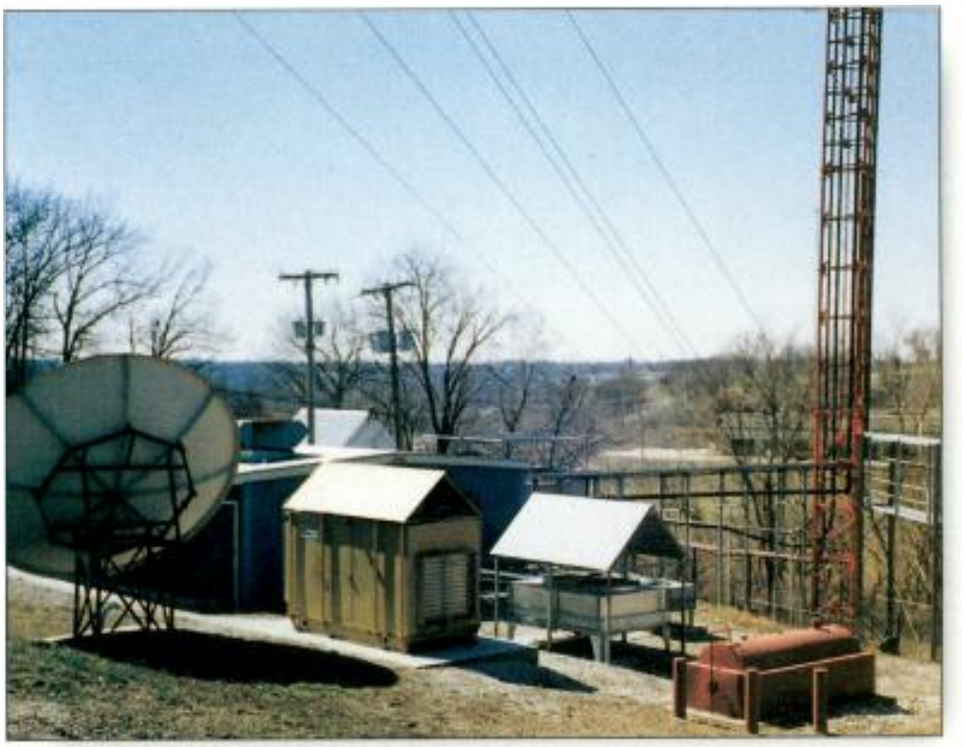
somewhat. Stations should have a written agreement with all contractors that specifically identifies who is responsible for both hazard assessment and safety training. An example of this would be a tower project. The responsible tower company representative should perform an assessment of the project and its hazards. That assessment should be posted on the site and all workers should be required to be aware of its contents. To protect the station and you (CYA), require a statement from the tower contractor that they accept full responsibility for the hazard assessment, that they have provided all safety training required for the project, and that they will provide all necessary safety equipment to comply with OSHA regulations. Then, require a listing of all of the employees who will be working on the project for the contractor along with the date on which they received their safety training.

Before you start thinking that this is a bit of overkill, realize that many tower companies are currently doing some or all of these items routinely. A number of the larger firms have been working closely with OSHA to develop workable standards and methods for tall tower work. The items listed in the previous paragraph are a good start.

Remember, if something goes wrong, *someone* will be held responsible for managing the project. If adequate documentation fixing that responsibility does not exist, OSHA will make the determination as to who will bear the burden. You may not like its decision. Certainly there are some areas where the station and its management must bear the responsibility. These include the normal station operations and such areas as the previously mentioned ENG truck. As a chief engineer, you should not be held responsible for safety training of a tower crew, its work practices or equipment. To protect yourself and the station, get it in writing.

If something does go wrong and an accident occurs, don't try to cover up the actual events under any circumstances. If OSHA does get involved, answer all questions fully and honestly. If you have honestly been trying to operate safely and to protect your staff, you aren't going to be hung out to dry. Yes, you may get a fine but you will learn a lot about how to manage your staff in the future. The fine will be enough to get your attention but isn't going to put you out of business. On the other hand, if it is determined that you knew of a dangerous condition and tried to get the work done anyway, you are in deep trouble. The really big fines concern accidents where someone knew of the danger but didn't tell anyone or just tried to push on through hoping that no one would get hurt. OSHA doesn't like that, nor should you want them to. You are also in the workplace – don't do stupid or risky things yourself and don't tell someone else to do them.



A typical transmitter site contains numerous potential hazards that, among others, may include falling objects, high voltage and fuel storage.

It is strongly recommended that you consult good legal counsel when starting any major project. It is also a good idea for routine operations just to be sure that you are complying with all applicable safety regulations. For new or major projects, let your attorney fashion the documents that establish responsibility as described in the earlier paragraphs. Doing that provides reasonable assurance that the documents will hold up in case of an accident. By doing this, you have engaged in the old CYA game once again by placing the responsibility in the hands of someone who is being paid to accept it. Remember if something goes wrong, ambulance chasers will be coming out of the walls to go after anyone with pockets, regardless of how deep they are. It isn't enough, sadly, to simply do your own work. If you are in any type of a supervisory position, you must learn to protect yourself from the errors of others. Otherwise, you may see all that you have worked for go down the drain faster than that cheerleader left you for the quarterback. ■

If you are in any type of a supervisory position, you must learn to protect yourself from the errors of others.

Don Markley is president of D. L. Markley and Associates, Peoria, Ill.

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

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Audio compression systems

BY JIM STARZYNSKI

Dolby Labs' AC-3 audio bit reduction technology made its debut in the 1991 film *Star Trek VI: The Undiscovered Country*. Who could guess that this new technology would play such an important role for recording and transmitting audio in the not-so-distant future?

That future is now, and AC-3/Dolby Digital is just an example of the many formats that let us experience high-quality multichannel digital sound that otherwise would be impossible to fit into our present storage and transmission mediums. Let's take the journey and explore bit reduction technology by analyzing the way we hear and perceive sounds, and then proceed with the terminology, variations, formats and applications of digital audio coding.

The inside story

In order to understand how perceptual digital audio compression works (actually, *bit reduction* or *coding* are more accurate terms), it's helpful to understand the human auditory system. A vibration (sound) causes air pressure changes that are funneled by the outer ear and routed into the auditory canal. This pressure impacts the eardrum. The bones in the middle ear couple this movement to an oval window, the outermost surface of the inner ear. This causes ripples in the fluid inside the inner ear's vestibule. When these ripples move, hair cells growing on the cochlea membrane get stimulated, just like seaweed inside a current. The frequency of the ripple effects a portion of the cell rows tuned for that particular sound. We identify this stimulation as pitch. The amplitude of the ripple causes a greater or lesser number of cells in that row to react, creating what we understand as loudness. These cells are connected to the eighth nerve, which passes these impulses to the brain, creating a sound.

So what does this have to do with audio coding? The ripples in the fluid of the inner ear stimulate the exact nerve endings for a particular pitch and loudness and also impact nerve cells nearby. As the ripple's amplitude diminishes, some hair cells are moved causing only minor stimulation. The hearing process uses filtering and can produce aural masking. The latter is a phenomenon in which a louder sound masks a softer sound happening at the same time. Although minor stimulation occurs, the softer impulses they create are not perceived. This forms the basis for audio perceptual coding of a lossy, frequency domain transform coding system. A lossy system's mathematical algorithm uses hearing as a model. The goal is to determine what parts of a sound are important for accurately perceived reproduction and which aren't. This psychoacoustic-based process uses band filtering and masking as the key to the formula for the codec (coder/decoder).

Audio compression technology has enabled the transfer of high quality audio between remotely located studios. Shown here is some of the equipment used to record announcers from remote ISDN-equipped studios and home-based announcers. Equipment includes: Telos Zephyr, APT Reporter, Wohler speakeramp and an RDL Mini Mixer

Executing this concept with an algorithm allows a digital audio signal to be bit reduced and then quantized. After coding, the new audio signal retains only what's perceivable and, as a result, fits into a smaller amount of bandwidth. If done effectively, the resulting audio closely matches the sound of the original source and non-perceived sounds are eliminated and not using up bandwidth. The goal is to maintain as much freedom from error as possible; however, the process is always a compromise.

Accuracy vs. bandwidth

It's the precision of the codec based on the psychoacoustic model that sets the various coding schemes apart from each other. Some simply sound different or better. Each is formulated for a particular application: multichannel DVD film soundtracks, the transmission of digital audio for DTV, or high-end audio to name a few. Another example, lossless bit reduction, uses a method similar to computer file zipping and unzipping, not perceptual coding to process audio. There's no loss of sound or data whatsoever, therefore lending the process to the preservation of pristine sound but still using less bandwidth than the original signal.

Unfortunately, lossless coding requires more bandwidth than lossy methods and can't apply to many current storage and transmission mediums that must fit video and other data with the audio. In what's termed *near-lossless coding* or *time-domain coding*, a digital signal is broken into frequency sub-bands by filtering. Predictive analysis is used to process these signals; the coder predicts what the next digital sample in audio signal will be and subtracts this from the actual sample. A resulting small error is transmitted to the decoder, which adds the prediction back in from identical tables stored in its memory. There is no psy-

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choacoustic model and 4:1 data-compression ratios can be achieved.

Effective digital audio bit reduction lets us store, transmit and enjoy high-quality audio which otherwise would be impossible to do with noncoded signals. Its progression has been quite a feat. One can only imagine what cutting edge improvements audio coding technology will bring to the next millennium.

The technologies

Here's a rundown of popular coding schemes and applications for their use.

APT/Audio Processing Technology is a Dublin-based company whose APT-X near-lossless algorithms are used for ISDN, studio-to-transmitter links and digital audio workstations. It provides technology to other manufacturers for everything from component-level through PCB-sub assemblies to complete systems.

Dolby Laboratories is a San Francisco-based company that develops audio technology for film, music recording, video, television and multimedia on a pro and consumer level. It licenses technology to suppliers and manufactures pro audio equipment. Dolby AC-3/Dolby Digital is the accepted format for ATSC DTV in the U.S. Its algorithms are lossy.

DTS/Digital Theatre Systems is a California-based company that develops audio technology for the motion picture, music and video/audio pro and consumer industries. It has developed a lossy audio-coding scheme called DTS Coherent Acoustics that runs at bit rates up to 4.096Mb/s and is capable of up to eight channels of 96kHz/24-bit.

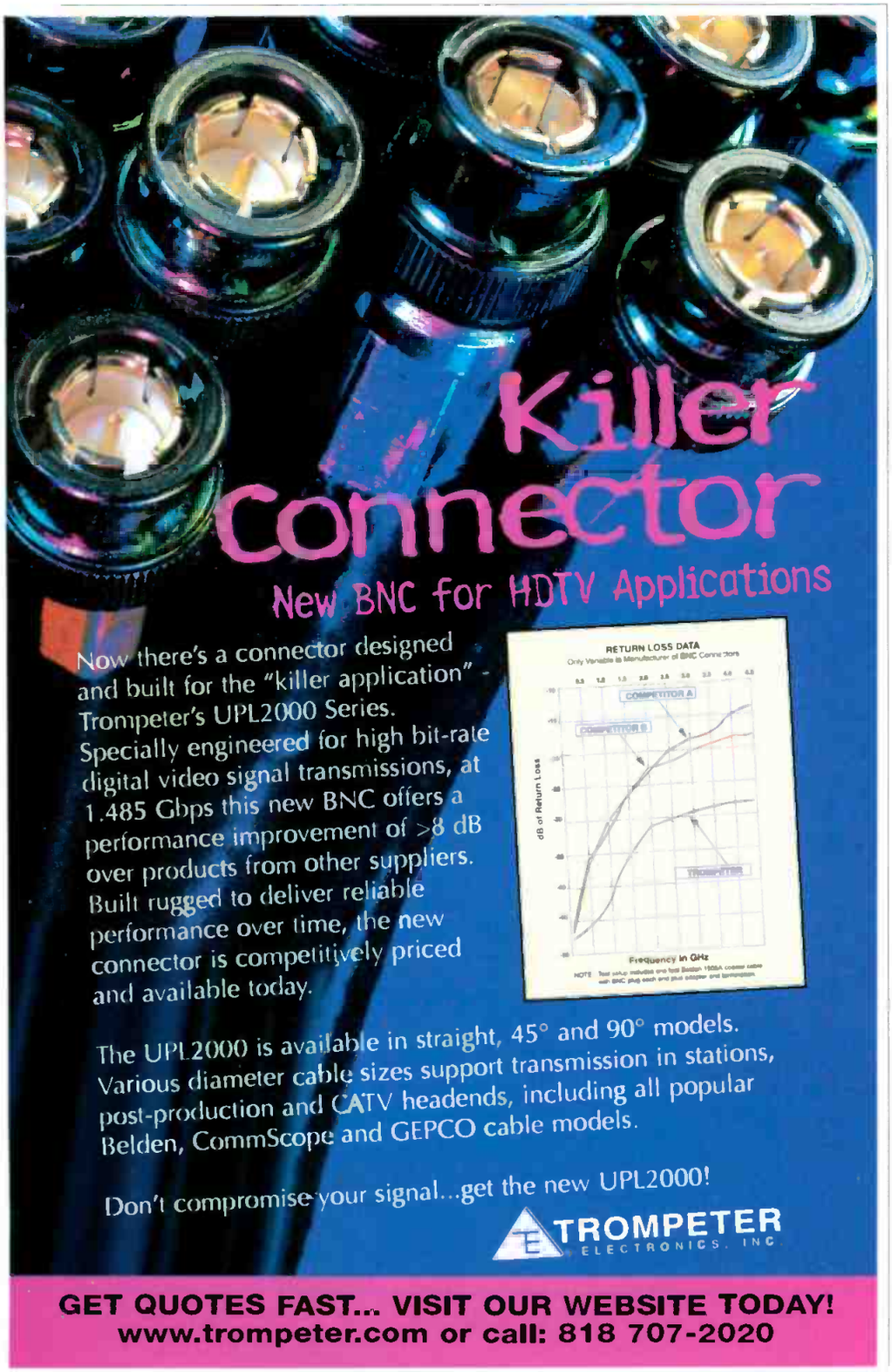
MLP Meridian Audio is a U.K.-based company manufacturing consumer audio equipment. A recent development, Meridian Lossless Packing, is a coding scheme without a psychoacoustic model. It's geared toward the high-end audio market and saves bandwidth in a way similar to the way computer files are compressed. It's capable of up to 164 channels, 44.1-192kHz at 24-bits.

MPEG (Motion Pictures Expert Group) is a working group in a subcommittee of ISO/IEC that generates generic standards for video and audio compression. Manufacturers of encoders develop their own programming to comply within a pre-established MPEG syntax. MPEG is also involved with defining the means for multiplexing of audio and video into one bitstream, such as the ATSC-transport stream. MPEG systems are lossy. MPEG definitions are described as dashed numbers and layers. The dash number represents a phase of encoding (MPEG-1, MPEG-2 , etc.) and the layers represent the complexity and efficiency of the encoding and decoding.

MUSICAM is a New Jersey-based company specializing in ISDN audio codecs. It uses a form of MPEG-2 Layer II with an enhancement allowing dynamic bit allocation. In the early 90s the MUSICAM name was close to synonymous with MPEG-type coding.

Sony ATRAC (Adaptive Transform Acoustic Coding) is a lossy technology developed by Sony for consumer and broadcast applications of its Minidisc System. The minidisc records 74 minutes of bit-reduced stereo audio on a 2 1/2-inch computer-like magneto-optical diskette. ■

Jim Starzynski is a project engineer at NBC headquarters, New York.



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- A/D-D/A converters: 24bit resolution with analog pre-scaling.

INPUT FORMATS

Switch easily between AES/EBU, S/PDIF and Analog inputs. Sample rate conversion is available on both Digital inputs.

OUTPUT FORMATS

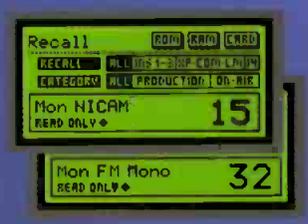
AES/EBU, S/PDIF and Analog outputs are all active simultaneously. Digital outputs may be dithered to resolutions between 8 and 24bits. The optional TC Master Fader allows for post-processing real-time fades, or a fade time may be dialed in and an autofade executed.

CLIENT TO CLIENT

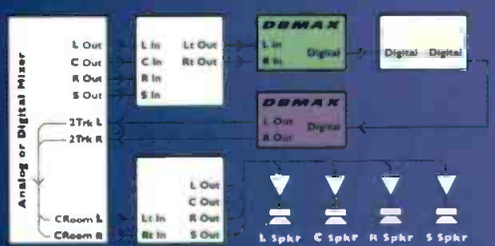
With the DBMAX it is easy to move from client to client or to target the mix for a VTR, DAT, DAW or broadcast.
Load your favorite preset and use different level setups to conform to any client's specifications or standards.

REAL WORLD

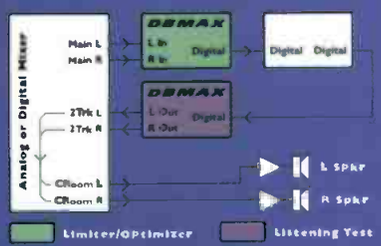
Listen to your mix under varied and realistic conditions. By emulating different broadcast and listening environments, you can make corrections to your mix based upon the sound at the end listener.



Surround Production



Stereo Production



NOTE:

The focus of this brochure is Production. The DBMAX also provides a variety of tools for use in Transmission processing. Read more about this in the separate Transmission brochure.

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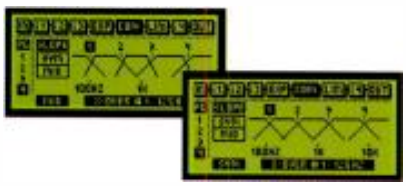
The Ref. Levels button gives you access to store or load your client's level specifications. This convenient feature is unique to the DBMAX.

The user interface is very intuitive. The Navigation Control allows for easy adjustment of parameters.

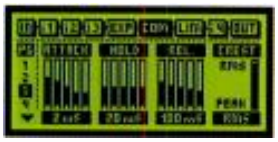
COMPRESSOR

The heart of the DBMAX is the most powerful dynamics tool you've ever heard: A five-band Compressor with adjustable slopes and cross-over frequencies. The advanced Look-ahead Delay may be used to reduce dynamic distortion and transient overshoots.



You can easily change the DBMAX multi-band structure from one to five bands.

Take control over individual band parameters or adjust them in groups.



Find a Preset you like and adjust the More / Less master compression control.

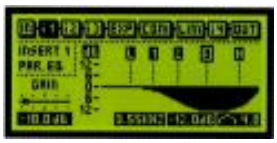
INSERTS 1-3

These insert blocks give you the ability to use plug-in types of processing tools before the 5-band Compressor/Limiter/Expander. Three simultaneous pre-dynamics inserts are available and you decide the order.

Insert examples: Parametric EQ, Normalizer, Dynamic EQ/De-esser, AGC (Automatic Gain Control), MS Encode/Decode and Stereo Enhance.

INSERT: EQUALIZER

Properly used multi-band compression is often a more desirable form of EQ - with the DBMAX you can do both.
With the high quality multi-band Parametric EQ, you can adjust the spectral content of your mix and preserve or enhance its transparency and energy.



INSERT: DE-ESSER

In a Digital audio environment HF limiting is often required. The Dynamic EQ/De-esser in the DBMAX lets you perform dynamic notching or shelving over a wide frequency range, all within the Digital domain.

LIMITER

Both the five-band and wide-band Limiters may be used simultaneously and each has variable look-ahead capability.
The multi-band Limiter acts on peak material in each band.

The final wide-band Limiter ensures maximum level in either an Analog or a Digital peak sensing environment. Soft clipping may also be added for further optimization. DBMAX now enables you to deliver perfect results for both the Analog and the Digital environment.

WIZARD

The new Wizard function allows you to find perfect settings quickly. Based upon know-how from post production engineers around the world, the Wizard will produce optimum settings for you. Play a bit of your source material and press the OK key.

TOOLS

For alignment and signal check, many precision tools are included:

- Peak Hold Meter with 0.1dB resolution.
- Surround Meter showing L, C, R, S levels.
- Phase Correlation Meter with time-base.
- Internal Headroom Metering.
- Oscillator for calibration 30Hz-15kHz at levels from -30dBfs to 0dBfs.
- Digital Status Tool lets you monitor input status and decide how status bits are handled through the machine - great when converting from S/PDIF to AES/EBU or vice versa.

DBMAX

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DBMAX

FIVE BAND DIGITAL COMPRESSOR & LIMITER

AES/EBU & S/PDIF Digital I/O's with outputs always active.

GPI input for preset changes, Bypass, or for connecting an optional TC Digital Master Fader.

The auto-sensing power supply automatically accepts and adjusts itself to 100-240 V, 50/60 Hz.

Balanced Analog I/O's with outputs always active.

Word Clock BNC input ensures accurate sample rate synchronization and asynchronous sample rate conversion.

These connectors carry both RS485/RS422 and MIDI for remote control.

TECHNICAL SPECIFICATIONS:

DIGITAL INPUTS AND OUTPUTS

Connectors:	XLR (AES/EBU)
	RCA Phono (S/PDIF)
Formats:	AES/EBU (24 bit),
	S/PDIF (20 bit), EIAJ CP-340, IEC 958
Output Dither:	HPF TPDF dither 8-24 bit
Word Clock Input:	BNC, 75 ohm, 0.6 to 10 Vpp
Sample Rates:	32 kHz, 44.1 kHz, 48 kHz
Processing Delay:	0.5 ms @ 48 kHz
Frequency Response DIO:	OC to 23.9 kHz ± 0.01 dB @ 48 kHz

Sample Rate Conversion

Type:	Asynchronous
Dynamic Range:	120 dB
THD+N:	-106 dB 44.1 to 48 kHz @ 1 kHz, -2 dBFS
Input Rate Range:	31 kHz to 49 kHz

ANALOG INPUTS

Connectors:	XLR balanced (pin 2 hot)
Impedance:	20 kohm (balanced)
Max. Input Level:	+27 dBu (balanced)
Min Input Level (for 0 dBFS):	-4 dBu (balanced)
A to D Conversion:	24 bit (1 bit, 128 times oversampling)
A to D Delay:	0.8 ms @ 48 kHz
Dynamic Range:	>103 dB (unweighted), >106 dB(A)
THD:	-95 dB (0.0018 %) @ 1 kHz, -6 dBFS (FS @ +18 dBu)
Frequency Response:	10 Hz to 20 kHz: +0/-0.2 dB
Crosstalk:	<-80 dB, 10 Hz to 20 kHz
	typical –100 dB @ 1 kHz

ANALOG OUTPUTS

Connectors:	XLR balanced (pin 2 hot)
By-pass:	Through relay
Impedance:	40 ohm (balanced)
Max. Output Level:	+26 dBu (balanced)
Full Scale Output Range:	-4 dBu to +26 dBu (balanced)
D to A Conversion:	24 bit (1 bit, 128 times oversampling)
D to A Delay:	0.57 ms @ 48 kHz
Dynamic Range:	>100 dB (unweighted), >104 dB(A)
THD:	-86 dB (0.005 %) @ 1 kHz, -6 dBFS (FS @ +18 dBu)
Frequency Response:	10 Hz to 20 kHz: +0/-0.5 dB
Crosstalk:	<-60 dB, 10 Hz to 20 kHz
	typical –90 dB @ 1 kHz

EMC

Complies with:	EN 55103-1 and EN 55103-2
	FCC part 15, Class B
	CISPR 22, Class B

SAFETY

Certified to:	IEC 65, EN 60065, UL 1419 and CSA E65

ENVIRONMENT

Operating Temperature:	32° F to 122° F (0° C to 50° C)
Storage Temperature:	-22° F to 167° F (-30° C to 70° C)
Humidity:	Max. 90% non-condensing

PCMCIA INTERFACE

Connector:	PC Card, 68 pin type 1 cards
Standards:	PCMCIA 2.0, JEIDA 4.0
Card Format:	Supports up to 2 MB SRAM

CONTROL INTERFACE

RS485/RS422:	5 Pin DIN
MIDI:	In/Out/Through: 5 Pin DIN
GPI, Pedal, Fader:	1/4 inch phone jack

GENERAL

Finish:	Anodized aluminum face and top plate
	Plated and painted steel chassis
LCD:	56 x 128 dot graphic LCD-display
Dimensions:	19" x 1.75" x 8.2" (483 x 44 x 208 mm)
Weight:	5.2 lb. (2.35 kg)
Mains Voltage:	100 to 240 VAC, 50 to 60 Hz (auto-select)
Power Consumption:	<20 W
Backup Battery Life:	>10 years

WARRANTY

Parts and Labor:	1 year

Note: Due to continuous development and standardization all specifications are subject to change without notice

OPTIONAL DIGITAL MASTER FADER AVAILABLE

Jan-99

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Sunset Post's new HDTV telecine suite featuring C Reality, Glendale, CA. Photo by Tony David of Tony David Photography.

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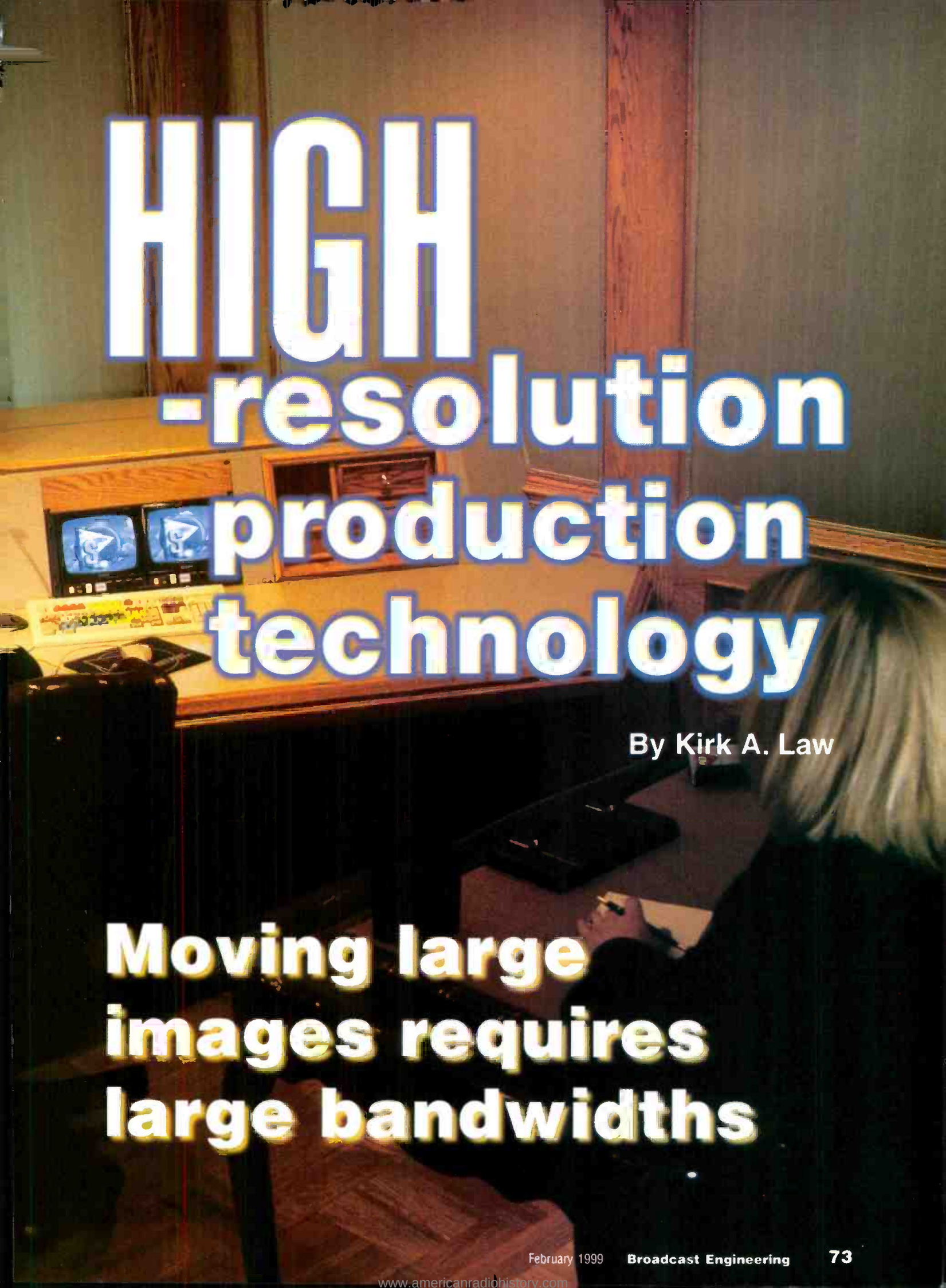

HIGH-resolution production technology

By Kirk A. Law

Moving large images requires large bandwidths

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A Henry suite at Henninger Video, Arlington, VA.

The advent of DTV in the U.S. has heralded a new era in the post-production industry. The desire for DTV and, more importantly, HDTV content by the networks has lead early adopters to search for DTV-compatible hardware and software solutions. HDTV formats require approximately six times the resolution of today's uncompressed component digital formats. Implementing these high-resolution formats will require significant changes throughout facilities.

Over the last 10 years, the post-production industry has embraced computer-based solutions. Historically, the performance of computer-based systems has not matched the performance of dedicated hardware solutions; most notably in the area of data throughput and manipulation. With the onslaught of HD, accommodating multistream, uncompressed content may require a reversion to the more traditional, linear method of content manipulation and editing. Many manufacturers now offer a range of dedicated HDTV production equipment and are 1advocating a reversion to linear-based editing models. At face value, this appears to be a step backwards for the post-production industry. For many, dedicated equipment is required in HDTV production environments (i.e., live environments). A wide range of nonlinear, multilevel comput-

Color-space (Sampling)	# Bits/component	# Bits/pixel	Byte Rounded # Bytes/Pixel	Reference Name
YCrCb (422)	8-bits	16-bits	2	YCrCb8
YCrCb (422)	10-bits	20-bits	3	YCrCb10
RGB (444)	8-bits	24-bits	3	RGB8
RGB (444)	10-bits	30-bits	4	RGB10
RGB (444)	16-bits	48-bits	6	RGB16

Table 1. Color pixel definitions

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er-based editing and compositing solutions are available, but the throughput capabilities of these systems are limited relative to high definition.

The tremendous amounts of data inherent in high-resolution productions require a new approach to computer system architecture. Within a post-production environment, bottlenecks become the weak links. If film be can converted to digital and stored on a local server in real time but cannot be transferred to the editing bay in real time, that becomes a bottleneck. This bottleneck reduces the facility's overall efficiency, and, in terms of HD production, most owners would prefer to test the waters without making a huge capital outlay. Not everyone wants to do HDTV 100 percent of the time. Many of today's solutions are either standard-resolution or high-definition. Only a few products support both. However, scalable resolution computer-based solutions can provide support for both standards, and more importantly, these can accommodate all of the proposed HDTV formats.

The push for the many DTV resolutions has caused many to dream of digital film mastering and publishing to the respective distribution formats. There is a great deal of discussion around the generation of a digital master, as well as its format. Although image repurposing has traditionally been more important to the animation/film production crowd, those involved with episodic production must consider this as a possible direction for their facility. There are a number of transmission or distribution paths for this content ranging from Web to HDTV or electronic cinema distribution. Broadcast news production and weekly broadcast production might also use digital masters utilizing compressed digital formats instead of the higher resolutions.

The digital master

Many users are considering the use of a progressive, 24Hz format for use as a "film-like" digital master. Animation, film, and post-production facilities (long shelf-life assets) have been thinking along these lines for some time. Live broadcast uses (short shelf-life assets, e.g., today's news) may fit this format, but not as well. Generally, high-dollar live broadcasts, such as sports, would prefer a 60Hz progressive format. Episodic production, along with its medium-to-long shelf-life assets (the new season of 90210 and its potential for syndication) fit somewhere in the middle. When the program goes into syndication, however, the distribution method may be different from the original target, e.g., 1280x720@60p versus an original in NTSC. The need for asset repurposing reveals a strong overlap with animation/film/post-production facilities in the areas of data handling, storage, archiving and manipulation of a scalable image format.

Film scanners with HiPPi (100MB/s) interfaces have helped usher in some new approaches to handling larger resolution digital masters. This approach provides approximately six frames per second of 2048x2048 image resolution data. A new interface, gigabit system network (GSN) called *Super HiPPi* operates at 800MB/s. On film scanners, this allows for real-time acquisition of 2048x2048 resolution content to digital storage. Several manufacturers are adopting this interface to help solve the data movement problem.

The real need now facing those in animation, post, and broadcast is *format dynamic range* or having a scalable infrastructure to handle a mix of media formats. There are several issues to consider when using nonlinear operations methods versus linear or a combination of the two. The choice of the application, computer and peripheral supplier vendors and their respective philosophy towards how they solve the format dynamic range problem will ultimately determine a substantial portion of a facility's capabilities.

Multiresolution creative editing suites can employ one or more basic data handling models:

•The editor works directly with the uncompressed video/data.

Image H-Size (Pixels)	Image V-Size (Pixels)	Frame Rate (Hz)	Streaming Pixel Rate (M Pixels/s)	Format Reference Name	YCrCb8 2-Bytes/pix (MB/s)	YCrCb10/RGB8 3-Bytes/pix (MB/s)	RGB10 4-Bytes/pix (MB/s)	RGB16 6-Bytes/pix (MB/s)
720	486	29.97	10.49	486@30i	20.97	31.46	41.95	62.92
720	486	59.94	20.97	486@60p	41.95	62.92	83.90	125.85
1280	720	23.976	22.10	720@24p	44.19	66.29	88.39	132.58
1280	720	59.94	55.24	720@60p	110.48	165.72	220.96	331.44
1920	1080	23.976	49.72	1080@24p	99.43	149.15	198.87	298.30
1920	1080	29.97	62.15	1080@30i	124.29	186.44	248.58	372.87
1920	1080	59.94	124.29	1080@60p	248.58	372.87	497.17	745.75
1920	1440	23.976	66.29	1440@24p	132.58	198.87	265.16	397.73
2048	1556	23.976	76.40	1556@24p	152.81	229.21	305.62	458.42
2048	2048	23.976	100.56	2048@24p	201.13	301.69	402.25	603.38

Table 2. Formats and their streaming bandwidth equivalents. Color pixels are rounded up to the nearest byte boundary.

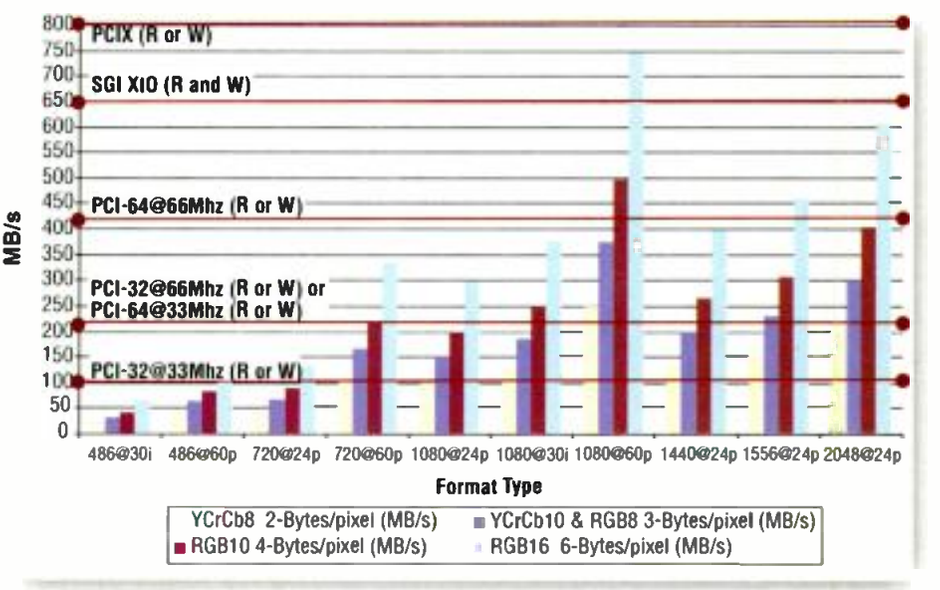

Figure 1. Streaming real-time bandwidth for various raster sizes along with computer I/O expansion bus de-rated bandwidths.

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HIGH-res

•The editor creates an EDL based on a proxy and subsequently conforms a full-resolution master in a linear or VTR-like manner.

•The editor works on a combination of compressed proxies or uncompressed images. Real-time compression/decompression processors are used as appropriate for compiling transitions and effects. Compiling may be accelerated to be real-time or faster-than-real-time with specialized hardware.

Each workflow offers various advantages and disadvantages. The approach computer-based solutions use to handle compressed and uncompressed data varies. Some computer manufacturers promote a memory-centric style that frees application vendors from specific or predetermined hardware processing algorithms. By leveraging high-memory bandwidth architecture, many streams of higher resolution images can be shuttled about in real-time or faster-than-real-time depending on the application's desires and on the size and configuration of the system.

Several vendors take a bus-based approach. This method keeps the real-time streaming imagery away from the main processor and memory subsystem in favor of hardware accelerators that reside in the I/O bus space of the computer, e.g., the PCI bus. Other solutions include the use of over-the-top buses that run between the various PCI devices and bypass the system's main memory. While bandwidth to these devices may be achieved, they are typically not as scalable as the memory-centric approach. This approach may not offer much leverage for the eventual GHz-and-beyond processors, radically increasing memory-controller bandwidths and graphics and imaging accelerators that will eventually become off-the-shelf equipment.

Sunset Post's new HDTV telecine suite featuring C Reality in Glendale, CA .

(NOTE: % Realtime BW calculations use 20% derating of Interface Peak BW for protocol overhead)

Interface Type	Used as Disk/Network Interface	Interface Peak MB/s	%RTime 486@30i YCrCb8 20.97MB/s	%RTime 720@24p RGB10 88.39MB/s	%RTime 720@60p YCrCb10 & RGB8 165.72MB/s	%RTime 1080@30I YCrCb10 & RGB8 186MB/s	%RTime 2048@24p RGB10 402.25MB/s
GSN	Future/Y	800	3052%	724%	386%	344%	159%
1000bT ENET	N/Y	125	477%	113%	60%	54%	25%
Serial HiPPi	Y/Y	100	381%	91%	48%	43%	20%
Fibre Channel	Y/Y	100	381%	91%	48%	43%	20%
ATM-OC12	N/Y	77.75	297%	70%	38%	33%	15%
Ultra-SCSI	Y/N	40	153%	36%	19%	17%	8%
SCSI-II F/W	Y/N	20	76%	18%	10%	9%	4%
ATM-OC3	N/Y	19.38	74%	18%	9%	8%	4%
100bT ENET	N/Y	12.5	48%	11%	6%	5%	2%
FDDI	N/Y	12.5	48%	11%	6%	5%	2%
DS3	N/Y	5.63	21%	5%	3%	2%	1%
10bT ENET	N/Y	1.25	5%	1%	0.6%	0.5%	0.2%

Table 3. Network and disk bandwidths compared to image formats as a percentage of their real-time streaming requirements.

Multiresolution digital formats

To understand a computer's ability to handle streaming media efficiently, one must first understand the rate/size of the problem. Table 1 lists the color pixel definitions, while Table 2 includes raster sizes, frame rates, and the real-time streaming rates for these images in MB/s.

There are two general issues when dealing with higher resolution images. The first is interfacing the computer with higher resolution equipment, such

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as scanners and HDTV equipment. The second is moving and manipulating the image stream within the computer.

As Table 2 illustrates, the bandwidth needed to sustain real-time throughput is wide, ranging from 21MB/s to 756MB/s. Several of these raster sizes, rates and precisions will be supported under interface standards set by SMPTE. The availability of SMPTE-defined interfaces will allow computer manufacturers to offer I/O solutions compatible with traditional broadcast equipment.

In addition, there are other types of I/O solutions. These are made up of digital disk I/O devices, RAM or frame I/O devices, and analog or digital computer graphics output formatted for HDTV raster types. While these devices provide real-time record for a short sequence into their local storage, they generally have less-than-real-time interfaces to a computer. The throughput from the HD device to the computer for these types of devices might range from two to 12 frames per second, which is generally acceptable for animation and visual effects, but is somewhat slow for true editing applications. Some computer workstations can handle outputting all ATSC high-resolution image formats as well as higher resolutions in real-time directly from the graphics subsystems.

Typically, computer graphics subsystems output RGB analog video. Several commercial devices are available to convert from HD analog RGB to digital parallel or serial digital YCrCb. Native digital video out to HDTV interfaces will eventually appear on the output of these graphics devices. In terms of storage and networking, Table 3 lists the major interfaces implemented in today's computers and compares their peak ratings to the throughput requirements of several interesting image streams.

To increase bandwidth, disk subsystems based on SCSI, Ultra-SCSI, and Fibre Channel are typically striped together. Generally, disk subsystems are much less efficient when performing random access operations. Such is the case with nonlinear editing. Some manufacturers apply up to a 50 percent derating on the disk subsystem's (not the disk interface itself) peak data rate. This allows the data rate to be sustained, and prevents dropped frames. This is a form of dynamic range allocation imposed on the disk subsystem.

Flipside Editorial's Smoke room featuring straight to finish editing techniques that combine both offline and online editing in one editing box.

Computer architecture and requirements

Most computer architectures have some basic components in common. Combined, these components and their architecture determine the unit's capabilities:

•Processor speed: number of, type, multiple instruction ability, and data cache handling all affect processing while streaming images.

•Memory subsystem: Amount, configuration, and type affect data availability while processing and available bandwidth while streaming.

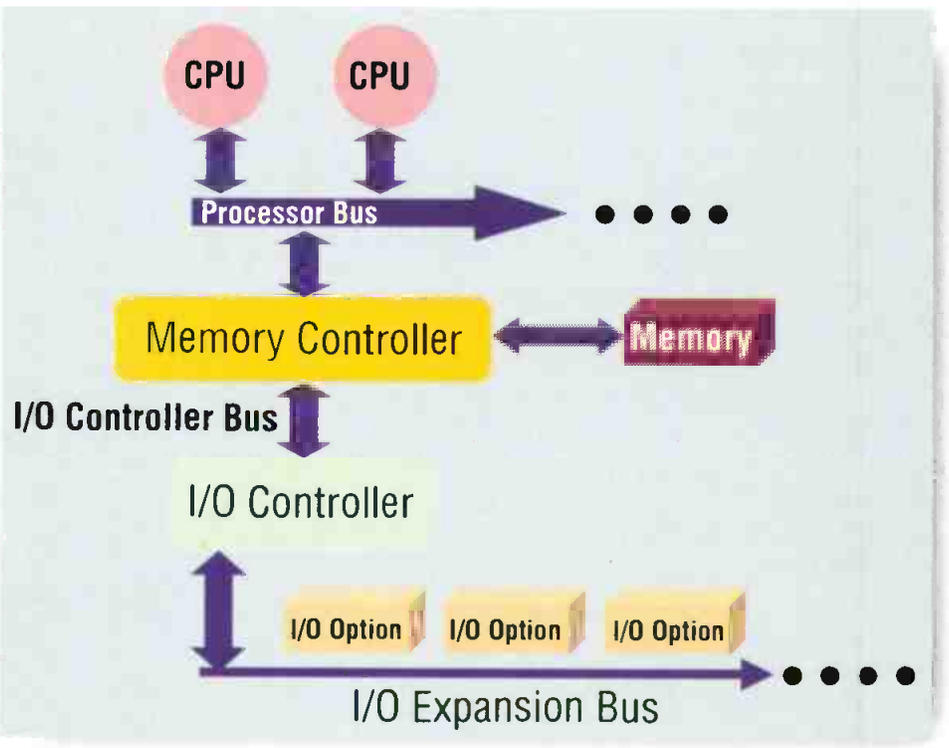

Figure 3. Typical computer architecture

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HIGH-res

•Memory controller: Affects the ability to multitask and overall bandwidth handling.

•I/O controller: Must complement the memory controller, otherwise throughput bandwidth may suffer. Low-latency, event-handling mechanisms help handle interactive tasks while streaming images.

•Processor interface bus to the memory controller: Able to handle large amounts of data throughput and handle processor and I/O data requests efficiently.

•Memory controller interface bus to I/O controller: Able to handle multiple and simultaneous high-bandwidth traffic streams coming to/from memory and I/O devices.

•I/O expansion bus for I/O options and peripherals: Must be able to handle high bandwidths, provide efficient methods of fault handling and bus contention with other I/O devices while still supplying good throughput. Must have a good balance of data I/O for streams of bytes as well as smaller bursts of bytes.

Figure 3 shows a basic computer architecture.

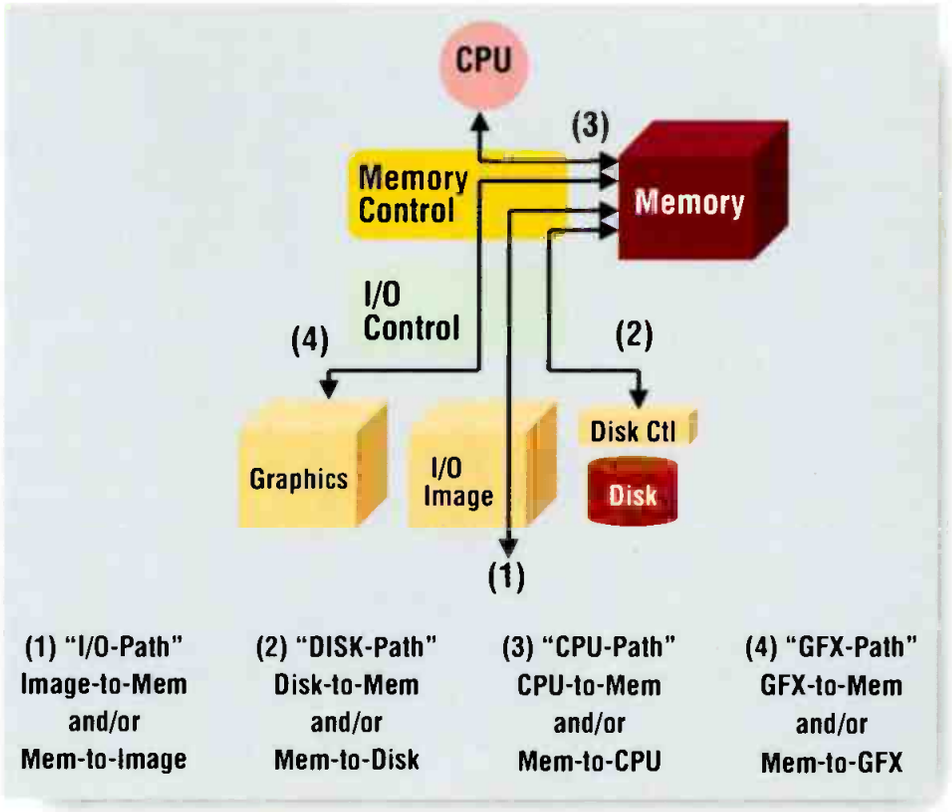

Figure 4. Example of memory-centric data movement paths

Data path definitions for memory-centric programming

Let's examine the data paths that are involved with a memory-centric data-movement paradigm. It is important to acknowledge the bandwidths needed to stream images to and from main memory and to the various consumers of this data within the system. Some examples are video to memory and memory to disk. A memory-centric data movement approach allows applications to program to the computer's standard resources. This natural data-flow programming approach results in scalable applications as new technology becomes available. Figure 4 illustrates some typical data flows.

The most common form of I/O bus technology today is the Peripheral Component Interface bus (PCI bus) with PCI I/O peripherals. The PCI bus standard specifies both 32-bit and 64-bit versions with different clock speed choices. These clock speeds and the number of bits representing the data bus are factors governing maximum possible bandwidth over this interface. One rule of thumb suggests de-rating the theoretical bus bandwidth by 20 percent to get the protocol overhead for bus transactions. Other areas of de-rating must be taken into account at all the points through which data flows. A PCI bus configuration might be able to handle the data rate, but the I/O controller, memory controller, and memory subsystem may become bottlenecks. Additionally, the PCI bus is a half-duplex bus, meaning that devices on the bus share it for read and write operations. Therefore, the realizable bandwidth to memory is based on the I/O expansion bus, the I/O controller, the memory controller and the type of memory subsystem. The operation system's ability to allow system tuning for low-latency and real-time performance is important as well.

The bit and speed combination of 32-bits at 33MHz is the most common configuration found in today's consumer PCs. Typically, consumer-level PCs cannot realize the bandwidth potential of this bus. Much of this due to price/performance design

Bus Type	Bus Width (#bits)	Bus Clock Speed (MHz)	Theoretical Bandwidth (MB/s)	Half or Full Duplex Bus	De-rated Bandwidth (MB/s)	Technology Availability
PCI-32@33Mhz	32	33	128 (RD or WR)	Half	»105	Now
PCI-32@66Mhz	32	66	264 (RD or WR)	Half	»211	Now
PCI-64@33Mhz	64	33	264 (RD or WR)	Half	»211	Now
PCI-64@66Mhz	64	66	528 (RD or WR)	Half	»420	Now
PCIX	64	133	1064 (RD or WR)	Half	»850	Proposed
XIO	16	400	1600 (800 RD & WR)	Full or simult. Reads & Writes	»1200 (600 RD & WR)	Now

Table 5. I/O expansion bus configurations and bandwidth comparisons.

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points and application focus. Consequently, many PC systems achieve only 20-50MB/s.

Silicon Graphics offers an additional proprietary I/O expansion bus called XIO. XIO has high bandwidth, low latency, and allows for scalable I/O peripherals and related application solutions. XIO delivers a theoretical bandwidth of 800MB/s in a full-duplex fashion. Full-duplex means there is a dedicated read and write bus in the infrastructure. This allows 800MB/s in both directions simultaneously. (see Table 5)

It becomes obvious that many of the formats listed in Table 2 are not supportable in real-time on the most common PCI I/O expansion buses. Figure 1 shows the de-rated bus bandwidths superimposed over the streaming bandwidth data for various image resolutions.

Other components of the computer architecture must be well matched with the ability of the I/O expansion bus for the system to perform as desired. In the case of multiple streams of large images, one may require multiple I/O controllers and a well-designed memory controller architecture to achieve a well performing memory-centric application.

Figure 5 illustrates data-flow paths example that could be used in a memory-centric application in a production suite. Observe the number of times an image passes through the I/O bus and its controller, memory controller, and main memory subsystem. In the example, the image data passes through these subsystems four times. In the case of 1920x1080@30i with YCrCb8, this would be as much as approximately 496MB/s of sustained bandwidth, or approximately 124MB/s per stream through each of these points within the architecture. In this case, the I/O bus would need to handle approximately 248MB/s as would the disk subsystem.

This bandwidth requires the use of high-performance subsystems throughout the architecture. To the extent possible, multiple subsystems might be used in parallel to ease some of this burden. This might take the form of multiple I/O controllers to allow spreading the bandwidth

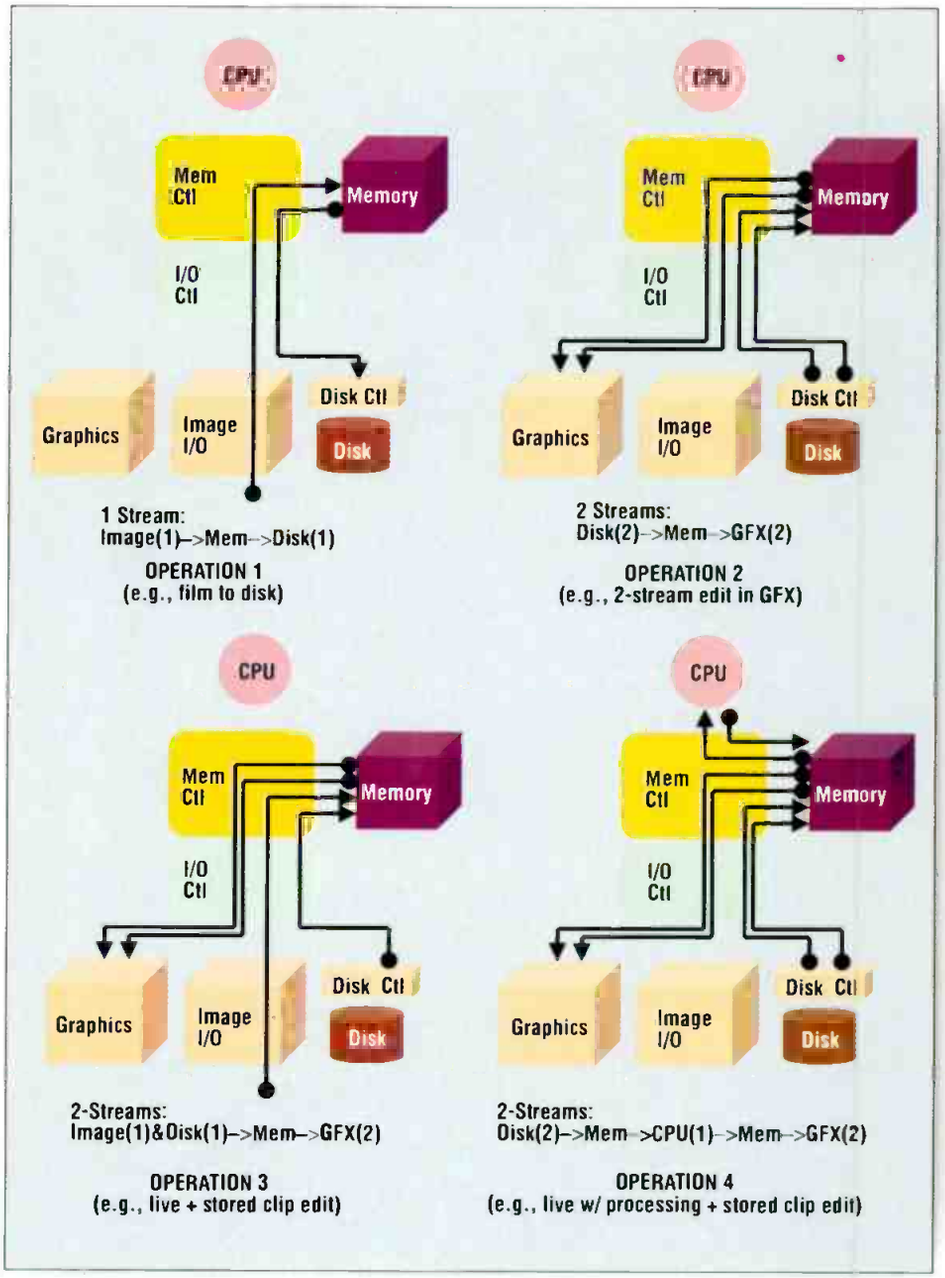

Figure 5. Typical streaming-media data paths through a generic computer architecture.

requirements across multiple I/O expansion busses.

There are a host of important items that must be considered for high-resolution, multistream editing. For example, disk-storage technology choices, networking choices, storage area networking architecture and the overall facility workflow must all be understood for high-resolution image handling. This is especially true for multiformat high-resolution image editing. The fundamental limitation of dealing with memory-centric applications requiring multiple standard and high-definition streams on traditional workstations and servers is that they typically use an inadequate or nonscalable bus-based architecture. This type of architecture may be sufficient for solving problems when smaller amounts of data need to be moved, but becomes a critical bottleneck when dealing with uncompressed and/or larger image resolutions of digital media. Handling multiple streams of high-resolution data within an off-the-shelf computer system is not as illusive as one might think. Predictions are that if technology continues at its current pace, the bar will continue to lower, offering more computer architectures the ability to handle larger data rates. ■

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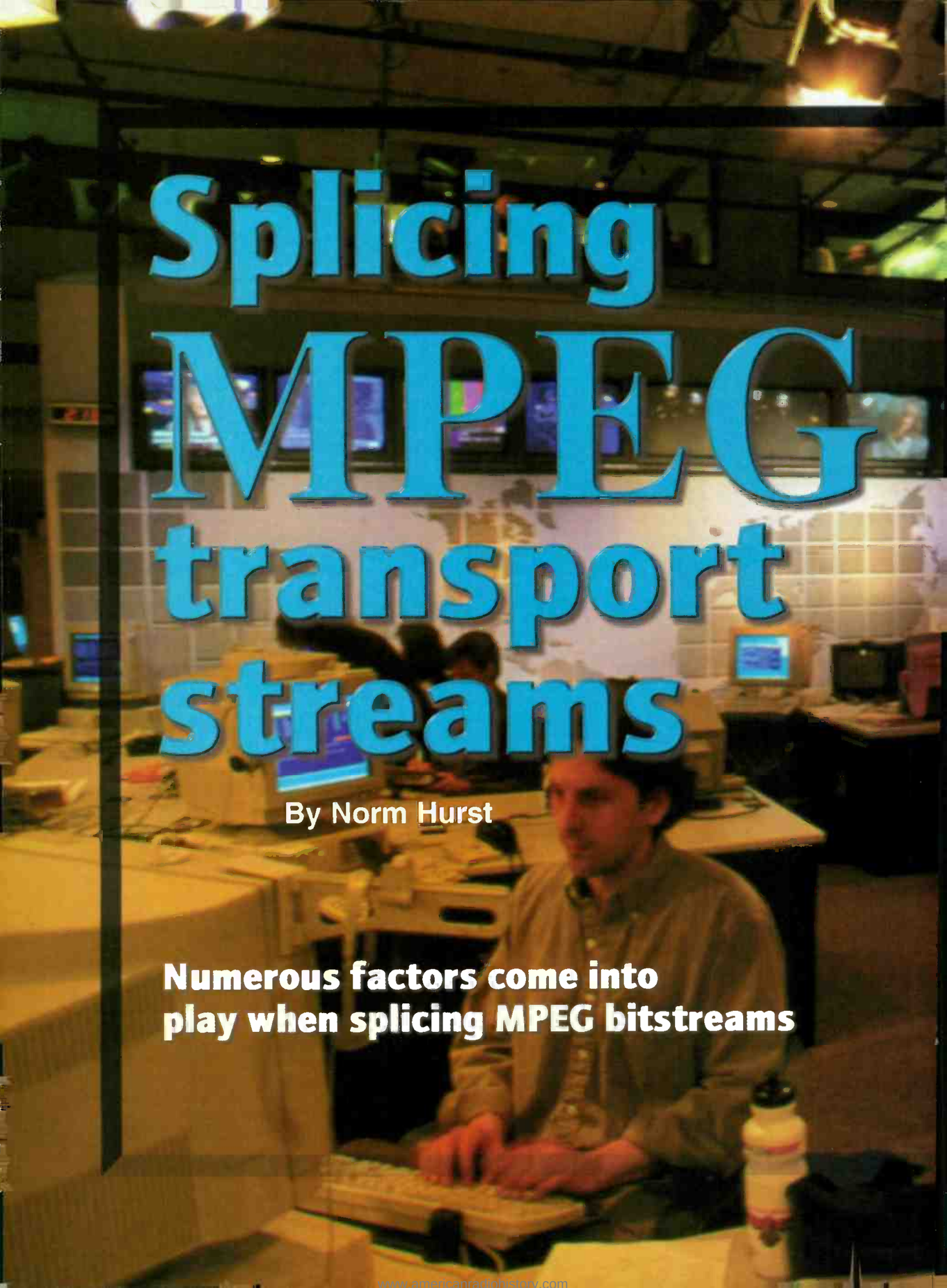

Splicing MPEG transport streams

By Norm Hurst

Numerous factors come into play when splicing MPEG bitstreams

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MPEG is everywhere. With MPEG, switching from one bitstream to another is described as splicing. Splicing one MPEG transport stream to another requires a splicer, and all splicers are not the same. This article examines the difficulties of MPEG splicing and provides some questions to ask when purchasing a splicer.

Making the switch

Switching NTSC or PAL is relatively simple. Frames in the videostream occur regularly. Once the frame boundaries are lined up and have the same timebase (using a frame sync, if necessary), the switch from the old signal to the new signal is done during the vertical blanking interval. Switches from A to B and back again can be done on any chosen frame. It's seamless and frame accurate.

The same thing can be done with MPEG streams by first decoding to video, then switching the video and finally re-encoding the switched video. This is seamless and frame accurate, but has two drawbacks: high cost and reduced picture quality. Encoders are expensive, and each time the stream is decoded and re-encoded additional coding artifacts are produced (technologies such as the MOLE may reduce this problem). Directly splicing the bitstream would be a better solution. Two things make splicing difficult. The first is different frame types and the second is VBV bitstream buffering.

MPEG uses three different frame types; I, P and B. I frames are self-contained and independent, while P and B frames

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contain mostly frame differences. Jumping into a bitstream at a P or B frame means the I frame to which the P or B frame refers is missing. The result is garbage until the next I frame. To add to this, B frames are frame differences from both a previous and a future frame. They are sent out of order, after the future frame that they reference.

The amount of time required to send MPEG frames varies. Because video frames occur at regular intervals, MPEG decoders use a buffer to reconcile the differences between input and output data rates. MPEG encoders must carefully construct bitstreams to prevent decoder buffer over/underflow. Splicing different bitstreams together can cause buffer management problems.

Picture types

Much of MPEG's compression capability is a result of sending only the changes between frames. A P frame instructs the decoder to predict the next frame from the previous P or I frame in the stream. The coded P frame merely carries fine tuning information to fix up prediction errors.

Consider splicing from one I-P bitstream to another. With no B frames, the presentation order and the transmission order are the same (see Figure 1). Exiting the old stream after frame P_1 and entering the new stream at frame P_{39}, results in the decoder trying to reconstruct frame 39 by making a prediction from frame 1. Having created one garbage frame, the decoder then reconstructs frame 40 by predicting from the garbage frame 39. This continues until frame 42 (an I frame) provides a valid starting point. Without B frames, the old stream can be left at any point.

B frames are like P frames, except the prediction is made from both the previous I or P frame and also the next one. For example, in Figure 2, frames 6 and 7 are B frames, and they are each predicted from frames 5 and 8. The decoder cannot reconstruct frame 6 or 7 until it has reconstructed the frames needed to predict them, (frames 5 and 8). Both frames 5 and 8 must appear in the bitstream before frames 6 and 7. B frames are sent delayed: instead of 5, 6, 7, 8 we have 5, 8, 6, 7.

With B frames in the stream, splicing complexity increases. In terms of presentation order, the old stream can be left after any P or I frame, but not after a B frame—that cuts off the backward prediction reference frame. In the bitstream, this means leaving after a P or I frame and all the B frames (if any) that immediately follow it. For example, to exit the old stream after frame P_5, (see Figure 2) the out point would immediately follow frame B_4, otherwise the new stream would have one or more holes due to missing B frames.

Getting out of a stream is one thing, getting into the new one is another. The obvious in-point is an I frame, but it is not that simple. Consider frame I_8 in Figure 3. How will the decoder interpret the next two frames (B_6 and B_7)? The problem is not that frames 7 and 8 precede frame 9 but that those two B frames may reference frame P_5, which will not exist in the spliced stream. If they do reference P_5, they belong to an open Group of Pictures (open GOP). Open GOPs contain frames which reference frames in another GOP, whereas closed GOPs do not. Most encoders make a running sequence of open GOPs, presenting a challenge to splicers trying to make sense of the first B frames in the GOP after a splice.

Buffer problems

Every decoder has a bitstream buffer at its input. At startup, the buffer fills for some period of time before the first picture is removed for decoding. This is called the startup delay, the value of each frame's startup delay is contained in the stream itself. Decoders that do not honor the startup delay risk a buffer overflow or underflow at some later time. An underflow will likely cause the picture to freeze while an overflow will result in data loss and could have disasterous results.

When a bitstream ends and stops going into the buffer, some bits still remain; perhaps several pictures worth. It can take several picture times (frames)

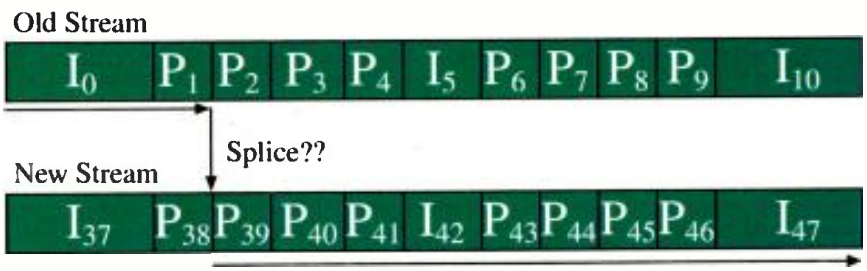

Figure 1. Entering a new stream just before a P frame (frame 39 here), results in nonsense until the next I frame occurs because the predictions are made (incorrectly) based on the wrong I frame (frame 0).

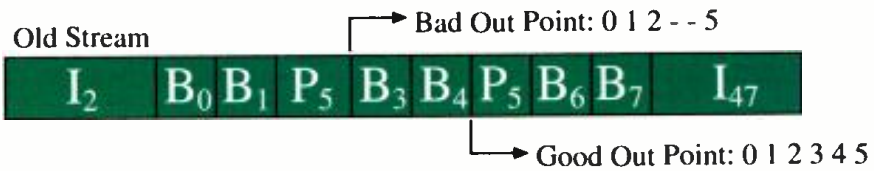

Figure 2. B frames are sent out of order, so leaving a stream after the desired last P frame, but before all the following B frames, leaves holes in the frame sequence, possibly producing a motion freeze just before the splice.

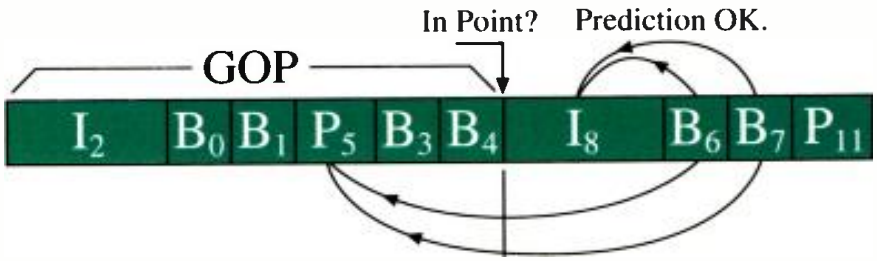

Figure 3. Entering a stream at an I frame does not always work. The first B frames after the I frame may refer to the P frame before the I frame. Because this P frame does not exist in the spliced stream, the result could be a short motion judder after a splice.

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for the decoder to finish decoding these remaining pictures. The time between when the bitstream ends and the last picture is decoded is called the ending delay. Like the startup delay, the ending delay is unique for each frame in the stream.

A splice can be thought of as the overlap of the ending delay of the old stream and the startup delay of the new stream. The trick is overlapping these without causing the buffer to underflow or overflow. To have an unbroken sequence of frames and avoid a buffer overflow, the startup delay of the new stream at the desired inpoint should be one frame-time (or less) longer than the ending delay of the old stream at the desired out point. When this happens, it is possible to create a seamless splice.

When the startup delay is less than the ending delay, delay must be added to the new stream. There are several ways to do this. Sometimes the ending delay of the outgoing stream is shorter than the startup delay of the new stream. To honor the startup delay of the new stream, the decoder must wait after decoding the last frame of the old stream before decoding the first frame of the new stream. During this time the picture will probably freeze (MPEG specifications do not define decoder behav-

MPEG Splicing Glossary

closed GOP n. a Group of Pictures which does not contain pictures that make reference to pictures in the preceding GOP.

crash splice n. A simple-minded switch with totally unpredictable results, usually due to syntactic or semantic errors in the spliced stream.

ending delay n. The time it takes the last frame of a bitstream to traverse the decoder buffer. It is a unique value for each frame in a given bitstream.

frame-accurate adj. (1) a splice which occurs precisely at the frames selected by the user. (2) A splicer capable of splicing precisely at the frames selected by the user.

inpoint n. (1) a splice point that has been specifically **preconditioned** to provide an opportunity to enter that bitstream, esp. of SMPTE inpoint. (2) a place in a bitstream where a person has decided to enter the bitstream. (3) a place in a bitstream where a splicer has decided to enter the bitstream.

new stream n. (1)) in relation to a particular splicing operations, the stream that is switched to. (2) the portion of a spliced stream following a **splice**. Also called "inbound stream" or "in stream."

nonseamless splice n. a splice which is not a seamless splice: it is either not **visually seamless** or not **syntactically seamless**. May cause a momentary freeze, blank screen, or motion judder. Many nonseamless splices may appear to be seamless to some viewers; whether it is good enough is subjective. The appearance of the splice usually depends on the relationship between the two spliced streams at the time of the splice.

old stream n. (1) in relation to a particular splicing operation, the stream that is switched away from. (2) the portion of a spliced stream preceding a **splice**. Also called "outbound stream" or "out stream."

open GOP n. a Group of Pictures which contains pictures that make reference to pictures in the preceding GOP. Open GOPs are difficult to splice into for this reason.

out point n. (1) a splice point that has been specifically **preconditioned** to provide an opportunity to leave that bitstream, esp. of SMPTE outpoint. (2) a place in a bitstream where a person has decided to leave the bitstream. (3) a place in a bitstream where a splicer has decided to leave the bitstream.

PCR discontinuity n. a step change in the sequence of program clock reference samples that are sent with each program. PCR discontinuities are allowed by MPEG, so a seamless splice may include one, but some decoders have a hard time decoding smoothly through a discontinuity.

performance symmetry n. the characteristic of a splicer whose A and B inputs may be interchanged without affecting the performance.

preconditioned adj. of a bitstream, constrained more than the basic MPEG requirements to create **splice points** which are opportunities to splice.

progressive update or **progressive refresh** n. A valid MPEG coding technique that avoids the use of I frames, but instead codes a few I macroblocks in each picture. Without I frames, these streams are difficult to splice into.

restamping n. the process of continually offsetting PCR and timestamp values, usually to remove a discontinuity introduced by splicing.

seamless splice n. a splice which is both **syntactically seamless** and **visually seamless**.

SMPTE 312M n. An industry standard which defines how MPEG bitstreams may be further constrained (**preconditioned**) to create **splice points** which facilitate performing a **seamless splice** at those points, and which defines a command protocol for signaling downstream splicers.

splice (1) n. the process of leaving one bitstream and joining another. (2) v. the act of such joining. (3) n. the place in the resulting bitstream where the joint has been made. Splice types include **crash, syntically seamless, visually seamless, seamless, and non-seamless.**

splice point n. (1) a place in a bitstream that has been **preconditioned** to provide an opportunity to perform a splice, esp. of SMPTE splice point. (2) a place in a bitstream where someone has decided to enter or leave the bitstream.

splicer n. a device that can switch from one bitstream to another.

startup delay n. The time it takes the first frame of a bitstream to traverse the decoder buffer. It is a unique value for each frame in a given bitstream.

syntactically seamless splice n. a splice which results in a bitstream which meets the syntactic and semantic requirements of MPEG-2 Video and Systems specs 13818-1 and 13818-2. Not necessarily a **visually seamless splice** (possibly due to insertion of **transition frames**).

transition sequence, transition frames n. a short bitstream sequence of frames synthesized by a **splicer** to interpose between the end of the **old stream** and the beginning of the **new stream**, usually to control buffer levels.

visually seamless splice n. a splice which results in an unbroken sequence of decoded frames such that the last frame of the old stream is followed by the first frame of the new stream without intervening **transition frames**, but which is not a **syntactically seamless splice**. Visual performance may depend on decoder characteristics that are not defined by MPEG-2.

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ior under these conditions). Transport stream splicers which claim to create a seamless splice under these circumstances are either wonderfully clever or violating the laws of physics and MPEG.

SMPTE 312M describes standard ways to precondition an MPEG stream to create seamless inpoints and seamless outpoints at locations selected during the encoding process. The encoder forces a certain buffer delay at these points, and ensures that outpoints appear after the last B frame following an anchor frame, and that inpoints start with an I frame at a closed GOP. Unfortunately, SMPTE 312M does not define when or how often streams should contain splice points.

Manufacturers have devised splicers that can perform reasonable splices under most conditions on streams that have not been preconditioned. However, sometimes the streams conspire to make splicing difficult. Under these conditions, splicer performance can be vastly different from one manufacturer to another, as each has a different technique for cheating time to match up mismatched stream delays at the splice.

Splicer evaluation

It is important to remember that just because a splicer can make a visually seamless splice once does not mean it can do it under all conditions. Different streams, no control over one or more streams, or even decoders or IRDs from other manufacturers could cause less than ideal splices.

Because splicer performance depends on the state of the two streams at the splice, be wary of canned splicer demos. Ask if you can push the button that causes a switch, and ask if there are multiple sources. Switch back and forth several times, and note if there is an occasional performance difference when switching from A to B vs. B to A. Ask if the bitstreams are the same bit rate, or if switching among bit rates can be demonstrated. Switching from a lower bit rate to a higher one can cause a buffer overflow if done incorrectly.

Ask what the worst-case frame accuracy is, and on what it depends, e.g. the arrival of an I frame from the network. Frame-accuracy, or the lack of it, may affect your operations.

Consider this: You have a 30-second (900-frame) spot for which the ad agency is paying $900,000 each time it goes to air. That's $1000 a frame. They want all the frames they paid for. If a splicer delays the start of the spot by three frames to match it to the outpoint delay, what happens at the end of the spot? Are the last three frames cut off, or does the schedule slip by three frames (at every splice)? Or put another way, how big an avail slot is needed to guarantee that all 900 frames get shown? 903 frames? 907?

Additional questions for splicer manufacturers regarding input could include:

•Does the splicer work with any ATSC- and DVB-compliant streams? Does it support AC-3 audio? Will it work with MP@ML, and MP@HL? Will it work

VBV Buffering

Consider an end-to-end encoder and decoder system. Video frames go into the encoder at 30f/s (for example) and emerge from the decoder at 30f/s. But between encoder and decoder is the world of the bitstream, where picture boundaries occur at irregular intervals. Decoders have a bitstream buffer at their input to reconcile the world of regular and irregular frame boundaries. Encoders must construct bitstreams so that the decoders' buffers will neither underflow nor overflow.

The MPEG specification defines a theoretical decoder's buffer model called the Video Buffering Verifier, or VBV. The VBV is a bitstream constraint. It is not a decoder specification. These bitstream constraints allow a practical decoder buffer to be designed.

To understand the concept of splicing MPEG video we must understand the VBV model.

The VBV models a theoretical decoder's buffer. There is no physical buffer – it is just a model used to constrain the bitstream as it is created. This imaginary buffer is simple: a FIFO with an input and an output.

To be MPEG-compliant, bitstreams must meet a simple constraint: neither underflow nor overflow the VBV buffer, which make the buffer fullness of great interest. Buffer fullness depends on two simultaneous buffer processes: input and output. The MPEG specification defines how and when bits enter the buffer, and how and when bits leave the buffer.

Buffer output: Bits leave the buffer in chunks — one picture at a time. All bits for a given picture are removed from the buffer instantaneously (remember, it's a model). Pictures are generally removed from the buffer at regular intervals, once per frame. Exceptions include the effect of 3-2 pulldown and field pictures. The time at which a given picture is removed from the VBV buffer is called the decode time for that picture.

Buffer input: There are two modes of buffer input: variable bit rate (VBR) and constant bitrate (CBR). In VBR, mode bits enter the buffer until it is full and then input stops. Input resumes when the buffer is no longer full (due to the output process removing bits). In the CBR mode, bits simply enter the buffer continuously at a constant bit rate for each picture, and it is up to the encoder to ensure that the buffer does not overflow.

Startup delay, buffer initialization: When a decoder resets and begins to decode a stream, the VBV buffer is empty. The VBV buffer is filled for a period of time specified in the bitstream (in CBR mode) or until it is full (in VBR mode), at a rate specified in the bitstream (both modes). This determines the initial buffer fullness, and is crucial to prevent overflow or underflow at a later time.

Ending Delay: When the bitstream ends (buffer input stops), the buffer still contains bits, which drop from the buffer one picture at a time until the buffer is empty.

Splicing: The trick with splicing is to connect bitstreams which are likely to have mismatched ending and startup delays. This implies some kind of delay jump, and something's got to give. There are two basic scenarios: short-into-long, and long-into-short.

When splicing from a short delay to a long delay, some wait time is required. This usually causes a buffer underflow. When this happens, the decoder must wait for data and the picture freezes momentarily. Instead, the splicer can add time by inserting transition frames. Or, ideally, the last few frames of the old stream can be requantized to remove some bits and increase the ending delay.

When splicing from a long delay to a short delay, the splicer can add time by holding off the new stream a precise moment, to make up the time difference, or by adding null stuffing bits to the end.

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with 422P@ML?

•Does the splicer require one input to always be present, even if not selected? For instance, does the primary input provide the timing reference for the output, even when a different stream is selected?

•Are splices between streams with different bit rates possible? What about between HD and SD streams?

•How are open GOPs at an inpoint handled?

•What happens when switching to a bitstream that uses progressive refresh and contains no I frames at all?

And for output:

•Is the spliced stream continuously MPEG compliant through each splice?

•Does the picture quality at the splice depend on decoder behavior not defined by the MPEG-2 specification or does the spliced stream determine the picture at all times?

•Is the splicer frame accurate? Under what conditions? Is control of the start time of the new stream required to achieve this level of performance?

•Is the splicer seamless? With any MPEG-2-compliant stream, or only with certain preconditioned streams? Is control of the start time of the new stream required to achieve this level of performance?

•Does the splicer restamp the program clock reference (PCR), or does it insert a PCR discontinuity at the splice? Either is valid MPEG. Seamless splices may have a PCR discontinuity, but decoding smoothly through a PCR discontinuity is difficult. Does the splicer restamp time references in the SMPTE 312M splice_info_section?

For systems:

•Is the delay constant through the splicer or does it change from splice to splice?

•Is the splicer performance the same switching from network to local as it is switching from local to network?

•Does one of the feeds have to be locally controlled or can you splice two live feeds? Does the performance change when splicing two live feeds?

•Is extra bandwidth required in the multiplex to achieve the specified performance? How much? What if there is no extra bandwidth available at the time of the splice?

•Can a 900-frame spot be inserted in a 900-frame avail without truncating any frames from the spot or the program? If not, how many frames are needed to guarantee that all 900 frames will play out?

•What does the splicer do with a multiprogram transport stream? Can any stream in the mux be replaced? Are the program association table (PAT) and program map table (PMT) remapped? Is the relative delay of the programs in the mux changed?

•What effect does statistical multiplexing (stat-mux) have on the splicer's performance?

•Can splices be made into encrypted streams?

•Can the splicer work with a multiprogram transport stream that contains only one program clock reference packet identifier (PCR PID) to which all of the programs make reference, or must each program have an independent PCR PID?

•Does the splicer understand and take advantage of SMPTE 312M protocol when present? Does the splicer pass SMPTE protocol for downstream splicers?

Creating a continuous program stream by switching from one signal source to another is a basic operation, but the advent of compressed MPEG streams has made this simple function a very challenging one. Although some of the issues involved have been examined, there are other important subjects such as audio, system control, statistical multiplex, splicing aux data, etc. that remain.

Many manufacturers have devised clever ways of switching the bitstream directly, instead of decoding, switching and re-encoding. The performance of these techniques varies, so buyers need to select carefully. This field is so new that not even price is a good predictor of performance. However, a long series of make-goods could quickly make the cost of any splicer a small issue. ■

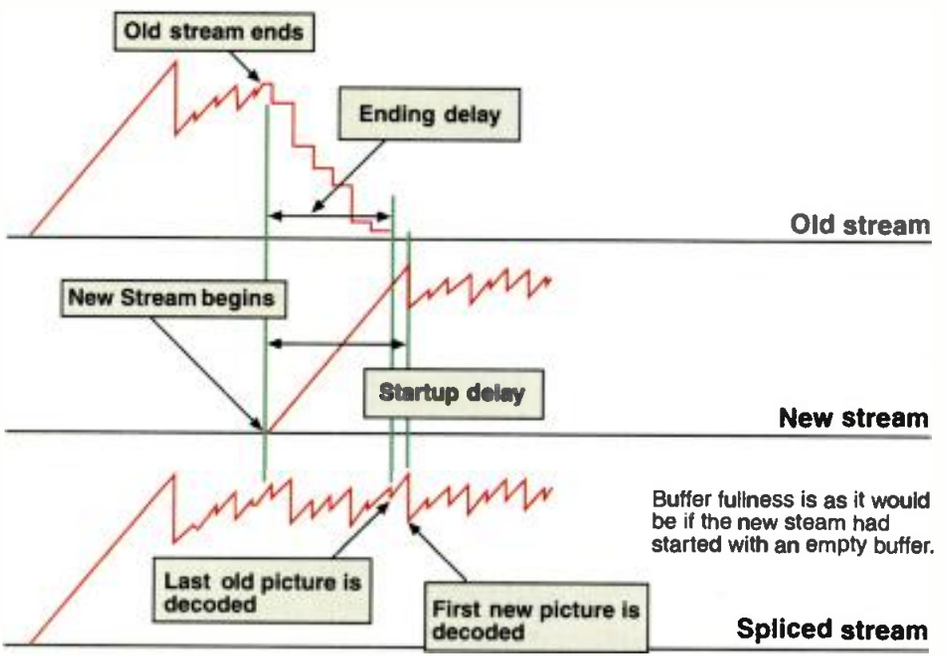

Figure 4. When the old stream ends it takes the last frame ending delay to get through the buffer. When the new stream starts, the decoder must wait the startup delay before decoding the first frame. These delay times are unique for each frame in each stream. Splicing involves overlapping these two processes without overflowing the buffer.

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Thanks to the following who contributed to this glossary: Jose Brunheroto, Guy Cherry, Katie Cornog, Hillel Gazit, Mukta Kar, Tassos Nakassis, Marty Picco, and Chris Ward.

For more information:

A FAQ on the SMPTE 312M splicing standard:
www.mpeg.org/MPEG/splicing-FAQ.html
A guide to splicing by Philips:
www.broadcast.philips.com/hi-tech/splice.htm
A paper on splicing from NDS:
Dallard, Nigel and Bock, Alois; "Splicing Solutions in Digital Broadcast Networks", IBC'98 Proceedings, pp. 557 - 561.

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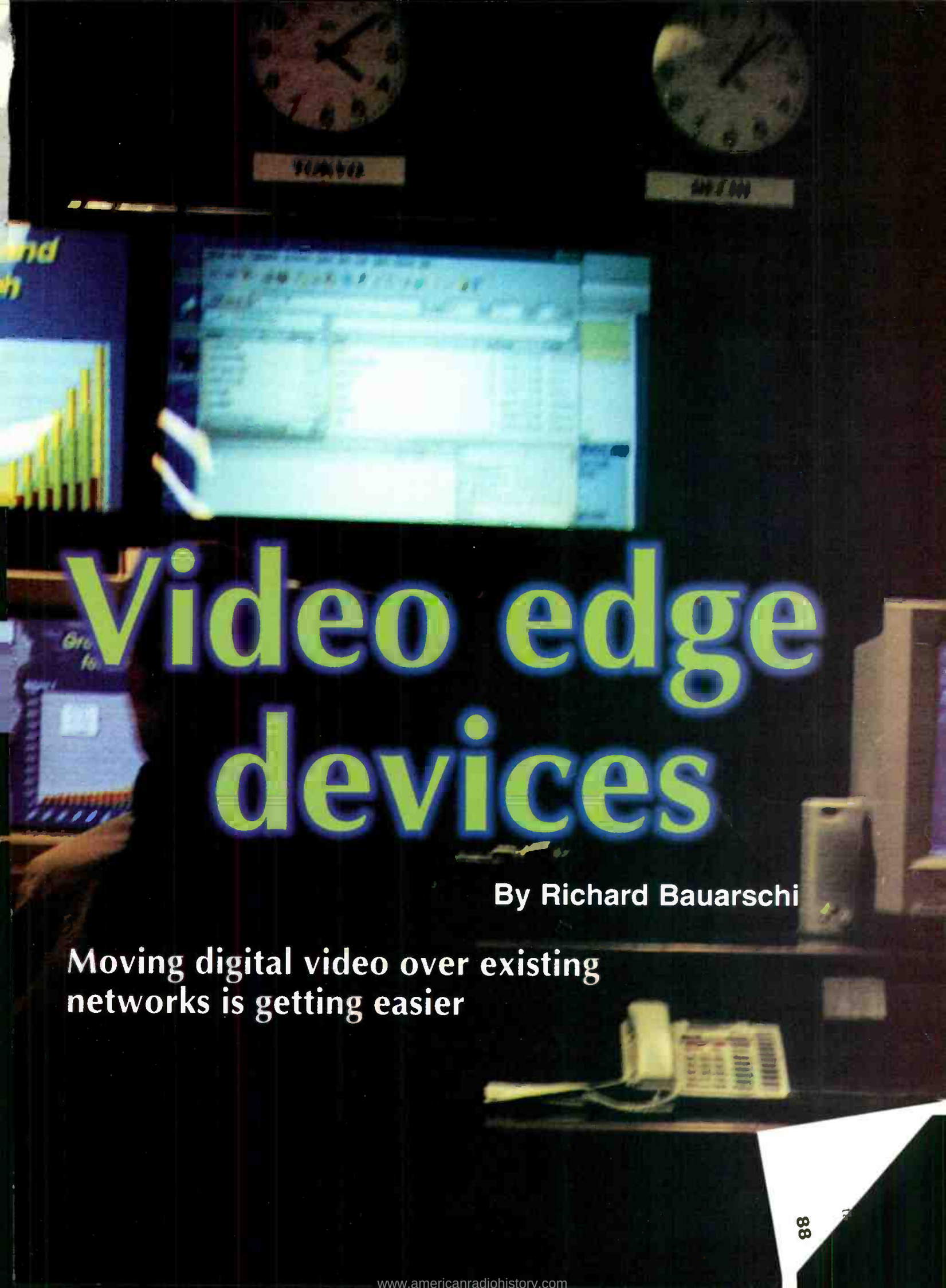

Video edge devices

By Richard Bauarschi

Moving digital video over existing networks is getting easier

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Video

As TV studios and post-production facilities transition to an all digital infrastructure, these changes will likely turn the world of video transmission inside out. Sending broadcast quality video over any distance presents quite a challenge, and digital video is making that challenge ever more difficult. In the comfortable world of NTSC, the video transmission interface is always the same: 1Vpp into 75Ω. In digital video, there are as many interfaces as there are opinions on which is best. Common bitstreams include data rates of 19.4, 25, 38.8, 45, 50, 155, 270 and 360Mb/s as well as 1.5Gb/s. Because it's no longer a simple, universal interface, a variety of needs must be accommodated.

Point-to-point video transmission is traditionally broken up into two categories, local loop and wide area or long haul circuits. For local loop transmission, solutions include microwave, a variety of fiber optic solutions and a few free space optical links. For wide area applications, the choices are limited to on-network terrestrial carrier circuits, or satellite-based circuits.

Today's local loop

For years, local loop video transmission has been accomplished using privately owned microwave systems. However, over the last decade microwave frequencies have become virtually exhausted in most major metropolitan areas. Telco fiber-based services are increasingly being used for new video circuits. Fiber services presently available include:

•Dark fiber. Fiber that is in place, but not being used by its owner. The advantage is that bandwidth is limited only by the type of fiber and the terminal equipment used. Disadvantages include the fact that it is a dedicated fiber line and, while in use, it cannot be shared for other services. Furthermore, it is difficult to find and too expensive for most occasional users to install. When available, it's usually the cable companies and alternate carriers that may be willing to lease it. Alternate access carriers do not offer dial tone services, but do offer bulk traffic hauling via DS1, DS3, or SONET (Synchronous Optical Network) to long distance points of presence.

•TV-1. Telco service based on analog NTSC transmission with a specific set of tariffs and performance characteristics. This service can be based on a number of different rate structures, beginning with hourly, all the way up to multi-year contracts. In most major cities, switched video services are available, or are becoming available.

•270Mb/s SDI. In a few areas of the country, carriers are implementing switched 270Mb/s SDI networks for non-compressed local loop transport of serial digital video. The initial thrust for SDI circuits was from post-production houses that needed high quality circuits for collaboration, review and approval. As more and more broadcasters convert their facilities to SDI, switched services are becoming more viable.

Despite its attractiveness, 270Mb/s services are likely to remain in the local loop. Getting beyond the local loop requires compression. It is almost impossible to secure dark fiber from Los Angeles to New York, for example, and even if it were possible, the cost would be astronomical. In an on-network scenario, the 270Mb/s data does not easily scale into the telco hierarchy without compression, or through the use of very high bandwidths such as SONET OC-12 (622Mb/s). Typically, the SDI data is compressed into a 155Mb/s SONET OC-3 payload, or a standard 45Mb/s DS3 asynchronous payload. Some manufacturers are introducing a 622Mb/s SONET OC-12 solution for transporting 270Mb/s SDI streams, but the price of such circuits is prohibitive and availability is limited.

Digital Interface	Data Rate	Equivalent	Comments
DS0	64kb/s	One VF Channel	Basic building block
DS1	1.544Mb/s	24 x DS0	Popular in data world
DS2	6.312Mb/s	4 x DS1	Not widely used
DS3	44.736Mb/s	28 x DS1 or 7 x DS2	Most popular for video

Table 1. North American telco digital hierarchy

Over the long haul

Long-haul video circuits are based on transmission systems that scale into the existing interexchange networks. Carriers like AT&T, MCI, Sprint, Vyvx and others, all use digital networks descended from voice and data hierarchy.

The traditional North American digital hierarchy (see Table 1) is based on a very rigid set of interface standards. The approach made sense when it was developed because the only real concern was in coming up with a method of multiplexing digitized voice circuits onto a coaxial or a microwave carrier. Data transport was a low priority, and video was analog. The typical services offered include:

•DS0 (64kb/s). Although sometimes fractionalized, DS0 is usually the lowest common building block. It is the digital equivalent of one voice-grade telephone circuit. Multiple DS0s are often bonded together, or combined in a process called inverse multiplexing to gain greater aggregate throughput.

•DS1 (1.544Mb/s). Also known generically as T1, DS1 was initially made up of 24 DS0s plus framing bits. These circuits have recently been fractionalized into 1/4 T1 (384kb/s), 1/2 T1 (756kb/s) and 3/4 T1 (1.152kb/s). Fractionalization allows services of different bandwidths to be supported in a DS1.

DS2 (6.312Mb/s) Although officially part of the hierarchy, DS2 never became popular except as a microwave modulation rate to support four DS1s on the same carrier.

•DS3 (44.756Mb/s). DS3 is considered by many to be the new ubiquitous network connection. The term DS3 video is often used, but there are some misconceptions about how the service works. Do not call your local exchange carrier and ask for a DS3; you are likely to be transferred to the business service folks, who will quote an obscene amount of money. Clear-channel DS3s are tariffed in accordance with the equivalent voice and data capacity. Telco business service people could care less what you put in the DS3, they just know what

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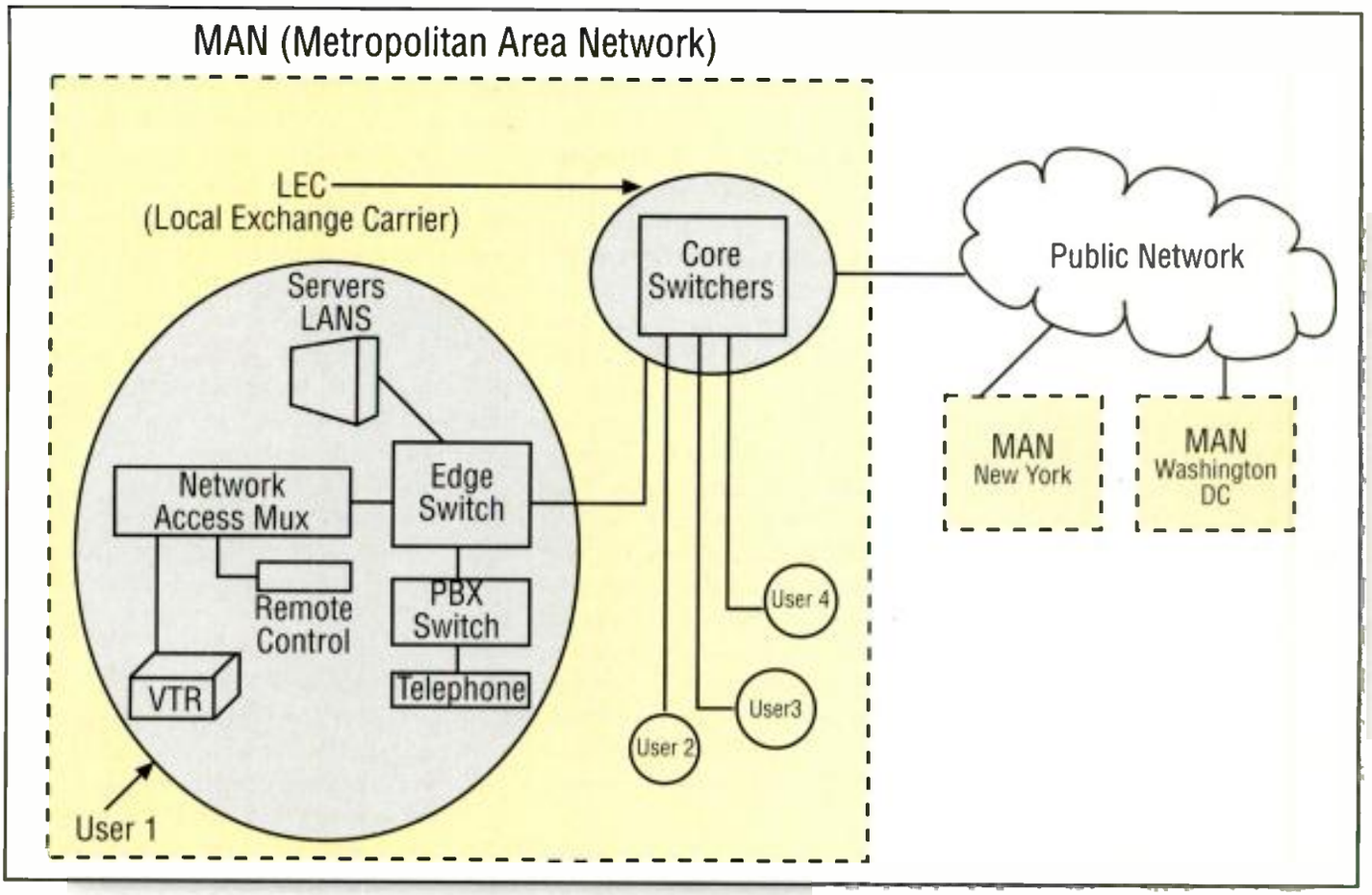

Figure 1: Simplified ATM network.

they have to charge for it. However, a compressed video service is one that simply makes use of part or all of a DS3 and it is tariffed as a video service, on a different scale from other services.

SONET

The movement towards DS3 ubiquity began in the 1980s when digital fiber systems came of age. Early products were limited to 45Mb/s, but eventually 560Mb/s asynchronous fiber systems became the norm. These heavy route systems could support 12 DS3s on a single fiber. The downside was that the entire digital payload had to be demultiplexed to gain access to any part of it; an expensive proposition.

SONET Interface	Electrical Interface	Data Rate
OC-1	STS-1	51.84Mb/s
OC-3	STS-3	155.52Mb/s
OC-12	STS-12	622.08Mb/s
OC-48	STS-48	2488.32Mb/s
OC-192	STS-192	9953.28Mb/s

Table 2. SONET transmission rates

Early in the 1990s, carriers began to deploy SONET transmission systems. The primary benefit in deploying a synchronous network, like SONET, is that you can see into the entire aggregate datastream and selectively extract any individual channel without demultiplexing the entire payload. SONET fiber systems allow simpler, less expensive, intermediate repeaters, where traffic can be added or dropped. All existing North American asynchronous digital transport services, like DS1 and DS3 can be mapped into SONET payloads.

A big advantage in SONET transmission is that basic building blocks can be combined or concatenated to support large-bandwidth requirements like video. The SONET equivalent of a DS3 is known as an OC-1. It is a 51.84Mb/s datastream with 49.5Mb/s of useable payload. If, for example, more bandwidth than 49.5Mb/s is needed, SONET technology allows multiple OC-1s to be concatenated into an OC-3, thus providing triple the bit rate while still existing within the SONET hierarchy. Such a circuit would be known as an OC-3c. Higher order concatenations, like OC-12c and OC-48c are also possible. This kind of flexibility is not possible in the asynchronous world.

Table 2 is a summary of the various SONET transmission rates. It is easiest to remember that the SONET carrier number (i.e. OC-3) is an exact multiple of the OC-1 rate. In looser terms, it can also be related to the number of DS3s that can be mapped into a SONET payload. An OC-12 can support 12 DS3s.

A new development, known as Dense Wave Division Multiplexing (DWDM) now allows multiple optical transports to coexist on the same fiber, similar to combining multiple microwave systems on the same waveguide. The continuous deployment of extremely fast SONET transports, DWDM in the long haul, and interexchange networks will eventually provide enough bandwidth to crisscross North America with virtually any video application.

ATM

Asynchronous Transfer Mode (ATM) technology has been rolling out for the better part of this decade. Following on the heels of X.25 packet switching and frame relay, ATM has long held the promise of providing a universal solution for combining totally disparate

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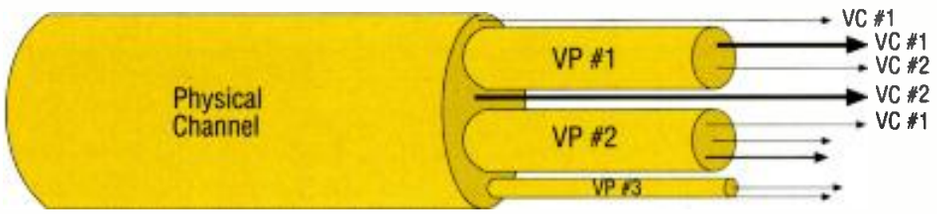
data in the same pipeline and seamlessly switching it through network nodes to its final destination. Because of its wide-ranging adaptability, ATM is a key technology contender in both local and long haul video transmission, and it is completely compatible with SONET transmission systems.

What is ATM, and why does it make sense in the broadcast or post-production world? To begin with, it is important to visualize ATM as a switching technology versus a transmission technology. That is not to say that ATM does not bring new dimensions to transmission; it's quite the opposite. The real strength of ATM is in its ability to provide seamless switching of disparate information through a single transmission medium.

Living on the edge

There have been numerous technologies developed for data transport and switching over the years. After considerable experience with all of the available methods, ATM has turned out to be the best choice for video as well as other forms of data. The primary reason is that it is technically scalable from T1 at 1.5Mb/s to OC-192 at 10Gb/s. As much or as little bandwidth as needed can be used within the network.

In simple terms, ATM networks capable of delivering video are made up of access nodes and switch nodes. Switch nodes may be core switches, enterprise switches, or edge switches, depending on their placement. Access nodes are network edge devices located at the studio and may consist of an edge switch, or an access multiplexer. Access multiplexers do not provide any switching, rather they serve as a concentration point for various datastreams into an ATM switched network. An ATM edge switch is used for data switching within the facility, and between the facility and the outside world. If you have seen the terms *access concentrator* and *access multiplex*, both mean the same thing. Access multiplexers include interface ports for video, audio and machine control (see Figure 1). These are connected to an edge switch that accepts inputs from LANs, as well as voice (PBXs) and data servers. The edge switch may be connected to a telco core switch, for local and metro area switching tasks, and finally passed to the wide area. An edge switch is sometimes placed between the access multiplexer and a carrier core switch, and performs like a traditional facility data router.



Virtual Path + Virtual Channel = Virtual Channel Connection
Vcc is the basic connection between ATM Devices
- Characterized by grade of service
- Cell sequence preserved

Figure 2: ATM virtual paths and channels.

In a network such as the one in Figure 1, local carriers can offer a variety of ATM services tailored to customer needs in terms of aggregate bandwidth and type of circuit. Circuits no longer need to be active at all times. A User Network Interface (UNI) -compliant ATM access device can make calls, much like a normal voice telephone call. If a post-production house in Los Angeles wishes to send video to a broadcaster or another post facility in New York, a call is set up, the video is transferred, and the call is torn down once the process is complete. Beyond the fixed monthly port charge, the cost for the video delivery to New York is based on the bandwidth requested and the duration of the connection. The same action holds true for a metropolitan area connection that never leaves the LA basin.

Within the video world, there have been some concerns associated with ATM in the areas of latency and jitter. Video professionals have always had to deal with latency, whether it was prerolling a VTR to make an edit or the delay associated with a satellite return path. The issue boils down to network congestion, noise bursts, or some combination of the two. An excellent cure for ATM latency and jitter is buffering. Products that include dynamic buffering for the audio and video allow the system to be optimized for network conditions. Furthermore, buffering allows audio and video delays to be adjusted independently to maintain synchronization. When properly implemented, the net effect is a predictable absolute delay with synchronized signals.

The magic of ATM

ATM cells are 53 bytes in length, and include five header bytes. The 48 bytes in the payload can contain video, LAN, T1, audio, SMPTE time code, literally anything that is presented to the proper interface at the access multiplexing device. These cells are organized in the transmission medium as virtual channels that take virtual paths. Figure 2 shows a physical channel, which could be an OC-12 at 622Mb/s. Virtual path #1 originated in Los Angeles, and is destined for New York. It contains two virtual channels, one is video, and one is data. Each virtual channel is made up of some number of ATM cells. Here is where some of the magic of ATM lies.

In an ATM network, it is possible to use the bandwidth in any way necessary to pass the traffic. A 50Mb/s MPEG-2 channel would send cells at a certain rate. A 25Mb/s MPEG-2 stream would send cells at half that rate. The amount of bandwidth used is proportional to the rate of cell transmission. This makes for an infinitely flexible multiplex scheme. The pipe can be filled with any number of cells at different rates as long as the pipe's aggregate bandwidth is not exceeded. Each cell has an address that ATM switches can read, making the network an automated router and delivery system.

As mentioned, ATM is capable of dial-tone-like connectivity. The two main modes of operation are permanent virtual circuits (PVC), and switched virtual circuits (SVC). The PVC is always connected and the carrier charges

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Video edge devices such as the Synctrix FiberHydrant (foreground) can be easily integrated into a facility's equipment room.

accordingly. The SVC is the ATM equivalent of a telephone call, complete with the signaling and billing intelligence that a voice circuit offers.

Another attribute of ATM is the ability to choose a quality of service or QoS. The two dominant service choices are Constant Bit Rate (CBR) and Variable Bit Rate (VBR). CBR guarantees a certain data rate, and in doing so, the maximum bandwidth needed is reserved for this data whether it is being used or not. In the VBR mode, cells are sent only as the traffic requires, and bandwidth in the network is reserved according to a traffic contract specifying peak and sustained data rates. Interestingly, VBR is inherently more efficient than CBR because cells are only sent as needed rather than at a fixed rate. Figure 3 shows the mapping of ATM cells into a SONET OC-3 payload, and illustrates the difference between CBR and VBR QoS levels.

Video edge devices

In establishing services for broadcast and production video, the access multiplexer is the most visible network appendage, and one that will be extremely important in supporting the services needed to efficiently operate a digital television station or post-production facility. The first wave of ATM access hardware was specifically aimed at the traditional business services, like T1, Ethernet, token ring HSSI, DS3 PLCP, etc.

The wide scale deployment of optical transmission equipment, coupled with a growing need to move digitized video easily over small and large distances has lead to the development of a new breed of ATM access multiplexers. These products bring video interface options that support analog and digital video and audio as well as a simple graphic user interface, providing the user with a set of tools not previously available at any price.

For post production, ATM provides an ideal, scalable solution in the local loop or the wide area. Video transmission rates may be adjusted to support lossless compression of SDI to an OC-3 rate, or to a much lower and therefore less expensive bit rate for viewing dailies. It's a pay-as-you-go situation. Additional features such as timecode, machine control, PBX tie lines and Ethernet LANs, may be supported by the same ATM edge device and network.

For broadcast groups and networks, edge devices readily support point-to-point and point-to-multipoint transport. It is not much of a stretch to envision a news director in Atlanta browsing footage on a server via IP video, through an Internet connection to a sister station in Detroit. Upon finding an interesting clip, the director then downloads the same video by setting up a real-time broadcast quality ATM link on the same network connection. The cost of IP browsing was nil, and the high-quality transfer was only a few minutes in length, thus not very expensive.

For HDTV, ATM can and will offer the flexible array of short, medium, and long-haul transmission solutions. Whether it is distribution quality at 19.4Mb/s, contribution quality at 360Mb/s (mezzanine level), or uncompressed at 1.5Gb/s, the secret is in its adaptability, scalability, and in its compatibility with all types of synchronous transmission standards. ■

Rich Bauarschi is vice president of sales and marketing for Synctrix, Glendale, CA.

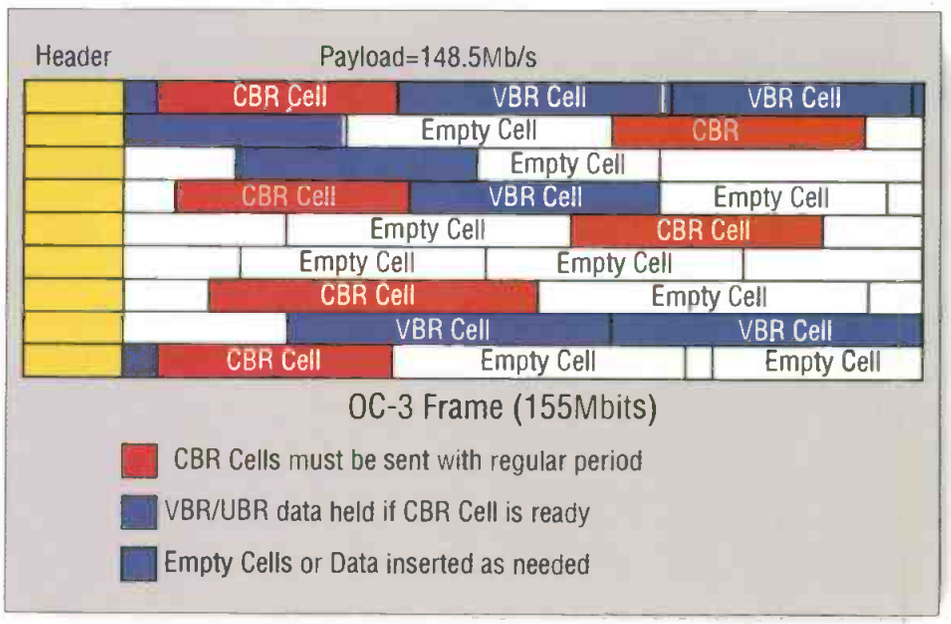

Figure 3: Mapping ATM into a SONET OC-3 frame.

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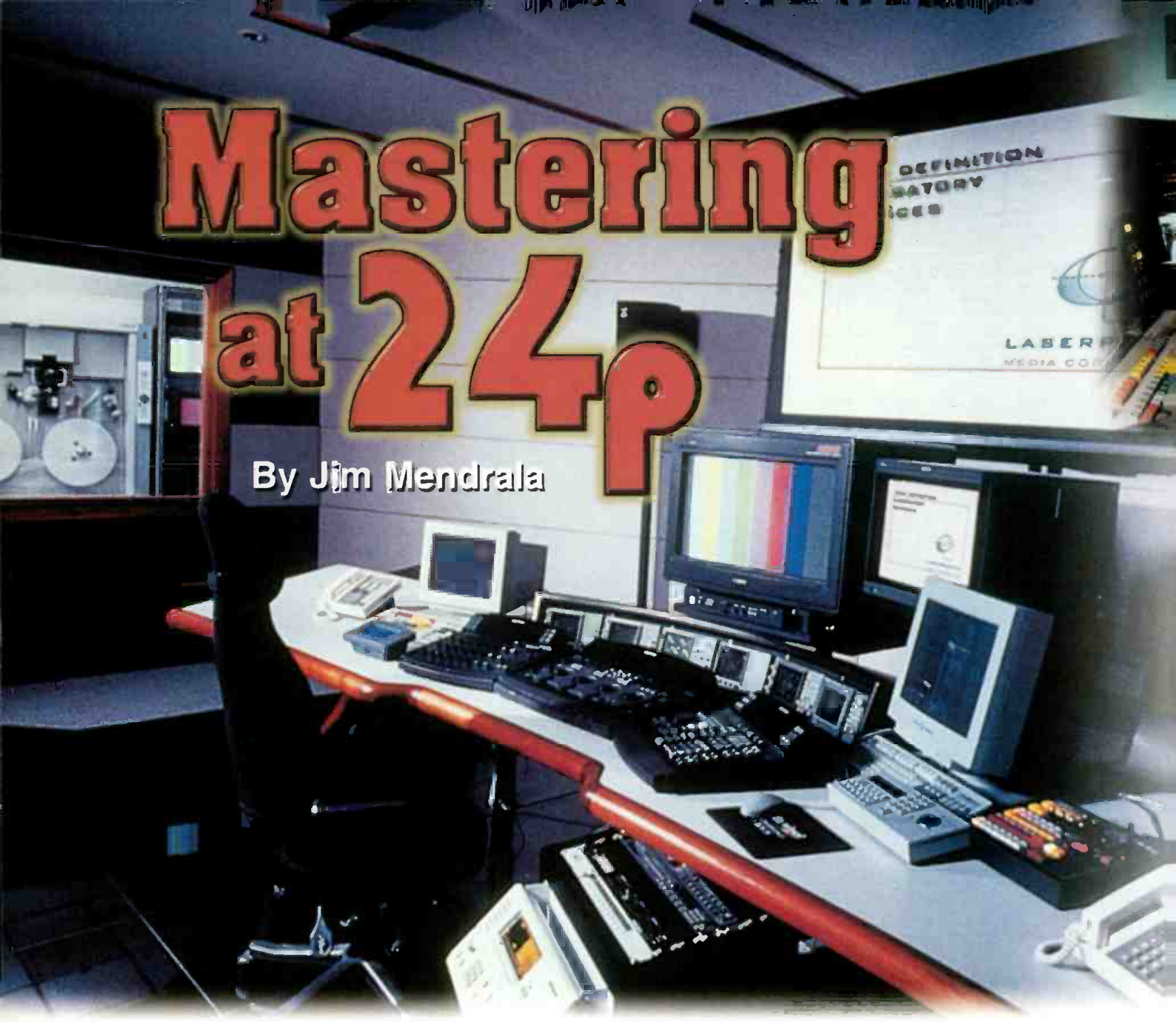
Mastering at 24p

By Jim Mendrala



Will 24p become a new video mastering format?

In the FCC's questionable decision to let users decide, the ATSC DTV standard permits the transmission of any one of five video formats: three SDTV formats (480x704, 16:9, non-square pixels; 480x704, 4:3, non-square pixels; and 640x480, 4:3, square pixels) and two HDTV formats (1080x1920 and 720x1280, 16:9, square pixels). Add to this mix each format's respective variations of interlaced or progressive scanning and you have yourself standardized confusion.

With the advent of DTV, high-end transfer rooms like this one at Laser Pacific are finding their schedules increasingly full. Shown is a DaVinci HD color correction system.

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Bob Festa, director of telecine/colorist in a Spirit bay at Encore Santa Monica, CA .

To many, the plethora of choices is creating an impossible scenario for the production and post community. In the past, producers have delivered products in NTSC, PAL or component, at either 30fps interlaced (60 fields/sec) or 25fps interlaced (50 fields/sec). With the introduction of DTV, the major networks and independent TV groups are able to specify a variety of formats from the famous ATSC Table 3. Without leadership, we've ended up with some programs being produced at 1080x1920 at 30fps interlaced and some at 720x1280 at 60fps progressive. Other producers want to create content at 480x640 at 30 interlaced, while still others want 480x704 at 24fps progressive. The result is an impossible operational and financial burden on the production and post industries. For instance, the cost of a telecine to accommodate all these formats would be enormously expensive — not to mention operationally inefficient.

A new mastering format

For some, the solution has been to step back and look at the primary source of content — film. The 24fps progressive capture rate, high detail and resolution make film the media of choice for the majority of producers. So, the question becomes, why not take advantage of that? Because most primetime TV programs today originate from film, it's desirable to transfer those programs in the most efficient manner.

Finally, because HDTV and data scan telecines are expensive, transfer costs are likewise costly. It doesn't make sense to transfer film to HDTV then change the telecine to NTSC, then change it again to PAL to create the needed master tapes.

To solve conversion problems between original material and multiple transmission standards, most of which originate from the ubiquitous 24p film standard, a new mastering format has been proposed to the video community. The new solution is to master at 1080x1920, *24p*. This will simplify the process of converting to the various video standards the networks and broadcasters worldwide want to use. The process makes the final video program spatially and temporally compatible with 480p 24, 480p 60, 720p 60 and 1080i 30. For purposes of this article, all references to 24fps and 30fps also apply to 24/1.001 and 30/1.001, except where noted.

The SMPTE proposal

In addition to a 24p master format recommendation, conversions from the 24p master format and 24p display issues were also discussed at a recent SMPTE working group meeting. The committee is currently accepting comments from the production and the post industries on these issues. The proposal includes two important characteristics:

- A 1080x1920, 16:9, 24p *mastering format* standard for film-originated TV programs.
- A new 24p standard referred to as *48sF* where each frame is progressively scanned and output as two *segmented Frames* (sF). With this new format, segmented Frame 1 contains all the odd lines of the frame, and segmented Frame 2 contains all even lines of the frame derived from the progressively scanned film frame. It's important to keep in mind some new nomenclature. A small *f* is used to indicate *frame* as opposed to a capital *F* for *segmented Frame*.

Because all HDTV telecines internally scan film progressively at 24fps, the image can be easily output at 1080x1920, 24p. Today, a telecine will output a signal in 30i or 25i for composite, component or standard digital interface (SDI). However, HDTV recorders like the D-5 only record 60 or 50 fields. A native 24p videotape or disc recorder, while possible, isn't available. Although several equipment manufacturers have unofficially stated they plan to show 24p hardware at NAB99, deliveries would be later. If this concept flies, producers could have the devices they need to begin supplying content in the new format by the fall 1999 season.

The use of a 1080x1920, 24p mastering format means that all telecine film-to-tape transfers would be done at the highest resolution possible under the ATSC's transmission standard. Just as important, all other lower-quality formats can be derived from this 24p master format. This means that NTSC, PAL, or even the HDTV 720x1280 formats with their slightly lower resolution can be downconverted from a high-definition 24fps master. With the 24fps rate, higher-frame or segmented Frame rates can easily be generated. As far as DTV is concerned, there is no reason to convert to a higher rate. Only those programs that have to be simulcast and transmitted as NTSC or PAL would have to use the conversion to a higher interlace frame rate. (*Editor's note: For another viewpoint on this issue, see Paul McGoldrick's* EOM *column on page 146.*)

In order to simplify the transfer process to make a 1080x1920 image, 24p becomes the more economical format of choice. It complies with ATSC Table 3 and is progressive. Being a film rate and

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progressive, it compresses more efficiently than interlaced formats. A 1080x1920, 24p signal can easily be upconverted to a higher frame rate, such as 30p, 60p (using 3:2 pull-down), 72p, or 25p, 50p and 75p. Even 25fps countries can take the 24p recording and play it back at 25fps. That's only a 4 percent change in speed and is comparable to what is being done today in the movie theaters.

Progressively scanned 24fps images running through an MPEG encoder can reduce the needed bit rate (compared to 30i) anywhere from 25 percent to 35 percent. Image quality may be improved without increasing the bit rate. With a lower frame rate and adjacent picture elements from the progressive scan, motion vector calculations become more efficient because there is more time (per frame) to perform the computations.

Why a 48sF signal?

The second suggested change, *48sF*, has come about because of the need to meet a shortened product development time and, therefore, production schedules pertaining to equipment for the fall 1999 season. This can be done by converting 24p images into signals that resemble an interlaced signal. Later, by recombining the two segmented Frames, a full progressive frame is restored. Because most HDTV recorders are interlace (field) based, a modification to convert the recording operation to a slower field rate is relatively easy. The machines would just record two segmented Frames instead of two fields.

Therefore, the process would be to capture images at 24p and then convert them to 48sF with each segmented Frame having half the number of scan lines (540 instead of 1080). One argument for the process presented by two equipment manufacturers, is that because 24p equipment does not exist, the use of 48sF would enable HDTV products to be released quickly. With only slight modifications to existing equipment, a 48sF signal could be recorded on interlace devices.

The monitor problem

With 24p, some problems do arise. One concerns monitoring the signal. If you've ever watched a movie at 24fps with a single-bladed shutter, you'll recall that the flicker drove you nuts. A slightly faster 25fps is no better. So how do we monitor a 24p image?

Long ago, the film industry recognized the flicker problem and adopted the use of a two-bladed shutter and limited the light on the motion-picture screen to 16 foot Lamberts. With an open-gate projector, this helped reduce flicker and was highly successful. All movies shown today use this technique. But to view a 24p video, a CRT display device needs to display the frame captured in 1/24 of a second at least three times that 24fps rate (72fps) before the next frame is shown. This requires the monitor to reproduce the 24p at 72fps. The problem in a CRT display is that, because of the phosphor's decay time, it must be continuously refreshed.

Some of the new microdisplay products, such as organic light-emitting diodes (OLED), digital micromirror devices (DMD), liquid-crystal displays (LCD) and flat-panel plasma displays, do not have the same decay time problem. Therefore, 24p looks fine and is free of flicker. However, a CRT monitor would require a frame buffer. The buffer would take in the signal in 1/24 of a second, but then read out that same signal three times during the next 1/24 of a second. Although this might raise the monitor's price because of the added frame buffer, there would be no visible flicker. In ATSC transmissions, the display conversion is handled by the receiver/decoder. All incoming video standards are converted to the receiver's native display format.

Do we need another standard?

An important issue is whether the use of 48sF will result in the installation of a new set of segmented-Frame and desegmented-Frame black boxes. Furthermore, monitoring, as addressed above, is another issue. Do we need another standard? Will the problems created outweigh any advantages?

Video editing with such a new standard does create serious issues. For instance, the editing software must track every frame. When looking at a piece of content, it will have to ask, "Is this segmented Frame 1 or segmented Frame 2?" Switchers with DVEs will need to convert interlaced pictures to progressive frames internally with frame buffers.

Under this proposal, only true 1080x1920, 24p video from film-originated material would be distributed around a facility unless converted to some other desired format. Devices that use a CRT and need to reduce the 24p flicker, or recorders that cannot record the 24p signal directly, would need to use the 48sF format. Any translations or conversions for display or recording should be handled internally in the device and be transparent to the user. 48sF, with its own set of problems, should be kept out of production and post-production environments. The 48sF format should never be used outside of any piece of video equipment.

1080x1920, 24p mastering format for production, post and broadcast facilities should be the standard of choice. 1080x1920, 24p is the K.I.S.S. (Keep It Simple, Stupid) approach and gives everyone something that will work without needing patches just to keep other things in order. Adding another video standard to the ATSC standard is neither acceptable nor desired. ■

Jim Mendrala is vice president of technology at Real Image Technology Inc., Val Verde, CA.

The cost of a film transfer

Transferring film to tape is expensive. In a typical telecine suite, an average one-hour movie requires approximately 40 hours of actual telecine machine time. Because of reel changes and color correction considerations, another week is usually added to the production of just one telecine transfer of a color master.

During the second week, more film handling is required for the many and varied broadcast formats, such as pan-and-scan, letterbox, anamorphic or squeeze portrayals, NTSC, PAL in 4:3 and 16:9, and HDTV in 16:9. All NTSC, PAL and HDTV distribution masters made from those telecine transfer color masters take anywhere from three to five times the length of the source to process.

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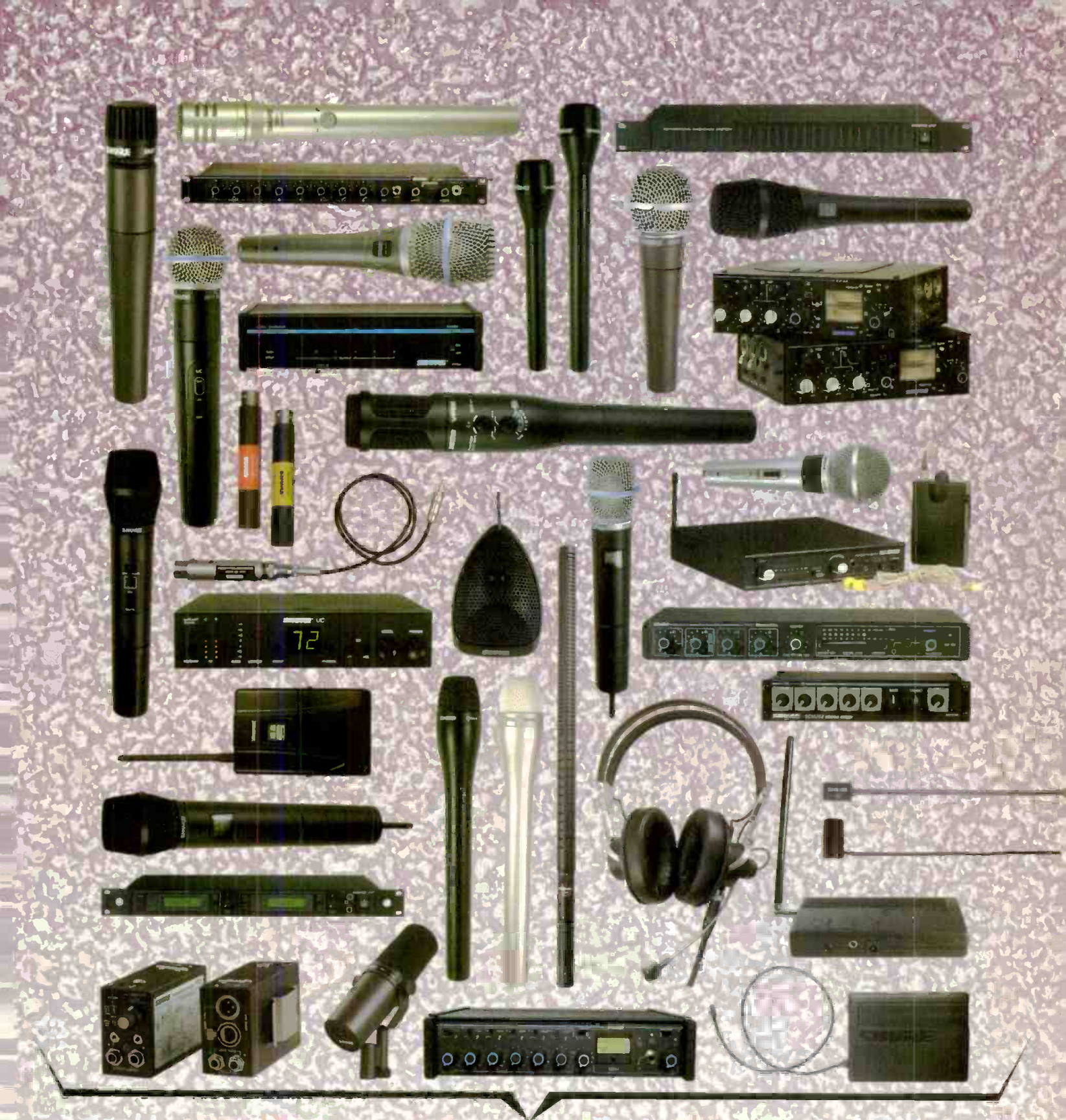

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Applied Technology

Philips integrated DTV solutions

BY M. MICHAEL D'AMORE

Building for DTV

U.S. broadcasters are facing the difficult task of building a completely new digital broadcast systems, while at the same time, preserving today's NTSC revenue stream. Needless to say, this is a complex and expensive task.

While no one can predict the future of DTV, Philips firmly believes that we'll all get there, but that the process should be an evolution rather than a revolution. In order to maximize options and opportunities, while keeping risk to a minimum, Philips' believes that a time-phased building-block approach to DTV should be used. Regardless of station or market size, each broadcaster will be required to operate at two facilities, analog NTSC and DTV, until the analog spectrum is eventually returned to the government. This means that automation and station connectivity will become increasingly important.

With this in mind, an important key for broadcasters is to seek vendors that can provide a complete line of hardware and software systems for the storage, switching, distribution, and transmission of both HD and multichannel programming. In addition, these solutions must also be scalable to meet the individual needs and budget of each station.

DTV transmission solutions

Regardless of a station's particular DTV plans, the selected solutions need to be based on a serial component digital infrastructure. For those that have already made the conversion to serial digital, further upgrades and equipment expansion will be easier because of the range of products available to meet your needs and budget.

Let's first look at some example scenarios to getting into DTV. Here are five practical studio architectures, one of which should meet the needs of most stations.

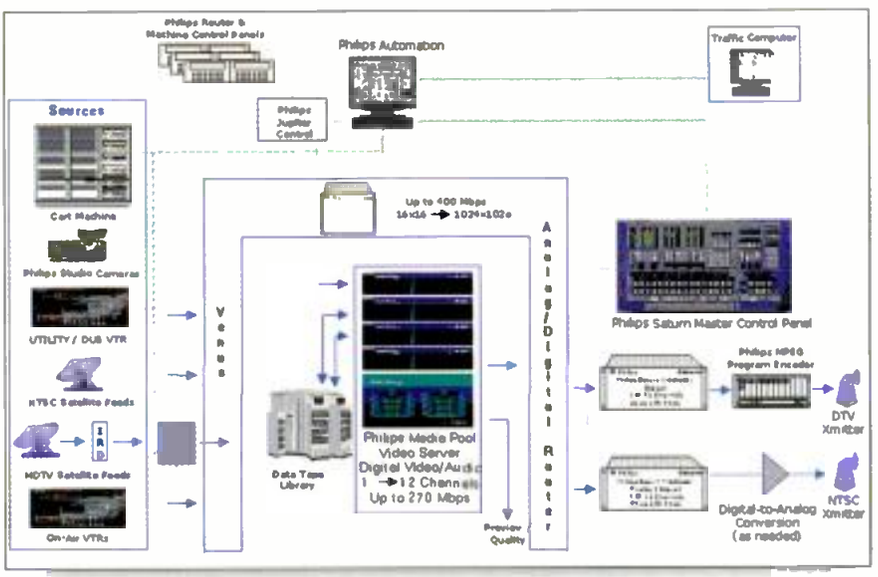

Figure 1. Many stations will want to take a minimalist step as shown here. By adding an SDI infrastructure, both NTSC and SD can be easily handled by centralized server and digital master control switcher.

• Multiple NTSC transmission capability:

For those broadcasters not yet ready for DTV transmission, upgrading to SDI capability should be the first step. The multichannel capability is especially important to those needing to implement an LMA.

Such a facility can be centered on analog equipment, thereby greatly extending the life of legacy equipment. The facility can grow through the addition of SD and HD converters and a digital master control switcher such as the Philips Saturn.

• *SDTV with HD pass-through and NTSC transmission:*

Many facilities will want to operate their NTSC and DTV facilities in parallel for a period of time. Such an operation is shown in Figure 1. This configuration is centered around SDI interconnections and centralized storage. In this model, the router handles both analog and digital signals, which means legacy analog equipment need not be replaced until needed.

This approach offers stations several advantages. The initial process becomes the foundation for total migration to DTV at a later date. Having a digital infrastructure offers both consistent picture quality and operational/control advantages. Plus, and for many stations critical to their business plan, this platform becomes the basis for future multi-channel operation.

The minimal step does have one disadvantage. It doesn't allow the facility to originate HDTV material. This could put the station in a disadvantaged competitive position with stations using higher resolution formats.

Figure 2 solves the problem of not being able to handle HDTV programming. In this scenario, the HD signal is captured by satellite and output at 19.39Mb/s to an MPEG splicer. This allows local inserts to be added to the network's HD Feed.

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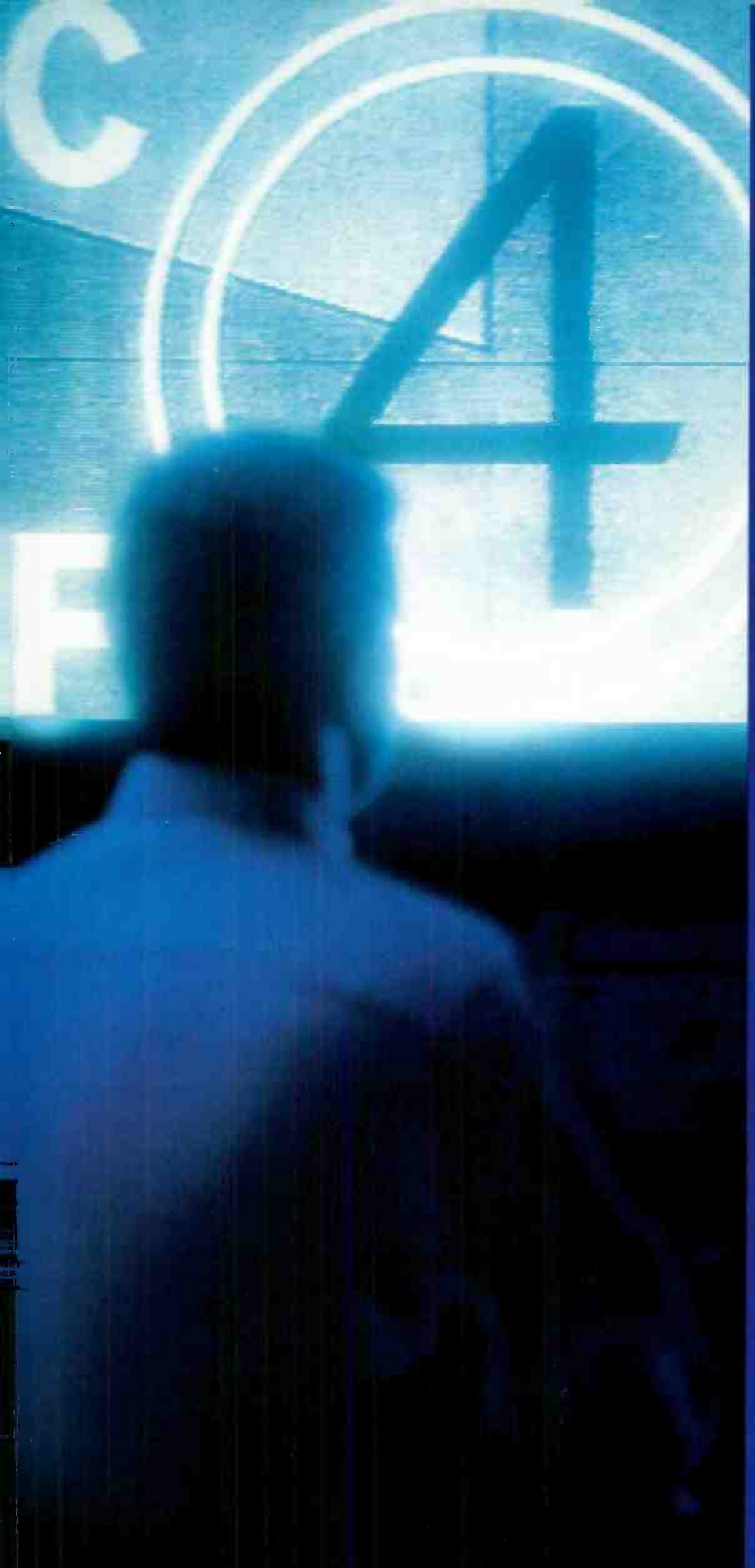

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This model has the advantages of providing the benefits of a strictly SDTV solution, plus a cost-effective HDTV transmission path. Another major advantage to this approach is that it's not necessary to purchase a separate HD MPEG-2 encoder. This model does assume that your network will be delivering HD as 19.39Mb/s compressed streams. Its disadvantages include the amount of local branding and keyed inserts that can be added. Also, squeeze-and-tease effects not yet available with today's technology.

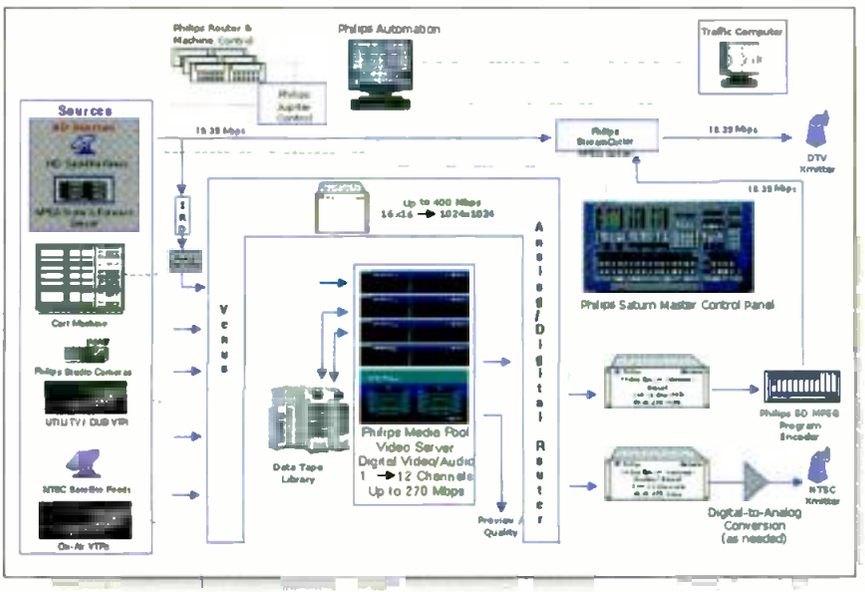

Figure 2. For those stations wanting to be able to pass-through HD, this approach works well. The network feed at 19.39Mb/s is routed directly to air, avoiding the need (and expense) to re-encode the signal.

• HDTV digital transmission with NTSC transmission:

The next step in terms of complexity is to build an island of HD capability. The stations could install a separate 1.5Gb/s router just to handle HD signals. Along with an HD MPEG-2 encoder, this system provides full capability for HD production.

Key advantages include capability for HD local branding and key inserts along with providing a consistent high quality picture throughout the day. A disadvantage is the cost of adding an island of HD equipment and converters.

• *HD transmission and SD multicast with NTSC transmission:*

Figure 3 illustrates how a broadcaster, who prefers the most optimized usage of valuable DTV bandwidth, can provide both HD and multicast programs while still maintaining full control over the NTSC program stream.

With this solution, one HD channel and up to 14 simultaneous SD channels can be controlled by a single Philips Saturn digital master control switcher. Each HD or SD channel has its own dedicated video and audio processors and encoders. This allows additional channels to be added with minimal system re-configuration.

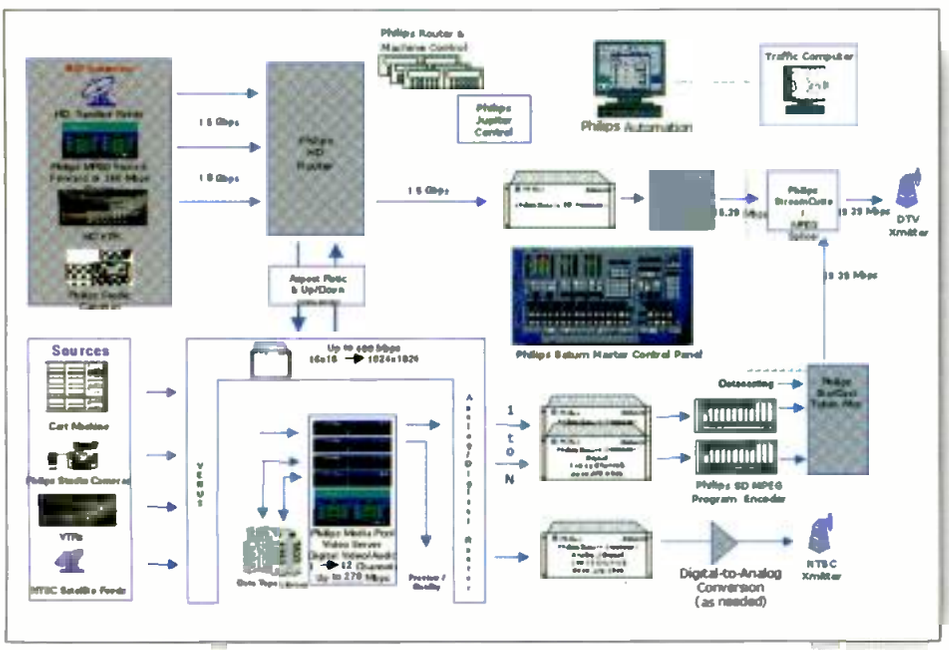

Figure 3. A full-blown HD and SD multicasting operation is shown here. Local insertion of both HD and SD material is possible, along with some HD production capability.

When coupled with a Philips StatCast, statistical multiplexing can be used to optimize channel bandwidth allocations according to each channel of programming's content. This maximizes the usage of available spectrum. Such a configuration can permit the insertion of opportunistic programs and data services.

An important part of this configuration is the MPEG-2 splicer. It allows switching between HD and multi-channel SD program streams as needed. Advantages include full HD transmission along with SD multicasting capability. It supports insertion of opportunistic program services such as regional news and advertising, data broadcasting, even internet services.

Making the right choice

Regardless of where you are in your DTV migration, making the right equipment choice is but the first decision. Just as important is the company to provide the support for those devices.

When considering all the options to building for DTV, there are at least five major points to consider. Be sure your system supplier can:

- Provide a modular system solution that protects your current and future equipment investment.
- Provide an organized and *natural* (for your station) progression to digital and DTV operation.
- Support multiple DTV transition scenarios. There is no *one* right approach, so don't be boxed into a package that doesn't fit your needs.
- Coordinate with a range of software/firmware vendors and that the company will make upgrades available to ensure maximum life of the system.
- Provide after-sale support to their products. ■

M. Michael D'Amore is vice president of Business and Technology Development for Philips Digital Video Systems.

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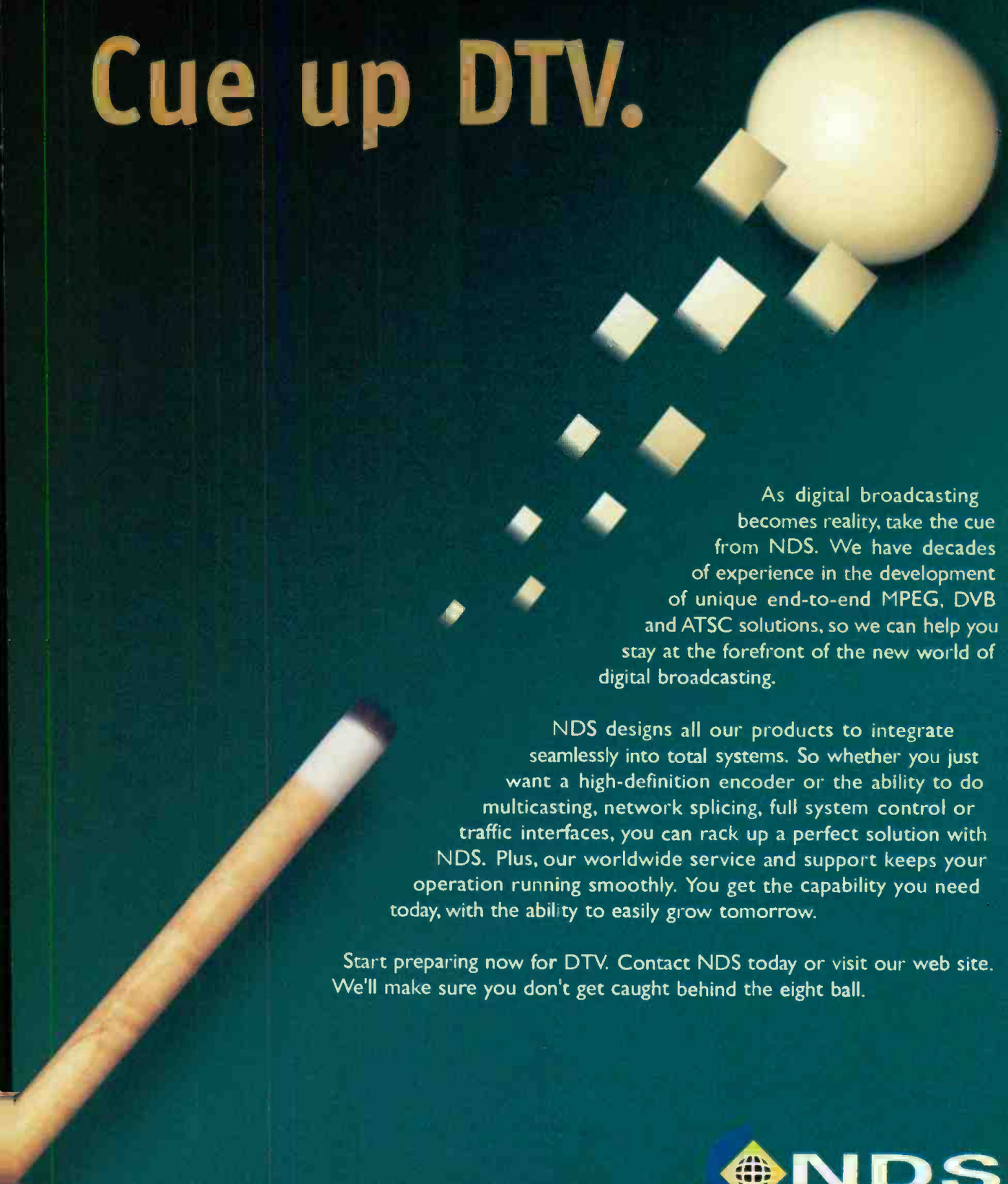
Cue up DTV.



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NVISION Achieves the Impossible

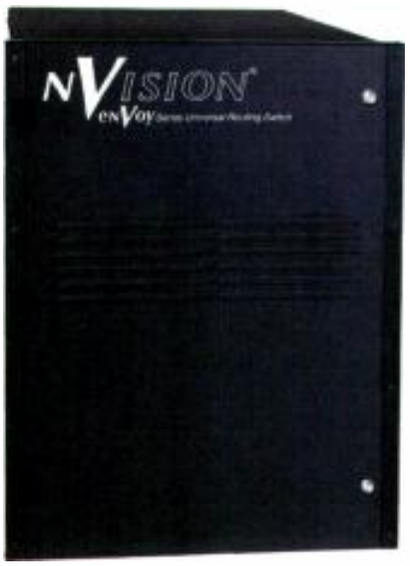
These days, the pages of this magazine, and others, are full of articles and letters discussing the transition to an all digital environment. DTV, DVB, DVB-ASI, and HDTV are the acronyms *du jour.*

Discussions often refer to the difficulties of creating and operating a multi-format system that will allow all of the desired digital formats to coexist—without adding a couple of trillion to the national debt, or significantly impacting the cost of medical insurance due to a massive surge in stress related illness.

"NVISION has surprised the industry by announcing a new family of universal digital video routers, ... called ENVOY."

Grass Valley, California-based NVISION has found some of the answers to these questions. For several years, NVISION has been helping the industry front-runners solve the difficulties of incorporating digital audio signals within a video system. Indeed they have introduced several 'firsts' over the years, including synchronous AES routing, dynamic data routing, and digital audio signal management. Apparently, this company has been quietly laboring in the California Sierra foothills to bring some astonishing developments to the market.

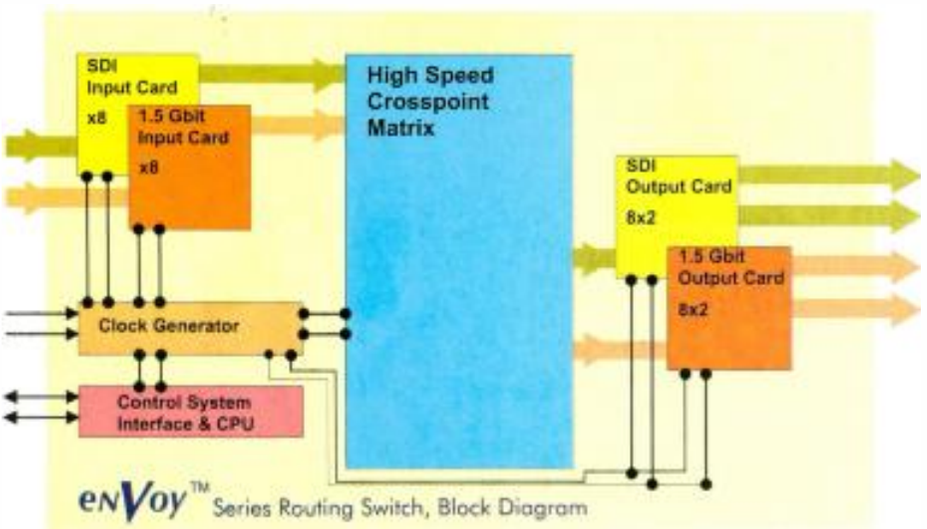
At the heart of any system is the routing equipment. New signal formats and standards often require that additional layers of routing be added due to lack of signal compatibility. Router manufacturers are telling our industry that in order to accommodate full bandwidth HD formats, switch sizes must be kept to 16^2 or 32^2, or additional and separate routing is required. When asked if HD-SDI (1.5Gbit) signals could be managed from within a large SDI routing system, the answer is resounding: "Impossible."



NVISION's ENVOY Series 6128 router

Many manufacturers agree that 1.5 Gbit routing is a relatively straightforward extension of 270 Mbit technology. However, most are able to provide only a limited solution for 270 Mbit/1.5 Gbit signal management.

NVISION has surprised the industry by announcing a new family of universal digital video routers capable of managing a wide range of signal formats.



This new router family, called ENVOY, is designed around a novel high speed crosspoint architecture that will handle data rates in excess of 1.5 Gigabits. This structure is combined with various I/O modules to accommodate several data rates. ENVOY users will be able to route any standard rate SDI signals *and* HD-SDI–within the *same* switch, at the *same* time.

Also, NVISION assures us that they have cured the problems associated with pathological signal content at both SDI and HD-SDI data rates, by developing novel design implementations for cable drivers, equalizers, and reclockers. And, the ENVOY design ensures that no signal inversions take place; for systems handling DVB-ASI data streams, this is essential. (DVB-ASI is NRZ coded and cannot be inverted.) These facts, combined with the ability to control the router from an existing control system, provide the user with tremendous flexibility.

Input and output modules include SDI (143,177, 270 and 360 Mbits) and HD-SDI (1.5 Gbit). Different I/Os can be included in the same switch, as can dual references to allow simultaneous dual standard 59.94 and 50Hz vertical interval switching. Outputs include dual connectors for each destination, to minimize DA requirements.

"ENVOY users will be able to route standard rate SDI and HD-SDI signals–in the same switch, at the same time."

With the ENVOY series, digital video routing is available at competitive pricing. Three frame sizes are available: 64^2, 128^2, and 256 x 128.

This new router series will enable users to purchase an expandable SDI router and add HD-SDI I/Os incrementally, as and when required.

Looks to me like NVISION has achieved the impossible!

NVISION can be contacted at 1 800 719 1900 or by fax at (530) 265 1021. You can visit their website at www.NVISION1.com.

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Applied Technology

ECI's Video Quality Assessment System

BY ORLY STETTINER AND MARK LUTSKER

As the use of compressed digital video becomes more common, the ability to evaluate video compression systems has become a vital function, one that is especially important to manufacturers developing compression products or using compression products in other applications. The ability to evaluate and compare the quality of video after the compression and decompression process has proved to be a difficult task.

Evaluating compression systems is difficult because video quality can be measured in either a subjective or an objective manner. Subjective measurements are the results of observers providing their opinion of the video quality. But subjective testing is a complex and time-consuming process that is not practical for product and system development.

Objective measurements are performed with the aid of computerized instruments that give numeric or graphical indications based on mathematical algorithms. But researchers have determined regular mathematical difference calculations do not correlate well with the difference perceived by the human visual system.

ECI Telecom developed an objective testing system for company use that would produce results similar to those of subjective testing. The goals were twofold: to gain expertise in video quality assessment and to improve the video quality of the ECI Hi-TV system and ATM broadband service multiplexer.

Defining the problem

The first problem in developing an objective quality assessment tool is that the human eye does not perceive changes in pixels (or color) in a linear manner. That is, if we keep two of the components of the usual color spaces (e.g., RGB, YCbCr) constant while adding consistent amounts of the third component, we would expect that the eye will see the "jumps" in a linear manner. The eye has a very nonlinear response in these color spaces and some changes are more noticeable than others.

Research was required to find a new color space that is truly "homogenous" for the human eye (uniform steps in each component result in uniform difference observed by the human eye). A "difference" in this color space is proportional to the difference perceived by the HVS.

The second problem that the eye does not perceive a pixel as a stand-alone object; rather our brain takes into account the pixel's surroundings. This fact is well-documented by a number of phenomena: bright objects appearing brighter when against a dark background, greater sensitivity to distortions in the green component vs. the red or blue components, and distortions in contours or edges being much more visible than in non-edge regions.

For every pixel, it is important to analyze its environment and grade each one based on parameters measured for its surroundings. Special attention is given to edge and contour distortions, to which the human eye is particularly sensitive.

In the same manner, a grade for the entire picture will be based on the grade of each "block," again taking into account the grades of the surrounding "blocks" in a manner that incorporates human visual system properties.

Interpreting the picture's grade

The graphical tool developed by ECI enables users to give a grade to an entire sequence, to each picture in the sequence and even to look at the block level to identify problem areas within each picture.

Moreover, the program provides insight into the compression technique. For example, when two different rate control (or motion estimation) algorithms are applied, using the same bit rate and GOP structure, it is easy to see

GRADE	EXPECTED ARTIFACTS
100 %	No visual differences between original and resulting video sequence.
90%	Very slight illegibility. In some cases, non-complete contrast and color coincidence.
80%	In some cases, very slight edge noise; slight contrast and color non-coincidence.
70%	Slight edge noise & slight edge oscillations, contrast and color non-coincidence, slight genera illegibility.
60%	Edge problems (noise, oscillations, vibrations), contrast and color non-convergence, slight blurring.
50%	Edge problems become serious in some places,local contrast and color failures of convergence, noise effects, blurring.
40%	Serious edge problems,contrast & color failures of convergence, blurring,tiling.
30%	Very bad edges, bad contrast & color convergence, serious blurring, serious tiling, slight jerkiness.
20%	Block distortion, no contrast & color convergence, smearing, jerkiness, shapes are hardly recognizable.
10%	Severe block distortion, severe smearing; severe jerkiness, most of the shapes are not recognizable.
0%	Total picture distortion.

Table 1. Grades given by ECI's Objective Video Quality Assessment Tool.

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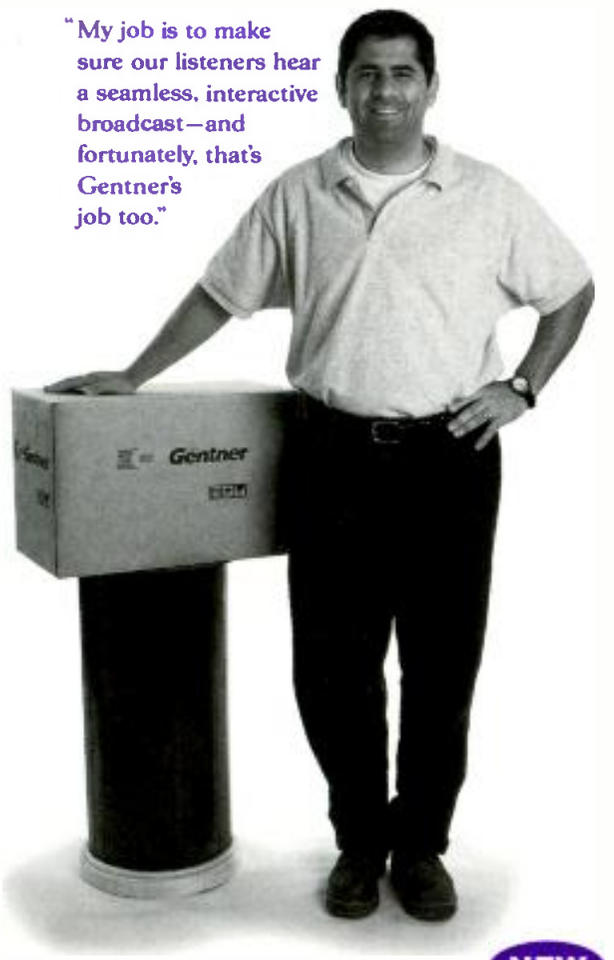

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Figure 1. Comparison of original and two pictures with added artifacts. From left to right – original picture, picture graded 50 percent and picture graded 25 percent.

the perceived quality differences between the resulting sequences. This enables the developers to investigate and improve compression algorithms.

Grades are given in percentages and indicate particular artifacts caused by the compression standard (Table 1). Figure 1 illustrates detected quality grades with the addition of artifacts. The picture on the left is the original, the one in the middle is graded at 50 percent and the one on the right is graded 25 percent.

Graphical tool

In addition to assigning grades to a picture, the system also includes an option for a graphical analysis mode that allows a professional user to investigate and analyze a single picture in detail from numerous aspects.

So far, we have described the "quality assessment" mode of the ECI Telecom evaluation system, which provides grades to a picture that is similar to subjective results.

A second (optional) mode of the system, which we believe to be unique and attractive, is a powerful graphical analysis mode, which allows a professional user to investigate and analyze a single picture in detail from numerous aspects.

The tool enables the user to focus in the desired area of the picture and zoom from a frame/field level down to macro block, block and even pixel level. At each level, the application enables the user to look at the original reference picture, and two different degraded pictures, perhaps from different encoders or from the same encoder, using different compression parameters. The different pictures are shown separately for luminance and each chrominance component, illustrating the effects of each component on the overall quality degradation. Naturally, "low" quality is indicated if it is possible to see the original contours on the luminance difference picture.

Moving a cursor across the picture will show the numeric values of each pixel. Alternatively, the Discrete Cosine Transform values of each block can be presented visually to provide more understanding of the picture's behavior in the frequency domain, as a way of optimizing the compression system.

ECI Telecom's Video Quality Assessment System is proving to be an extremely useful tool that can help the analysis of digital compressed video. The tool provides a scalar "grade" and the means to interpret this grade, analyzing each picture down to the pixel level and optimizing compression algorithms.

The newly developed color space, selected as a basis for the analysis, is unique and believed to be a reliable estimation of the human visual system model. Thus, objective quality results given by the system are correlated to those of subjective testing. ■

Orly Stettiner is marketing manager and Mark Lutsker is algorithms engineer of the professional television networking division of ECI Telecom Inc., Petah Tikva, Israel.

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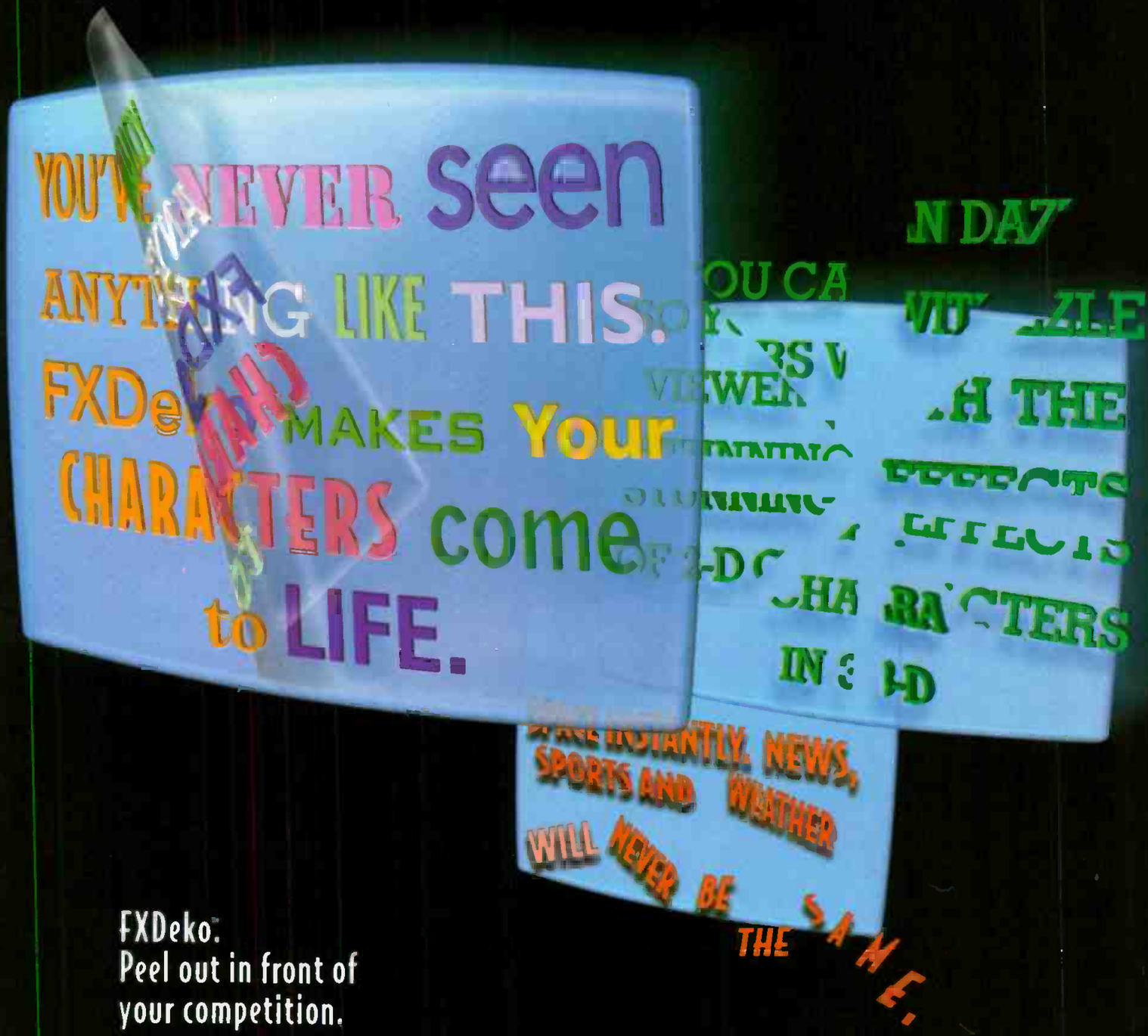

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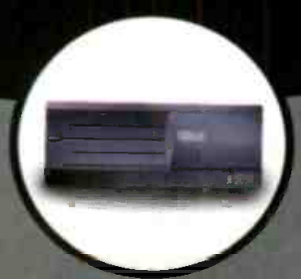

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Applied Technology

NUCOMM dual digital HD/NTSC STL

BY DAVID O. THOMAS

Much has been learned in the past few years about microwave HDTV STL systems and their performance. It was not long ago we were all wondering how we were going to transmit our HDTV and NTSC signal out to the transmitter site.

Topics

When planning a HDTV STL, there are two key areas to consider: modulation formats and data rate throughput capacity. It is important to understand the relationship and tradeoffs between the modulation formats used and the throughput capacity vs. the performance of the link or Fade Margin. For example, the modulation format QPSK offers a robust signal (better than analog). However, its data throughput capacity is limited compared to other digital modulators. 16QAM offers high throughput, but the link performance does not fair as well as an analog link.

There are typically two types of "all digital" HDTV STL systems. One system transmits just the 19.39Mb/s ATSC signal. The other more complicated system carries the ATSC and MPEG-2 NTSC encoded signal. In the second case, an encoder is required to digitize the analog signal or compress a digital signal and then combine or multiplex it with the ATSC signal. In either case, different data rates result, thus giving an option as to which modulation format gives the best data throughput capacity and link performance.

In cases where a second microwave channel is not available, multiplexing the ATSC and MPEG-2 encoded NTSC signal on one microwave channel is one solution. Therefore, the link must operate at a higher data rate. It is typical to run the MPEG-2 encoder at 15- to 20Mb/s and achieve excellent video quality. Combine this data rate with the 19.39Mb/s and the result is 34.39Mb/s.

Modulation types vs. link performance

Table 1 illustrates link performance vs. modulation types. The analog signal starts off at a high S/N level but rapidly declines as the receive signal level decreases. As the receive signal level approaches –80dBm, the audio becomes noisy and then is lost at around –82dBm. At this time, the video has become noisy and is finally lost at –86dBm. Now compare this to the digital signals. The QPSK modulation, for example, starts out at 60dBm S/N but remains flat as the receive signal levels decreases out to –80dBm. It is at this point that the S/N begins to roll off until picture is lost at –89dBm. QPSK has an extended threshold range when comparing it to the analog NTSC signal.

For the 16 QAM modulation, video is lost much sooner at –81dBm. The video signal performance for 8PSK and 8VSB modulation types (not shown) are maintained until –85dBm. In all digital modulation types, the picture is perfect up to the moment the system reaches its respective threshold level. This is unlike analog NTSC where the video quality gradually degrades before being lost in the noise.

This is where you must decide which is more critical: fade margin (link performance) or throughput capacity.

QPSK and 8PSK provide a robust signal but lower data throughput compared to the other modulation types. 16 QAM has a very high data throughput capacity but is susceptible to poor environmental conditions and multipath conditions. The threshold level shown for 16 QAM is best case. Due to environmental and multipath conditions, the threshold is far less than –81dBm. COFDM and 8VSB have excellent data throughput capacity and robustness. More work is being conducted to prove their market viability. COFDM and/or 8VSB look promising for ENG applications.

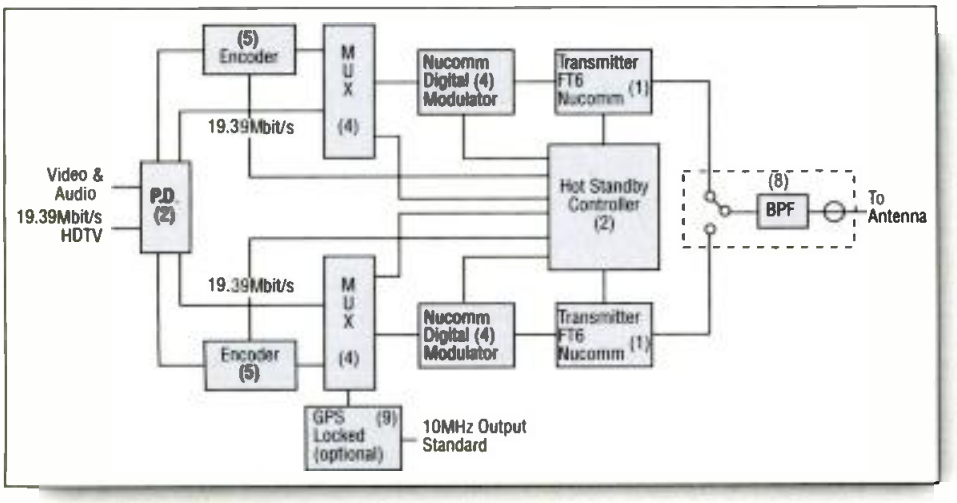

Figure 1. HDTV STL transmitter block diagram of NTSC + HDTV with full redundancy

Modulation vs. receiver threshold

The various modulation formats use forward error correction techniques (FEC) and adaptive equalization to improve link performance. FECs help to extend receiver threshold levels and reduce the effects of selective fading. There are several types of FEC available. Many work together within the modulator and they include Viterbi, Reed Solomon and interleaving. To further improve link reliablity, adaptive equalization is used to overcome multipath conditions.

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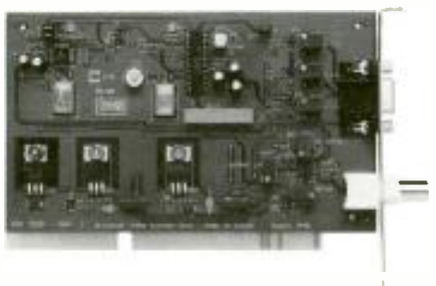

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Modulation type	Threshold level	Data Rate throughput for a 25MHz channel: w FEC
QPSK	-89dBm	32.0Mbs
8PSK	-86dBm	48.0Mbs
16QAM	-81dBm	64.0Mbs
8VSB	-85dBm	48.0Mbs
COFDM	-84dBm	32.0Mbs

Note: Forward error correction (FEC) used: V=5/6 and RS=188/204

Table 1. The modulations, their thresholds and throughput capacity.

HDTV STL systems vs. modulation types

For those broadcasters lucky enough to have a second STL RF channel, one can be used for high-definition and the other for NTSC. The HD STL accepts the 19.39 ATSC signal, modulates it and upconverts the 70MHz modulated signal to the microwave frequency. At the receive end, the microwave frequency is down-converted to 70MHz and then demodulated to recover the 19.39 ATSC signal that feeds the HDTV transmitter. The systems are available in redundant and nonredundant configurations.

To achieve the best performance from this link, sending a 19.39Mb/s ATSC signal only, QPSK should be chosen. The 19.39 signal fits well within the 32Mb/s limit for this configuration. There is extra room to send other data signals if needed.

Dual digital HDTV STL system

For those not so lucky to have a second RF channel, there are two systems available that combine both the ATSC and NTSC signal. A dual digital system whereby both the NTSC and ATSC signals are digital. The other system, dual stream, combines an analog NTSC and the ATSC 19.39 signals. This article will focus on the dual digital approaches.

The dual digital system (Figure 1) combines the NTSC and ATSC signals. This system digitizes the NTSC signal and multiplexes it with the ATSC signal. The two signals combined gives a combined data rate. The combined signal is then fed to the modulator and upconverted the to the 70MHz microwave transmit frequency. At the receive end, the microwave signal is downconverted to 70 MHz and demodulated. This signal feeds the demultiplexer where both ATSC and digitized NTSC signals are recovered. At this point, the ATSC signal is fed to the HD transmitter and the digitized NTSC signal is decoded and fed to the NTSC transmitter.

In the dual digital configuration, the NTSC encoder is running at 15Mb/s and is multiplexed with the 19.39Mb/s ATSC signal. The result is a data rate of 34.39Mb/s from the multiplexer. An 8PSK modulator could be used for this system. There is about 13Mb/s of data rate left for other requirements such as control and monitoring.

Conclusion

Having a second STL channel can certainly make life easier but most stations will not be so lucky. Dual digital will allow you to send both the NTSC and 19.39 ATSC signal down one microwave channel.

The modulator plays a vital role in the STL link by determining throughput and system performance. Examine each situation and determine what is more important, performance or data throughput. Remember QPSK provides the best performance but limited data capacity whereas 16QAM provides high data throughput but a lower level of system performance. ■

David O. Thomas is the director of sales and marketing for Nucomm Inc, Hackettstown, NJ.

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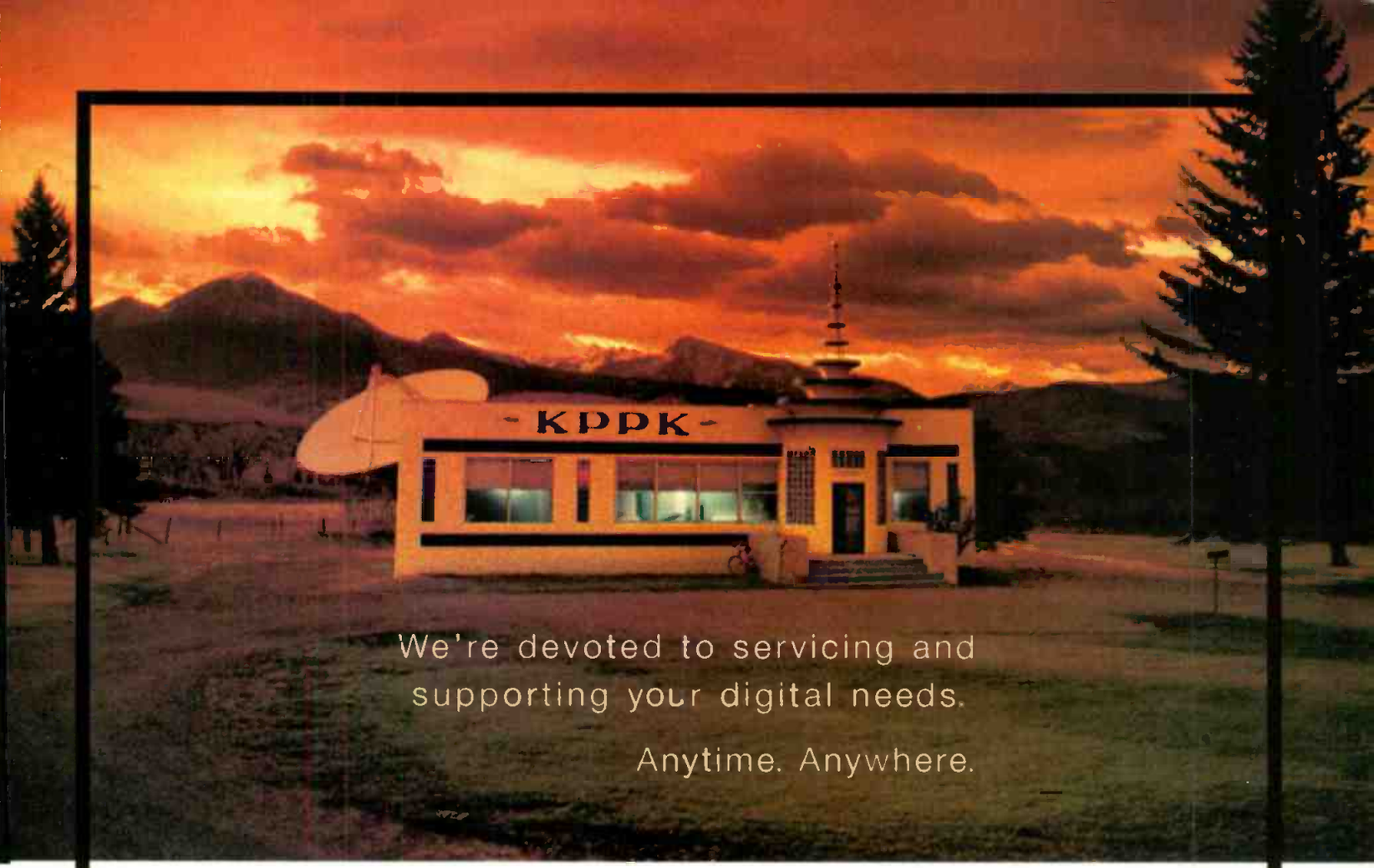

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Go slow to go faster

BY KARE ANDERSON

Rarely do two people simultaneously recognize a difference in positions or interests. That first person usually has the greatest opportunity to influence whether the conflict will escalate and harden. In that pivotal moment he can turn in one of two directions. It should be understood that there are no neutral actions, especially when our guard is up in anticipation of a fight.

A lot happens in those first few moments when one person realizes the possibility of conflict. He can lower his guard in an attempt to foster a positive response to the other person. On the other hand, he can close up and look for more signs of disagreement. His attitude and action can set the tone and influence the situation, the rules by which they will engage in discussion, and the tempo of the action. Actually, some apparent differences can be resolved even before the other person realizes there is a conflict. The first person can choose to observe the situation coolly, looking for ways to settle the matter without engaging the other person in discussion. The second person in the situation can also use that pivotal point to stay open, even if the first person has already acted, but the second person's actions will have less effect in the situation.

Suppose you are that first person to experience a conflict rising. You feel vulnerable and instinctively put your guard up. Ironically, that reaction withwill make you even more vulnerable. In that pivotal moment, your choice towards remaining open serves not only to move you toward eventual resolution, but also to protect you. You will appear safer to others in the situation, and you will maintain more options, including the option to escalate later on. Instead of following your natural instinct to look for more bad signs and prepare to defend yourself or retaliate, you will find it natural to stay aware and open. You will then gain more information about the situation and more insight into the motivation and real meaning of the other person's actions.

The roundtrip to resolution

It's always more productive to be proactive, to see how you can clear the air. The benefits to both parties are obvious: if it's a relationship you wish to continue, you can do so; if it isn't, you can at least be civil to the people whenever you meet them. You haven't created an enemy.

I know it is difficult to reach an agreement when tension is rising, but if you follow a four step process it is easier to reach a resolution to conflict than any alternative I have found. If you are serious about wanting to change your method of operating in the world, memorize and practice these four steps every day in the low- level conflicts that will arise frequently in your office, in your manufacturing plant and in your home.

If you steady yourself and decide to be proactive rather than reactive, you will be proud and satisfied with the results and the ensuing relationships. It's an accomplishment that is well worth the effort.

The following is a brief summary of the four steps.

Step One: Tell yourself the truth

In a moment of confrontation, either real or imagined, we escalate into the hottest negative reaction we can summon. At such moments, we need to slow down the process and seek personal clarity by asking the important question: What do we want? What's our bottom line?

Step Two: Reach out to the other side

Ask yourself these questions. What is this other side's greatest need? What is most important to them? These questions are particularly important if the other side doesn't know their greatest need.

Step Three: Listen attentively to the other side

Listen to the other side and demonstrate to them that you have heard their concerns. Proper respect must be shown at all times. You must mean it.

Power plays will not work at this stage, or later on for that matter.

Step Four: Prove you are fair

When you propose a solution, prove that you are fair, by addressing the other person's interests first. Describe, in that person's language, how they can benefit.

Then you can discuss the benefits of such a resolution to yourself as well.

A roundtrip will work because it teaches you how to go slow in order to go fast. What seems like an agonizingly slow process will prove to be a fast lane to resolution. Please spend enough time to get clear about the two most important factors at every stage in the negotiation: your most important need and the other person's most important need.

By taking the time, you will get centered and accumulate the information necessary to formulate the correct approach to the situation. Then and only then, you can move more quickly. The beginning of a conflict is the time to become sure of what you are doing, to slow yourself down to the point where you can be honest about yourself and empathetic about the other person. ■

Kare Anderson is a speaker and author.

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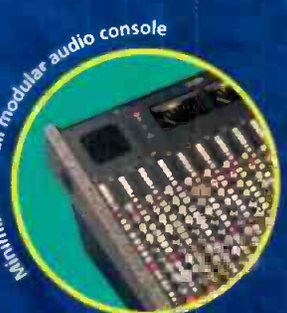

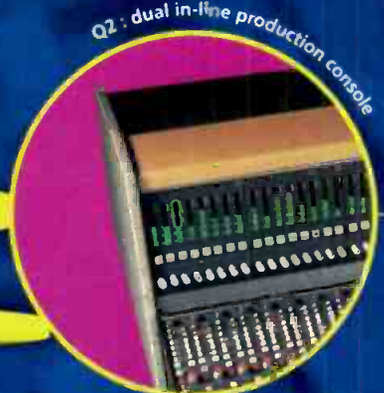

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Commercial insertion systems

BY BE STAFF

Commercial insertion systems might be thought as money printers. They represent a cost-effective and efficient way to air commercials and short segments into cable and TV stations' programming. When considering the purchase, what should you look for?

First, be sure the system can output a signal in a format compatible with the rest of your infrastructure. If the server outputs 601 and you need analog NTSC, what will a convertor cost? Second, consider how much storage is needed. Be sure you allow for growth. Third, what bit rate (quality level) is required? In general, you can trade image quality for storage time. Fifth, determine how much redundancy is needed. Do you really need a mirrored backup, or would backup power supplies and a spare card be sufficient? Finally, consider how you'll get material into the system. Are editing and record features standard with the system? There are many flavors of solutions available, so consider several vendors' products before you decide. ■

Manufacturer	ChannelMatic/LIMT	nSTREAMS	Quantel	SeaChange	Spencer Technologies	Vibrint Technologies
Model	LVS 300	adSTREAMS	SpotRunner	Broadcast MediaCluster 800/1200	Spotstore	Vibrint Video Server
Video ouptut signal	MPEG-2	MPEG-2	DVCPRO	MPEG-2	JPEG, MPEG-2	Analog composite or serial digital
Automation and archiving interfaces	Major T&B vendors and all archiving mediums — JAZ, DAT, DVD	Louth protocol (RS-422) TCP/IP and FTP (proprietary)	Comprehensive remote control protocol, compliant with major automation suppliers	Drake, Florical, Louth, Odetics, Omnibus	Louth, Odetics, and Spencer archiving software (proprietary)	Louth, Odetics and Sony BVW-75 (RS-422)
Fault-resilence	Single-channel integrity, redundant capable	RAID - RAID X software, redundant capable	RAID storage, automated backup facilities	MediaCluster (proprietary)	RAID-5 with redundant controllers, power and fans	RAID 3, redundant local storage, mirroring schemes
Server capacity (hours of storage, I/O channels)	200 minutes — more than 48 hours scalable; TCP/ IP	maximum 24 channels per chassis, max imum 144GB per chassis, chassis can be stacked	24 hours DVCPRO 4 channels	800 series: four channels (three in one out) 11hours at 25 Mb/s or 33 at 8Mb/s. 1200 series: 12 channels and 96 hours at 8 Mb/s or 32 hours at 8 Mb/s.	maximum 100 hours, maximum 16 channels	4GB internal hard drive, supports two 18Gb drives, four channels
Image quality in bits/s	8Mb/s	15 Mb/s	DVCPRO compressed 25Mb/s or 50 Mb/s	15 Mb/s 4:2:2 profile coding up to 24 Mb/s	100 Mb/s, scalable from 8 Mb/s to 100 Mb/s	MPEG-2 4:2:2 or 4:2:0 video, up to 40 Mb/s
Can storage be scaled in I/O and capacity?	yes	yes	yes	yes	yes	yes
Free Info Card	#291	#292	#293	#294	#295	#296

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Digital multichannel encoder

Dolby DP569 digital multichannel encoder: supports encoded bit rates from 56 to 640Kb/s and channel configuration from mono to 5.1-channel surround sound; it lets broadcasters use time code to trigger configuration changes automatically for smooth program transitions, disk-authoring facilities can use timecode to encode separate program segments accurately and create single encoded soundtrack files; other features include fault-monitoring circuits that warn of system failure, bypass connections for hot-standby operation in broadcast installations and remote control from Windows95/NT-equipped devices; 800-33-DOLBY, 415-558-0200; fax 415-863-1373; www.dolby.com

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Digital signal processing convertible cameras

Panasonic AW-E300, AW-E600 3-CCD convertible cameras: permit use of plug-and-shoot video cards and are available with three optional feature cards; the AW-E300 offers 800 lines of horizontal resolution 63dB S/N ratio and high-speed shutter with seven settings; the AW-E600 features a high-speed shutter with seven settings, a higher S/N ratio and 850 lines of horizontal resolution; 800-528-8601; www.panasonic.com.

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HD production switcher with chroma keying

Grass Valley Model 110-HD production switcher: now offers chroma keyer option with auto-setup function; features 1080i and 720p operation form same panel and 3-bus multilevel mix effects system; 800-547-8949; fax 503-627-7275; www.tektronix.com.

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Format transcoder

Feral Industries' A4:2:2SX transcoder: format transcoding and time-based correction solution produces broadcast-quality images; accepts and provides Y/C (S) component (YUV) and serial digital signals; 913-492-4666; fax 913-895-7496; www.grunder.com.

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Cassette storage cabinet

Winsted Corporation Model T7144: storage cabinet is designed for DVCPRO medium and 8mm cassette-sized tapes; cabinets are 88 inches high, 4 1/2 inches deep and 36 inches wide; each cabinet section has 14 shelves and can hold 616 8mm cassettes or 588 DVCPRO tapes; 800-447-2257; fax 800-421-3839; www.winsted.com.

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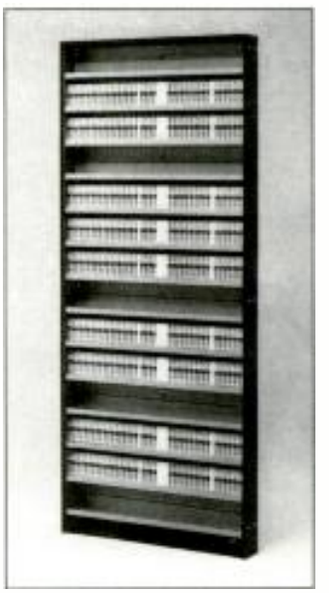

HDTV digital signal generator

Leader LT 440D: HDTV signal generator operates in the 1125/59.54 interlaced system with 1035 or 1080 lines displayed; provides three SDI outputs with eight channels of embedded digital audio and a separate AES/EBU stereo output; 800-645-5104; fax 516-231-5295; www.leaderusa.com.

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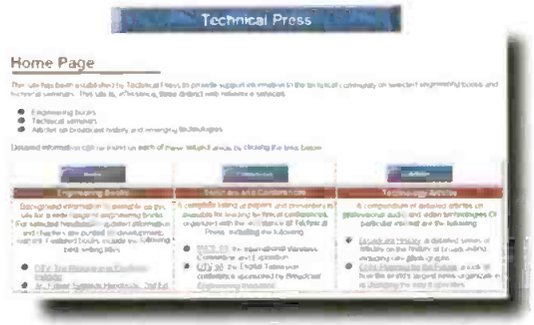
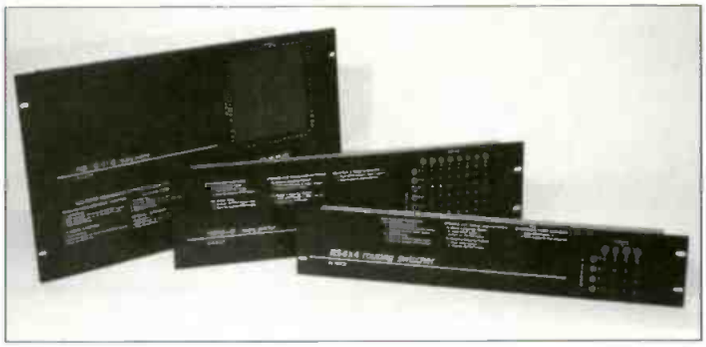


www.technicalpress.com

Technical Press is a web-based reference site that supports more than adozen 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.



Component routing switcher

Knox Video Technologies RS8x8 RGBS: new component switchers available in RGB, RGBS and also capable of routing R-Y, B-Y standard; offers maximum bandwidth of 200 MHz; features Phoenix connectors and headroom greater than +18dB; 301-840-5805; fax 301-840-2946; www.knoxvideo.com.

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RGB Spectrum VLI 200: a variable line interpolator designed for AV venues and home theaters where video signals are viewed on large screen displays; accepts any video source including NTSC/PAL composite video and S-Video; features decoding, adaptive comb filtering and de-interlacing; 510-814-7000; fax 510-814-7026; www.rgb.com

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Ice ICE'd Final Effects Complete Version 1.0: designed for use with ICE's BlueICE hardware card; speeds creation of special effects from two to 45 times over former FEC product; offers over 130 accelerated software effects filters for widely used video and film finishing environments; 888-ICE-THIS, 781-768-2300; fax 781-768-2301; www.iced.com.

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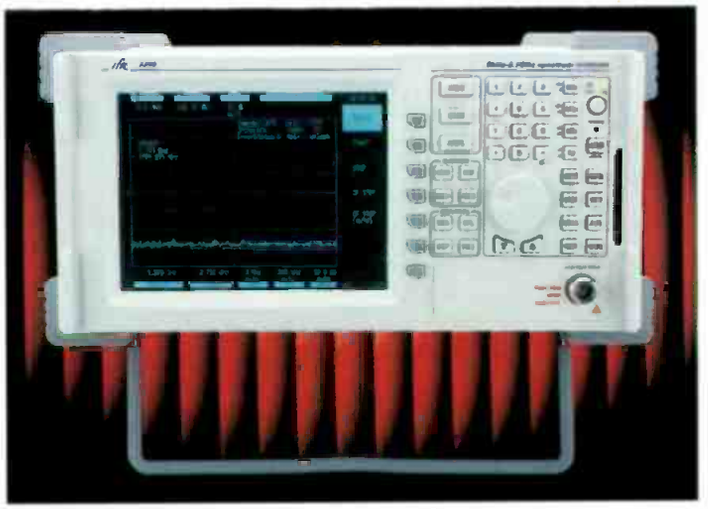

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Video fluid head

Bogen Photo G1380-Series Pro Video fluid head: available for a full range of lightweight ENG/EFP cameras, portable digital cameras and lightweight DV cameras; includes six specific counterbalanced springs; accommodates cameras and lenses from 2.2 to 22 pounds; 201-818-9500; fax 201-818-9177; www.bogenphoto.com.

Circle (274) on Free Info Card

Environmental control system

Liebert Deluxe System/3 Upflow DX environmental control system: new design maximizes installation flexibitiy and reliablity for cooling critical equipment; uses two semihermetic compressors; microprocessor controls maximize energy efficiency; 800-877-9222; fax 614-841-6973; www.liebert.com.

Circle (276) on Free Info Card

Digital audio cart replacement system

Virtual Sound and Video V-Cart: a digital audio cart replacement system for Macintosh; features 10,000-entry playlist, rapid file editing, and manual or automatic recording modes; 732-274-9451; www.V-CART.com.

Circle (275) on Free Info Card

VGA to NTSC encoder

Broadcast Video Systems EN500: accepts RGB and horizontal drive or sync from computer-generated VGA source; outputs encoded, interlaced video complete with EIA sync; plugs directly into an unused ISA slot on host PC; 905-764-1584; fax 905-764-7438; www.bvs.on.ca.

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*The Video Disk Editor (VDE) and Desktop Data Drive (DDD) make DiskCam truly practical for today's studio. Designed for both tape and data environments, the DDD's unique, dual-head design provides direct, non-linear random access, plus high speed transfer. To find out more about the DiskCam product suite, call NEC at **1-888-383-4DTV** or visit us at www.nec.com.*

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RS-232 data tranceiver

Math Fiber Optics RS-232 microtranceiver: designed to extend the normal transmission range of most RS-232 compatible equipment and accessories; may be configured for either point-to-point or repeat modules; operates with all data rates up to 200Kb/s; 516-273-0404; fax 516-273-1638; www.commspecial.com.

Circle (278) on Free Info Card

Camera remote control panel

Telemetrics CP-ITV-VC3 Serial Control Panel: designed specifically for Canon's VC-C3 Pan/Tilt Cameras; provides joystick control with programmable presets for each camera; offers control over zoom, focus and iris adjustment; 201-848-9818; fax 201-848-9819; www.telemetricsinc.com.

Circle (278) on Free Info Card

DVCPRO camcorder

Panasonic AJ-D400 DVCPRO camcorder: is designed for an array of applications from event videography to electronic newsgathering; features three low-smear, low-noise, 1/2-inch, 410,000-pixel FIT CCDs; with viewfinder, battery and cassette pack the AJ-D400 weighs less than 13 pounds; 800-528-8601; www.panasonic.com.

Circle (279) on Free Info Card

Video edge device

Tektronix M2T 300 video edge device: delivers high-quality, real-time MPEG-2 digital video at any bandwidth; able to support a number of video-trunking applications including post-production, event coverage and studio/transmitter links; 800-547-8949; fax 503-627-7275; www.tektronix.com.

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Tektronix offers upgrades for measurement set and waveform monitor

Tektronix 1735HD Waveform Monitor: now supports analog video signals used to create 480p, 720p and 1080i DTV formats; earlier 1735HD monitors can be upgraded to support new DTV rates.

Tektronix VM700T automated video measurement set: now offers SDTI analysis as standard feature on the Option 1S serial digital video analyzer; delivers real-time acquisition, analysis of SDTI transport interface and associated data packets and synchronizing signals; 800-547-8949; fax 503-627-7275; www.tektronix.com.

Circle (281) on Free Info Card

Digital Color corrector

Videotek SDC-831 Digital Color Corrector: has internal 4:4:4, 16-bit processing; provides control of gains, gamma and black levels for total video and components; features include RGB gamut legalizing, encoded gamut legalizing and vector limiting; can be used with any combination of up to 30 panels and units; 800-800-5719, 610-327-2292; fax 610-327-9295; www.videotek.com.

Circle (282) on Free Info Card

Fibre Channel disk drives

Leitch 18GB Fibre Channel disk drives: drive reduces the cost of storage for the Leitch ASC VR300 broadcast video server; the FCR-301 disk array holds 10 18GB Fibre Channel disk drives; 800-387-0233; fax 416-445-0595.

Circle (283) on Free Info Card

RAID-based storage

Storage Concepts FibreRAID Express: storage system for applications that require continuous transfer capabilities of over 80 MB/s; offers RAID 3 architecture; connects to host using a dual Fibre Channel interface; 800-525-9217, 949-852-8511; fax 949-852-8930; www.storageconcepts.com.

Evertz offers software for closed caption encoder

Evertz XDS Packet Control Software: Windows 95 application program designed for use with the Evertz 8074 Closed Caption Encoder; allows insertion of network ID, station call leters and time information into the XDS portion of Line 21 of the VITC; 905-335-3700; fax 905-335-3573; www.evertz.com

Circle (284) on Free Info Card

Azden Corp. offers new microphones and element

Azden now offers two new microphones for use with their VHF and UHF body-pack transmitters; the **Sony ECM-44** is a omnidirectional electret condenser lavalier microphone; comes with standard 3.5 mm connector or four-pin locking Hirose connector. The **K & K Sound Systems CMX-5** is a gel-mounted soft cardioid capsule that withstands up to 140 dB SPL.

Azden also offers the VLM capsule used in the Audix OM-3xb as an alternative element for Azden's 41HT wireless UHF hand held microphone/transmitter; capable of handling up to 140 dB SPL; 516-328-7500; fax 516-328-7506; www.azdencorp.com.

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Business

HBO has purchased 19 Panasonic AJ-HD2700 D-5 HD VTRs and three HD Smart-Cart automation systems in what Panasonic bills as the largest sale of D-5 high-definition recording systems. The sale represents the delivery of Panasonic's 300th D-5 VTR worldwide.

American Product Services purchased Sony Electronics' DXC-H10 high-definition camera for graphics capture. The camera is part of a larger purchase of equipment in APS's high-definition edit suite. APS is the first broadcast-level studio to purchase the camera.

Liman Video Rental, New York, has selected Canon's HJ15X8B Standard Zoom and HJ9X5.5B Wide Angle Zoom lenses for its HDTV customers.

Ulster TV, Belfast, Northern Ireland, will be installing a Telex Communications Inc. RTS ADAM Digital Intercom System in its new master control room. The digital intercom system will serve the entire Ulster TV facility and links to OB and remote trucks.

JB Broadcasting, Torrence, CA, and the Texas Network have purchased automation systems from Channelmatic/LIMT.

Fairlight ESP has announced the sale of a Fairlight Medialink Fast Audio Network Solution and four MFX^{plus} digital audio workstations to Superdupe Recordings in New York.

Composer and producer Stephen Bray purchased two Otari Radar II HDR series digital multitrack recorders for his Saturn Sound Studios.

WaveFrame has announced the sale of three 24-track WaveFrame 408-Plus digital audiostations to Pacific Sound Services, the audio post-production division of LaserPacific Media Corporation.

Panasonic has delivered its first AV-HS3110 1080I MilleniuM High-Definition Switcher to Post Logic, a post facility that specializes in HD feature transfers and commercial, trailer and long-form finishing. Post Logic also purchased two AJ-HD2700 D-5 HD VTRs.

Tektronix and Avid Technology Inc. have announced the incorporation of Avstar Systems LLC, a joint newsroom computer venture. Avstar, which began operating this month, will produce digital news production products.

JVC has announced NASA's Jet Propulsion Laboratory bought a DLA-G10 direct-drive image light amplifier for project design and 3-D rendering.

Mira Mobile Television has added five Sony BVP 500 studio cameras with three 70x and two 55x Fujinon lenses for use in its production trucks.

Drake Automation Inc. opened its third office in Culver City, CA. The new office's phone number is 310-645-7171.

Five TV stations have recently purchased Euphonix's 3100B broadcast mixing system during the last three months. The stations are KCBS, Hollywood; KCNC, Denver; KNSD, San Diego; KNVX, Phoenix; and WTXF, Philadelphia.

MSG Network has been using Orad's Cyberset M virtual set system for its National Finance SportsDesk and Sharp Jets-Giants Report programs.

Otari Corp. is expanding its Northeast Regional Sales & Support office to include a demonstration facility. The demonstration space will feature the ADVATA Digital Production System and RADAR II GDR Series Digital Multitrack.

Cyclotron at Post Perfect has been using Quantel's Hal Express to produce two branding shots for The History Channel.

Fujinon has announced the sale of six HA20x7.5BEVM lenses and two HA10x5.2BEVM wide-angle lenses to Bexel Corp., a video equipment rental house. The new lenses will be used to complement Bexel's Sony HDW-700 high-definition camcorders.

Harris Corp. has entered an exclusive agreement to provide Hearst-Argyle Television Inc. with a full range of digital and analog TV equipment. In the first transaction, Harris will provide SigmaCD UHF DTV transmitters to two Hearst-Argyle stations.

CNN Airport Network has begun using Scientific-Atlanta's PowerVu satellite transmission system. CNN Airport Network offers programming at 1350 gates in 32 airports throughout the U.S.

Tektronix will be rebuilding the transmission infrastructure and installing a new server-based commercial transmission facility for three Dutch National Channel of NOB, a Dutch broadcasting services corporation. NOB will be

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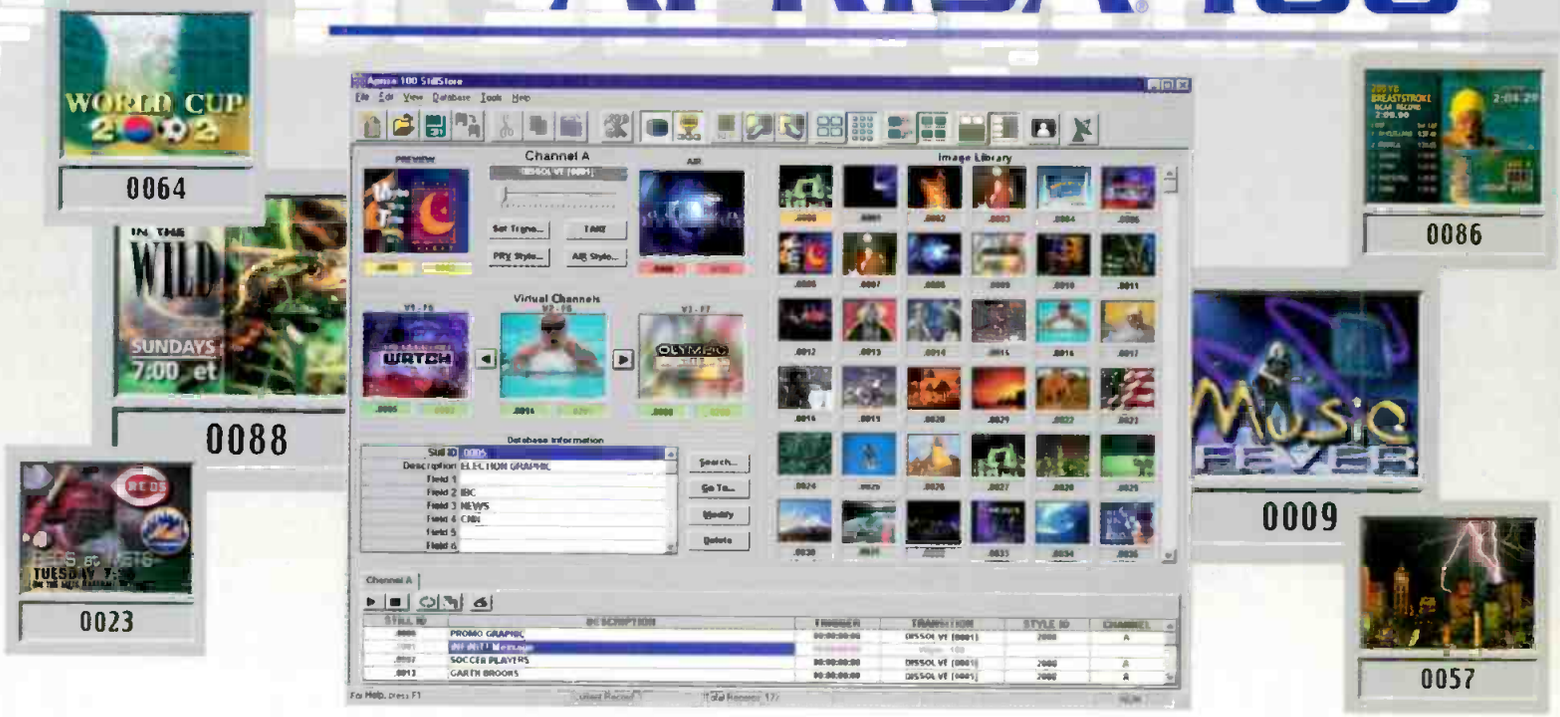

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Aprisa 300

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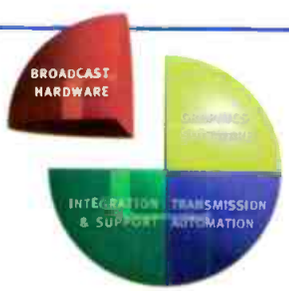

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equipped with six Profile PDR300 Video Servers, a Grass Valley M-2100 master control switcher, Grass Valley routing products and WFM601 waveform for signal analysis.

The state of Nebraska has awarded COMARK, a division of THOMCAST Communications Inc., Alexandria, VA, a contract to produce a complete planning study for the transition of the Nebraska Educational Telecommunications network to DTV.

New Century Productions, Allentown, PA, received a 60-channel Q2 dual inline analog console from Calrec Audio Ltd. The console will be installed in a 53-foot NCP III TV truck.

Quantel Inc. has opened a sales office serving the Midwest in downtown Chicago. The office is located at 541 North Fairbanks. The Chicago sales staff may be reached at 312-755-1766.

Johnson Broadcasting Company of Texas has selected JVC's 4:2:2 DIGITAL-S for KNWS-TV of Houston and KLDT-TV of Dallas. Johnson Broadcasting uses BR-D750 edit recorders to dub shows and uses BR-D350 recorders for on-air playback. KNWS-TV crews also use a BR-D40 recorder docked with a KY-D29 camera for local sporting events.

Granada Media Group has purchased 12 Panasonic DVCPRO VTRs (AJ-D750/650/230), two AJ-D700 camcorders and five AG-EZ1 DV palmcorders for its new joint venture shopping network called Shop!

People

Charles Steinberg, president of Sony Electronics' Broadcast and Professional Company, was named adviser to Dr. Teruaki Aoki, president and chief operating officer of Sony Electronic. Michael A. Vitelli, executive vice president of Broadcast and Professional Company, assumed responsibility for BPC operations.

Jeffery Klitzner will be the group manager for nonlinear editing systems for Panasonic Broadcast & Digital Systems Co.

Magni Systems Inc., Hillsboro, OR., has appointed Richard Friedland, former chief executive officer of General Instrument Corporation, to its board of directors.

Pluto Technologies, Boulder, CO, has appointed Pete Mountanos to its board of directors.

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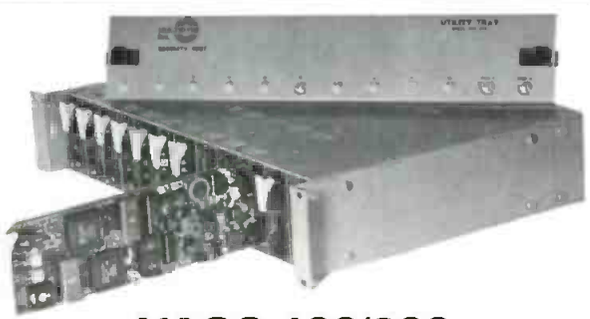

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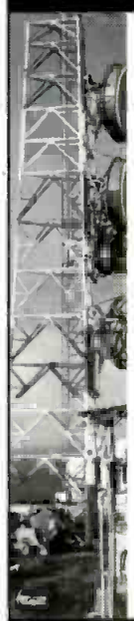

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SONY

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.

PVM-14N5U/14N6U & 20N5U/20N6U
13-inch and 19-inch Presentation Monitors

With high quality performance and flexibility, Sony's presentation monitors are ideal for any environment. They use Sony's legendary Trinitron CRT and Beam Current Feedback Circuit for high resolution of 500 lines as well as stable color reproduction. They also accept worldwide video signals, have a built-in speaker and are rack mountable. The PVM-14N5U/20N5U are designed for simple picture viewing, the PVM-14N6U and 20N6U add RGB input and switchable aspect ratio.

They Feature:
- 500 lines of horizontal resolution
- They handle NTSC, NTSC 4.43, PAL, and SECAM.
- Picture (chrome, phase, contrast, brightness) and setup adjustments (volume, aspect ratio) are displayed as easy-to-read on screen menus.
- Closed captioning is available with the optional BKM-104 Caption Vision Board.

PVM-14N6U/20N6U Only:
- (Last Input Switch) - Contact closure remote control allows you to wire a remote to an existing system so that the monitor's input can be remotely controlled to switch between the last previously selected input and the current input.
- 4:3/ 16:9 switchable aspect ratio

PVM-14M2U/14M4U & 20M2U/20M4U
13-inch and 19-inch Production Monitors

Sony's best production monitors ever, the PVM-M Series provide stunning picture quality, ease of use and a range of optional functions. They are identical except that the "M4" models incorporate Sony's state-of-the-art HR Trinitron CRT display technology and have SMPTE C phosphours instead of P22.

- HR Trinitron CRT enables the PVM-14M4U and 20M4U to display an incredible 800 lines of horizontal resolution. The PVM-14M2U and 20M2U offer 600 lines of resolution. M4 models also use SMPTE C phosphours for the most critical evaluation of any color subject.
- Dark tint for a higher contrast ratio (black to white) and crisper, sharper looking edges.
- Each has two composite, S-Video and component input (R-Y/B-Y, analog RGB).For more accurate color reproduction, the component level can be adjusted according to the input system. Optional BKM-101C (video) and BKM-102 (audio) for SMPTE 259M serial digital input.
- Beam Current Feadback Circuit
- 4:3/16:9 switchable aspect ratio.
- True multi-system monitors they handle four color system signals: NTSC, NTSC 4.43, PAL, and SECAM.
- External sync input and outputcan be set so that it will automatically switch according to the input selected.
- Switchable color temp: 6500K (broadcast), 9300K (pleasing picture). User preset.(3200K to 10000K).
- Blue gun, underscan and H/V delay capability
- On-screen menus for monitor adjustment/operation.
- Parallel remote control and Tally via 20-pin connector.

QUICK DIAL 74

SONY

UVW-100B 3-CCD Betacam SP Camcorder

More affordable than ever, the UVW-100B offers 700 lines of horizontal resolution, 60dB S/N ratio, 26-pin VTR interface, compact design and ease of operation– making it ideal for field shooting applications.

- 1/2-inch Power HAD CCDs attain sensitivity of F11 at 2000 lux (4 lux low light), 700 lines of resolution & 60dB S/N ratio.
- Gain-up can be preset in 1dB steps from 1dB to 18dB.
- Auto Iris detects the lighting conditions and adjusts for the proper exposure.
- Clear Scan records computer monitors without horizontal bands across the screen. Shutter speed can be set from 60.4 to 200.3 Hz in 183 steps. Also has a variable high speed shutter from 1/100 to 1/2000 of a second.
- SMPTE LTC time code and UB generator/reader. Rec Run/ Free Run, Preset/Regen are easily set. For multi-camera operation, genlock to an external time code is provided.
- Genlock input and built-in color bar generator.
- 26-pin VTR interface for feeding component, composite and S-Video signals to another VTR for simultaneous recording. Sart/stop are controlled and external VTR status such as Rec and Tally are shown in the viewfinder.
- 8-digit LCD display indicates time data, warning indications and video status. Battery status audio level are also shown in a bar graph meter.
- Diecast aluminum, 1.5-inch DXF-601 viewfinder is rugged yet comfortable while providing 600 lines of resolution.
- Large diameter eye cup reduces eye strain and simplifies focusing. Diopter adjustments (-3 to 0) compensates for differences in eye sight.
- Zebra level indicators, safety zone and center marker generator. Shows tape remaining and audio levels.
- With Anton/Bauer Digital Batteries remaining battery power is displayed on the LCD panel and through the viewfinder.
- Weighs 15lb. with viewfinder, battery, tape and lens. Shoulder pad is adjustable, so you maintain optimum balance when using different lenses and batteries.

DXC-637 3-Chip Color Video Camera

- PVW-637 - Perfect camcorder operation with the PVV-3
- Compact size, lightweight and low power consumption
- High density three 2/3-inch IT Hyper HAD sensors
- 800 TV lines of horizontal resolution
- HAD sensor structure
- 2 dimensional optic low pass filter
- Clear scan function for shooting computer displays • Hyper Gain mode
- EZ mode and EZ Focus functions enable cameramen to get ready for shooting swiftly
- Dual Pixel Readout technology
- Can be coupled directly with the DSR-1/PVV-3 for high quality component acquisition or with the EVV-9000 for handy operation
- Can be combined with the recorders from Panasonic or JVC
- Can be connected with computer equipment via CA-325A/325B camera adapter.

DXC-637 with Fujinon 16:1 zoom lens, tripod plate and hard case **$7495**
Also available in Betacam or DV-CAM packages, call for prices.

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

The UVW-1600 and UVW-1800 are the other half of the UVW 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 and sophisticated circuit technology ensure low noise, wide dynamic range, and extremely stable signal transmission and reception. Ideal for broadcasting stations, film production facilities, and ENG work.

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Panasonic

QUICK DIAL 74

WJ-MX50 Digital A/V Mixer

- Four input switcher and any two sources can be routed to the program busses. • Two-channel digital frame synchronization permits special effects in each A/B bus.
- Combination of 7 basic patterns and other effects creates 287 wipe patterns. • External edit control input for RS-232 or RS-422 serial controls. Also has GPI input.
- Wipe boundary effects: soft/border (bold, eight background colors available). • Digital effects:strobe, still, mosaic, negative/ positive, paint, B&W, strobe, trail, and AV synchro.
- Real-Time compression - entire source image is compressed inside a wipe pattern.
- Fade-in and fade-out video, audio, titles individually or synchronously faded .• Dual stream keyer with selectable sources from character generator or external camera.
- "Scene Grabber" moves a pattern while upholding the initially trimmed-in picture integrity.
- Eight separate memories enable instant recall of frequently used effects. • 8 preset effects including: Mosaic Mix, Position Stream, Corkscrew, Bounce, Flip, Shutter, Vibrate, and Satellite .• Audio mixing capability of 5 sources with 5 audio level adjustments.

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.

sachtler Tripods & Fluid Heads

QUICK DIAL 74

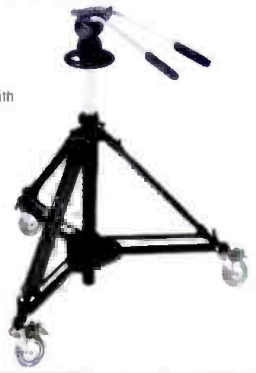
Precision Manufacturing

Parts and structural components for all Sachtler's fluid heads have to pass they're quality control before being used. That means passing fatigue tests simulating five years of continuous use.

Frictionless Fluid Damping

A prerequisite for perfect pictures is panning movement without jerks and vibrations. Starting resistance, or what is known as hysteresis effect should never occur, either at the beginning or the end of the movement. All outside vibrations must be dampened immediately. Sachtler's patented damping system is not influenced by pressure or temperature, and works without friction. This is because the damping modules perform no other tasks such as counter-balancing the camera.

Video 20 III Fluid Head



- Suitable for production work, this compact fluid head assures mobility and is strong enough to hold ENG cameras with EFP accessories.
- Sachtler Touch & Go quick release with auto camera lock and safety lever
- Enlarged contact surface for camera
- Integrated sliding balance plate with extended setting range
- Dynamic counterbalance in 7 steps
- Frictionless leakproof fluid damping with seven levels of drag
- Vibrationless vertical and horizontal brakes

Caddy Systems

Sachtler quality is available to low budget users. The price of a CADDY system includes the 7-step dampened CADDY fluid head, ultra-light but rugged carbon fiber tripod, lightweight spreader and either a soft bag or cover. The CADDY fluid head features an adjustable pan arm, 7-step adjustment for quick counter balance and the self-locking Sachtler Touch and Go System.

CAD D1 Single-Stage ENG Carbon Fiber System:
- CADDY Fluid Head
- ENG Single-Stage Carbon Fiber Tripod
- SP 100 Lightweight Spreader
- Transport Cover 100

CAD 2A 2-Stage ENG Carbon Fiber System:
- CADDY Fluid Head
- ENG 2-Stage Carbon Fiber Tripod
- SP 100 Lightweight Spreader
- Soft padded ENG Bag

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.

anton bauer

DIGITAL PRO PACS

The ultimate professional video battery and recommended for all applications. The premium heavy duty Digital Pro Pac cell is designed to deliver long life and high performance even under high current loads and adverse conditions. It's size and weight creates perfect shoulder balance with all camcorders.
- **DIGITAL PRO PAC 14 LOGIC SERIES NICAD BATTERY**
  14.4v 60 Watt Hours. 5 1/8 lbs. Run time: 2 hours @ 27 watts, 3 hrs. @ 18 watts
- **DIGITAL PRO PAC 13 LOGIC SERIES NICAD BATTERY**
  13.2v 55 Watt Hours. 4 3/4 lbs. Run time: 2 hours @ 25 watts, 3 hours @ 17 watts

DIGITAL TRIMPAC

Extremely small and light weight, the Digital Trimpac still has more effective energy than two NP style slide-in batteries. High voltage design and Logic Series technology eliminate the problems that cripple conventional 12 volt slide-in type batteries. The professional choice for applications drawing less than 24 watts.
- **DIGITAL TRIMPAC 14 LOGIC SERIES NICAD BATTERY**
  14.4 v 43 Watt Hours, 2 3/4 lbs.
  Run time: 2 hours @ 20 watts, 3 hours @ 13 watts.

QUAD 2702/2401 Four-Position Power/Chargers

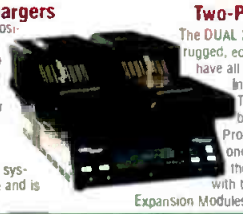
The lightest and slimmest full featured four position chargers ever, they can fast charge four Gold Mount batteries and can be expanded to charge up to eight. They also offer power from any AC main: in a package the size of a notebook computer and weighing a mere four lbs! The 40 watt 2401 can charge 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.

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 viewfinder 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

Dual 2702/2401 Two-Position Power/Chargers



The DUAL 2701 (70 watt) and 2401 (40 watt) are sleek, rugged, economical two position Power/Chargers that have all the features of InterActive 2000 technology including DC camera output and LCD display. The DUAL 2701 will charge any Gold Mount battery in one hour, the DUAL 2401 charges ProPac batteries in two hours and Trimpacs in one. Compact, lightweight design makes them the ideal for travel. They can also be upgraded with the Diagnostic/Discharge Module and/or with Expansion Modules to charge up to 6 batteries of any type.

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	3.29	BGR-60	3.99	BGR-120	4.49

H471S S-VHS Double Coated

ST-30	6.79	ST-60	7.49	ST-120	7.69

M221 Hi 8 Double Coated

Metal Particles				Metal Evaporated			
P630HMP	4.99			E630HME	7.69		
P660HMP	6.39			E660HME	10.29		
P6120HMP	8.29			E6120HME	13.59		

M321SP Metal Betacam (Box)

05S	17.95	10S	18.49	20S	19.95
30S	22.95	60L	31.95	90L	49.95

DP121 DVC PRO

12M (Med.)	7.99	23M	9.49	33M	11.99
63M	21.99	64L (Lg.)			22.99
94L	32.99	123L			42.99

maxell

Hi8 Metal Particle (XRM)

P6-120 XRM	6.99

Broadcast Quality Hi8 Metal Particle

P6-30 HM 8Q	5.39	P6-60 HM 8Q	6.09
P6-120 HM 8Q			7.99

P/1 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

8Q Broadcast Quality VHS (Box)

T-30 8Q	3.89	T-60 8Q	3.99	T-120 8Q	5.99

8Q Professional S-VHS (In Box)

ST-31 8Q	6.79	ST-62 8Q	6.89
ST-126 8Q	7.49	ST-182 8Q	13.99

Betacam SP

B5MSP	15.75	B10MSP	17.75	B20MSP	19.75
B30MSP	16.99	B60MLSP	27.99	B90MLSP	39.99

Panasonic

Mini DV Tape

AY DVM-30	7.99	AY DVM-60	7.99
AY DVM-60 (10 Pack)ea.	7.49	AY DVM-80	16.99

DVCPRO

AJ-P12M (Medium)	8.49	AJ-P23M	9.99
AJ-P33M	13.49	AJ-P63M	22.99
AJ-P64L (Large)	24.99	AJ-P94L	34.99
AJ-P123L			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	8.89	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-30PM	3.49	T-60PM	3.99	T-120PM	4.79

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

T-30BA	3.49	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)	8.29	KCS-20 BRS (mini)	8.99
KCA-10 BRS	8.19	KCA-20 BRS	8.69
KCA-30 BRS	9.69	KCA-60 BRS	13.39

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

KCS-10 XBR (mini)	8.79	KCS-20 XBR (mini)	10.19
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)	13.29
BCT-20M (small)	13.99	BCT-30M (small)	14.99
BCT-30ML	21.49	BCT-60ML	23.49
BCT-90ML			34.99

Mini DV Tape

DVM-30EXM w/Chip	15.99	DVM-60EXM w/Chip	17.99
DVM-30EX "No Chip"	12.99	DVM-60EX "No Chip"	14.99
DVM-30PR "No Chip"	9.99	DVM-60PR "No Chip"	11.49

Full Size DV Tape with Memory Chip

DV-120MEM	25.89	DV-180MEM	29.99

PDV Series Professional DVCAM Tape

PDVM-12ME (Mini)	18.99	PDVM-22ME (Mini)	20.99
PDVM-32ME (Mini)	23.99	PDVM-40ME (Mini)	25.99
PDV-94ME (Standard)	34.99	PDV-124ME (Standard)	38.99
PDV-184ME (Standard)	49.95	PDVN-64N	27.50
PDVN-124N	34.95	PDVN-184N	43.95

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NewTek

QUICK DIAL 731

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 realtime 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, iNFiNiTi 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 playback 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
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- 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
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- Teac CD-532e 32X EIDE Internal CD-ROM Drive • 3.5" Floppy Drive
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- Viewsonic G771 17-inch (1280 x 1024) Monitor (0.27mm dot pitch)
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- Windows NT 4.0 Operating System Software
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- Truevision TARGA 1000 or 1000 Pro Video Capture Card

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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 route 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-pad 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.

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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, fine 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.

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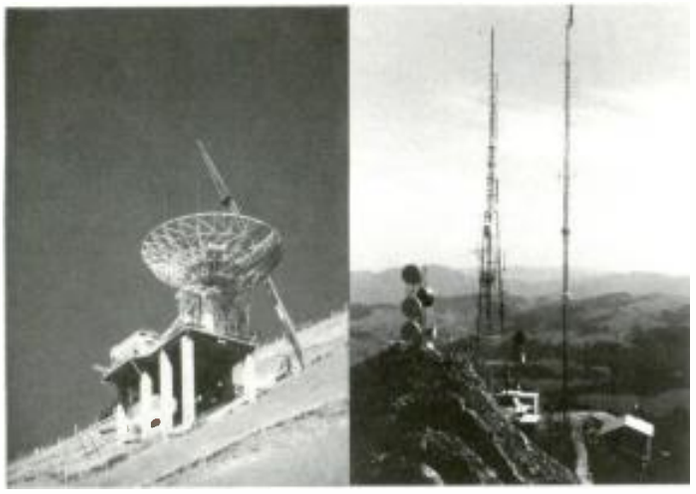

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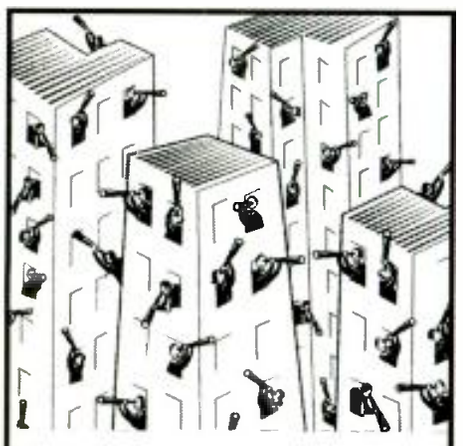

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The New York Network (NYN), a function of Advanced Learning and Information Systems, Office of the Provost, State University of New York System Administration provides television production and transmission services for SUNY, the agencies of State government and electronic media. Located in the Alfred E. Smith State Office Building in Albany, NYN also operates SUNYSAT, a satellite television network. NYN seeks nominations and applications as follows:

TV MAINTENANCE/COMPUTER TECHNICIAN

The position will involve the operation, maintenance and repair of electronic equipment for satellite and base band video, studio and field production as well as computer equipment for in-house LAN and broadcast digital compression system. Candidate will, on occasion, be required to work off-site at transmission facility and/or remote studio locations.

Candidates for the position should possess a college degree or equivalent in electronics or related field, and have 1-2 years experience in broadcast studio maintenance. **Salary:** $29,500

SATELLITE ENGINEER

The successful candidate will perform operations for satellite and terrestrial transmissions as well as occasional field assignments as a mobile uplink technician. Exper-ience in both digital and analog important. Strong computer skills necessary. Applicant should have excellent people skills and be able to work nights and weekends. SBE and/or FCC certification is helpful.

Candidates for the position should possess a college degree or equivalent in electronics or related field, and have 1-2 years experience in broadcast transmission. **Salary:** $26,500

Send resume and letter of application indicating position of interest by February 16, 1999 to: **Roy T. Saplin, Jr., Search Chair, New York Network, Alfred E. Smith State Office Building, 12th Floor, P.O. Box 7012, Albany, New York 12225.**

The State University of New York is an EEO/AA employer. Applications from women, minority persons, disabled workers and/or Vietnam Era Veterans are especially welcome.

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Taft Broadcasting Company
P.O. Box 8170, Moreno Valley, CA 92522-8170 or
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EOE

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KRON-TV

The NBC affiliate in San Francisco seeks a highly skilled individual to manage a staff of technical maintenance engineers, develop and manage an operating budget, and train technical staff on electronic systems and equipment requirements. Includes heavy internal customer interaction requirements in a very fast-paced work environment. Requirements: 8+ years of in-depth technical experience focused on computer, network, and digital technologies (to include digital video servers, storage solutions, networking, schemes, video compression technologies, and computer systems support at a broadcast-quality level,) minimum of 3 years management experience in a technical work environment, and excellent interpersonal skills. BS in Electrical Engineering and work experience in a unionized environment preferred.

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EOM

For DTV, film doesn't cut it

BY PAUL MCGOLDRICK

I have always been ambivalent about film. As a trainee engineer being taken through all the operational jobs in a studio, it was exciting to be handed a piece of just-edited 16mm film destined for air within a few seconds. Not only did your fingers seem to turn to butter, but you knew if you looked over your shoulder, everyone would be staring. Once the telecine rolled, the output had to be adjusted. Within the first couple of frames, levels and balance had to be set — with minimum annoyance to an observant viewer.

That situation was usually self-created. The most important items always seemed to be the last ones to come in. We did not have the luxury of ENG, not because equipment was unavailable but because there were union problems related to the reduction of staffing levels for electronic pickup.

We have now come full circle. Film is the accepted standard behind DTV. Film of whatever width can be slapped into a modern telecine and all the allowed compression formats can be produced. Everyone has been saying that as long as the production is shot in film, it will provide the simplest, high-performance storage available for later transmission — in whatever standard is desired.

Subliminal viewing

There are several differences between the viewing experience in a movie theater and a typical home theater, negative and positive. For me, the negatives include the overall cost of the experience — unless you're good at smuggling popcorn and sodas in under your coat — as well as the surrounding noise of your fellow moviegoers, the uncomfortable seats, the sticky floor ...well, you understand what I mean.

The positives in a decent theater include the great audio and the experience of seeing all the details on a screen bigger than anything we could dream of in a home, even in HDTV.

How much of that experience is subliminal? If the print has a relatively poor color balance, you will begin to ignore it within minutes. The darkness does strange things to your reference points (something you learn really quickly when you fly by instruments: believe the instruments, not what your senses tell you). Within minutes, the print looks perfect. The same scenario applies to audio; unless the distortion or hum is really high, you sink into the experience.

For DTV there is a completely different set of circumstances. Even with good source materials and a reasonable home setup there will probably be more light in the viewing area. There will likely be less artificial noise and a reduction in things such as the dynamic range of the material being viewed. Color balance is not an issue – hopefully. But there is another feature of film that theater viewing hides: It moves too slowly.

If we are going to have film as the master standard for all formats across all international boundaries, the film industry needs to go faster.

Motion artifacts

Producers will expend many millions of dollars on upcoming projects. They will use sophisticated computer rendering and color key (sorry, "blue screen") techniques to make everything believable. But everything will be shot at a speed that is *too slow*. A 24fps rate doesn't cut it as the tail end of a starship jumps into warp/hyper/light (choose one) speed.

Motion artifacts in the standards conversion process, as well as the A/D-D/A processing of DTV, can be controlled to a large extent. Of course this is somewhat dependent on the dollars and memory you are willing to throw at the algorithms. When the source material itself is at fault it is not fixable.

There have been several recent meetings to finalize production standards at 24fps throughout the electronic chain. That is a perfectly allowable standard and practice under the Table 3 constraints of ATSC's A53 document. If we are going to have film as the master standard for all formats across all international boundaries, the film industry needs to go faster, preferably by changing the film rate to 30fps. As far as I can deduce, the 24fps standard was the hand-cranking maximum. I don't think technology has that limit today.

Yes, there would have to be a lot of camera changes, there would have to be a lot of projector and editing equipment changes. But the film industry is adept at accepting change in film width, audio standards and the like, so speeding up the film should be minor. Then film can truly be considered the master source for imaging into the 21st century. ■

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

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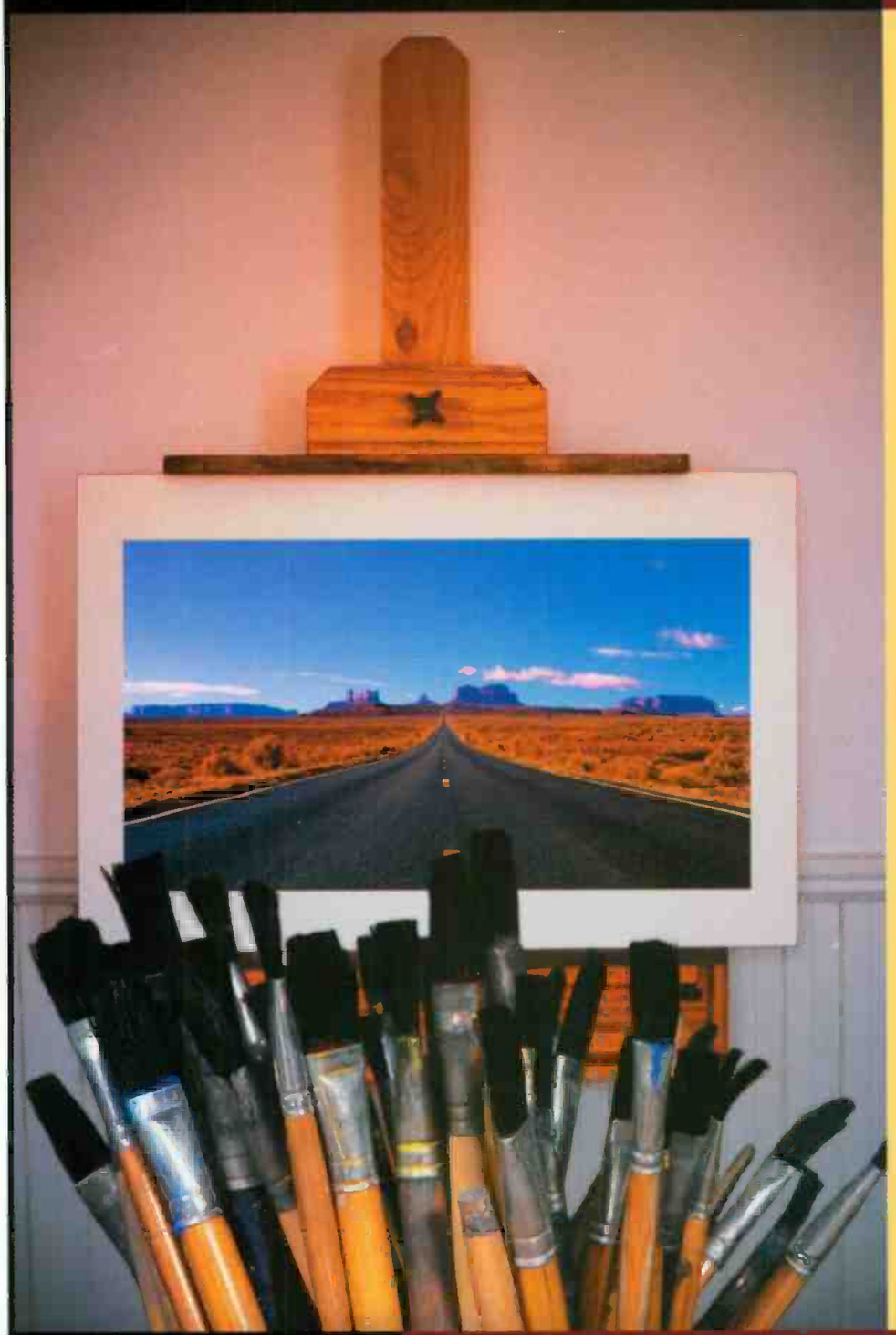

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