BROADCAST ENGINEERING®

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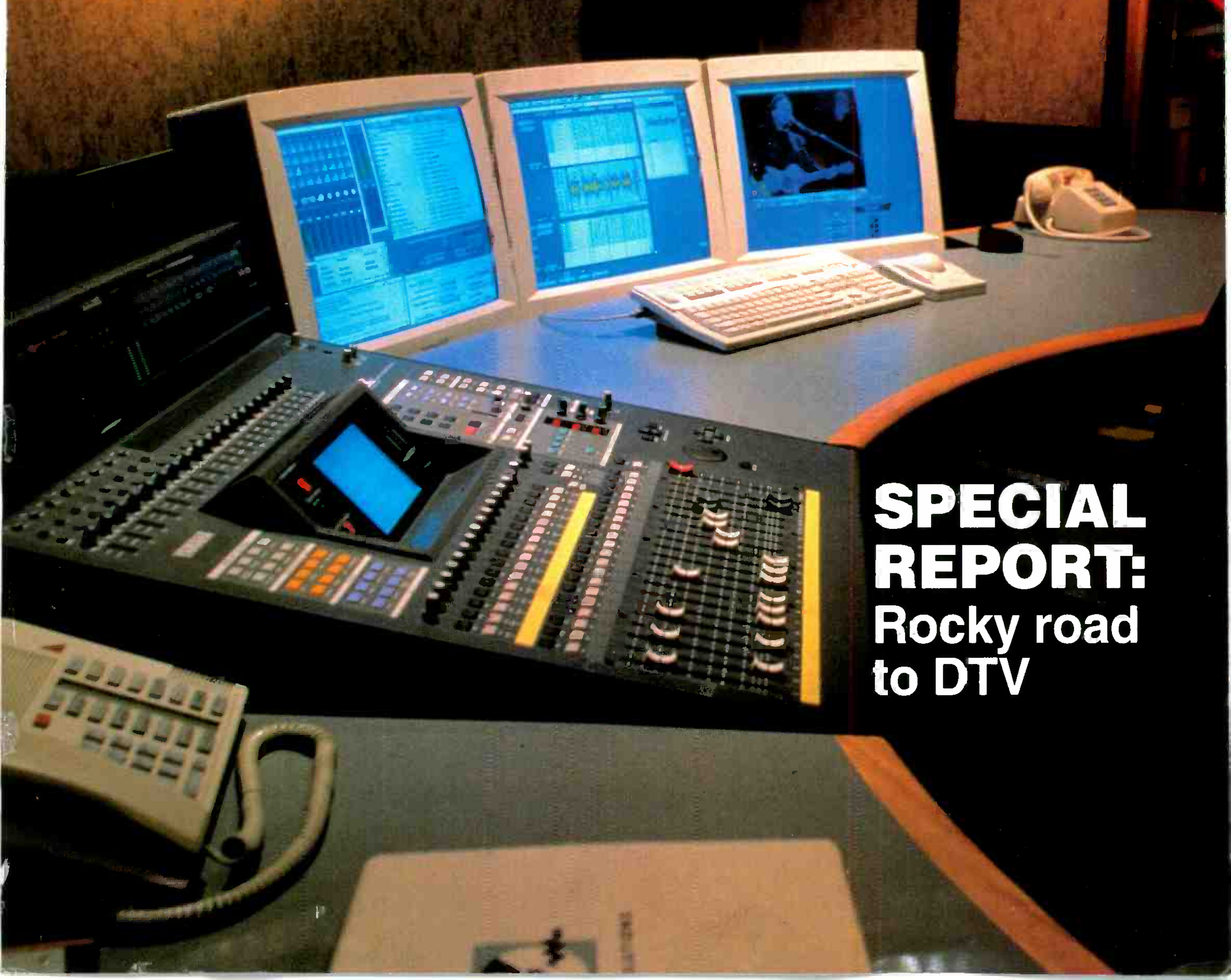
September 1997/$10.00

DIGITAL AUDIO UPDATE

- Implementing digital audio
- SDI and embedded audio

NETWORKING DIGITAL ISLANDS



SPECIAL REPORT: Rocky road to DTV

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BROADCAST ENGINEERING®
September 1997
Volume 39, Number 10

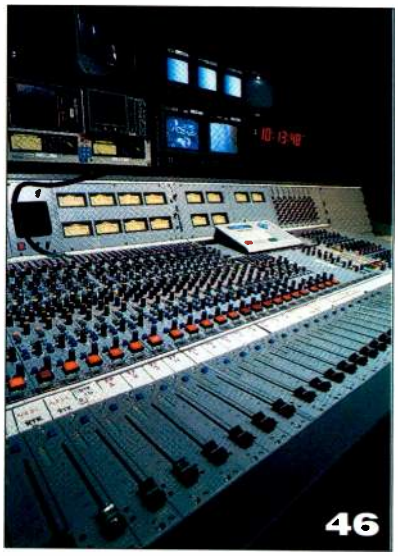
features

Implementing Digital Audio **32**
By Skip Pizzi
Making the transition to digital audio can be challenging and complex.

SDI and Embedded Audio **46**
By Jim Boston
Whether embedded in the video or not, digital audio has its own quirks.

Networking Digital Islands **58**
By Raju C. Bopardikar
More and more, computer networks are becoming integral to facility infrastructure.

DTV's Rocky Road **70**
By Dr. Joseph G. Schatz
Not enough equipment, lack of trained engineers, and inadequate studios are just a few of the obstacles that need to be overcome.



46

columns

FCC Update **12**
FCC to auction TV auxiliary frequencies

Transition to Digital **14**
Testing serial digital, part 2

Management **18**
Motivating engineers

Computers & Networks .. **20**
Data security

Production Clips **22**
Good, fast and cheap: Pick two?

Interactive **26**
Separating the couch potatoes from the computer geeks

DTV Update **28**
Only multichannel use of DTV spectrum?

Cabletec **30**
Building a cyber community

Transmission **86**
DTV: It ain't that hard

Technology News **90**
Two minutes in broadcasting eternity

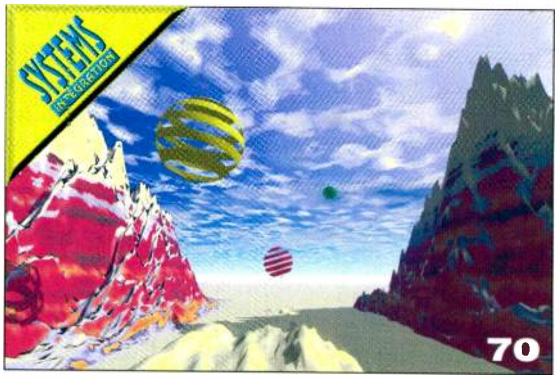
Applied Technology ... **92**
ECHOlab 5000: Video switchers with Windows NT

Applied Technology ... **93**
Transmission robustness and error mitigation

New Products **94**

Digital Basics **114**
Sony and telecines

58



70

departments

Editorial **06**
News **08**
Classifieds **109**
Advertisers' Index ... **113**

ON THE COVER: TNN's Audio Edit 4 digital editing room includes a Yamaha 02R console, Sonic Solutions' Sonic Studio audio workstation with No Noise, ISDN digital interface, eight-track digital tape, DAT, CD printer and Dolby Surround capability. Studio design and photo courtesy Russ Berger & Assoc.

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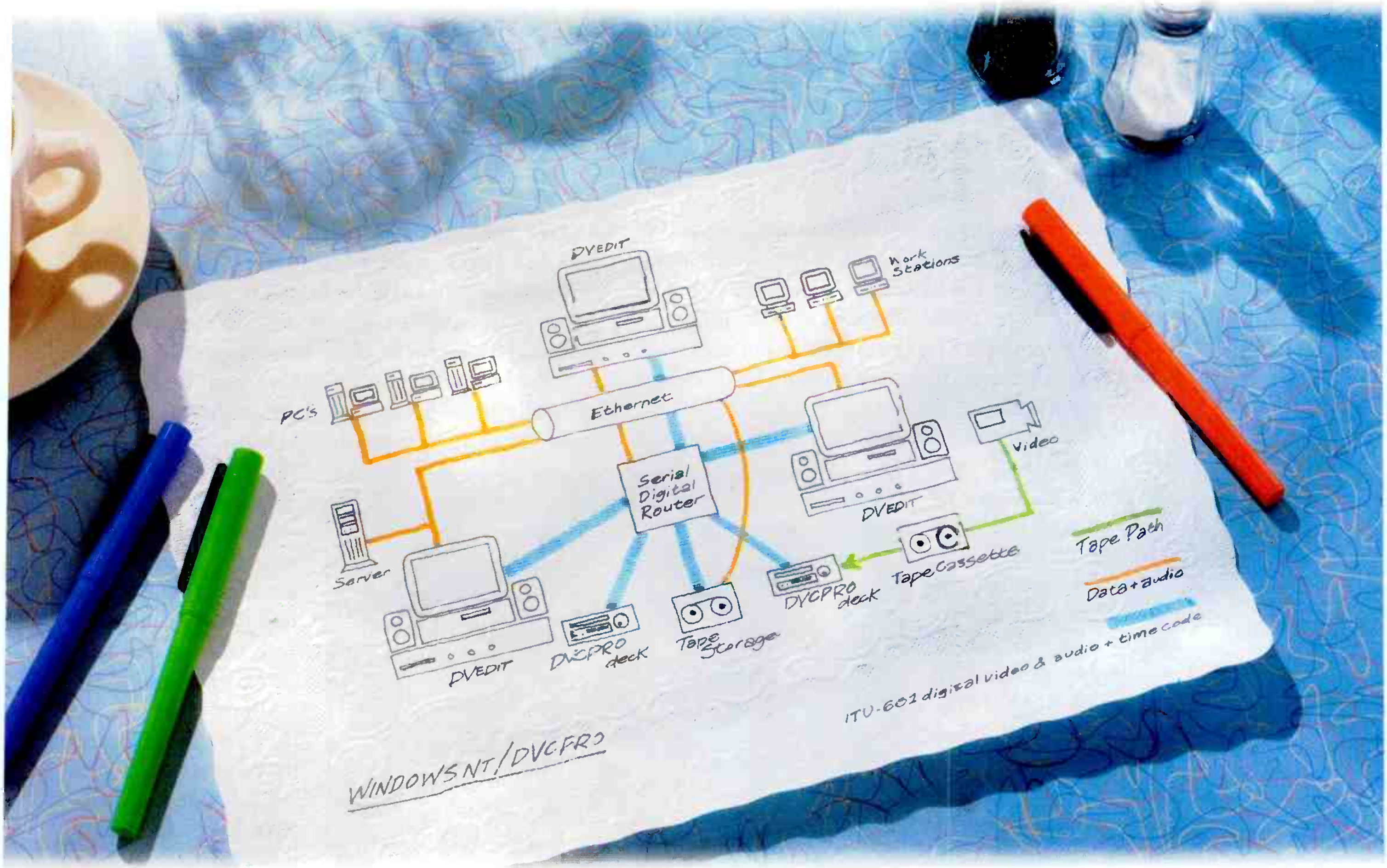

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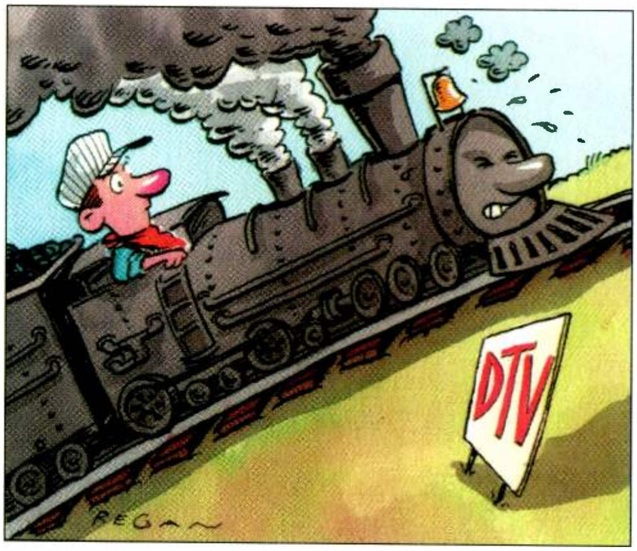
Get onboard the DTV train

I remember reading to my children the book, "The Little Engine That Could." Come on, you aren't too old to remember this classic children's tale are you? Anyway, the point of the ditty was that the little train engine could make it over the mountain if it only tried. Therefore, if a person tries hard enough, he or she too can be successful.

Well, I think we've finally reached a similar point with DTV. If you look over the past few months of press releases and *BE's* coverage of digital television, it should become more clear that our industry is moving, albeit grudgingly, toward an all-digital future. One point that remains unclear is how soon this might happen.



Although some in the press have flung the term "digital TV" around like chaff in the wind, the fact remains that there is no digital TV solution. A digital broadcast or production center capable of handling multichannels of digital video and HDTV requires a lot of new technology. Much of the press noise has been announcements of products that aren't real, don't work and have yet to see the light of day. These so-called products were meant to be more trial balloons than anything else, designed to garner your attention — and future purchase — when these products are finally birthed. This fact remains: all the pieces of this technological puzzle are not here yet, and they won't be for some time.

However, with the showing at NAB of working DTV transmitters, the first real step in broadcasting's *transition to digital* (to use a phrase we coined at *BE)* was taken. Although the number of stations claiming to be broadcasting HDTV are few and far between, an increasing number of stations have announced plans to follow their lead. Add to this the edict from the Godfather Hundt, and TV stations have been forced to get off their backsides and begin planning for DTV broadcasting. This is good.

By the time next year's NAB rolls around, real shipping and almost cost-effective HDTV and DTV products and solutions will be available. Although all the puzzle pieces won't be there, enough will be to move the building process forward. So what does this have to do with the little train that could? It means that stations, especially those in the large markets, can now safely begin the design process for tomorrow's business climate. And it's that business aspect that's much more than just putting a new transmitter on the air. It's creating a focus on how to make money with more channels and better pictures.

Although the future isn't yet digitally clear, the fuzzy edges are starting to come into focus. Just keep saying, "I think I can. I think I can. I think I can." In fact, maybe that could become your new mantra. If nothing else, saying it often enough might get you locked up in a padded room that doesn't even have a television. Then you could forget the whole thing.

Brad Dick

Brad Dick, editor

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By Dawn Hightower, senior associate editor

First digital HDTV broadcast in China airs at ISBT '97

The Advanced Television Systems Committee (ATSC) conducted the first over-the-air broadcast of digital high-definition television in China. The digital signals, with crystal-clear HDTV pictures and CD-quality sound, originated from the central TV tower in Beijing and were received at the Great Wall in Ba Da Ling, 55km away. The landmark broadcast was held in connection with the 1997 International Symposium on Broadcasting Technology (ISBT).

The ATSC HDTV demonstrations were organized under the direction of the Academy of Broadcasting Science (ABS), in the Chinese Ministry of Radio, Film and TV (MRFT), which also sponsored the Symposium. ABS and MRFT also are playing a leading role in evaluating the ATSC digital TV standard and other possible approaches for the introduction of DTV services in China.

According to ATSC chairman Robert Graves, the ATSC DTV standard offers broadcasters around the world the flexibility to provide different combinations of HDTV, multiple programs of SDTV and a virtually limitless set of potential information services. Implementing the ATSC standard will mean a quantum improvement in the technical quality of TV service. It will also provide data delivery capability that represents a fundamental improvement in the information infrastructure of the nations that adopt it.

SBE recognizes TV system pioneers

The Society of Broadcast Engineers (SBE) will present Life Achievement Awards to TV system pioneers Philo and Elma Farnsworth at its national meeting in Syracuse, NY, Sept. 26.

Philo, who died in 1971, worked in relative obscurity developing a TV system. His wife Elma worked by his side keeping the notebooks, making sketches and taking classes so she could help her husband in the lab.

In recent years, Philo has received more recognition for his work, with historians giving credit to he and Vladimir Zworkyn, as the inventors of television.

Philo held more than 300 patents at the time of his death. Besides that of a TV system, they included patents for an electron microscope, a gastroscope and incubator for babies and his pioneering efforts in missile guidance systems. He has been described by *Scientific American* magazine as one of the 10 greatest mathematicians of all times.

Elma and her son Kent have published a book she wrote about her and her husband's life together.

The DTV Team acquires new member

The DTV Team now has a new member. Lucent Technologies joins Compaq Computer, Microsoft and Intel. The DTV Team was formed to speed the deployment of DTV technology for PCs and televisions. The team is working with broadcast and cable TV industries to further consumer acceptance of digital television by bringing new and affordable digital broadcast services to the market. The goal is to develop a new generation of DTV products and services that will allow broadcasters to transmit a mix of video, audio and data to home televisions and PCs by next fall.

Lucent will provide expertise in digital communication applications that include encoders, receivers and other integrated circuits that link PCs to digital networks.

Sinclair to use DTV to broadcast multichannels and Internet data

Sinclair Broadcast Group plans to use its DTV channels to broadcast multiple channels of television. The TV program channel will be free, while other TV programs, like those found on cable, will be available on a subscription basis.

According to Nat Ostroff, who is vice president of new technology for Sinclair, the over-the-air multicasting business will include high-speed data transmission to home and business computers. Ostroff also says that the implementation of diversified multiple programs, plus data service by over-the-air television, has the potential to revolutionize the way the American public gets information and entertainment to the same extent that television itself did 50 years ago.

Sinclair plans to roll out its first demonstration of multicasting in its headquarter's market of Baltimore in January. The first demo will use at least two TV stations' digital channels.

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HDTV suffers setback

According to ABC Television and Sinclair Broadcast Group, their first moves into digital television most likely will not include HDTV's best quality sound and pictures. Rules set by the FCC earlier this year state that broadcasters can choose between showing a single, top-quality HDTV picture or splitting up their spectrum to show several new digital channels with pictures just slightly inferior to HDTV. Initially, all stations were to begin broadcasting digital signals by 2006, but that is no longer a strict deadline.

Now, ABC is leaning toward using the digital spectrum assigned by the government earlier this year to broadcast several new channels, in addition to its current network setup. Sinclair also has decided to forego the highest quality HDTV and will instead offer several digital channels.

The digital signals ABC and Sinclair are considering offering could be received by adding a digital converter to an existing TV set at a modest cost, instead of paying around $5,000 or more for a new HDTV set.

The other networks have not yet formalized their digital plans.

Consumer electronic interference guide now available

The Consumer Electronics Manufacturers Association (CEMA) and the American Radio Relay League (ARRL) have produced a self-help pamphlet for consumers to help solve interference problems between consumer electronics equipment and nearby amateur radio transmitters.

The pamphlet, titled "What to do if you have an electronic interference problem" is a first-step guide to assist consumers in resolving interference problems. The pamphlets can be ordered from CEMA's Product Services Department by phone at 703-907-7670. The information is also available on CEMA's web site at www. cemacity.org.

KITV-TV to offer digital television

This December will mark the move of KITV-TV into the first facility in the country designed and built from the ground up as an entirely digital TV station. It will also begin transmitting digital television at that time.

KITV-TV, along with its satellite stations KMAU-TV and KHVO-TV, will begin transmission of a digital-quality TV signal on Dec. 1. The station's digital TV transmitters will be capable of delivering four or more quality programs to viewers simultaneously.

KITV has invested more than $15 million and more than two years of research and planning to enhance the station. It will offer high-speed Internet and other data services during the day and theater-quality picture during prime time.

SCTE data standard prepares for international recognition

In August, the Society of Telecommunications Engineers' (SCTE) recently approved standard regarding compatibility for the design and manufacturing of cable modems was reviewed by the International Telecommunications Union-Telecommunications (ITU-T) in Geneva for consideration as a globally recognized standard.

SCTE Standard DSS-97-2 "Data-Over-Cable Radio Frequency Interface Specifications" specifies radio frequency (RF) interference data transmission going from cable head-ends into subscribers' homes and businesses. The standard will enable the interoperability of cable modems purchased by consumers from one cable system to another.

The document defines the characteristics of the radio frequency interface on the cable system and the signaling sequences between the head-end and the subscribers' equipment as part of the data over cable specs.

CEMA establishes standards for DTV

The Consumer Electronics Manufacturers Association (CEMA) has established closed-captioning (CC) standards for DTV that will support the needs of caption service providers, CC decoder and encoder manufacturers, receiver manufacturers and signal-processing equipment manufacturers.

DTV CC will allow simultaneous transmission of captions in multiple languages and at multiple reading levels. Current analog CC can be transported at 960b/s, while DTV CC, designated as EIA-708, will work at 9,600b/s.

DTV CC will be more user-friendly and boasts an increased screen resolution range of 720 or 1,080 active scan lines. The heart of the DTV CC display is the caption window, which is identical to the window concept found in computer graphical user interfaces. The standard provides a description of DTV CC specific data packets and structures, a specification of how DTV CC information is to be processed, a list of minimum implementation specs for DTV receiver manufacturers and a set of recommended practices for DTV encoder and decoder manufacturers.

For more information on EIA-708 call Global Engineering Documents at 800-854-7179 or see the web site at www.global.ihs.com. ■

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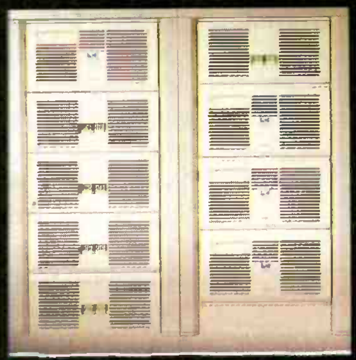

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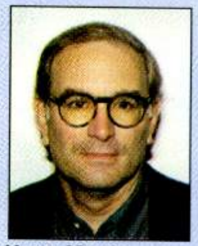
By Harry C. Martin

FCC to auction TV auxiliary frequencies

With hundreds of petitions for reconsideration of the DTV table of allotments pending, the balanced budget legislation, which was passed in August, appears to have settled a few points with regard to DTV's future. The act requires the FCC to reclaim digital channels by Dec. 31, 2006. Auction of the analog channels must be completed by Sept. 30, 2002.


Harry Martin

The legislation requires four channels in the Channel 60-69 band to be reallocated for public safety use, while the remaining six channels will be reallocated for commercial and broadcasting use. The channels for commercial use are to be auctioned. The legislation provides that the FCC may grant extensions for giving back analog channels under these circumstances:

- If one or more affiliates of a major network in a market is not broadcasting digital signals, provided that the stations have used due diligence in trying to convert to digital.
- If fewer than 85% of TV households in a market subscribe to a multichannel video service that carries at least one digital channel from each of the local stations.
- If fewer than 85% of TV households in a market can receive digital signals off the air, through use of a digital TV set or a converter box.

Petitions for reconsideration

Many petitions for reconsideration of the DTV table of allotments remain pending. In its petition, the Association for Maximum Service Television (MSTV) expressed concerns about interference to analog service from the new DTV stations. MSTV noted that some stations will be disproportionately harmed by additional interference to their existing NTSC service. MSTV pointed to areas in which many analog viewers would lose service, and expressed concern about the consequences to broadcasters, who have only analog service, if DTV doesn't catch on with consumers.

The Association of Local TV Stations (ALTV) has proposed that DTV stations in the UHF band be allowed to increase power. ALTV stated that its proposal would not create any widespread new interference with analog stations, and that its proposed interference guidelines would affect less than 1% of a station's coverage area.

Like MSTV, PBS and APTS expressed concern about maintaining interference protection for analog stations. Their joint filing noted that more than 60% of public TV stations operate in the UHF band, many with less-than-maximum NTSC facilities and urged the commission to allow UHF stations to maximize their DTV service areas.

Public safety groups also filed petitions for reconsideration of the FCC's plan for reallocation of Channels 60-69 for public safety use. The Association of Public Safety Communications Officials (APCO) stated that the allocation of spectrum will be delayed due to current analog stations, CPs for analog stations and 15 new DTV allotments in this band. APCO urged the FCC to eliminate the 15 DTV allotments, noting that broadcasters assigned channels in this band also had objected to the plan. APCO asked the FCC to refrain from assigning Channel 69 to DTV because of its proximity to public safety and land mobile operators using adjacent spectrum. ■

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

FCC to auction TV auxiliary frequencies

In the budget act, Congress has reallocated frequencies in the 1,990-2,110MHz and 2,110-2,150MHz bands for assignment by competitive bidding. Fifteen megahertz in the 1,990-2,110MHz band, which now is used under Part 74 for TV STLs and ICRs, and the entire 40MHz between 2,110MHz and 2,150MHz, currently available under Part 94 for private operational-fixed microwave services, will be auctioned off to other services. This creates a dilemma for broadcasters, because in March, the FCC moved all 2GHz TV auxiliaries to 2,025-2,130MHz effective Jan. 1, 2000 or the date the last fixed microwave station departs.

The commission is authorized to substitute other spectrum for auction if it determines that such a plan would better serve the public interest and would produce greater auction receipts. If the FCC can find more desirable spectrum using these criteria, it must report its findings to Congress by August 1999. It appears TV stations will be left with nothing in the 2GHz band unless the FCC can find other more valuable spectrum to auction. The law also requires the FCC to attempt to accommodate incumbent licensees displaced by the reallocations by finding other frequencies for them. ■

dateline

On or before Oct. 1, 1997, TV stations in Iowa and Missouri and LPTV and TV translator stations in Nevada must file their applications for renewal of license. Oct. 1 also is the optional early date for renewals for LPTV and TV translators in Iowa and Missouri.

Commercial TV stations in the following states and territories must file their annual ownership report certifications on or before Oct. 1: Florida, Puerto Rico, Virgin Islands, Iowa, Missouri, Alaska, Guam, Hawaii, Oregon, Washington and Samoa/Marianas.

Tower owners in Delaware, Kansas and Washington must register their towers with the FCC during the period Oct. 1-31, 1997.

By Jerry Whitaker, consulting editor

Testing serial digital, part 2

The use of the *serial digital interface* (SDI) to move signals within and among facilities is increasing every year, to the point now where it is commonplace. As with all good things, however, a few hidden problems are lurking in the background. Fortunately, these gremlins are usually easy to spot and even to predict.

The SDI cliff

Last month, we examined the underlying principles of SDI. One important point was that, generally speaking, the recovered signal from an SDI link is either perfect or basically worthless. SDI links that are experiencing zero or minimal errors are considered to be on the operational plateau of the SDI reliability curve, as illustrated in Figure 1. As the link is extended or the signal-to-noise (S/N) ratio degrades, the system moves forward to the error cliff. As the link progresses over the knee of this cliff, errors climb rapidly to a point sufficient to swamp the built-in error control mechanisms, rendering the path unusable. Avoiding this well-documented cliff requires careful attention to system planning, installation and maintenance, as well as ongoing quality control.

Jerry Whitaker

Measuring the S/N of the principle spectral elements in the SDI bitstream is an effective way to determine how far a path is from the error cliff. Experience has shown that there are two spectral components whose S/N values are useful in determining the overall health of the link. These are the fundamental frequency of 135MHz and its third harmonic (405MHz). Because of the coding method used, the fundamental frequency for a component SDI link is not 270MHz, but half that frequency. (For more information, see "SDI Headroom and the Digital Cliff," February 1997.)

The third harmonic is easy to observe with a spectrum analyzer. At the output of most SDI drivers, the third harmonic is approximately 35dB above the noise floor. The fundamental frequency will typically be 45dB to 50dB above noise. Tests demonstrate that once this signal has passed through approximately 300 meters (1,000 feet) of high-quality coaxial cable, the third harmonic is typically down to 8dB to 10 dB above the noise floor. As the third harmonic is reduced to 6dB above the noise floor, clock recovery becomes unreliable and the number of errors increases substantially.

As the error cliff is approached, the error rate at the receiver may increase from one per day to one per frame over an S/N range difference of just 3dB or less. Such links can become unusable even though the fundamental frequency experiences only modest attenuation through the path. In last month's column, it was noted that significant energies extend to beyond 1GHz on an SDI link running at 270Mb/s. It is those higher frequencies that are at risk on long cable runs.

Pathological testing

A number of tools are useful in determining how close a particular link is to the knee of the cliff. One is the use of pathological test signals. SDI receiver circuitry must regenerate the clock signal and to facilitate decoding most SDI receivers incorporate a signal equalizing circuit to boost the high frequencies of the incoming waveform. This permits easier clock regeneration and data-value determination. Pathological test signals produce bitstreams that stress these circuits.

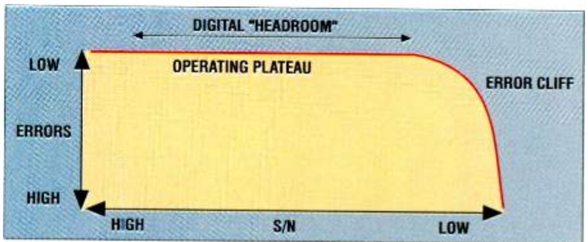


Figure 1. All digital systems are subject to the *cliff effect.* As illustrated here, performance remains optimal until S/N degrades beyond a certain limit, commonly referred to as the "digital cliff."

There are a large number of signal forms that fall under the general category of pathological testing. One signal commonly used for SDI stresses the clock regeneration and equalizing circuits by producing values for C and Y that force the SDI bit-scrambling circuits to produce a run of 19 zeros and followed by a single one. This signal has a large DC content that stresses equalization circuitry. Another common signal puts the values of C and Y such that a run of 20 ones followed by 20 zeros is produced. Because this signal produces a minimum number of zero crossings, it stresses the clock recovery circuits. Both these signals are combined into a test signal known as the SDI checkfield. (For more information, see "Transition to Digital," November 1995.)

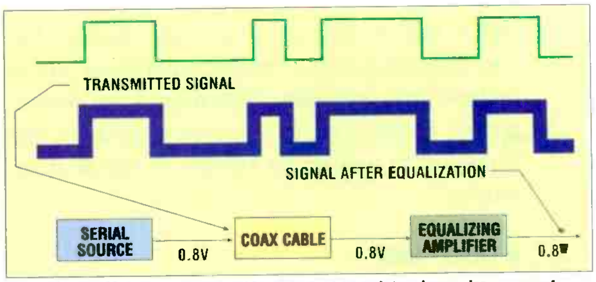


Figure 2. Basic serial digital transmitter/receiver system. Note typical voltage levels and the function of the equalizing amplifier.

Measurements under real-world conditions have found that a path will fail under testing with a pathological signal at received levels approximately 2dB higher than where a typical program (non-pathological) signal will fail. Such tests, therefore, can help to identify whether a given SDI path is at or near the error cliff.

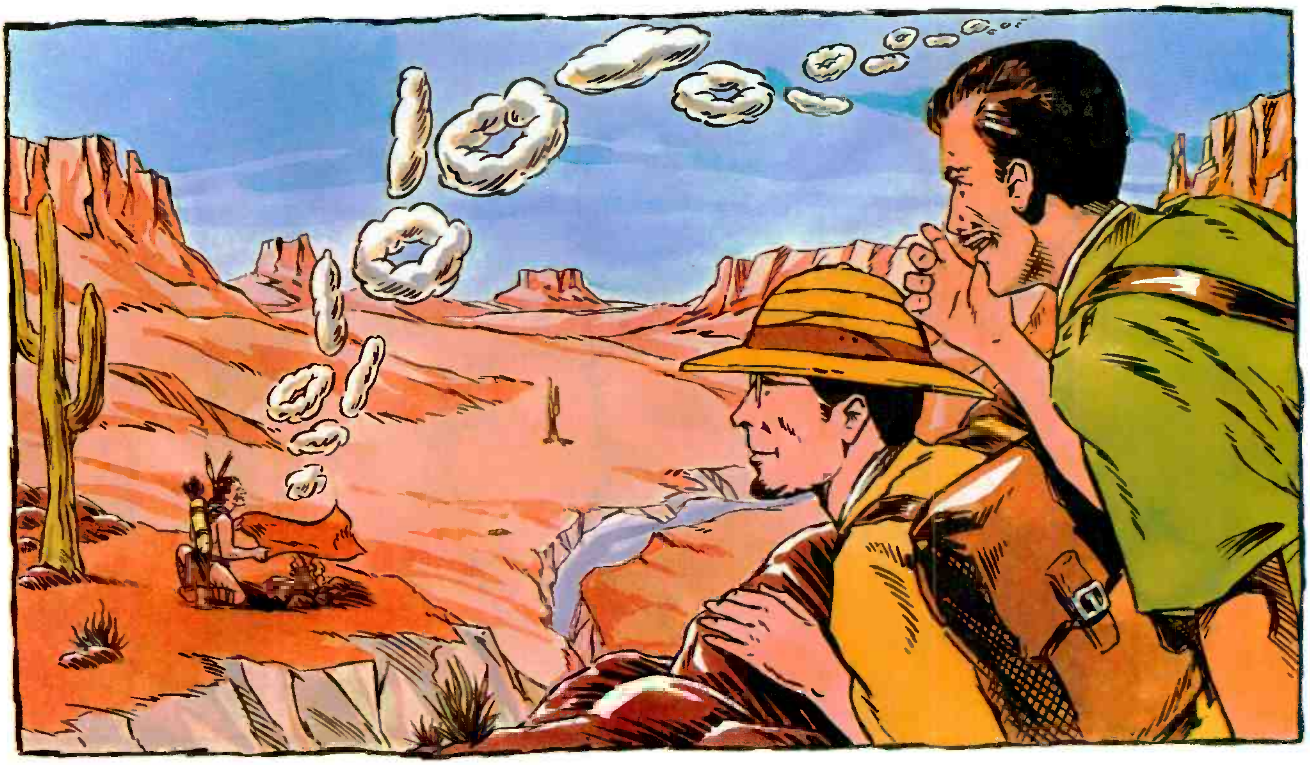
Quantifying errors

Errors in digital systems are usually quantified by the bit error rate (BER), which is simply the ratio of bits in error to total bits. The table gives the BER for one error over different lengths of time for various TV systems. BER is a useful measure of system performance where the S/N at the receiver is such that noise-produced random errors occur.

Bit scrambling is used in the SDI system to lower the DC content of the signal and to provide sufficient zero crossings for reliable clock recovery at the receiver. It is the nature of the descrambler that a single bit error will cause an error in two words (samples). Furthermore, there is a 50 % probability that the error will occur in one of the words in the most significant, or next to the most significant, bit. The resulting error rate of one error/frame will be noticeable by a reasonably patient observer.

Figure 2 shows a block diagram of a basic serial digital transmitter and receiver system. The intuitive method of testing the serial link is to add cable to the point where the link is unusable. Because coax is not itself a significant source of noise, it is the *noise figure* (NF) of the receiver that will determine the basic operating S/N of the system. Assuming an automatic equalizer in the receiver (which is usually the case), as more cable is added, eventually the signal level resulting from coax attenuation will cause the S/N in the receiver to be such that errors occur.

Error rates increase as cable length increases, as shown in Figure 3. As you would expect, there is a sharp knee in the graph as cable length is extended beyond a certain *critical point* (380 meters, or approximately 1,250 feet of 8281, for composite digital video). Figure 3 is essentially the inverse of Figure 1. Similar results are obtained for other standards; the



"LOOK WILCOX, THE DIGITAL COMMUNICATIONS TREND IS CATCHING ON EVERYWHERE," WHISPERED SNELL.

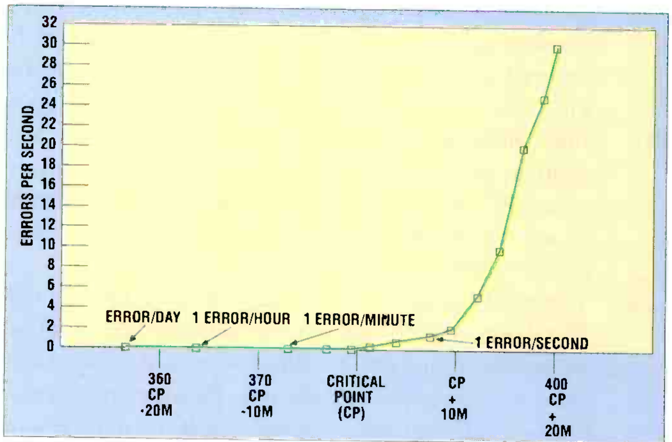


Figure 3. Error rate as a function of cable length on an SDI link. The critical point for Belden 8281 is approximately 380m for 143Mb/s signals, 360m for 177Mb/s signals and 290m for 270Mb/s signals.

critical point is 360 meters for PAL and 290 meters for 270Mb/s component digital video. Cable lengths and headroom scale proportionally. Good engineering practice would suggest a minimum of 6dB to 8dB margin for reliable SDI transmission.

Practical systems include equipment that does not necessarily completely reconstitute the signal in terms of S/N. For example, sending the SDI signal through a distribution amplifier or routing switcher may result in a completely useful, but not completely "standard" signal that is sent to a receiving device. The characteristics of this "non-standardness" could include jitter and noise. The sharp knee characteristic of the system, however, would remain, occurring at a different amount of signal attenuation.

A closer look

In this article, we have just scratched the surface of SDI system design and maintenance. Readers are referred to the sources listed for this month's and last month's columns, and to the manufacturers of SDI test instruments. Most companies offer detailed application notes that discuss the details of the serial digital interface, how to properly install a system and how to reliably test it. ■

Jerry Whitaker is a consulting editor for Broadcast Engineering *magazine.*

For more information, see the following:

Fibush, David K., "Error Detection in Serial Digital Systems," NAB Broadcast Engineering Conference Proceedings, *National Association of Broadcasters, Washington, DC, pgs. 346-354, 1993.*

Standard: SMPTE 259M, "Serial Digital Interface for 10-bit 4:2:2 Component and 4 Fsc NTSC Composite Digital Signals," SMPTE, White Plains, NY.

Stremler, Ferrel G., "Introduction to Communications Systems," Addison-Wesley Series in Electrical Engineering, *Addison-Wesley, New York, December 1982.*

"CLEARLY THE RESULT OF AN EARLY EXPERIMENT IN COMPRESSION..." MUSED WILCOX.

By William G. Covington, Jr., Ph.D.

Motivating engineers

Motivation does not come from outside a person. A manager cannot "motivate" another person to possess a positive attitude and participate in a desirable work environment. Motivation is personal and private.

Managing motivation

As a manager you cannot directly control your staff's motivation, but you can indirectly influence factors related to its absence or presence.

Because motivation is a personal attribute, hiring the right people is important. Most managers do not have the luxury of hiring a staff from scratch so they work with the staff they inherited. An organization's history and corporate parent are beyond the control of middle management, so the key is to focus on what you *can* control.

Trust is important in any ongoing relationship. If you have the reputation of treating your staff impartially, you will be given the benefit of the doubt in most situations by most people. So what you are creating is a climate of trust and mutual respect.

Engineering has been described by former Bell and Howell CEO (and engineer) Donald Fray as a combination of art and science. In seeking to solve a problem, a collaborative effort results when people are encouraged to try potential solutions in a climate of mutual trust and respect. When credit for solutions is shared in such collaborative efforts, and when an individual is rewarded for the specific contributions made to a given problem's resolution, trust is enhanced.

Don't compare apples, oranges, grapes and walnuts

Engineering doesn't attract the flamboyant personalities that flock to the news room or sales department. Engineers need an advocate who can make their case to upper management and vocalize what they sometimes are unable to effectively communicate in competing with some of the louder voices at the station.

Engineers often find themselves trying to translate complex jargon into the vernacular of non-technical people in programming, sales or traffic. It can be frustrating to be unable to adequately explain why a piece of equipment cannot achieve a desired purpose when a non-specialist was under the assumption that it could. Clear communication can alleviate stress and improve relations across the various departments.

Comparing the achievements of engineers to reporters, sales staff or secretarial staff is like comparing apples, oranges, grapes and walnuts. Quality isn't easily measured. A manager trained in engineering is more qualified to pass judgment on the work of his or her peers.

It isn't easy to compare the work of engineers at one facility with that of another. Equipment may be on the verge of being obsolete in one studio, while another station has five-year-old equipment.

Within the engineering department, one engineer cannot be fairly compared with other co-workers in that each individual is unique. Some acceptable standards can be expected of engineers doing similar work, but strengths and weaknesses will vary from one engineer to the next. A more accurate assessment of a person's progress is to compare his or her own growth over the years.

Put people over processes

Listening skills are essential to the success of any manager. It is an active behavior and a manager who actively listens to his or her staff is further enhancing the climate for positive motivation. Listening also maintains ongoing rapport with subordinates.

Any procedure that puts process over people is a sure way to choke motivation. Some organizations emphasize bureaucratic processes, such as evaluations, procedures and forms, over the individuals. Often, the intent for harm is not there, but the fact remains, people take a back seat to these practices.

Organizations are less hierarchical now than they were, but most still have a long way to go when it comes to eliminating unnecessary forms and procedures. Any manager who can reduce any amount of this workload for his or her engineering staff will find the staff's motivation to do the necessary work increased.

Motivation is private. A manager can create a climate for it among his or her staff by being a communicator, an advocater, a collaborator and an individual who reduces the bureaucratic burden of his or her staff. Like most things, it's not always easy to do what you know to do. It's a never-ending process and there are many competing contingencies. Clear thinking is a start. If you know where the target is, you can aim in that direction and little by little do the things that make a difference in providing the climate for motivated staff. ■

William G. Covington teaches mass communication courses at Bridgewater State College in Massachusetts.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By Brad Gilmer

Data security

CNN is one of the most heavily used sites on the web. During the national elections we took more than 50 million hits in an eight-hour period. With five T3 connections to the Internet, we are concerned about data security for our web services and internal intranet.

Taher Elgamal is the chief scientist at Netscape. During a recent interview he discussed a number of issues surrounding data security as it relates to networks, the web and broadcasting.

Brad Gilmer

Q: *What is the most challenging security issue?*

A: The issue of the lack of security built into operating systems is the most challenging. We think we have solved this issue with two technologies. One of these is the secured socket layer (SSL) protocol. SSL secures communications between two computers at the socket layer. This works regardless of whether the computers run the same or different operating systems. We had to tackle this problem at the socket layer because it would be costly to develop different solutions for every different type of computer running our software.

A second technology we are using is the digital certificate. The digital certificate is a number that authenticates a user or application. For example, you could issue a digital certificate to identify someone who has paid to use your web site. When they log in, your server will check for the proper digital certificate, much as passwords are used today.

Q: *Broadcasters are experimenting with streaming video and audio over the net. Are there any special considerations for data security in these cases?*

A: Not really. Streaming video and audio connections are established using socket services. The SSL protocol should provide the security you require in this application. As for moving large files, there is no major difference between that and moving smaller files. If you want to be sure that the files contain what you expect or that they are from who you think they are, the digital certificate can be used.

Q: *Can you talk a little more about specific technologies involved in Internet data security?*

A: Most of the early use of computers was desktop and limited connectivity, so putting the Internet on everyone's desktop is really a new thing. The most dangerous place is not the desktop. The most dangerous place is the Internet. With information flying across an open network, in essence, everyone has access to it without having to go anywhere. The first Netscape technology that addresses security is the SSL, which is really a socket interface that adds security at that interface. That turns out to be the best place to put security support for network products for several reasons.

Once you solve the socket/multiplatform issue, you get to the issue of web sites or applets getting unauthorized access to people's machines. The operating system itself does not really have good support to prevent unauthorized use. This is because it was envisioned that this would be a PC in your house not connected to anything. This is where Java brings the most promise, believe it or not, because Java runs in a restricted area in the computer. With the right implementation and security support, we could make sure that Internet-based applications get access to exactly the pieces they need to.

There is something in Java that we refer to as the sandbox. If you run the Java applet with our Communicator product, it calls for a signature from the author of the application. It tells you that this is an application from Netscape, for example. So, if an application came from Netscape, there is reason to believe that it will perform as expected.

We also support signed and encrypted E-mail between users. You can send your co-worker, friend or boss a signed E-mail message using SMIME standard message. So, we provide all the security features for users and we are working on the education part. ■

If you want to know more about data security on the net, and you are running Netscape 3.0 or Communicator, you can look at the topic ON SECURITY under the HELP tab. You can get more information on sockets and the SSL, at www.netscape.com/info/security-doc.html.

Brad Gilmer is director of advanced network operations & technology for Turner Entertainment Networks.

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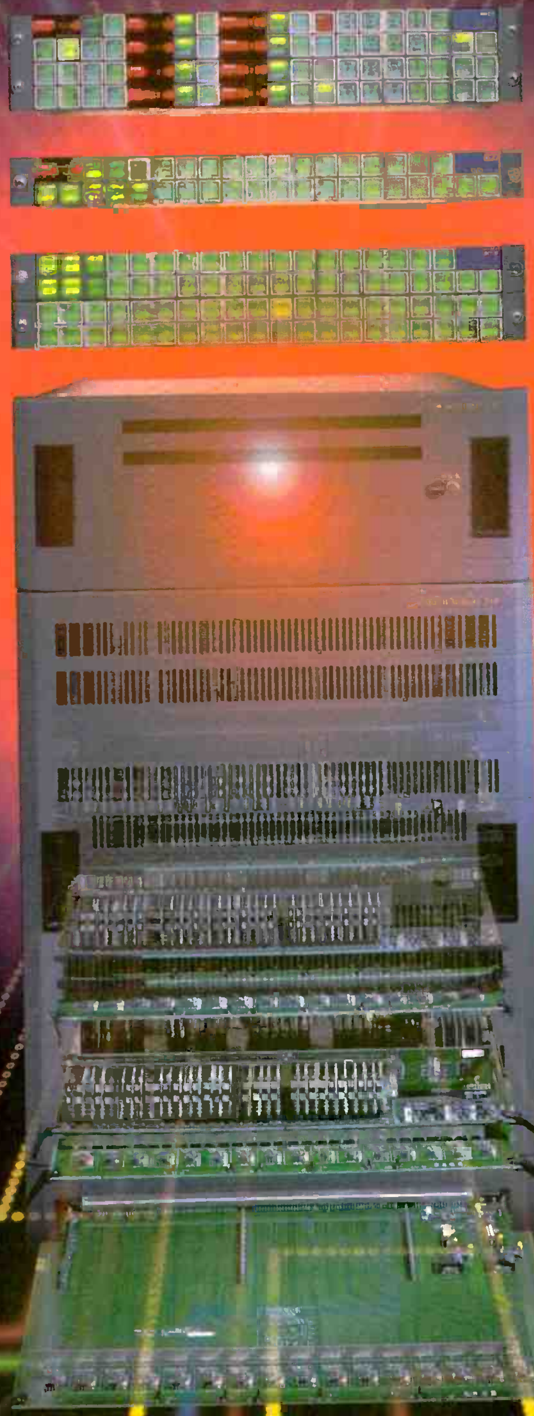

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Circle (7) on Free Info Card

By Skip Pizzi

Good, fast and cheap: Pick two?

There's an old saying among the service industries: "You say you want it good, fast and cheap? Pick two and call me back." It's common among consumers of service to want all three of these attributes optimized, but it's rarely achievable without compromise.

These maxims apply in no small way to broadcast technology. Recent developments have gotten closer to the ideal, but typically only two of the three axes can be totally satisfied.

Good and fast

High quality can be achieved in short order today with digital video. The highest quality is found in the linear media of digital videotape, with D-1 setting the bar to the top rung. Forget about cheap, however. If you want something this "good," you may not be able to maximize "fast." Production and post-production in D-1 is not significantly slower than other linear formats, but it may be hard to find a facility in your area or at least one that's available immediately.

Perhaps not quite as good, but certainly fast, in the post-production domain is non-linear digital video. Long considered a step down in quality from the best linear formats, advances in non-linear systems have reduced this differential and quality continues to improve. Speed is also increasing. Of course, field production is still typically shot on tape, then transferred to non-linear, requiring more time than direct non-linear recording might take. Although disk-based camcorders exist, they are relatively rare and still considered exotic by most users. If disk-based recording becomes practical and ubiquitous, and quality continues to improve, this technology will set the benchmark for "good and fast."

If we're looking at recording formats, there are plenty of options. Whether they qualify as "cheap" is opinion. The fact that they're "good" isn't.

Format options include Digital Beta and D-3 or D-5. Even though they may be on the high side of cost for some users, they still can provide a cost-effective and high-quality solution for high-end recording needs.

Other good recording solutions include Panasonic's DVC Pro, JVC's Digital-S and Sony's Beta SX and DC Cam lines. If that isn't good enough, there's a variety of consumer DV formats from these and other manufacturers. There are a wide variety of solutions, all you have to do is pick from the menu of options.

Unfortunately, technology sometimes makes the choices hard if only quality is the measuring stick. Sometimes, there is little difference between the perceived quality of one digital product and that of another. That's where the added factor of cost must be figured in. Fortunately, this same digital technology makes this quality available in a variety of flavors in a range of prices.

Fast and cheap

Where top-notch quality isn't required, numerous lower-end, non-linear post-production systems can make quick work of a project shot in any small analog format. For a modest overall investment, a fast and convenient system for low-frills production can be obtained.

An example of this approach might employ an 8mm or Hi-8 camcorder and a PC-based editor. This quality of production could be adequate for industrial, private or perhaps some cable or special broadcast TV uses.

Pick your poison

Often, the best path to a solution comes from deciding what you don't want, or absolutely must avoid, and building from there. This may be your first step in analyzing the good/fast/cheap conundrum.

If you have a tight, fixed budget you may be constrained to placing "cheap" at the top of your list. On the other hand, if reliability is paramount then "cheap" may be consigned to the bottom rung, with "good" taking the top spot. Alternatively, in the ENG world, "fast" may reign supreme.

You'll need to specify your own definitions for these general terms, as well. For example, a network's definition of "cheap" will probably differ from a small-market station's concept of the term. "Good" may be the most elusive, with some users equating it to video and audio fidelity, while to others it may imply high reliability or a strong feature set.

Refining and prioritizing these terms for your particular requirements will help you make the right choices in an increasingly confusing world of production possibilities. You probably won't be able to accomplish a complete solution that's truly good, fast and cheap, but as the song says, two out of three ain't bad. ■

Skip Pizzi is editor in chief of Broadcast Engineering's *sister publication,* BE Radio.

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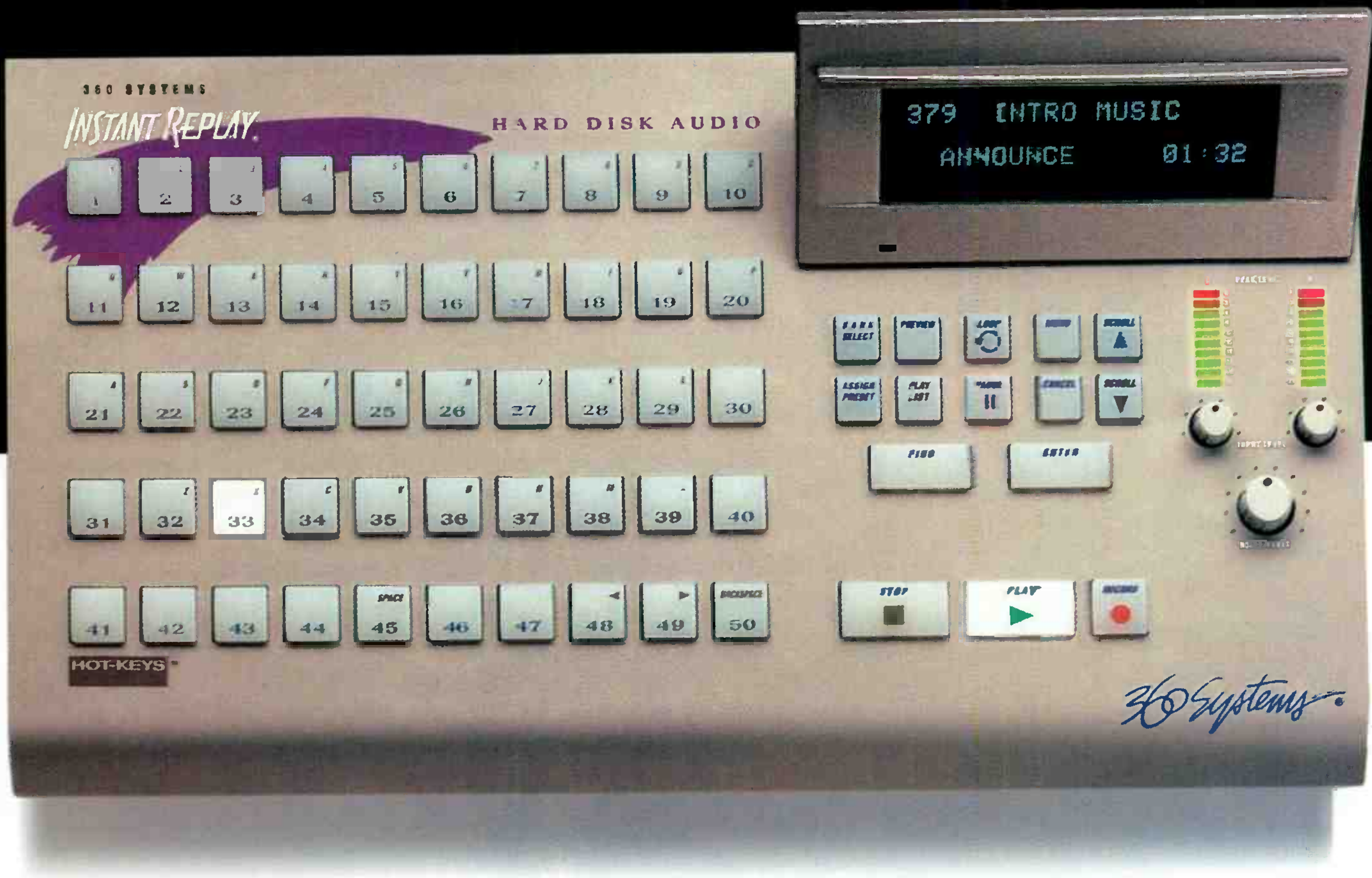

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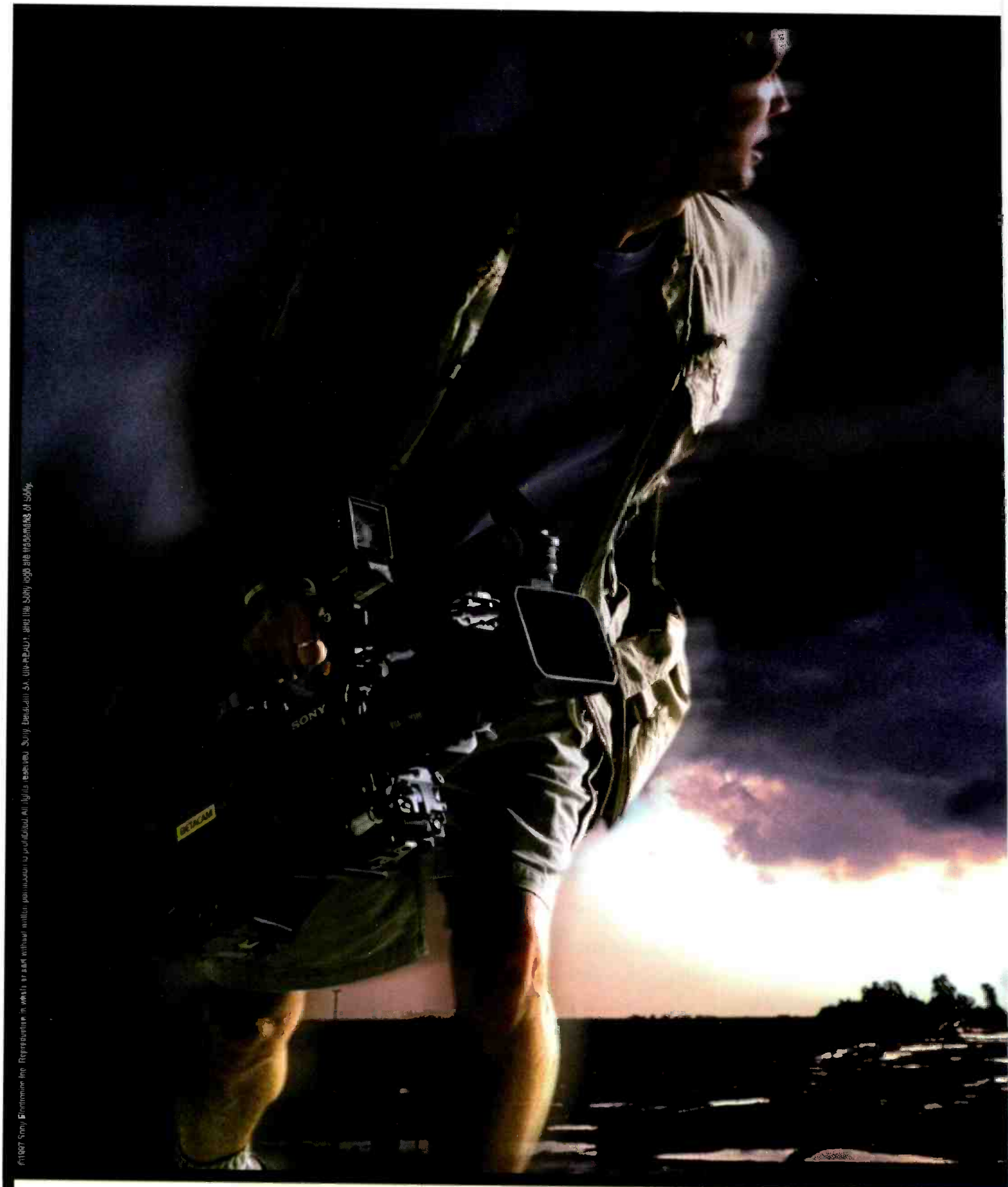

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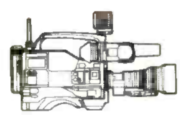
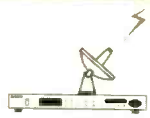
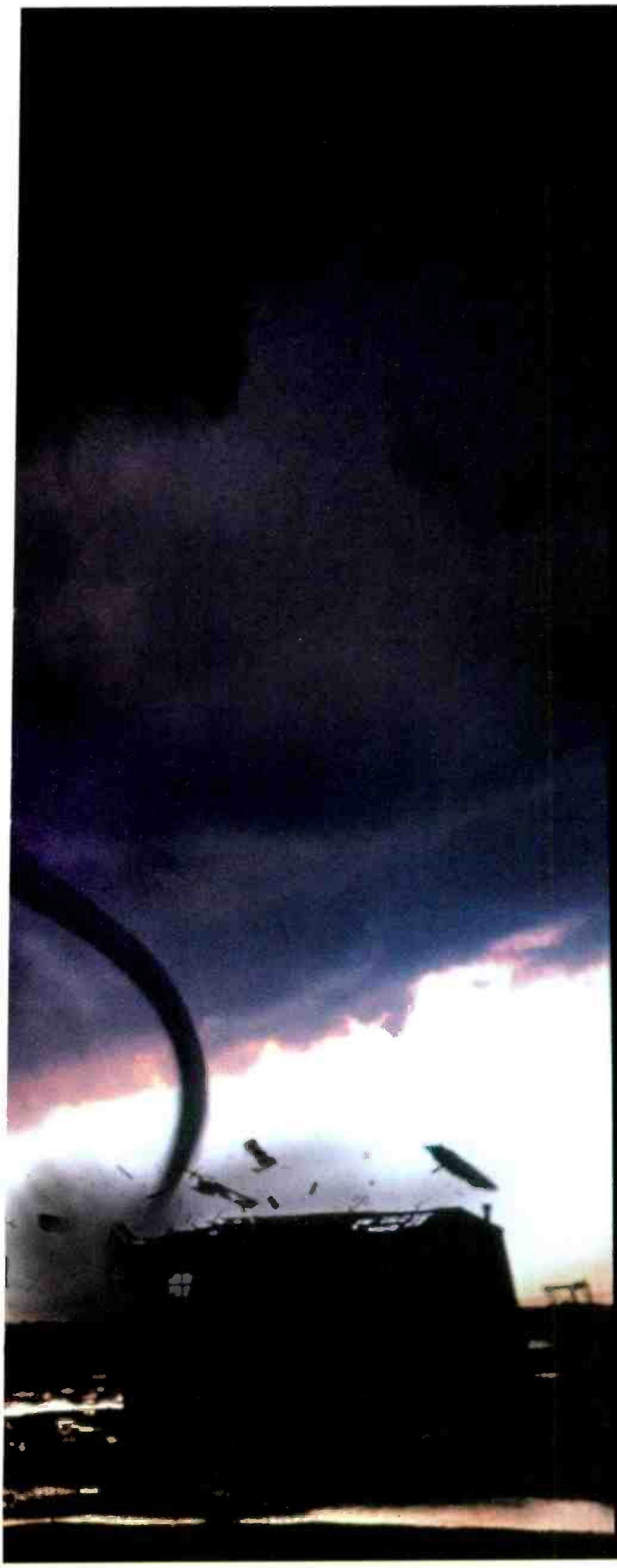


Acquisition



Transmission



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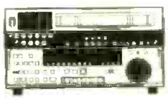


Recording

Storage

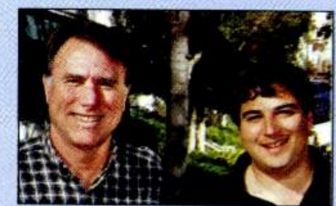
SONY

By Mark Dillon and Steven Blumenfeld

Separating the couch potatoes from the computer geeks

Those of us that specialize in the chariots of media — whether broadcast, cable or twisted pair — usually focus on the performance of the medium. Resolution, bandwidth, frames-per-second and how many megawhatsits are usually how we predict public acceptance.

Ever since the CD-ROM provided cheap mass storage for the computer, "full-motion video" seemed to be all that was required for the computer to replace the television as the preferred mass medium. This has not happened for several reasons. The computer is successfully competing with television for eyeball time, but on different terms and with different programming.



Mark Dillon and Steven M. Blumenfeld

Though televisions and computers rely on similar display devices, essential differences suggest that they may overlap, but neither will overtake the other's territory. Let's start with differences in physical environment and user involvement. (See Figure 1.)

Physical conditions (of the monitor, chair and body position) dictate that a computer user has an intense personal experience, while the TV viewer can lay back with a few friends and simply enjoy. Surveys show it is more fun to play *Myst* by yourself while it is more fun to laugh at *Friends* with friends.

These physical conditions strongly reinforce different entertainment experiences. As anyone who has worked on a movie of the week (as opposed to a feature film) will attest, television is about faces, close-ups and characters. Feature films are about big events telling large stories with a strict beginning, middle and end. No one walks into the middle of a movie and sits down.

On the other hand, television is a season of self-contained episodes broken down into 30- or 60-minute episodes, that are broken up into 15-minute chunks separated by 30-second commercials. You can tune in any time and not have missed anything.

The computer, because it is interactive, works against characters and stories. In a drama, either a character changes the outcome of events and/or is changed by them. If the user can interactively change the events, then the user is in control, not the character, and we have a game, not a story.

At the end of a game, you have won or lost, but you (the central character) are not changed. You are still you. In a story, the character is changed at the end whether he or she be Macbeth or *Top Gun* pilot "Maverick." Even Hawkeye Pierce changed in *Mash*, though it took a lot longer. The same process does not occur in *DOOM* or a flight simulator. You are still you. The game is there to be re-booted and played again. Based on the above logic, the following predictions can be made:

	TV	COMPUTER
Number of viewers:	A group	An individual or maybe two for a video game
Distance from screen:	10-20 feet	2-3 feet
Personal posture:	Sitting, slouching sleeping	Sitting upright
Image resolution:	Approx. 400x475	Up to 1,024x768
Control devices:	IR remote for channel selection	Keyboard for text; Mouse for fine movements; Joystick for simulations
Viewer participation:	Passive	Active

Figure 1. The physical conditions of televisions vs. computers.

1. Interactive movies will not become a genre on the computer or television. Despite occasional exceptions, there is no evidence that people want to control or vote on the outcome of a story. They want the story to tell itself, not be told by the audience.

2. Interactive games will not become a genre on television. The experience of more than two people in one room playing against thousands or millions of people in different rooms across the country should not be classified as entertainment — it is a public opinion poll.

3. The killer interactive TV application is already here: the channel guide. A computer is good at information retrieval and analysis, while the television is good at the display of visual media. To the degree that a computer program can assist you in finding something to watch, it will be valuable to you.

Our efforts to predict the consequences of internetworking on the computer and television miss the point by trying to extrapolate potential consequences of new technologies on existing media. Neither the Wright Brothers nor Henry Ford could have known how their technologies would change society — but they were smart enough to know they were not trying to make horses fly or cars run at 65mph. Unfortunately, today we are trying to make our computers fly and our televisions go 65mph. ■

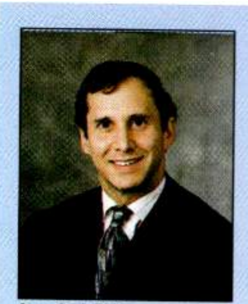
Mark Dillon is vice president, on-line services with GTE, and Steven Blumenfeld is general manager for GTE Internet Television.

By Louis Libin

Only multichannel use of DTV spectrum?

Last week, ABC president Preston Padden said that ABC was considering the use of multiplexing in the new 6MHz channel in standard TV format. Sinclair Broadcasting president David Smith said that Sinclair was considering multiplexing because HDTV is not economically feasible for the company.

These words angered many in Washington because it gave the impression of the true "spectrum giveaway" battles for the broadcast spectrum that have been and continue to be waged in Washington. The main 6MHz channels are still subject to auctions or spectrum fees and the broadcast auxiliary channels (used for distribution and contribution circuits) are also at risk.


Louis Libin

The combined effects of these ongoing battles can be seen in the FCC assignment table for digital television. The new complication of the assignment table is that individual broadcasters must evaluate the FCC plan based on its own merits, including the ability of the DTV channel to one day fully replace the NTSC channel, without audience loss.

Is this a sign that the broadcasters have given up hopes for implementing and transmitting HDTV? The answer is no. What we have is a number of knowledgeable broadcasters with a plan for their entry into DTV. Many broadcasters believe that at the starting "air-time" for their DTV channel, they will just begin their new business venture. It is time for them to wake up. DTV is expensive and the payback will not be for quite some years. Broadcasters need a financial incentive to get into the DTV environment.

House Telecommunications Subcommittee chairman Billy Tauzin told broadcasters that the intent of the new channels is for the transmission of HDTV, and there will be consequences to using it for other purposes. The subcommittee continues to treat the new spectrum as though the broadcasters are receiving a gift of spectrum that they will never have to return. Don't forget that broadcasters will only have two channels until DTV is a viable business. As many of us know, some broadcasters perceive DTV as a burden, rather than a gift.

HDTV in perspective

A glance at the broadcast industry from the inside will prove just how serious the industry as a whole is about the transition to DTV, and specifically about the transition from standard NTSC quality to HDTV quality. By now we know that many TV applications have different performance requirements. This fact, combined with the fact that the transmission will be digital and that there will be space available for other data, provides the appeal of multiple formats for the DTV standard.

Why does it look so good?

The Grand Alliance uses a motion-compensated discrete cosine transform (DCT) algorithm for compression of video signals. DCT exploits spatial redundancy, and motion compensation exploits temporal redundancy. DCT was chosen for its good energy-compaction properties, and the many fast algorithms available afford low-cost implementation. In addition, the Grand Alliance system employs source-adaptive coding and other techniques for greater coding efficiency. The field and frame motion vectors and the adaptive field/frame DCT coding greatly improve the compression efficiency of the 1,080-line interlaced format. The forward analysis with localized quantization-level control further decreases the visibility of the compression artifacts by exploiting the characteristics of the human visual system. These are the reasons consumers will flock to HDTV, once they have seen it.

HDTV — at what cost?

It is vitally important that we solve the technical issues and the financial issues as we finally begin the implementation phase. One example of where the technical issues and the financial issues collide is the towers that need to be built. In many areas, new towers are needed for stations to go on the air. This may be difficult to achieve with digital television. There are many zoning regulations, as well as community backlash against new towers. We require a clear technical direction for studio equipment technology and cannot neglect the need for access to a level of financial investment not seen before in this industry. That is the reason we are now beginning to see fresh new ideas for financing the transition. ■

Louis Libin is a broadcast/FCC consultant in New York and Washington.

By Brad Dick, editor

Building a cyber community

Building the long-awaited cyber community took a huge step forward this month in Highpoint Community in Romeoville, IL. There, MediaOne, a division of USWest, is installing the nation's first fully HFC system combining cable and Internet service on a community-wide basis.

Called MediaOne Express, the project will eventually connect 10,000 customers to the worlds of cable and the Internet. Scott Calloway, MediaOne's director of High Speed Data Services, said the venture marked a significant step in the company's commitment to supporting the convergence of the PC and TV.

System configuration

The MediaOne project is unique because of the high-speed Internet access it is providing to its customers. In fact, the fast Internet access feature isn't dependent upon being a MediaOne cable customer at all, although a $10-a-month discount is provided if you are.

Relying on a newly built 759MHz HFC interconnect, subscribers are provided cable TV and Internet access on one coax feed. Fiber is used from head-end to node and coax from the node to the home.

Because of the system's need for clean upstream, as well as downstream feeds, and the required computer interface, even the installation of the service is unique. A team of two installers is required to connect a subscriber to the service. One installer with RF expertise handles the actual coax installation. In fact, the service provides the replacement of any current coaxial cable from the pole or node up to and inside the home. This helps ensure a clean feed by reducing background-induced noise that may be picked up from home appliances or other neighborhood noise sources and sent back into the system. The RF installer runs the cable to the location desired, typically the room where the computer is located. At this point, the software expert takes over.

The cable modem (currently Motorola units are used in HighPoint, although LanCity modems are used in other locations) is connected via the new coax feed. Depending on the computer, an ISA or PCI card is then installed in the computer and the modem connected to it. The computer expert then downloads the needed software, which is compatible with Netscape and Explorer browsers, from the MediaOne server.

Typical FTP speeds on the system are 5Mb/s from the MediaOne server and 1.5Mb/s through the Internet. That's about 50 times faster than what's available from standard telco/Internet interfaces. Although the company doesn't guarantee any speeds, Calloway says T1-type service is typical for most users. Along with the express service is a custom E-mail address for each user and access to custom public areas for the HighPoint community.

Content is king

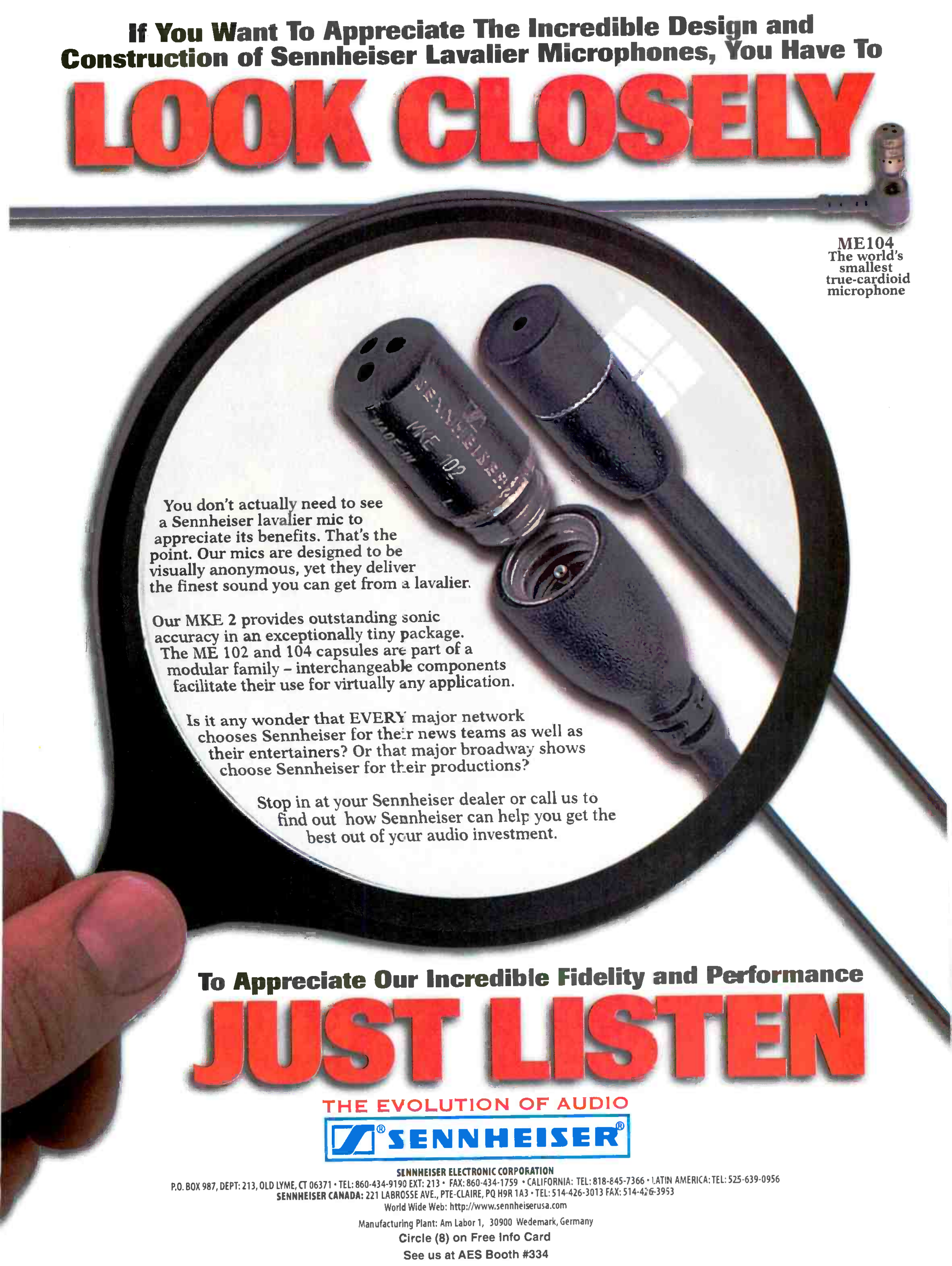
To make the browsing process as efficient as possible, content is cached via proxy servers at system head-ends. Just what pages are cached is more difficult to define. The system's software monitors where users are going and what pages they access. Those locations receiving high usage are targeted for regular caching. In fact, some sites, like CNN.com, are regularly cached overnight so access for most users will be at the 5Mb/s rate.

The whole issue of Internet via cable has raised concern among some that as more users sign onto such a closed-end system, access times will eventually slow. Calloway says that's not a complete picture of what happens. He claims that because MediaOne Express system software can identify those sites popular with users and then cache the content, many users receive their information via the MediaOne server, not the Internet. This helps prevent an increasing number of users from slowing down Internet access times. MediaOne monitors the top 1,000 Internet sites, along with customer preferences, and adjusts the content to help maintain quick access times for customers.

PC meets TV

So, is this High Point cybernet community the first of many TV meets PC marriages? Not necessarily. Although having a cable modem next to the PC makes connecting TV signals to the computer easy, Calloway doesn't see a wholesale shift to watching movies on the PC. "People will typically subscribe to both services," he says. "And in my case, being able to see something like CNN in a window on my computer while I'm working on a spreadsheet makes sense." However, Calloway believes that people are unlikely to download TV movies into the PC so they can watch them from two feet away. There's still a place for the large-screen TV in a living-room-type environment. ■

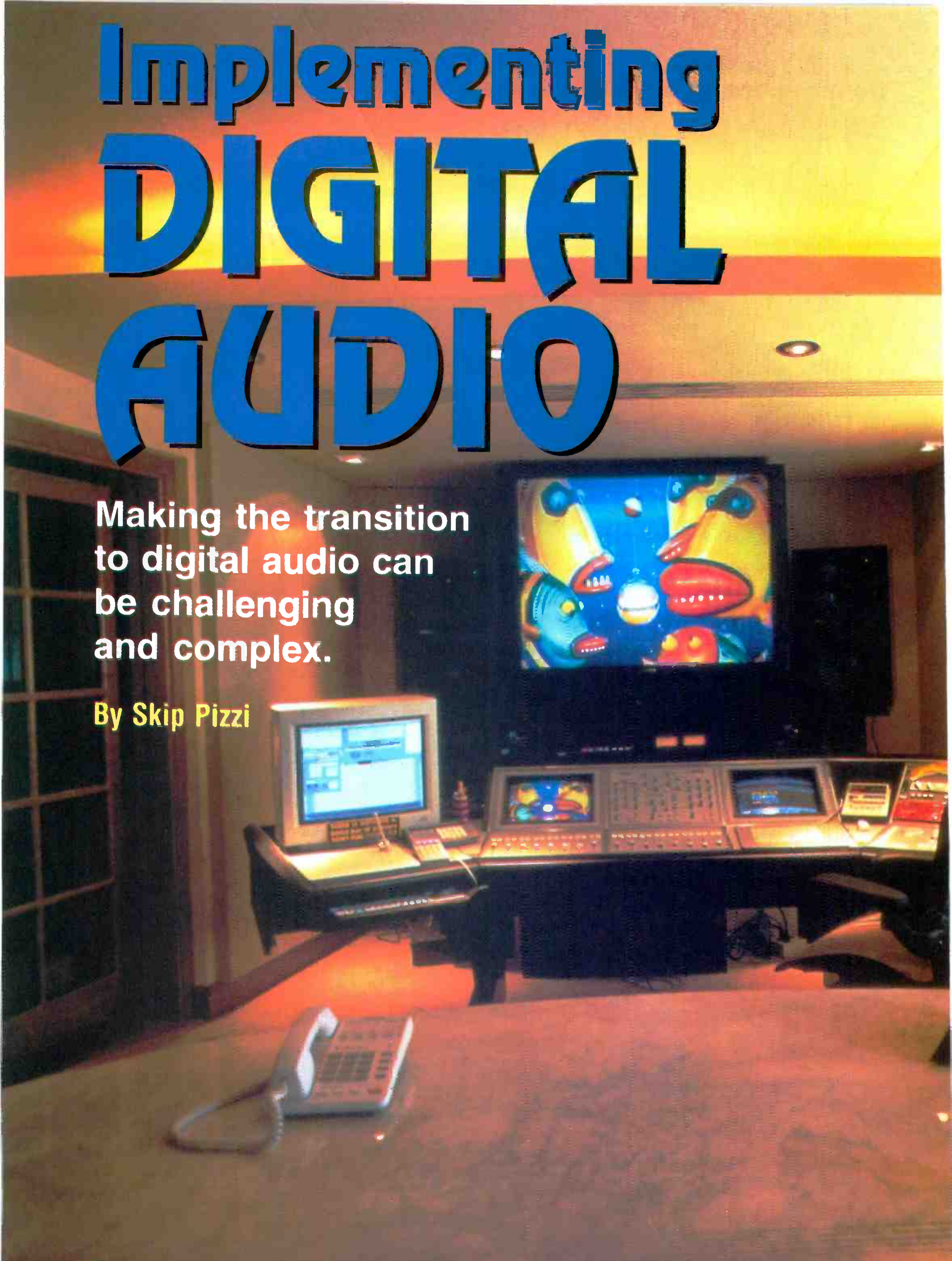
Editor's note: Thanks to Scott Calloway, director of High Speed Data Services for MediaOne for his help in preparing this article.



Implementing DIGITAL AUDIO

Making the transition to digital audio can be challenging and complex.

By Skip Pizzi



THE BOTTOM LINE:

Getting digital audio into the broadcast facility is not a simple process, but it's one whose time has come. Just as ATV and serial digital video require new learning and understanding, so too does digital audio. The results will be worthwhile, but until the process is complete, your digital evolution won't be complete. $

Ten years from now, we won't have these problems. But right now, we're in the middle of implementing digital audio for broadcast facilities — and it's not a painless task.

Consider the following issues:

1. Most video sources require four channels of audio and existing digital audio interface standards handle either two channels or eight channels and above.
2. The conversion to digital audio must take place, but a significant degree of analog audio capability must be maintained for some time to come.
3. Path-length and synchronization issues are now as important to audio as they always have been for video — but their parameters are different for audio.
4. Digital audio can be routed on coax or twisted pair, with pros and cons for each choice.
5. Digital audio signals can be routed using standard video switchers or on purpose-built digital audio switchers. Among the latter are synchronous and asynchronous designs. Which is best for your purposes?
6. "Hot switching" of digital audio can cause pops that never occurred with analog switching — even when everything is timed properly.
7. The serial digital video interface (SDI) allows the inclusion or "embedding" of multiple audio channels with each video signal, but this feature can be costly and problematic.
8. The industry's "standard" resolution of digital audio signals is changing from the 16-bit words of the CD era to the 24-bit capability of DVD and other digital video systems.

The list goes on, but let's quit at eight for this article — it's a nice round number in digital (i.e., binary) terms. All of these are primary issues that should become familiar territory to broadcast technologists soon, if they aren't already.

Beyond these engineering matters are even thornier operational items, like how to measure and ride levels with digital audio and how to get the most out of its improvements over analog in a surround-sound environment using data-compressed transmission.

Photo: Aural Fixation Studios, an audio-for-video mixing suite in New York, designed for First Edition by Walters-Storyk. The suite includes an SSL OmniMix console and Avid's Audio Vision digital audio workstation. Photo by Damion Clayton.

Implementing DIGITAL AUDIO

But we'll leave those for another day. For now, the facility's basic digital audio infrastructure is sufficiently challenging.

Digital interconnection

The only professional digital audio interface that truly can be called a standard today is the two-channel system standardized by the Audio Engineering Society (AES) and the European Broadcast Union (EBU). The AES/EBU standard, also called AES3, after the name of the standards document, can be implemented on twisted pair or coax.

Twisted pair implementations are limited to 100m runs and are specified to use 110Ω cable terminated on standard XLR connectors. AES3 on coax (75Ω with BNCs) allows paths up to 1,000m, so it is preferred by larger installations. This can have a substantial cost impact, however, due to the higher price of coax cable, plus the cost of adapters from coax to the XLR connectors used on many devices' AES3 inputs and outputs. Remember also that the four audio channels of the typical video source require two AES3 paths to each input and output.

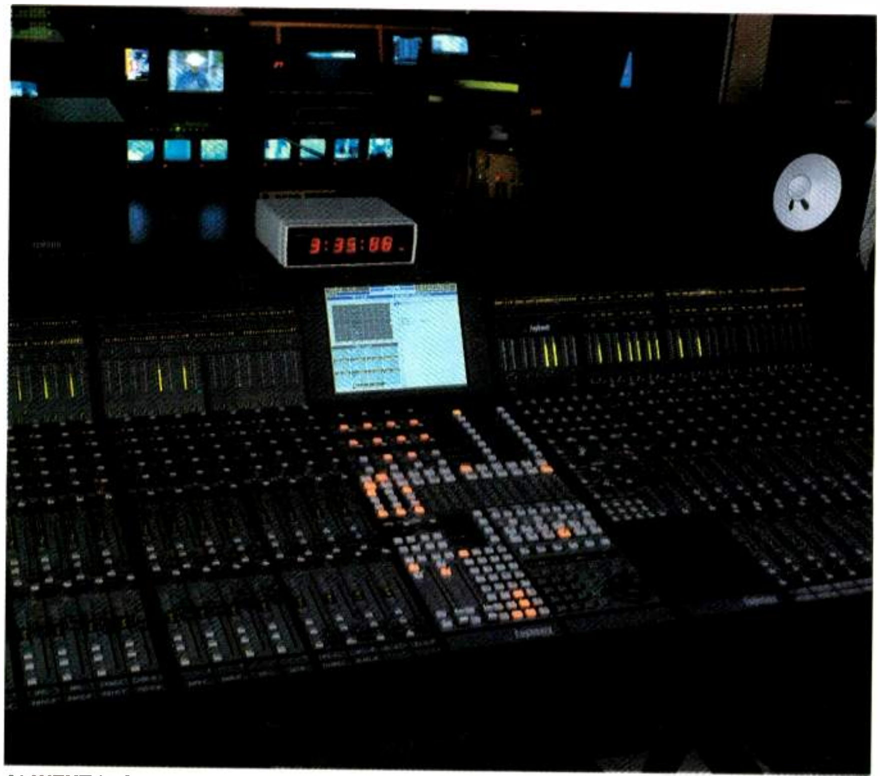
> The AES has defined a set of recommended practices for synchronization under the AES11 standard.

As Figure 1 illustrates, each frame of the AES3 datastream carries alternating subframes of a "left" and "right" channel. Each audio channel can carry up to 24 bits of audio data, plus eight bits of overhead — four bits on either side of the audio data. Optionally, the four least significant audio bits can be dedicated to carrying auxiliary user information (leaving a maximum of 20 bits for audio sample resolution). The 32 bits of each subframe make up the 64-bit AES3 frame.

AES3 can accommodate audio sampling rates of 32kHz to 48kHz, with a +/-12.5% tolerance for varispeed. This produces a maximum data rate of around 3Mb/s on an AES3 path.

For brand new facilities, it is possible to build most, if not all, of the audio infrastructure digitally, using digital mixers, digital storage devices and AES3 routing. Analog audio can be limited to microphone and speaker lines and perhaps some remote, telephone and outboard hardware connections. Some new facilities may not want to use digital mixing, however, and may also wish to retain some existing analog storage systems. This will require a hybrid analog/digital audio infrastructure design; the same applies to any rebuild or upgrade of existing facilities.

In these latter cases, analog and digital audio routing will both be necessary. Two wholly separate switching systems can be used, but a more sensible solution to the transition integrates the two. An analog audio switcher of traditional design is interfaced to an AES3 router via tie lines through a third "path-finding" switch. With the facility's analog I/Os connected to the analog switcher and all AES3 I/Os interfaced to the digital switcher, any analog audio source can be routed to any AES3 destination or vice versa, via the smart tie lines of the system. As the digital audio transition continues, the



At WFXT in Boston, a Fox affiliate, the Euphonix CS2000 audio console is used mostly for news broadcasts. Photo courtesy of Euphonix. Photo by Scott Menaul.

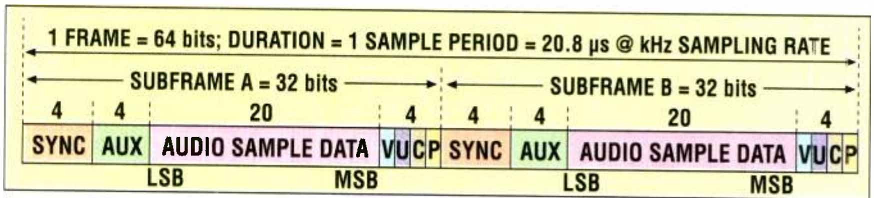


Figure 1. The AES3 standard frame format. The four bits labeled AUX can be applied to audio (for 24-bit resolution) or for auxiliary user data (for 20-bit audio resolution). The first four bits of the subframe are synchronization data, while the last four are applied to sample validity (V), user data (U), channel status (C) and parity (P), respectively. (Source: The Digital Interface Handbook.)

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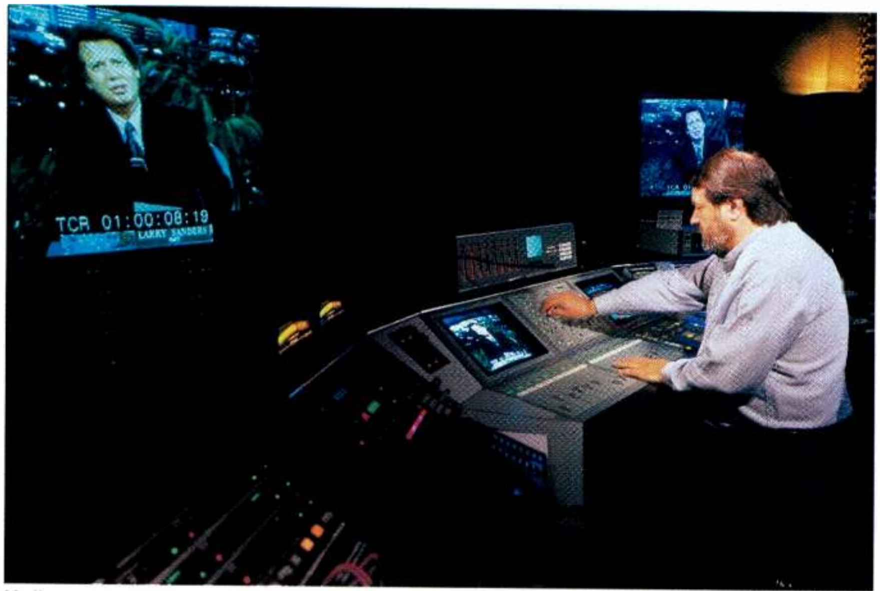
analog router can gradually be reduced in size and the AES3 switch expanded.



Hollywood Digital is an all-digital post-production facility, including two SSL OmniMix surround-sound audio-video production systems and two ScreenSound digital audio-for-video editors. Pictured at one OmniMix system is senior audio mixer Ed Golya. Photo courtesy of SSL.

Synchronization

The AES3 system is self-synchronizing, meaning that a receiving device requires no separate sync signal to resolve the incoming signal. In a complex system like a broadcast facility, however, it is important that all digital audio devices are synchronized to the same signal. Relying simply on each device's AES3 audio input for facility-wide digital audio sync is not a workable solution in most facilities.

Therefore, the AES has defined a set of recommended practices for synchronization under the AES11 standard. It specifies that a separate AES3 signal of high stability be provided to AES sync inputs on all devices. But few devices have this sync input as yet. Digital audio devices without an external sync reference, therefore, should be "genlocked" to the incoming AES3 signal.

Digital video devices, on the other hand, are typically synchronized to a house reference and these devices' AES3 I/Os can in turn be synchronized to this house video reference. To satisfy all situations, audio-only devices (such as mixing consoles) that do have AES3 reference inputs can be synchronized to an AES11 reference signal generator that is itself referenced to the house master clock or video sync generator.

System timing can be cumbersome, however, due to differing frame rates of digital audio and video signals. This isn't too difficult in PAL or SECAM environments, where an integer relationship exists between video rates and all standard digital audio sampling rates (32kHz, 44.1kHz and 48kHz). NTSC, on the other hand, isn't so lucky. None of these audio sampling rates line up in an integer relationship with NTSC frame rates, so a "pull-down" must be used, whereby frame edges line up only on certain frames in a repeating pattern.

There is not complete agreement on how to accomplish this by all manufacturers, so consult with your equipment's designers for specifics. (See also references at end of this article.) The most significant problem encountered with this issue occurs when edits or switches take place on video frames that are not aligned to AES frames. Frame buffers can solve the problem, and in any case, timing errors are rarely enough to create obvious lip-sync difficulties.

Sorting out these and other AES3 problems is greatly aided with the use of an AES3 signal analyzer. Several test equipment manufacturers offer these units (some in hand-held form), which display the data status of the AES3 stream. Standard test equipment can be used to monitor the electrical and mechanical facets of the AES3 interface.

Switcher philosophies

Switching AES3 signals can be handled in a variety of ways. A video switcher with sufficient bandwidth can be used, but this only makes sense if a surplus video switcher is available. Purpose-built AES3 switchers are generally much less expensive than today's video switchers of equivalent size, so new purchasers should consider only AES3 switchers.

Both synchronous and asynchronous architectures are available in AES3 switchers, with a significant price difference (averaging about 2:1) between them. The less-expensive asynchronous designs are typically adequate for facility routing, where quiet, glitch-free switching is not required. Production switching may need synchronous AES3 routing for more transparent operation, but even these can create audible pops at the switch point.

> None of the standard audio sampling rates line up in an integer relationship with NTSC frame rates, so a "pull-down" must be used.

This has been a particularly vexing problem to facilities who make the extra investment for synchronous routing. A synchronous router alone is not the solution. Incoming signals must all be commonly referenced and all word clocks commonly phased. This can require substantial effort, but even after the appropriate conditions are achieved, audible pops may still occur.

The ultimate reason for these mysterious pops may be a function of the audio waveform itself. When an abrupt

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change in the audio signal occurs at a discrete point (such as a frame or sample edge), the discontinuity in the audio waveform can manifest itself as an audible pop. This phenomenon is nothing new. When analog tape editing was first developed, a vertical splice often produced the same result. That is what led to the development of the angled splice, which "ramped" the transition across the vertical gap on the playback head as it passed, rather than presenting the entire transition to the gap all at once in a single "burst." The angled splice acted as a physical crossfade between the in and out points of the edit, avoiding any strong audio waveform discontinuity and its resulting pop or click.

Digital audio switching is constrained to occur at a discrete point, so the risk of these pops is inherent unless a similar crossfade is introduced at every switch, which would likely increase the cost of a switcher dramatically.

RESOLUTION	DATE RATE	STORAGE REQUIREMENT
16 bits	1.5Mb/s	11MB/min
20 bits	1.9Mb/s	14MB/min
24 bits	2.3Mb/s	17MB/min

Table 1. Data rates and storage requirements for three resolutions of digital audio (assumes 48kHz sampling throughout).

The severity of this problem should not be overstated, however. Note that asynchronous or mistimed synchronous systems will exhibit loud and frequent glitches during switching, while well-timed synchronous routing will only suffer a mild, occasional pop. Unlike the tape-splicing example mentioned above, good synchronous routing generally will not pop during a switch made in silence (or "audio black"). These mystery pops typically occur only when audio is present on one or both sides of the switch.

Embedded audio in SDI

The serial digital interface (SDI) for video signal transport (also referred to as CCIR-601 or SMPTE-259M) includes a provision to integrate digital audio signals. The composite (4fSC) SDI format allows four channels of audio, while the component (4:2:2) format allows up to 16 channels of audio.

The obvious advantage of embedding is the transport of a complete, uncompressed digital TV program in a single datastream, on one coax cable. This also implies that a single SDI layer could be used in the facility's routing switcher, allowing significant cost savings. The disadvantages include some of the same problems noted earlier with audio glitches at switch points, plus the additional expense of embed-

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ding and disembedding hardware. The latter is required at each location in a facility where audio signals must be demultiplexed from the SDI stream for separate access to them. The cost of this mux/demux hardware may wash out any savings attained through the single-layer routing switcher.

For these reasons, embedded audio is not often used in a production environment and a routing architecture consisting of a single digital video and dual AES3 layers (plus control and timecode layers) is preferred. (See "SDI and Embedded Audio," p. 46.)

Higher resolution

The original digital audio formats of the early 1980s — both professional and consumer — were all built on a standard of 16-bit resolution. This means that the data words used to quantify each digital audio sample are each 16 bits long.

The discrete level values provided by a digital system are determined by this resolution, similar to the gray scale of a visual system. A one-bit audio system has two levels — on and off (i.e., a switch); a two-bit system has four levels — off, low, medium and high; a three-bit system has eight levels, and so forth, following the powers of two. (Number of levels = 2n, where n is the number of bits.) Therefore, a 16-bit system provides 65,536 discrete levels (216 = 65,536).

Using the rule of thumb that each bit of digital audio resolution provides 6dB

Managing the AC-3 format at the broadcast facility will be the next challenge in the digital audio transition.

of dynamic range, a 16-bit system offers a dynamic range of 96dB. (The actual theory defines dynamic range in a digital audio system as 6.02n + 1.76dB, where n = word length.) This provided a significant improvement in dynamic range over analog recording systems, even when using noise reduction.

Audio dynamic range is the number of decibels between the noise floor and the clipping point of a system. To best manage this parameter, a reference level is set, which subdivides the dynamic range into two regions: signal-to-noise ratio (S/N or SNR, the distance between reference level and noise) and headroom (the distance between reference level and clipping). In digital audio, the reference level is generally set at 20dB below clipping, although in the analog days, when dynamic range was less plentiful, this number was often closer to 10dB. The remainder of the dynamic range is applied to S/N, which means that the noise level in a 16-bit system is about -75dB below reference

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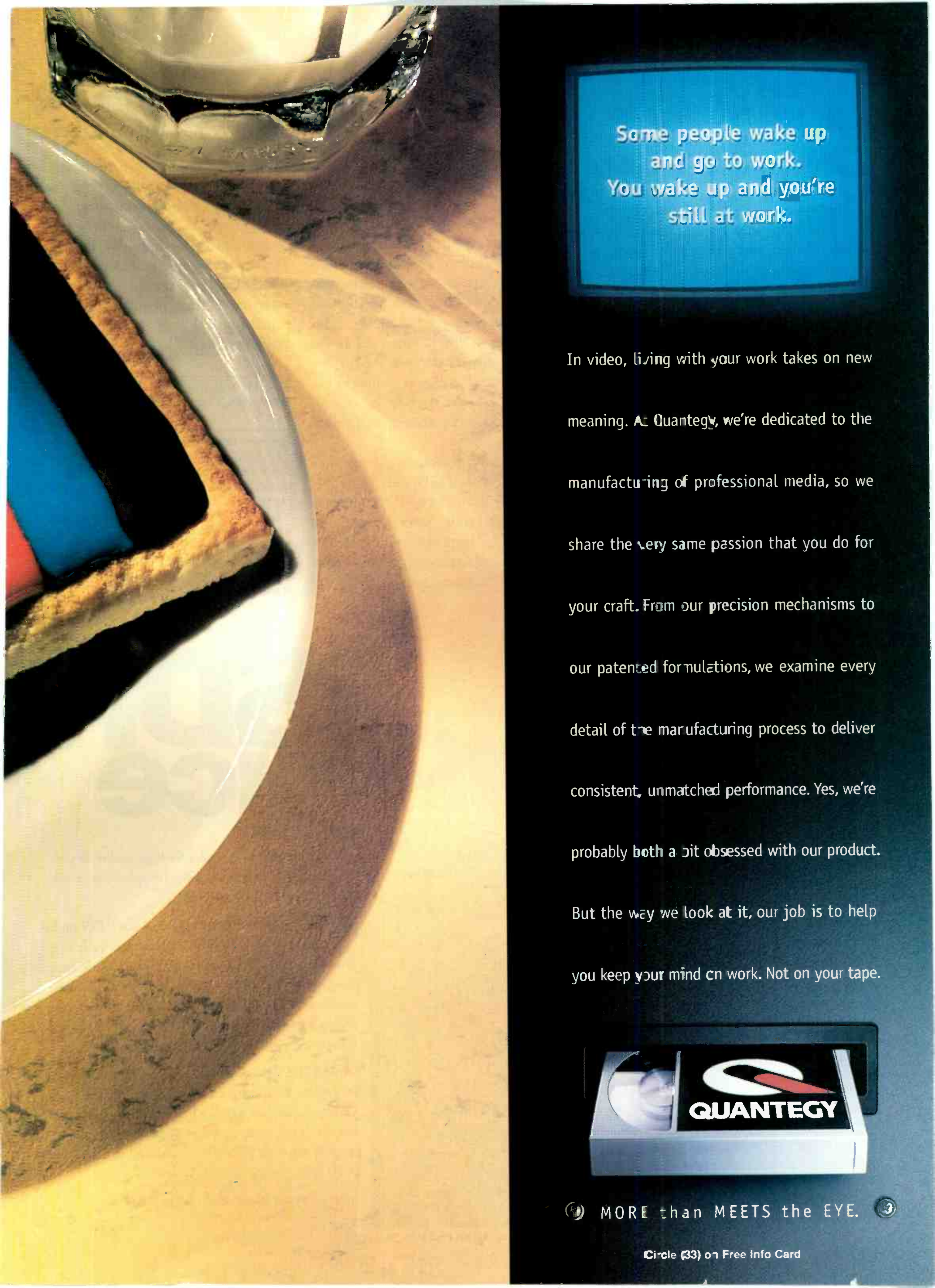
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level. (A noise level of -60dB is generally considered to be "silent" in most consumer applications.)

This originally implied that 16-bit digital audio was plenty. Although most converters of the early digital audio days didn't provide true 16-bit resolution, today's converters typically do. The baseline converter today is an 18-bit design, offering two bits of a different sort of "headroom" that virtually guarantees full 16-bit accuracy.

In practice, however, the 16-bit system has a problem in that the entire audio chain — from original professional recording to final consumer playback — all has the same theoretical dynamic range. In analog days, the professional environment had a wider range to accommodate the unknown levels of live sound, after which control could be applied during production to optimally fit the audio signal into narrower dynamic range windows for consumer delivery.

To return this advantage to the professional, newer systems offer 20-bit performance today, and practical 24-bit systems are on the horizon. These provide theoretical dynamic ranges of 122dB and 146dB respectively (using more than 1 million and more than 16 million discrete level steps, respectively). Production and post-production can take place in a significantly wider dynamic range domain than the 16-bit delivery format. The price paid for these enhanced dynamics comes in the form of increased data to be stored, processed and transmitted, as Table 1 illustrates.

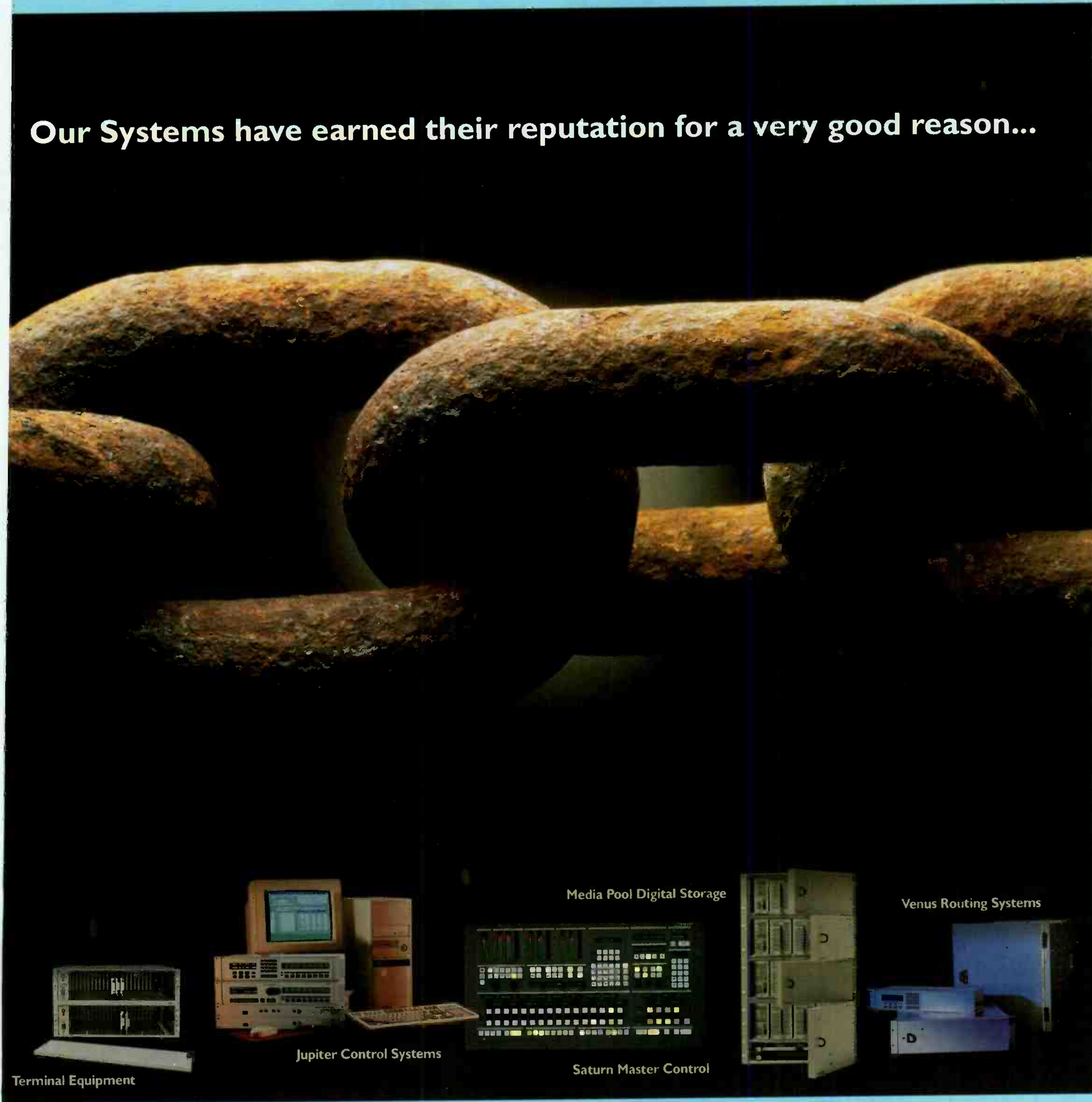
Ironically, the emergence of the digital versatile disk (DVD) may bring 24-bit delivery of audio to the consumer (in an audio-only format), perhaps ratcheting up the process yet again. On the other hand, data-compressed delivery of multichannel audio is driving the resolution race in the other direction. The Dolby AC-3 audio format of ATV transmission will provide 5.1 channels of audio in only 384kb/s.

Managing the AC-3 format at the broadcast facility will be the next challenge in the digital audio transition. Proposals are currently under consideration for handling the AC-3 datastream on an AES3 infrastructure. It's just one more reason for broadcasters to implement a flexible and comprehensive digital audio solution at their facilities today. ■

Skip Pizzi is editor in chief of Broadcast Engineering's *sister publication,* BE Radio.

For more information see the following:

1. *AES3-1985 (and subsequent revisions), Serial Transmission Format for Linearly Represented Digital Audio Data. Audio Engineering Society, New York.*
2. *AES11-1991, Synchronization of Digital Audio Equipment in Studio Operations. Audio Engineering Society, New York.*
3. *The Digital Interface Handbook, by Francis Rumsey and John Watkinson. Focal Press, Stoneham, MA. 1993.*



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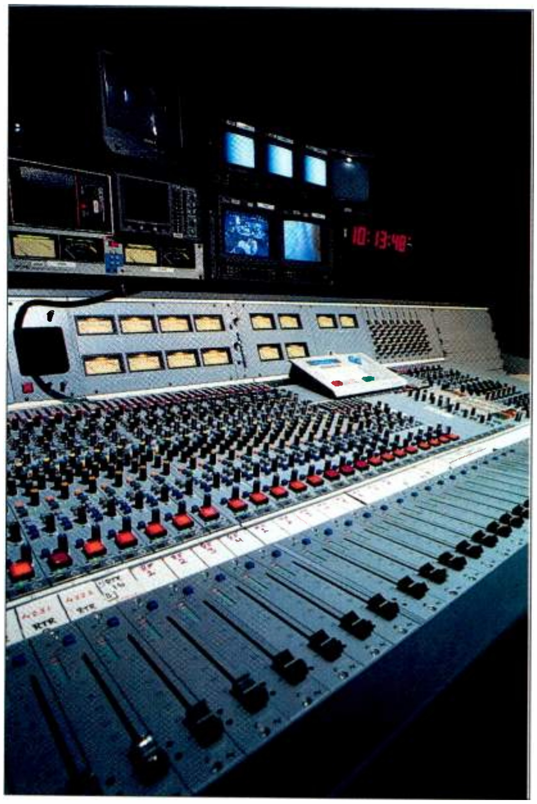

Whether embedded in the video or not, digital audio has its own quirks.

By Jim Boston

THE BOTTOM LINE:
Distribution of digital signals has solved a variety of problems common in analog environments. Unfortunately, it has created an entirely new set of problems. Among the challenges of digital distribution is the question of whether to distribute video and audio separately or as a single datastream. As always, balancing the solutions offered with the problems solved is neither easy nor painless. $

Early in the TV industry's history, engineers realized that the time required for a TV receiver to perform a retrace and start scanning the next line was not being used efficiently. Sure, horizontal synchronization and color-phase reference information was sent during that time, but even with fairly wide horizontal sync pulses and nearly a dozen subcarrier cycles during the blanking period, more than 30% of blanking time was void of content. Compared to horizontal blanking, the vertical interval could be thought of as a payload wasteland. Of course, early receivers and monitors needed all those equalizing pulses and vertical serration pulse trains for the analog synchronization circuitry to work. Many horizontal and vertical sync circuits worked by integrating the sync pulse(s). This process requires time, and thus fairly wide sync pulses. Plus, due to physics, some amount of time is required for vertical and horizontal retrace to happen. Horizontal retrace takes 17% of a horizontal line and the vertical sequence requires approximately 20

Photo: The Fox News Channel facility is all component digital and relies on the latest in networking technology to interconnect four studios, three control rooms and graphics, VTR and edit suites. Photo courtesy of A.F. Associates, Inc. Photo by Andy Washnik Studio.

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lines, about 7.6% of a field.

It wasn't long before test signals, closed-captioning, other types of data and control signals found their way into the vertical interval, hidden from the casual viewer. Today, digital audio is a predominant inhabitant of many digital video signal streams. It not only occupies portions of the vertical interval, but the horizontal interval also. The far majority of the audio data found in a SMPTE 259M signal stream resides in the horizontal rather than the vertical blanking intervals. There is enough room in a digital component bitstream for eight AES audio pairs (that's 16 individual channels). Digital composite only has room for two channel pairs. What follows is a look at how to get audio data into the SMPTE 259M bitstream and some of the knowledge required to handle that data.

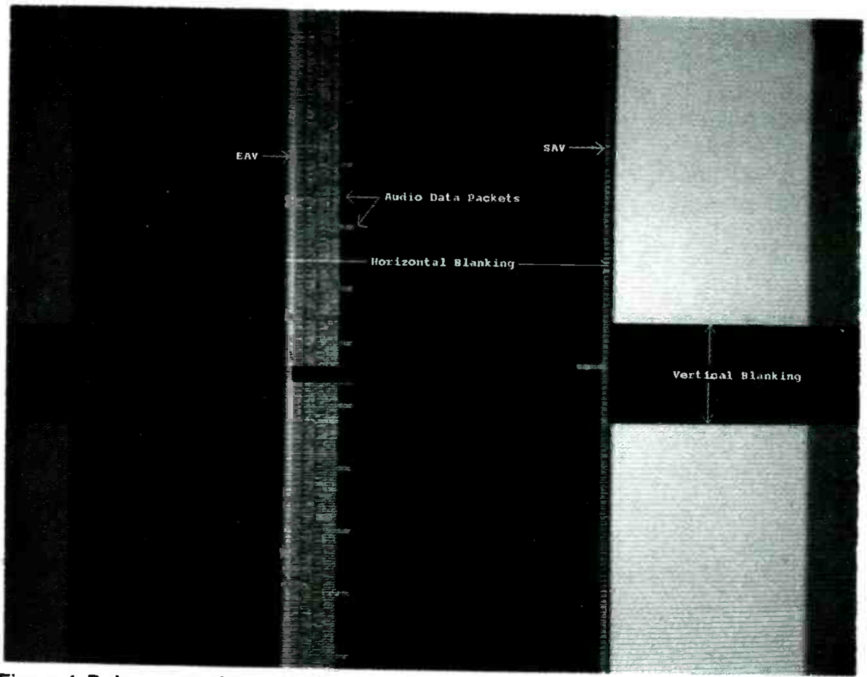

Figure 1. Pulse cross video monitor display of AES data inserted into a video datastream.

Audio sources

Many audio sources still produce analog audio signals. Before these signals can be embedded, the analog audio must be converted to digital. This requires quantizing the analog audio signals into a digital number sequence. Two important parameters for this process are sample rate and sample resolution. Sampling rates must be above the Nyquist rate. But how high above? The higher the sample rate, the lower the noise floor of the digitized

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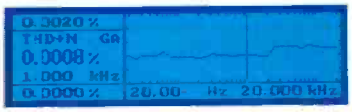

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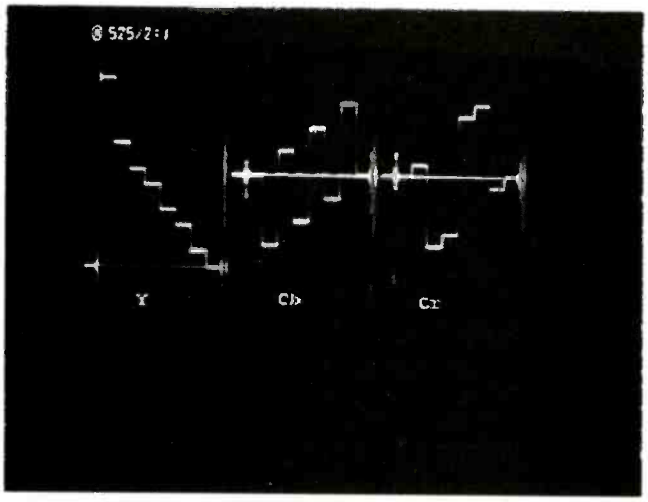
signal. Lower sample rates cause ambiguity as to the correct value of the low-order bits. If this ambiguity is non-correlated, it appears as noise. Correlated ambiguities appear as distortion. Higher sampling means less noise, oversampling at 2X the Nyquist rate (4X the highest expected frequency) results in a 6dB drop in the noise floor. Four times the Nyquist rate results in a 12dB drop. Oversampling allows for higher sampling resolution. An additional advantage of oversampling is that sampling at rates considerably higher than the Nyquist rate allows for gentler low-pass filtering to prevent aliasing. This results in fewer phase and peaking problems.

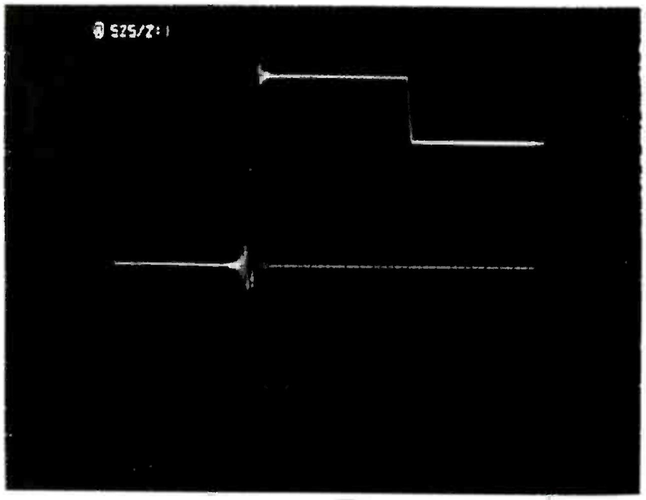
Sample resolution is also critical when converting signals from the analog to the digital domain. Originally, it was thought that 16 bits would provide enough resolution for each audio sample. Soon it was 18, now the number of bits used to describe the amplitude of each sample is generally 20, although up to 24 bits can be transmitted. As mentioned, sampling rates are a factor in digital audio's noise floor, so is the sampling resolution. Quantizing errors caused by the A/D process can appear as noise. Again, if the errors are correlated with the audio being sampled, they appear as distortion. If the distortion is higher than half the sampling rate, aliasing will result.

Correlated noise can be eliminated from quantizing errors by introducing dither. Dither de-correlates the errors from audio, but in the process adds noise. However, the benefits of dither de-correlation can be defeated. If a 20-bit audio signal is passed though an 18-bit box, the LSB bits will be lost, along with the dither. Another killer of sampling resolution is jitter in the sample clock. If jitter is bad enough it can reduce the effective resolution of a 20-bit sample to 16 bits. Jitter will also add distortion.

Although many audio sources may need to be converted to digital, some signals are already in the digital domain. This can cause problems because of differing sample rates. Most professional equipment uses a sample rate of 48kHz, however, consumer equipment typically uses sample rates of 44.1kHz or lower. Compact discs use a 44.1kHz sample rate, while the



A



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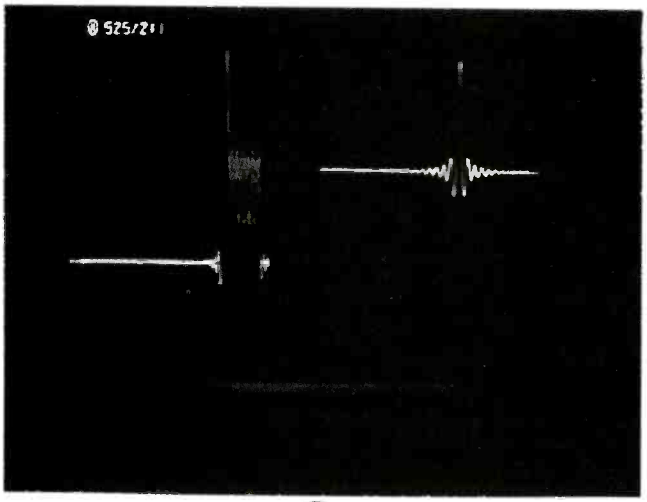

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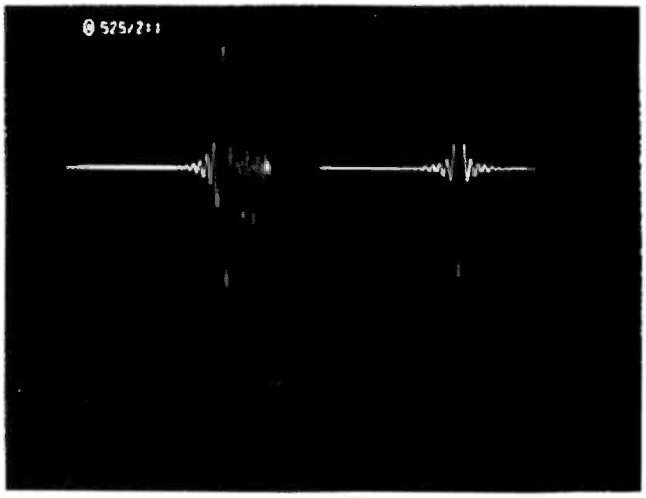

D

Because of bandwidth limitations, waveform monitors cannot properly display ancillary data in the SDI bitstream (A). Considerable ringing is present in the SAV signal prior to the Y component (B). The SAV associated with the C_b components is the 3FF word (C) and one of the 000 words is associated with the C_r component (D).

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SDI AND EMBEDDED AUDIO

EBU, along with the BBC, has used sample rates as low as 32kHz. The SMPTE 272M specification, which describes embedding AES/EBU audio into ancillary data space in a SMPTE 259M bitstream, allows for sample rates from 32kHz to 48kHz. Various pairs of data embedded in the same SDI video bitstream may have different sample rates. Because most professional equipment is sampled at 48kHz, that will be our primary concern. However, if your facility uses digital audio signals with different clock rates, often the only way to reliably get from one bit rate to another is to return the signal to the analog domain, and then convert to digital using the required sample rate. Even if the conversion is done in the digital domain, sample-rate conversion is not a transparent operation.

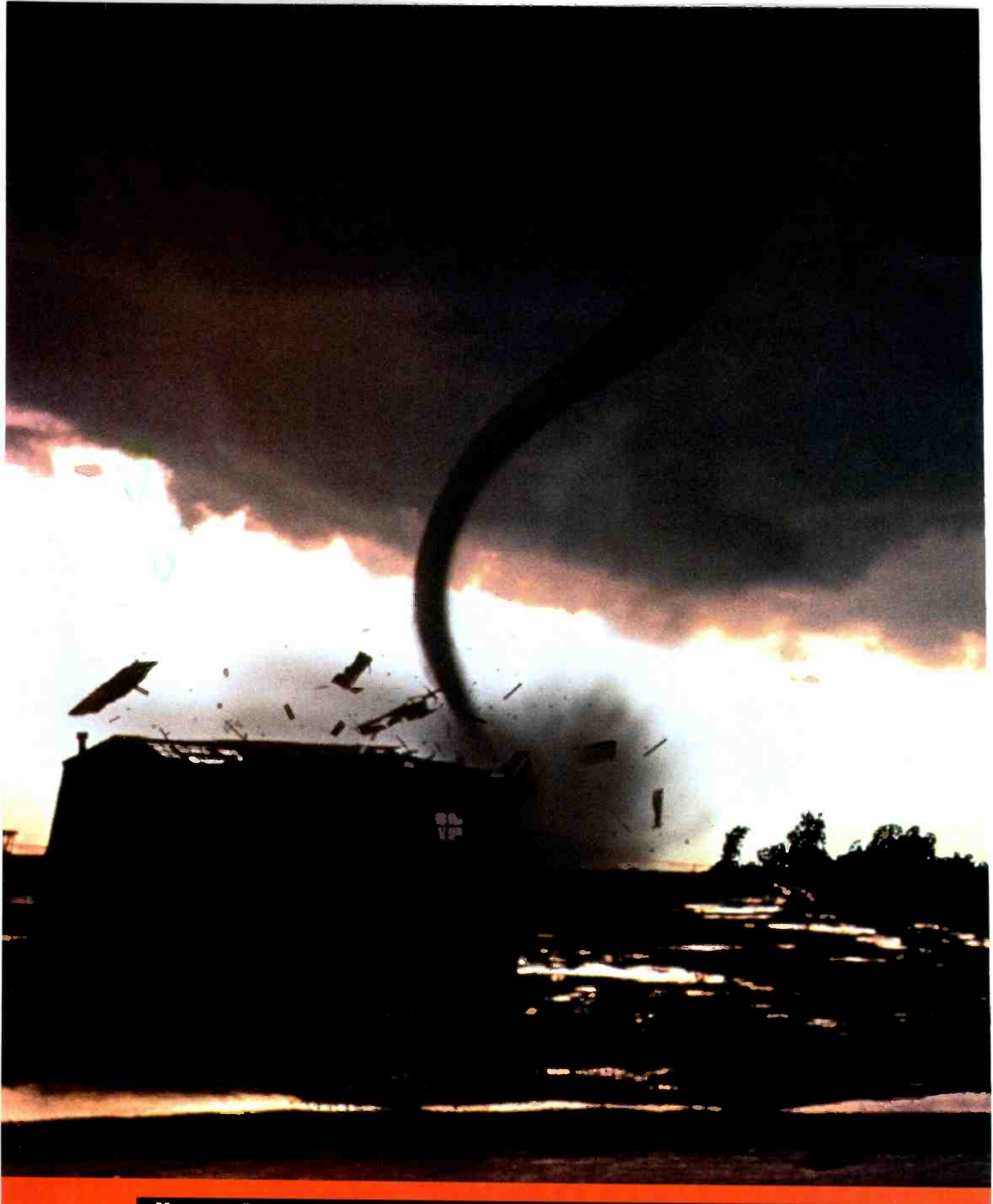
AES/EBU digital audio

The AES/EBU digital audio standard originated in 1985 and was revised in 1992. Officially, ANSI standard S4.40-1992, the bitstream is also known as AES-3. The bitstream uses an FM channel code where the logic level of the AES stream changes state in the middle of a bit cell if a one is represented and no transition happens during a zeros transmission. As with an SDI video stream, the polarity of the signal does not matter. AES-3's physical layer uses twisted pair cable along with a 110 ohm source and receive impedance. The original 1985 spec recommended a 250 ohm receive impedance so one AES transmitter could drive four AES receivers. This was dropped in the 1992 revision. Both source and receiver typically use transformer inputs and outputs combined with RS-422 drivers and receivers. AES-3 signals can be looped if all receive devices have high impedance inputs, except for the last one in the chain, and if the interconnect cables are fairly short. Longer cables can present problems due to reflections.

The AES specification also provides for the use of coax (described in SMPTE 276M). Audio signals using a 48kHz sample rate have a bit rate of just over 3MHz. Because of this, analog video DAs can be used to distribute AES streams. One problem is the original AES specification allowed signal amplitudes as high as 10V. The 1992 version restricts the amplitude to 2-7Vpp. When used in conjunction with video DAs, signals distributed at the higher level may require 6dB to 20dB attenuation. A matching network might need to be incorporated at the transmit side, and a similar impedance matching network may be needed at the receive end. A step-up transformer might also be needed at the receive end.

AES samples are assembled into blocks. Each block consists of 192 frames and each frame consists of two 32-bit subframes. Each subframe contains one sample of Channel 1 or Channel 2. At a 48kHz sample rate there are 250 blocks each second. Each subframe uses the first four bits as a flag pattern to signify which half of the frame it is (Channel 1 or Channel 2), or to signify the start of a new

Continued on page 80



SYSTEMS INTEGRATION

NETWORKING DIGITAL ISLANDS

More and more, computer networks are becoming integral to facility infrastructure.

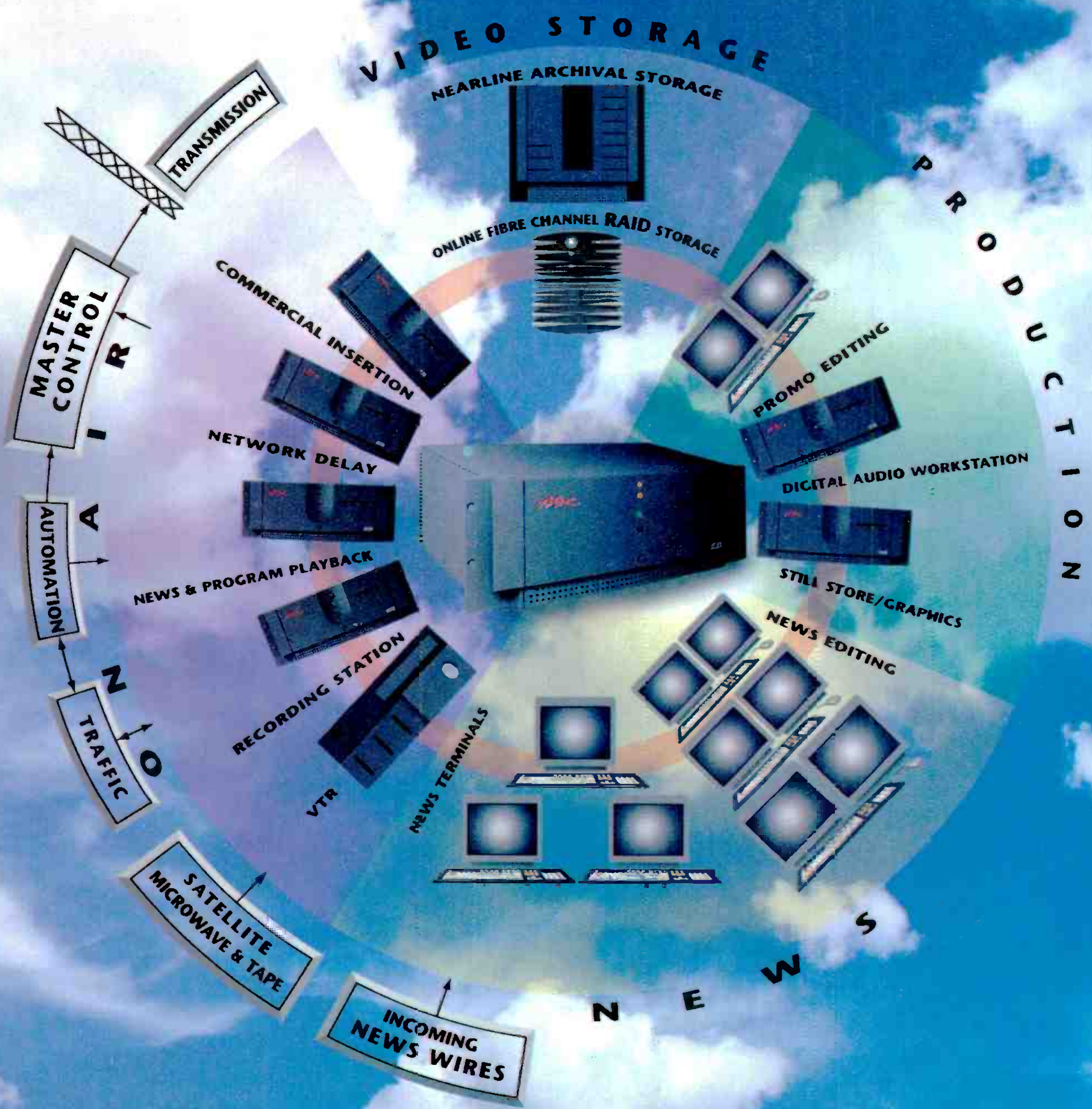
By Raju C. Bopardikar

THE BOTTOM LINE:
Installation and maintenance of computer networks can be costly. A careful choice of networking technology and topology can lead to work-flow efficiencies. These efficiencies can offset the cost of the network and lead to increased revenues, as they allow for a larger amount of work to be handled without the need to increase creative staff. $

You need only look at a TV or movie screen to see the way the post-production industry has changed. Visual effects are increasingly intricate and spectacular and the 3-D animation chillingly realistic. So complex and seamless are today's composites and visual effects that their production involves intricate digital teamwork; a creative collaboration of artists, animators, editors, compositors, along with others, all of whom need shared access to media files.

Increasingly, facility managers are turning to high-speed local area networks (LANs) as a means of connecting their workstations and on-line edit suites, allowing creative staff to work efficiently with the same assets. These assets are typically data-intensive, high-resolution video, HDTV and film files moving in real-time streams. Networks must be sufficiently robust to handle data throughputs ranging from 240Mb/s to 2.6Gb/s, for high-resolution video and film, respectively. Installing high-speed local area networks constitutes a major ex-

Photo: As production facilities adopt networked computer technology, the "look" of many suites will be adjusted to accommodate the new equipment types. Photo courtesy of Post Logic Studios, Hollywood, CA.



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NEWS EDITING
NEWS
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NAVIGATING THE COMPLEXITIES OF LANs

- Number of protocol packets per frame (frame size/size of network protocol packet).
- CPU use on the host computer (a function of processing the protocol packets above).
- Whether I/O is sequential or random.
- The performance when read and write are conducted simultaneously (typically a mixture of 50/50 or 75/25 read to write).
- Whether multiple processes are performing simultaneous, independent I/O.

At a time when video professionals are trying to tackle complex, rapidly changing networking technology, many vendors are finding it hard to resist capitalizing on the confusion in the marketplace. Because the technology is so new, there hasn't been sufficient time for vendor claims to be disproved or for buyers to develop greater network savvy. Performance hype is a universal problem shared by all types of high-speed networks, including:

- Asynchronous transfer mode (ATM), which promises 132Mb/s;
- Fiber distributed data interface (FDDI), which promises 100Mb/s;
- Fibre Channel-Arbitrated Loop (FC-AL) and switched Fibre Channel, which promise 1Gb/s (even though 800Mb/s is the maximum data throughput);
- HIPPI-800 (high-performance parallel interface), which promises 800Mb/s in each direction;
- 100 Base-T Ethernet, which promises 100Mb/s; and
- Gigabit Ethernet promises 1Gb/s.

These promises are burst rates or peak performance, not true sustained data transfer rates and should be only considered as maximum theoretical numbers.

Shared medium networks

Shared medium networks are similar to the old telephone party lines. As the number of active users increases, the network slows down and bottlenecks form. The bandwidth per node is inversely proportional to the number of workstations on the network 1/(N-1), where *N* is the number of workstations or nodes on the network, placing a severe limitation on network scalability. Fibre Channel-Arbitrated Loop, FDDI and Ethernet are shared medium network configurations that can quickly become saturated.

To illustrate, consider a four-workstation network. If these four workstations (called A, B, C and D) are configured in a loop topology, the total bandwidth must be shared. If A is sending to B, then C and D must wait for the next opportunity to converse with A or B. Also, if A is talking to B and C is talking to D, shared bandwidth means that each connection will have only half the full-bandwidth allotment available.

In the case of FC-AL, if any one of the four workstations goes down, the entire network fails. To avoid this problem, FC-AL can be used with a hub.

NAVIGATING THE COMPLEXITIES OF LANs

Hubs provide loop resiliency by bypassing the failed workstation. To get the bandwidth promised, users need to take an organized, coordinated approach to file transfer. That calls for planning, scheduling and managing of file transfers. However, in the real world, users shouldn't have to worry about when to move or send data, they want it on-demand.

For non-real-time processes, like frame-by-frame rotoscoping and file transfers after normal business hours, the slower-speed data transfers may be acceptable. In these cases, shared loops or slower networks like 100BaseT (for up to 10MB/s) or 10BaseT Ethernet (for up to 1MB/s) may be adequate. While the artist is touching up one frame, the next one is being transferred or buffered, provided the application does double buffering. By the time the artist is finished with the first frame, the next one has arrived and work proceeds without delay.

Switched networks

Because of the limitations noted above, switched network topologies, such as HIPPI, ATM, switched Fibre Channel and switched Ethernet have grown in popularity. They allow multiple conversations to happen simultaneously at full bandwidth. Unlike shared networks, the bandwidth between non-competing systems remains constant as you add workstations to a switched network. Switched networks create separate point-to-point connections between nodes, allowing multiple conversations to take place at full bandwidth and making the network more scalable.

Using our four-workstation network to illustrate, workstation A and C can have a conversation at full bandwidth, while B and D can also have a conversation at full bandwidth. When there are more than two workstations on a network or if delays cannot be tolerated, users should consider a switched topology. As a testament for switched network topologies, notice the mass conversion to switched topologies in the Ethernet LAN market.

With most networks, you can send and receive data, however, you can't do both at the same time (send and receive a packet at the same exact time). The exception to this rule is HIPPI. It is the only technology that provides separate ports for simultaneous read of 800Mb/s and write of 800Mb/s. This provides an effective bandwidth of 1.6Gb/s (two times 800Mb/s). This allows workstation A to send to B, while B is sending to C. This flexibility is not possible with any other network technology and can be significant in server-based topologies.

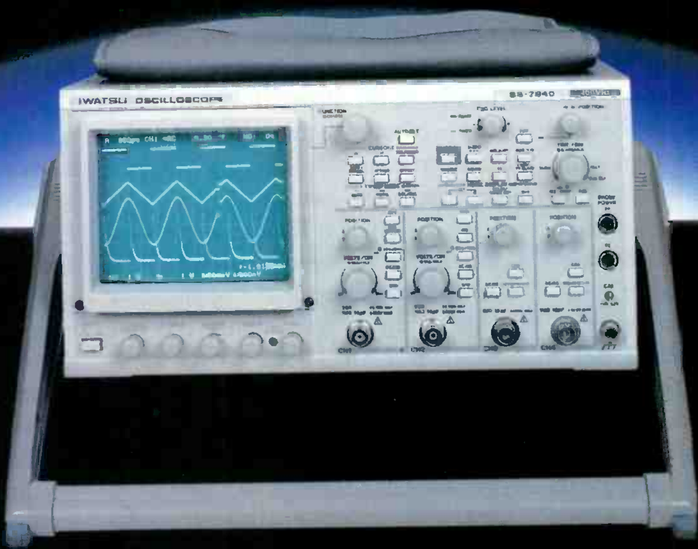
An important, but often overlooked, performance component is the number of packets per frame (as well as packets per second) that a system handles. The maximum TCP/IP protocol packet sizes for ATM and Fibre Channel are 48kB, 4kB for FDDI and for Ethernet it is only 1,480 bytes. Packets per frame is calculated as frame size/protocol packet size.

Because transmitting each protocol packet involves establishing a connection, data transfer, protocol processing and connection termination, the link's effective bandwidth is reduced proportionally by the ability of the receiving host CPU to receive and process the transmitted data. This factor of CPU use and network I/O has a direct bearing on network performance, and ultimately, the cost of ownership of the system. If you must dedicate a whole CPU to do network processing, then the CPU is not available for use by the application.

HIPPI is unique in that it can handle unlimited packet sizes using HIPPI-FP (an ANSI-standard) protocol, whereas all other network types use TCP/IP, an industry-standard communications protocol for establishing network connections. Using TCP/IP, because of the maximum packet size limitations, the processing overhead is increased for each frame. Despite this, TCP/IP remains one of the best ways to connect disparate computer and networking technologies. TCP/IP support is also important for wide area networks (WANs) including the Internet. WANs allow buildings to be tied together on a campus or partnered facilities to be connected over long distances.

HIPPI has been a viable computer networking protocol for almost 15 years and has been widely adopted by high-end computer manufacturers. Users can use the HIPPI-FP high-speed interface, in addition to TCP/IP, which HIPPI also supports. HIPPI promises to transfer data at 100MB/s, which in the context of an application boils down to about 70MB/s sustained. Two simultaneous full-bandwidth con-

ANALOG Oscilloscopes



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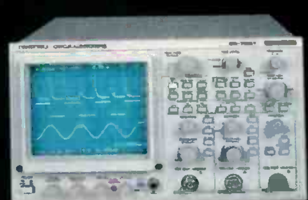

200MHz

SS-7821

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- Full TV triggering, field and line selectable
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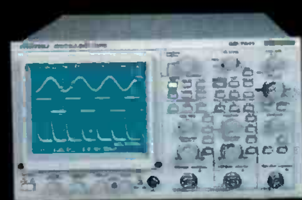

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NAVIGATING THE COMPLEXITIES OF LANs

nections would allow 140MB/s of aggregate bandwidth (70 in each direction). The next evolution of HIPPI, called HIPPI 6400 (due out in 12 to 18 months), promises 800MB/s data transfer in each direction, sufficient for streaming two high-resolution film or HDTV streams in real-time. HIPPI 6400 will be backward-compatible with HIPPI-800 and promises to be the most significant development in high-speed networking for the next few years.

Today, the most widely established network technology is Ethernet and 100Mb Ethernet (about 6-10MB/s effective) is being aggressively deployed. It is a built-in standard on most new systems. New Gigabit Ethernet, which promises to deliver about 80MB/s will also be backward-compatible with 10Mb and 100Mb Ethernet. The protocol compatibility between 10Mb, 100Mb and Gigabit Ethernet will be the cornerstone of the continued success of Ethernet in the LAN environment. Indeed, the success of switched 100Mb Ethernet is in large part coming at the expense of ATM and FDDI. When Gigabit Ethernet goes into full deployment, it promises to create problems for FC-AL.

The main issue with Gigabit Ethernet as a host LAN interface for the film and video environment is going to be the excessive packet per second count (on the order of 64,800 packets just for NTSC video). This puts a tremendous load on the host CPU, limiting effective network performance. To overcome this problem, the host interface card vendors are going to have to provide protocol processing on the network card itself and relieve the host CPU from the task. As such, real solutions probably won't be available until the first quarter of 1998.

As a final note, data transfer rates appear to increase substantially when the data is compressed. However, while slight compression might be acceptable for the final output (or playout) stage, it is generally not acceptable during the manipulation stage. Especially in the high-end post-production environment, where generation loss quickly builds up to unacceptable levels. With various high-bandwidth network options available, there is little need to resort to compression to save on throughput.

All the high-speed, high-bandwidth performance of these various network protocols is meaningless if not considered in the context of applications, such as Adobe PhotoShop, Softimage or Discreet Logic FLAME. If the transfer doesn't go directly into the application while you're working in it, then you must take into account the time spent outside the application to move the data around and into the application. I can fly from Boston to Montreal in one hour, but then it takes an additional two hours to get to and from the airport on each side, making the total time three hours not one. Likewise, it doesn't matter if a file can be moved lightning fast between two systems, if it requires going outside the application to capture the file and import it. If you cannot transfer files directly from within the application, then the extra time results in lost productivity.

Determining costs and ROIs

Comparing the costs of different computer networking technologies can be as confusing as sorting out all the performance hype. Basic Ethernet is affordable, but won't provide bandwidth and speed sufficient for real-time graphics and animation work or on-line editing sessions where clients want to affect the creative process and see immediate results. Expensive high-speed networks like HIPPI and switched Fibre Channel are overkill for non-real-time work, like matting and rotoscoping. However, in a hybrid configuration, clusters of workstations doing non-real-time work can be connected with a slower network (like 100BaseT Ethernet), while the workstations in the on-line suites can be connected with high-speed networks. Combining the two in the same facility can be a cost-effective approach.

In addition to comparing the cost of individual components, it is important to determine the total effective cost of ownership for the complete system. Facility managers should begin by carefully evaluating their productivity goals and their work flow, the way they want data to move about the facility. For example, is it preferable to build a centralized database on a video file server or distribute the storage to local drives throughout the facility or a combination of both? (The server topology issue is important, but beyond the scope of this article.)

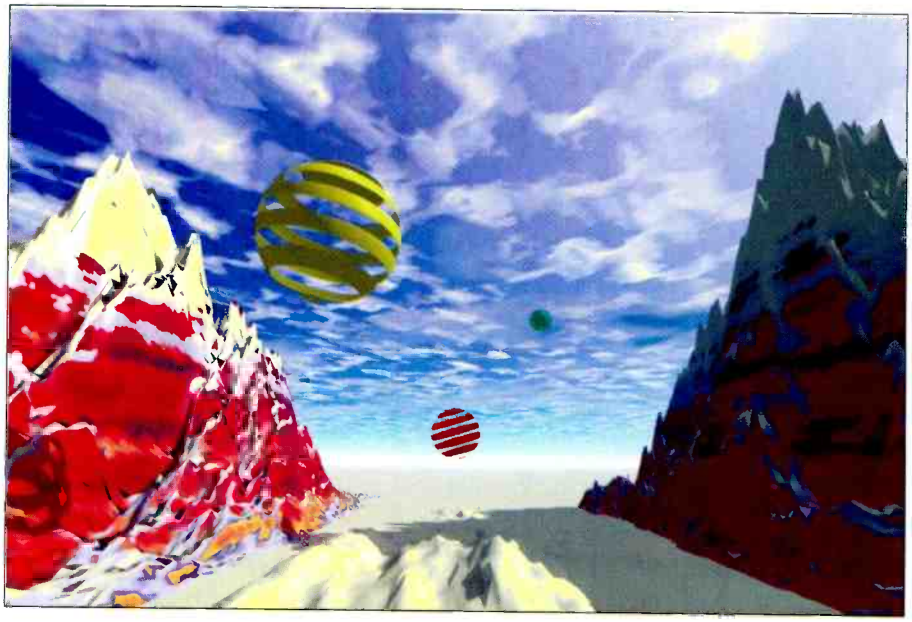
The more flexibility you want to build into a network, the more switches, hubs, interface cards and routers are needed. These can be costly items. Consider installing fiber-optic cable, rather than copper, because most high-speed networks can operate on the same fiber-optic cable. With a large group of people sharing the same data, it is worthwhile to implement data management software. This software tracks all the assets stored on servers and hard drives for better project management. Finally, considering the complexity of high-speed networks, facilities should arrange for technical support contracts through a VAR or add individuals to the staff with strong LAN troubleshooting expertise.

No study of costs is complete without a return on investment projection. This involves analyzing the ramifications and impact of various network configurations in the context of the applications in use and the existing resources at the facility. If the time spent loading and off-loading projects is reduced by three hours, that's three more hours that might be billable at $200 to $1,000 per hour, depending upon the suite or application involved. At that rate, a high-speed network could pay for itself in just three months. After that, the facility would be more profitable, as well as more competitive. And, competitive means that, as a direct result of an efficient collaborative network environment, facilities can now bid on jobs they could not accommodate before. With well-planned, effective high-speed network in place, the facility's team of artists, animators, editors and compositors will be able to concentrate on their core competencies, pushing the artistic envelope rather than waiting for files to load. ■

Raju C. Bopardikar is chief technologist for Discreet Logic, Montreal, Quebec, Canada.

SYSTEMS INTEGRATION

DTV's ROCKY ROAD



Not enough equipment, lack of trained engineers, and inadequate studios are just a few of the obstacles that must be overcome.

By Dr. Joseph G. Schatz

THE BOTTOM LINE:
TV broadcasters currently use a 6MHz frequency allocated to them by the FCC for one analog channel. Late last year, after 9½ years of deliberations, the FCC adopted a digital TV (DTV) standard for the United States. The DTV standard does not mandate one specific video standard, but rather outlines 18 different versions of the DTV standard. At their choice, broadcasters may use any one of these versions. $

To encourage the timely provision of DTV, the FCC will give each broadcaster an additional 6MHz allocation in which they may provide up to five digital channels and other services. The FCC is also mandating the period over which the analog-to-digital transition must take place. Initially thought to be 15 years, it appears that the FCC has opted for an eight-year period over which more than 40% of viewers will be given access to digital programming in the first two years. At the end of this transition period, the broadcasters are supposed to relinquish for reassignment the 6MHz frequencies allocated to them by the FCC for their analog channels.

The lack of a definitive standard combined with the flexibility to provide multiple services presents broadcasters and manufacturers with major challenges. This article will explore some of these issues and concludes that a practical transition to the DTV millennium will be dictated more by market forces and manufacturing capacities than by FCC caveat, thereby, extending the transition period to 2011 or beyond.

The winding path to the road

In 1993 it was decided that four competing digital high-definition TV (HDTV) technologies looked extremely promising. A small but powerful

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DTV's ROCKY ROAD

consortium, the Grand Alliance, was formed to test and evaluate these approaches. After another 2½ years of work, the Grand Alliance developed what appeared to be a compass and a map; a workable plan that it proposed to the FCC for adoption. However, the computer industry, a powerful and vocal group that had not been part of the process, disagreed with parts of the map and urged yet another alternative.

The United States appeared lost on the path to the digital millennium. Political, regulatory, competitive and technological pressures had reached an extraordinary level; everyone's patience was exhausted. However, in November 1996, a final compromise was reached and then adopted by the FCC the next month. The DTV standard that was adopted presented broadcasters with significant opportunities.

Unfortunately, the compromise DTV standard did not result in one traditional type of standard, but in one standard with 18 variations, including the possibility for broadcasters to provide multiple digital channels in the same spectrum allocation that they now use to provide one.

The standard

Originally, broadcasters were given a 6MHz allocation of frequency spectrum in which they could transmit a single analog TV channel in the standard NTSC format. This channel is displayed on a TV set in a step process called interlaced scanning that alternately presents half of the total 525 lines that make up a single screen at a time. Screen and visual persistence result in the appearance of a full picture.

In the DTV standard, three things differ from the existing TV technology:

1. The picture is transmitted in a digital rather than an analog format.
2. In their 6MHz frequency allocation, broadcasters have a choice of providing either a single high-quality HDTV channel or five to six standard definition TV (SDTV) channels. These latter channels give viewers a picture quality equivalent to that of the current NTSC standard.
3. The number of lines traced on a TV screen can vary from 480 to 1,080 and use either interlaced scanning or the single-step progressive scanning technique employed by computer manufacturers.

Thus, the "new" DTV standard provides for 18 different video-scanning alternatives, a representative set is shown in Table 1.

Warp speed

During this 9½-year journey of consensus, the FCC had proposed that the new DTV standard be phased in over a 15-year period. Now, it has agreed with broadcasters to adopt a much more aggressive strategy that will be completed in less than 10 years from adoption of the DTV standard and eight years from when manufacturers estimate they will have the first DTV standard-compliant TV sets available for sale.

Concepts, such as simultaneous broadcasting of regular, time-shifted and continuous special-interest programming, are now practical.

The transition plan initially focuses on network affiliates and the 10 largest metropolitan areas in the United States: Atlanta, Boston, Chicago, Dallas-Fort Worth, Detroit, Los Angeles, New York, Philadelphia, San Francisco and Washington. During this period, stations will maintain their current frequency allocation, and in addition, be assigned a separate 6MHz frequency slot for digital broadcasting.

The plan specifies that within 24 months (May 1999), all network affiliates in these areas must begin broadcasting in digital format. The focus is then to be expanded geographically, such that after 30 months (November 1999), the network affiliates in the 30 largest cities must start digital broadcasting. This requirement is expanded to all *commercial* stations by May 2002 and to all stations by May 2003. However, in 2006, the FCC will reclaim the current analog frequency allocations and DTV will be "the standard of the land."

During this transition period, stations may broadcast analog and digital programming, such that by April 2003, 50% of a station's analog video programming is on digital, increasing to 75% in April 2004 and 100% in April 2005.

The rocks in the road

Converting to the digital format in less than 10 years is a daunting challenge to the broadcasting industry, the equipment manufacturers and the consumer electronics firms who ultimately fuel the engine of change. Major issues must be explored; some represent business opportunities — others represent risks:

- How can I use the DTV standard to my business advantage?
- Where will all the new digital equipment and trained technicians come from?
- Will my customers be ready?

Business advantage

Broadcasters will have to make substantial investments in time and money to convert today's programming to an

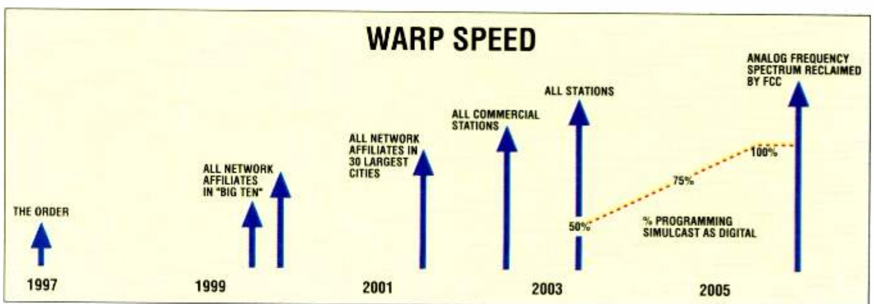

Figure 1. The DTV time line.

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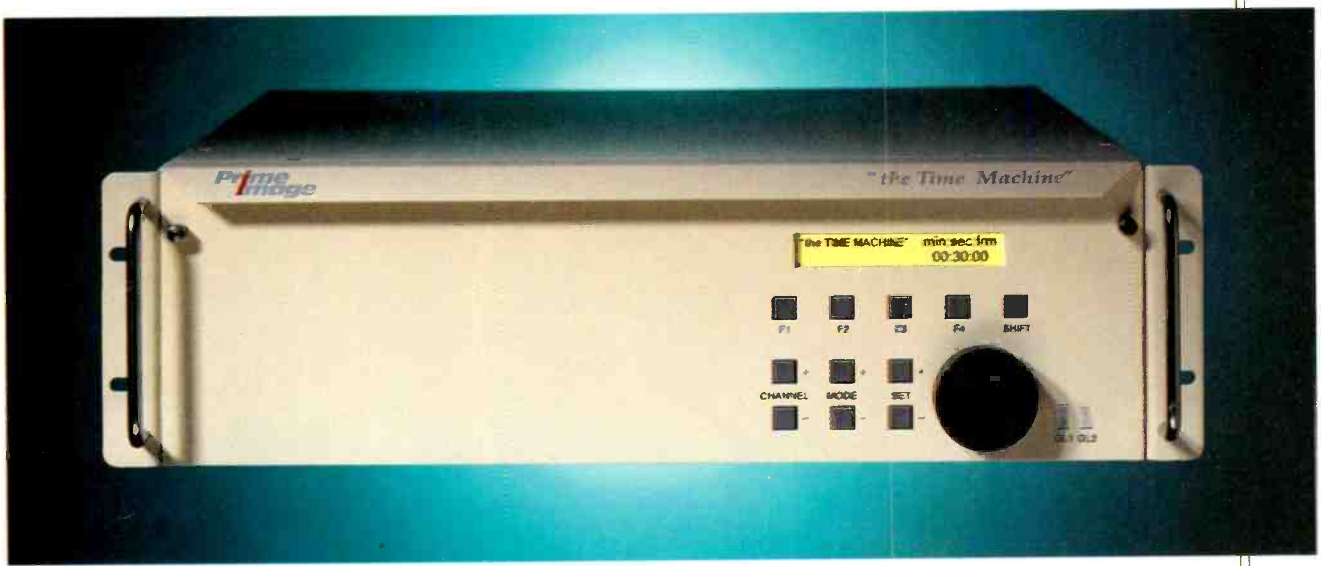
Create Commercial Time



The Time Machine is a new, technological break through product, which reduces program time, to create commercial insertion time. it is a self contained, small 3U rack mountable unit which requires no data compression.

The Time Machine is capable of changing time without changing the pitch (frequency) of the video or audio programming. The Time Machine consists of a main frame which houses the memory and all of the electronics necessary for control of the video and audio-Time Machine storage. A maximum of 30 seconds of video and two channels of time reduction audio is available.

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DTV's ROCKY ROAD

HDTV format. This conversion would substantially increase the quality of the video and audio presented to viewers; but will not significantly change the nature of the services provided or the traditional business equation of advertiser financing.

However, the DTV standard will provide broadcasters with the ability to provide new and innovative services to viewers via the SDTV format. Concepts, such as simultaneous broadcasting of regular, time-shifted and continuous special-interest programming, are now practical. Thus, the 7:00 p.m. network news broadcast on SDTV Channel 2A could be rebroadcast at 7:30 p.m. on SDTV Channel 2B without disturbing regular programming on 2A, and while weather, traffic and financial reports were concurrently being broadcast on SDTV Channels 2C through 2E. Programming of this type could be the basis of additional advertising revenue.

The additional SDTV channels could also support interactive services, such as shopping, banking, games or even Internet surfing. These types of services could be broad or narrowband and would require special security protocols (as well as a telephone line to implement viewer interaction). Similarly, subscription services, such as digital audio or a limited version of pay-per-view (the movie of the night), could be offered. However, interactive services based on either HDTV or SDTV will require an additional DTV-capable set-top device.

There appears to be a consensus that prime-time programming will use the HDTV format. This raises the question of when the chance to capitalize on the features of SDTV will occur. Many hypothesize that we will live in a two-tier TV culture. Daytime programming will be dominated by SDTV and programming will switch to an HDTV format at some convenient evening hour. But what about the Saturday morning cartoons! It appears that we will either have many more or our children's favorite superheroes will be most elegantly portrayed.

Implementation

The rollout of DTV will require a host of new equipment. There are approximately 1,600 TV stations in the United States, each of which will require new transmitting, test and monitoring equipment. In addition, existing transmitting towers will also require modification.

Studios may actually be a bigger problem. Not only will each existing studio require updated cameras, recorders and signal-processing equipment, but they will almost certainly require substantial physical redesign. Because of the increased ability of HDTV systems to accurately reflect what they see, set design techniques based on imitation brick and stone will no longer be adequate; the real thing may be required. The "all-seeing eye of the HDTV camera also extends to warts, wrinkles and other facial imperfections. Thus, current TV makeup techniques must also be upgraded.

The design and manufacture of the equipment and processes necessary to implement DTV nationwide requires time and investment. However, the force of engineers and other professionals who will install, maintain and operate the new digital infrastructure does not exist today. This problem is further compounded by the need for broadcasters to operate digital and analog facilities simultaneously. Thus, current engineers cannot just be retrained — instead the current skill pool must be augmented.

VERTICAL LINES	HORIZONTAL PIXELS	ASPECT RATIO		FRAME RATE			
1080	1920	16:9		30I		30P	24P
720	1280	16:9			60P	30P	24P
480	704	16:9		30I	60P	30P	24P
480	704		4:3	30I	60P	30P	24P
480	640		4:3	30I	60P	30P	24P

NOTE: I::= INTERLACED SCANNING P::= PROGRESSIVE SCANNING

Table 1. A representative set of 18 different video-scanning alternatives. Source: ATSC Doc. A/53 ("ATSC Digital Television Standard," Sept. 16, 1995)

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DTV's ROCKY ROAD

Customer readiness

What of the viewer? Virtually every household in the United States has at least one TV set, and it is common to have three or more. This amounts to more than 200 million TV sets, which according to the current FCC transition schedule will be obsolete by the year 2006. If the average DTV set costs $500, this will be a huge financial prize for the consumer electronics industry. Because current prices for DTV sets are $2,000 or more, the real question is can a $500 price tag be achieved? In addition, can the industry manufacture more than 25 million sets per year, averaged over eight years, without even allowing for the increased desirability of these new technology sets or a growing population?

> Daytime programming will be dominated by SDTV and programming will switch to an HDTV format at some convenient evening hour.

There are other pieces of consumer electronic equipment that commonly interface with the TV set. VCRs are almost as prevalent as TV sets. Currently available VCRs are designed to interface with today's NTSC standard and, therefore, must also be replaced in the transition to the digital millennium. To a lesser extent, many of the current home video camera systems depend on the television for playback and, therefore, will also require replacement or modification.

The viewer is not the only customer. Cable TV companies, because of the federally mandated "must-carry" rule, are also customers of the broadcasters. Cable has a 60% household penetration rate in the United States. Each of these households has the ever-present set-top box that provides among other things the frequency conversion of current NTSC signals. It is probable that a DTV-capable set-top device will have to selectively cope with HDTV and multiple SDTV channels. Although no such set-top devices are yet available, it is highly probable that they too will be significantly more expensive than their analog predecessors.

Many cable companies also offer to provide their customers with access to "digital TV via cable." Although the names are similar, the technical characteristics of this form of digital television are extremely different from those of DTV. Furthermore, the transmission formats used for these two services differ markedly, to the extent that the two technologies are not compatible. The transition to DTV will clearly obsolete the set-top boxes that cable companies currently sell subscribers to watch "digital TV via cable." At present, the impact of DTV on the cable industry has not been evaluated, but it is felt to be major.

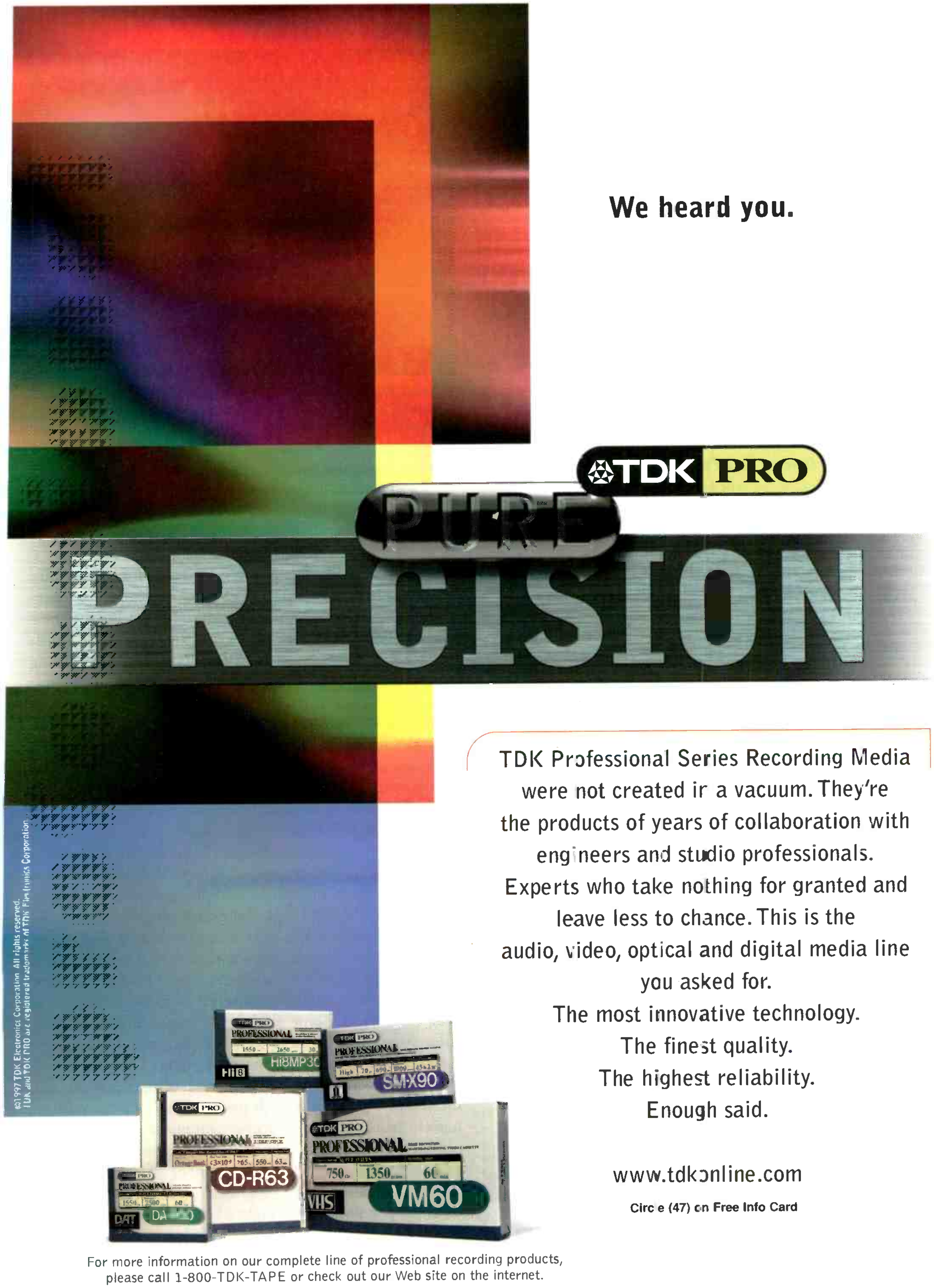
Prognosis

What will the future hold? In spite of the new business opportunities presented to broadcasters and the major increase in quality provided viewers, the road to DTV is indeed rocky. There isn't enough equipment. There are too few trained engineers. Studios are inadequate. The impact on cable television is unknown.

But probably the biggest obstacle of all is probable short-term impact on the viewers' pocketbook, from the expensive new equipment required, and on their freedom of choice between competing services — cable vs. broadcast.

An aggressive transition to digital television aggravates these problems. Industry participants will recognize, quantify and become more vocal concerning their impact. The prognosis is that things will move slower than anticipated today. The original 15-year transition plan may be more realistic, turning 2006 into 2011. Consumer and industry groups will petition the FCC for a more moderate transition and they will agree. ■

Joseph G. Schatz is vice president, telecommunications engineering services, Logica Inc.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SDI AND EMBEDDED AUDIO

Continued from page 54

block (Channel 1 of frame 1). These are generally referred to as X, Y and Z preambles, respectively. The next four bits are auxiliary databits. These can be used either to allow for 24 bits of audio amplitude resolution (as opposed to the 20 bits inherently provided for) or these four bits can be assembled into 12-bit words at one-third the sample rate as an auxiliary intercom channel as suggested by the ANSI spec. I have never seen this used. The next 20 bits contain the audio sample for that channel. The last four bits in each subframe signify:

- Validity — the sample data is actually audio;
- User data;
- Channel status;
- Subframe parity bit.

The audio channel bit from each subframe is combined to produce 24 eight-bit words for each subframe or channel per block. These status bytes contain information about synchronization status, the sample rate, the audio sample word length, source and destination IDs, stereo/mono channel relationship, channel reliability flags and a cyclic redundancy code (CRC) check byte, among other things. This constitutes an AES audio frame, which shouldn't be confused with the audio datastream that results when this AES audio data is inserted or embedded into a SMPTE 259M SDI stream.

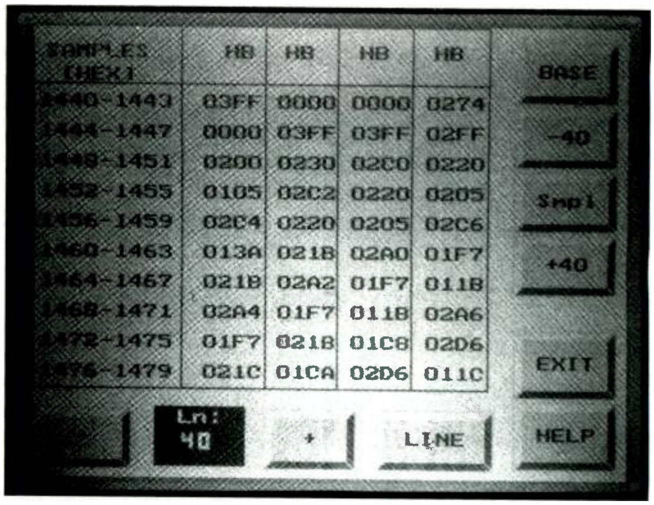

Figure 3. The proper way to view the data values is to use a monitor designed to display the actual values. The top row shows the EAV packet with audio data starting on line 2.

SDI embedded audio

SMPTE has developed a specification for doing this, SMPTE 272M (formatting AES/EBU audio and auxiliary data into digital video ancillary data space.) Because horizontal ancillary data in SMPTE 259M has 10-bit words and an AES frame consists of 64 bits, some reformatting must occur. This reformatted data starts immediately after the end-of-active-video (EAV) data words. The EAV data words consist of three 10-bit words with the values 000, 3FF, 3FF (as opposed to 3FF,000,000 for EAV/SAV timing reference signals). Only the EAV/SAV and ancillary data headers are allowed to have these values. Next comes the data ID word. Its value indicates whether the audio data packets that follow are audio group 1 (Channels 1-4), group 2 (Channels 5-8), group 3 (Channels 9-12) or group 4 (Channels 13-16) or one of four extended audio data packets. More on the extended audio data packets shortly.

Next comes a word that is the data block number. This number was meant to be incremented with each packet. For the incremented count, only eight of the 10 bits are used. This prevents illegal values reserved for TRS and ancillary data preambles. After reaching FF hex, the count value rolls back to 0. Some equipment uses a non-sequential value (when referenced to the previous packet) to indicate a switch has occurred in the audio data. The problem is many products, such as some test equipment, do not increment this number each packet. This can cause intermittent muting in some receive equipment. If this value is not incremented, it should be kept at 000h.

The next word indicates the number of data words to follow. A maximum of 255 bytes are possible. As with the data block number, only eight of the 10 bits is used. The number of data words depends on what horizontal line is being embedded with this data. Now, it gets slightly confusing. The AES 20-bit samples are mapped into three succes-

SDI AND EMBEDDED AUDIO

sive 10-bit SMPTE 259M words. The 10-bits left over [(3 * 10 bits) - (20-bit audio sample) = 10 bits] have AES audio channel status and user bits mapped into four of them, three bits indicate whether this is Channel 1, 2 or a Z frame (start of a 192 sample AES block) and the final three are used to protect against illegal values, which again are reserved for EAV/SAV or ancillary data preambles.

Because of this mapping technique, a single sample of Channel 1 and 2 (1 AES frame) requires six SDI words. One possible implementation is to have most lines carry six of these samples; that's 36 data words. The most common sampling frequency used in professional digital audio for television is 48kHz, which is not an exact multiple of the 59.94 field rate used for NTSC. To get the necessary 48,000 samples each second, 8,008 samples are required in the SDI stream every 10 fields. If those samples are to be spread evenly, most lines have six samples and every 12th line will have eight.

What about 24-bit audio? The first 20 bits are sent as just described, but the additional four bits of both channels in one AES frame are combined into one word and assembled into what is called an extended data packet. This extended data packet is sent immediately following the normal audio data packet. The extended data packet starts with the same preamble (0000,3FFF,3FFF), data ID, data block number and data count words as the normal audio data packet.

There is an optional "audio control packet" that can be sent in the second horizontal ancillary space following the video switch point. It is used mainly to signify audio with a sample rate other than 48kHz. Each audio group (four channels) requires its own control packet. These control packets must be sent before any other audio packets are sent. As stated, most professional TV audio is sampled at 48kHz and, therefore, this packet is not normally sent.

Dealing with embedded audio

Once audio is embedded into the SDI video datastream there are a number of common confusion points. Some are issues that invite misunderstanding with all digital audio. The first one is metering. As with all digital attributes, signals that are too high do not gradually degrade as they push against the path's amplitude ceiling. A digital signal is unaffected by distortion until its amplitude is such that all bits must be high to describe it. Then, any additional amplitude is simply clipped. To graphically show users exactly how much headroom is left, most digital audio meters do not revolve around the 0VU point. Instead, most display standard level as -20dB, with the top level being labeled 0. This display shows you that you have 20dB of headroom at normal levels. Additionally, not all digital meters try to mimic the ballistics of analog meters. The ones that do, generally do this by digital integration. This is done by taking multiple samples and finding their average value. The more samples averaged, the more the integration.

> It must be understood that the ancillary data displayed cannot be used for any critical measurements, only as an indication that the data is present.

Another common area of confusion is what are commonly known as "pops" and "clicks." This will happen any time you switch between two non-synchronized audio sources. In digital VTRs, whether or not the audio is embedded in the video datastream when it enters the VTR, it is laid down on tape as if it were part of the video stream. That means all problems that can plague video also effect the audio. Error concealment, when error correction has failed, is much less noticeable in the video than the audio. Something as simple as mistracking can show up as pops and clicks.

Finally, it should be mentioned that once an analog audio signal has been turned into a discrete number sequence, digital attributes can follow it back into the analog domain. If two digital signals are converted back to analog, and they are switched between, pops and clicks can still occur. This is because of the discrete nature (even though it is analog again) of the signal. A series of impulses each represented by $\sin^2$ (sin squared) functions are output. Each of these functions (each of which can also be thought of as pulse) is a sample. The $\sin^2$ pulses occur because the D/A output does not have infinite bandwidth. These pulses null at the center of each preceding and succeeding sample. Thus, they do not affect a continuous pulse train from a particular D/A. However, they do become a problem if one D/A's output is replaced (switched) by another's output.

Another common area of misunderstanding is when test equipment, such as a waveform monitor, displays the ancillary data space along with the active video. (See Figure 2A.) It must be understood that the ancillary data displayed cannot be used for any critical measurements, only as an indication that the data is present. Why? Let's start with the TRS signals that are displayed. TRS stands for timing reference signals. The timing reference signal is comprised of four data words. The first three are unique values (not allowed in active video). They are 3FF, 000, 000. The fourth word is known as the "XYZ" word. This word indicates whether the current field is field 1 or field 2, whether this is an EAV or SAV sequence and if the current line is in the vertical interval. The slew rate for going from 3FF to 000 (all bits on, to all off) is well beyond the bandwidth of normal SDI video. In essence, to faithfully pass this signal would require a bandwidth of 13MHz. The vertical bandwidth of most waveform displays is not nearly that wide. Therefore, there is considerable ringing and pre/over shoots when looking at these pulses.

The waveform displayed also depends on what parade mode is selected on the waveform monitor. If all three channels are on (Y, C_b, C_r) be aware of what the display is really showing. Just as horizontally you travel in time across the waveform display, the Y, C_b and C_r lines displayed each scan are one line delayed from the component in front of it. This means is that if you select line 20 for display (with all three channels on), the Y line is actually line 20, but C_b is line 21 and C_r is line 22. The SAV pulse shown with the Y signal (see Figure 2B) is actually the XYZ word (it will have four different amplitude values based

SDI AND EMBEDDED AUDIO

on whether it is the vertical interval or field 1 or 2). SAV associated with C_b is the 3FF word (see Figure 2C) and SAV with C_r is one of the 000 words (see Figure 2D).

Why? Because if this data space was actually video, C_b happens where 3FF occurs (max positive chroma value), C_r happens where the second 000 occurs (0 chroma value), and Y occurs twice, once at the first 000, and second where the XYZ word occurs. It gets even more confusing with EAV if ancillary data is present, because ancillary data begins right after the XYZ word. These data values present slew rates to the vertical deflection circuits of most displays that are also way out of band. Therefore, the TRS ringing has ringing from the ancillary data also mixed in. The only way to look at ancillary data in detail is with a device that displays actual ancillary data values as shown in Figure 3. Here, the array of data shows the EAV string in the top row, with an audio data packet starting in the second row.

As with any technical subject, a basic understanding of what is required, and why, will greatly diminish the confusion and trepidation encountered. This is also true when dealing with digital audio, whether separate from the video path or embedded into the digital video stream. ■

Jim Boston is a consulting engineer based on the West Coast.

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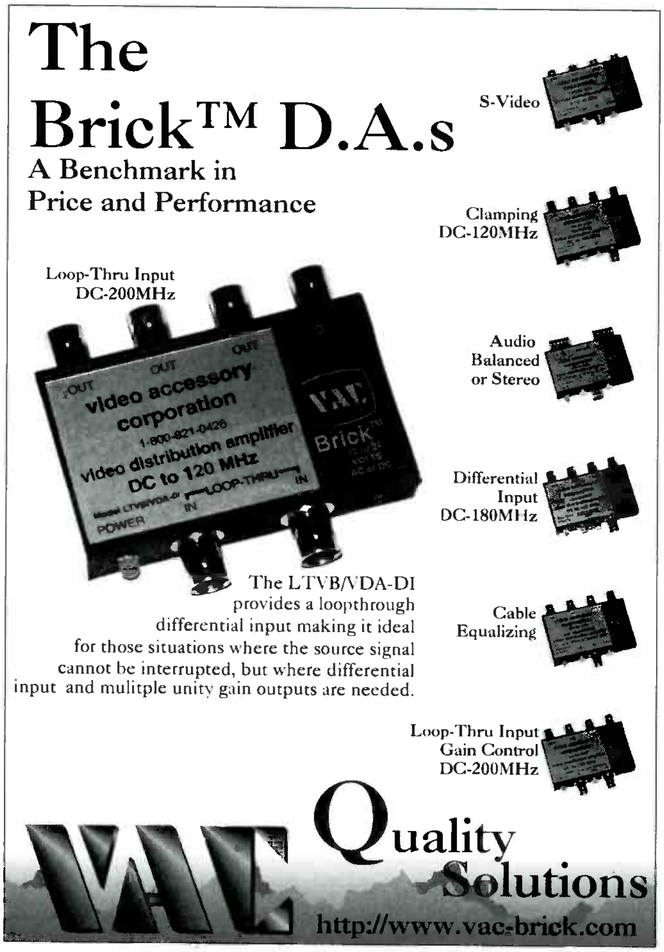

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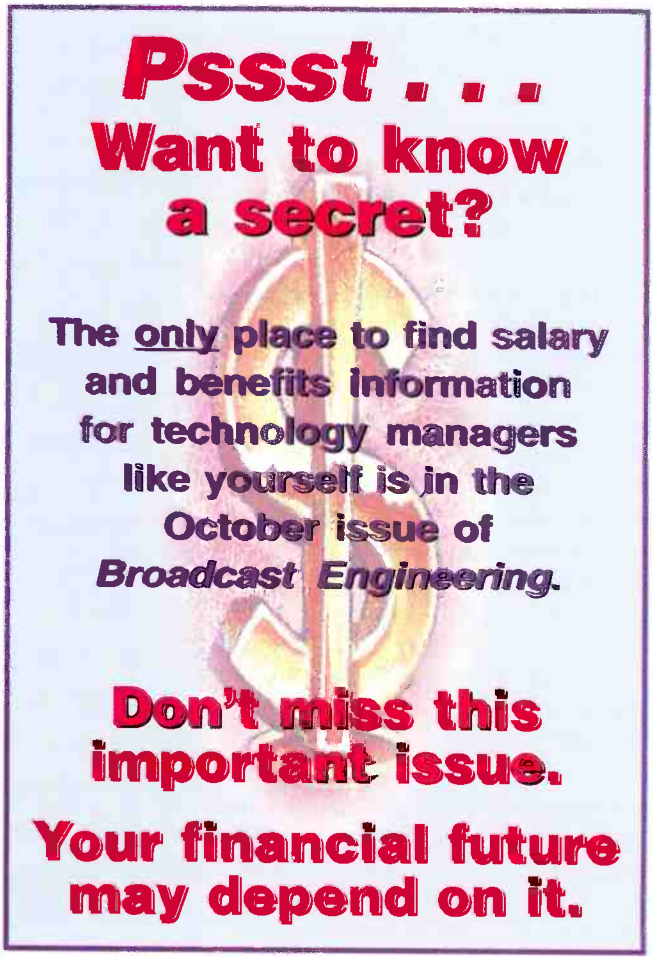

By Steve Epstein,
technical editor

DTV: It ain't that hard

As the DTV deadlines move closer, posturing among the various parties continues. Many of the players continue to remain silent, but a few are venturing early opinions as to the directions they are planning. In late August, both Sinclair Broadcast and ABC stated their intent to move toward multichannel standard-definition programming. CBS, NBC and some premium cable channels are voicing support for HDTV.

Even less direction is seen in the consortium of computer manufacturers with H-P, IBM and Packard Bell stating they have no plans to offer TV tuners inside future models. Without a solid computer industry backing, progressive scan systems seem to be progressively losing steam. Does anyone besides me find it interesting that about the only time the computer industry managed to speak with a single voice, it was to try and derail the DTV standards? They came together shortly before the midnight hour, and are now apparently falling apart only a short time later. At the same time, many broadcast manufacturers seem to be lining up to support the 1,080-line interlace standards.

On the RF side, many of the UHF broadcasters are still unhappy about the difference in the power levels that they have been assigned, relative to VHF stations. As Don Markley stated in last month's column, there is some room for maneuvering in this area, but stations will need to get their applications in early if they hope to see those requests granted. On the consumer side, 16:9 digital sets, and possibly set-top adapter boxes, are due to arrive in retail outlets in time for the 1998 holiday season. The question on consumers minds (if they are even thinking that far ahead) is what will these new sets receive, and why are they needed?

Finally, among the news items seen recently was a quote from Bruce Leightman of the Yankee Group, a Boston-based market research firm, referring to the DTV time table, "If you believe that 2006 will be the real transition date, you believe in the tooth fairy." With all this background do you get the idea that while there are a lot of intelligent folks out there, most of them are fairly confused as to what direction to take?

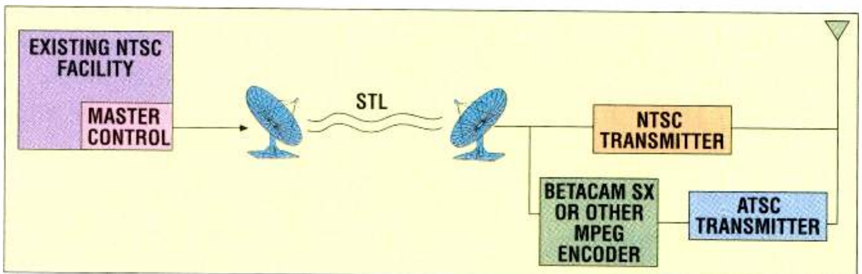

Figure 1. Using the model above, combined with a small amount of hardware, facilities could easily transition to digital broadcasting. Although it is not 16:9, nor high-def, nor even multiple channel, it does meet the FCC requirements.

Transmitting bits

Before getting wrapped up in the details, step back for a minute and think about the future. Do you (or your company) want to be in the broadcasting business in 10 years? If so, you will need to be broadcasting digital. *That* has been mandated by the FCC. While it is likely that the deadlines will be extended, one way or another companies that choose to remain in this business will be broadcasting digital bits rather than analog waves.

Thanks in part to the confusion generated by computer folks, exactly what those bits are is not specified. The current options include high-definition video, multiple channels of standard definition video and even data. As we have all learned, video (and, of course, audio), whether HD or not, can be easily thought of in terms of data. With that said, broadcasters have the opportunity to build a data pipeline that can carry 19.4Mb/s and simultaneously hit something on the order of a million homes. Viewed from a different perspective, that sustained transfer rate of 19.4Mb/s translates into more than 1GB every seven minutes. That's a lot of data! Especially when you consider that this service could be thought of as a potential "network" of more than a million "clients." Granted, that last statement was a bit of a stretch, but only a few years ago, 16MB was a lot of RAM. Now, the question becomes how to fill that data pipe?

For those conservatives (there are still conservatives in broadcasting aren't there?) and in terms of today's technology, there are several tape formats on the market that could be pumped into the ATSC datastream with little or no additional compression, and possibly

with a few bits left over. Digital-S is based on a 50Mb/s recording format, while DV and its professional derivatives DVCPRO and DVCAM are based on 25Mb/s. Betacam SX, however, is based on 18Mb/s leaving 1.4Mb/s for audio.

Assuming a single-channel, standard-definition operation, with the signal simulcast on both the NTSC and ATV channel, all that is required is to take the compressed output of a Betacam SX machine and feed it into a DTV exciter that includes the proper ATSC encoding equipment.

With the few bits in the datastream left over, it is likely in today's data-intensive world that those bits could be sold to someone. The simple addition of a

> Broadcasters have the opportunity to build a data pipeline that can carry 19.4Mb/s and simultaneously hit something on the order of a million homes.

universal serial bus (USB) port, an RS-232 port or if you want to get real fancy, Ethernet, on the TV receiver would provide the TV-PC connection we have all heard touted. That keeps the computer and the TV separate, but allows homes with computers access to broadcast data without having to put a tuner in their PCs. Presently, 98% of American homes have televisions, while only 39% have computers. Computer penetration is expected to increase to 55% by the year 2000. Beyond that, forecasts get more fuzzy.

In this example if more bits were sold than were available, real-time compression equipment could be used to increase the compression ratio of the single video stream freeing up as many bits as necessary — within reason. Simply converting the MPEG encoding process from the intraframe method used in the BetaSX machine to an interframe process would free up a substantial number of bits. Later, through the use of statistical multiplexing, a variety of services, both free and paid, could be offered. Over time that could mean multiple video channels or even HD broadcasts, but thanks to the FCC neither is required. This solution is not high-def, it's not 16:9, but despite the simplicity, it's a picture with sound, it's digital, it's cheap, it meets the FCC requirements and it can be done today. Better yet, in the words of our friends in the computer business, it's extensible and scalable! ■

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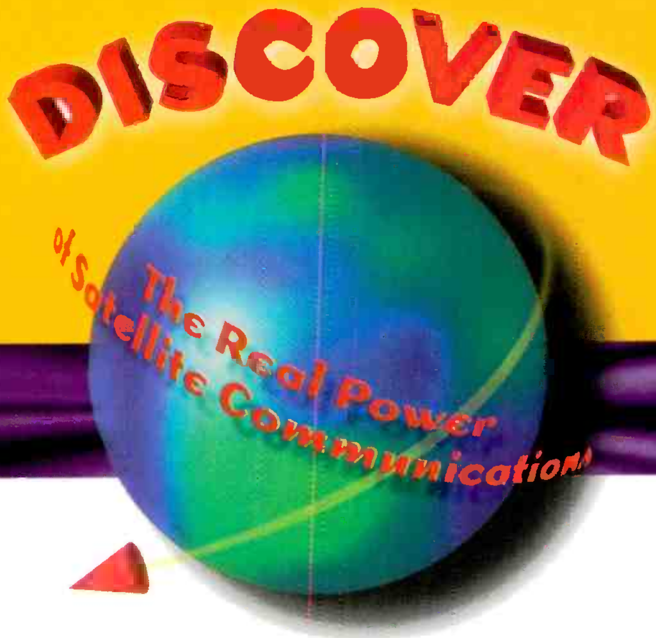

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By Ron Naumann and Roy Patton

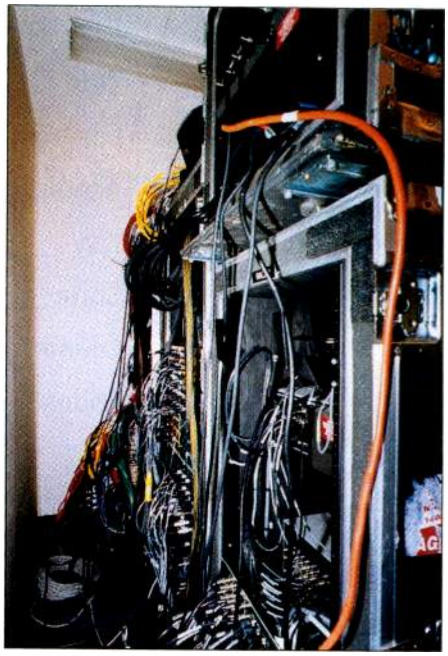
Two minutes in broadcasting eternity

Parades of women carrying hat boxes through the Louisville, KY, airport can mean only one thing to horse fans — the annual running of the Kentucky Derby. The Derby is undoubtedly among the most memorable and anticipated sports events of the year. This year's race, the 123rd running of the Derby, was one of the most exciting.

From a sports broadcasting point of view, covering the Derby is among the most challenging tasks to be undertaken. Since the race only takes about two minutes to run — two minutes that are among the most watched in television — the challenge is creating the 20 minutes worth of programming needed within two days, all from the confines of a parking lot at Churchill Downs. This programming was for ESPN's coverage, which sets the stage for ABC's Wide World of Sports' one-and-one-half hour race-day coverage.

This year's Kentucky Derby race proved to be an easy assignment for Sony's DVS-7250 switcher and complete edit suite — all packed into a handful of travel cases.

Winner Communications, a production company specializing in equestrian events and whose task it was to provide ESPN's production support, answered this challenge by bringing in a staff of 100 people, two Game Creek Video digital component production trucks and two 60-foot trailers that eventually housed two digital on-line edit suites, two off-line non-linear suites, a tape library, three logging stations, a voice-over booth and an office. The primary edit suite in one of the trailers — outfitted with Sony's DVS-7250 and a half dozen DVW Digital Betacam VTRs — provided around 100 packages, promos, highlights and bumpers. What was unique about this room was that all of the equipment came pre-engineered, pre-wired and packed in specially designed travel cases with the goal of providing remote broadcasting with post capabilities more commonly found in a permanently installed component digital video editing environment. This pre-configured, all-in-one system was designed by Sony with the sole purpose of providing an innovative, efficient solution to the problems inherent in doing television in a parking lot. The second on-line edit suite consisted of the Sony Digital Duo — a DVS-2000 with DME-3000 — controlled by a BVE-9100.



Despite its appearance, wiring for the Sony racks is well marked, and easy to connect.

Armed with this extensive on-site editing facility, the Winner crew was able to finish complete packages quickly, including graphics, reducing the post-production work load on the Game Creek Video production truck. To put this in perspective, in the past, Winner had to lay in the graphics live on air to meet the deadlines, but at this year's Derby, they had finished packages before going to air. These features included stories about the horses, jockeys, owners and the 123-year racing history of Churchill Downs. When completed, the features were integrated into ESPN shows on Friday, May 2 and Saturday, May 3, leading up to ABC's Wide World of Sports' coverage on Saturday.

Filling the remaining space in the parking lot were five ABC production trucks. One truck was used to route and subswitch the 50-plus cameras, providing video feeds from almost every vantage point on Churchill Downs, while the other four trucks (two for production and two for tape) were brought in to permit additional ISO recording and monitoring of the unusually large number of cameras.

ABC's race-day coverage incorporated some sophisticated camera positioning. In addition to the camera set up for the track itself, multiple cameras were mounted on the starting gate, permitting each horse and jockey to be observed approaching and entering the gates and in the Winner's Circle. When the race started, cameras down on the track were subswitched as the horses left the gates and proceeded down the track with the director cutting to different cameras all the way around to the finish. Thus, from the time the horses entered the gate to the time they crossed the finish line, every crack of the whip, move to the inside, change in position, stumble or questionable bump was captured. When the race was finished, along with covering the winning horse in the Winner's Circle, ABC had cameras ready to cover the track steward's (race officials) evaluation area in case there was a photo finish.

The front of the Sony racks still mounted in the shipping cases. The Sony 7000 switcher control panel is in the lower right.

During the breaks between races, roaming cameras were used for impromptu interviews in the paddocks, locker rooms, Jockey Club or at the Kentucky Derby Museum, where pole positions for the race were chosen the morning before. Located on the other side of the race track was the second Game Creek Video truck that was used to produce ESPN's morning shows on Friday and Saturday, with scheduled interviews of trainers, jockeys and owners.

On Saturday, ABC rehearsed by routing and subswitching the morning races and providing ESPN with a clean feed for domestic and international broadcast. The clean feed from ABC meant that ESPN received a logo and graphic-free feed which, by integrating with ESPN announcers and graphics, became ESPN's program. The final race, the "Run for the Roses" was a total team effort with ABC and ESPN sharing camera sources resulting in about 50 cameras for ABC's Wide World of Sports coverage. The rest is horse racing history. ■

Ron Naumann is marketing manager of production systems for Sony Electronics' Business and Professional Group, Montvale, NJ. Roy Patton is chief engineer for Winner Communications, Tulsa, OK.

By Ken Swanton

ECHOlab 5000: Video switchers with Windows NT

Why would anyone want a video production switcher with a built-in computer? How can it enhance a live production?

After making analog switchers for more than 25 years, ECHOlab could have followed other manufacturers and created yet another proprietary digital switcher. Instead, an open design was chosen because it offers several advantages. It accepts powerful built-in open options like a DVE, clip-store, still-store or CG. It enables the switcher to network and it's more cost-effective.

Hidden inside the ECHOlab 5000's frame is a Pentium computer running Windows NT.

On the outside, all three ECHOlab 5000 models look traditional. They have program/preset layouts with up to 2.5 M/Es, five keyers and three chroma-keys. They handle 33 inputs and 18 outputs. But, hidden inside the frame is a Pentium computer running Windows NT enabling video boards and software packages to run inside.

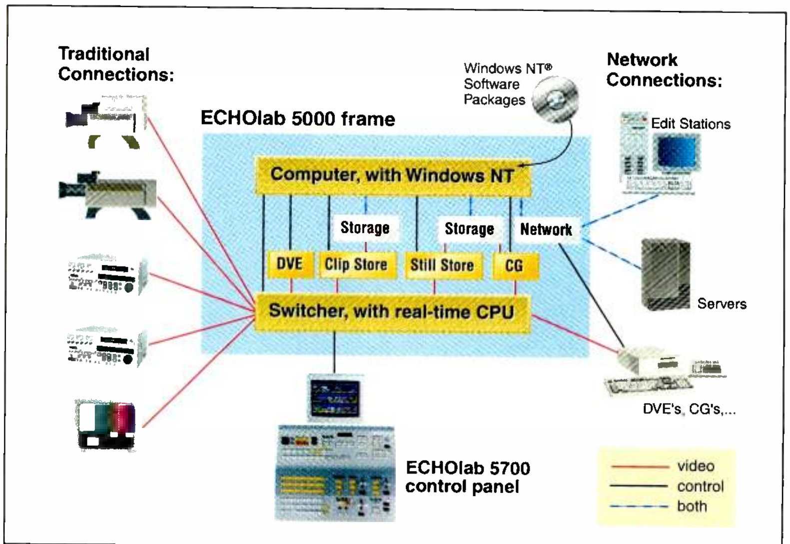
Built-in DVE, clip-store, CG and still-store

The ECHOlab 5000 provides two new ways for a switcher to intimately work with a DVE — plug one inside or network to one.

A Pinnacle Genie DVE card can plug inside the ECHOlab 5000 and its control screen can be displayed on the switcher's monitor. No proprietary commands need to be learned. Instead, anyone familiar with a Pinnacle DVE will instantly feel at home. Before a broadcast, all of the Pinnacle's functions can be controlled from the switcher's control panel, standard keyboard and mouse. Then, on-air play is streamlined with the control panel's hot keys, which start DVE sequences with one push. Playback can be controlled with the panel's familiar motion keys similar to those found on other motion devices.

The computerized switcher also makes it possible to have a built-in clip-store. A clip-store card from DPS or Matrox can be added that can re-cord hours of clips onto the switcher's built-in SCSI disks.The internal clip-store is a handy place to keep lead-ins, opens, bumpers, trailers and other frequently used clips. They can be fired off with hot keys and motion keys. The motion controls can set the clip's start point and even do slow motion.

The 5000 is capable of running any Windows NT software package. Inscriber CG Supreme can be installed for a built-in character generator. Add VideoCarte for an internal still-store that holds 10,000 stills.



The 5000's open architecture and networkability offers a number of configurations to the user.

Switchers that network

Networking, enabled by open architecture, adds two big benefits. First, networking provides another path into the switcher. Video and effects from anywhere in the studio can be sent over the network to the switcher and stored for play. A modem can be added to download effects and stills from remote sites or the Internet, and it can be used for extensive remote maintenance.

Second, networking enables the

Continued on page 106

By Robert L. Band

Transmission robustness and error mitigation

More broadcasters have begun using T1 digital circuits (and outside the United States, 2Mb/s E1 digital circuits) for program audio transmission in STL, TSL and studio-to-studio applications. Digital audio transmission offers many advantages over analog, but it also brings its own challenge: how to deal with bit errors.

Transmission noise

Any transmission system is vulnerable to impairments in signal quality over distance. Noise can be introduced by electrical transients, such as lightning or equipment switching on or off, crosstalk with other circuits or just the thermal noise associated with any electrical circuit operating at a temperature above absolute zero. On an analog system, almost any noise that enters the signal chain is there to stay. No effective method exists to allow amplifying or receiving equipment to dissect an analog waveform and determine with certainty which portion of it is the original signal and which is noise that has been picked up along the way.

Once an analog signal has been converted to the digital format, the situation is different.

A binary digital signal consists of a series of pulses, called bits, which can represent only two states: *ones* and *zeroes*. As long as the decoder can tell the difference between a one and a zero, the original signal can be reproduced perfectly.

For relatively constant noise conditions then, digital transmission offers an advantage over analog. But transient interference presents a different issue.

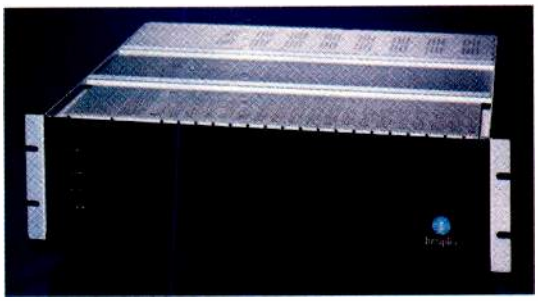
On an analog system, a noise spike on the line will appear as a click or pop in the audio signal. In digital transmission, a noise spike or dropout may cause the receiver to perceive a one as a zero or vice versa; this is called a bit error. Unfortunately, the effect of a bit error when the audio signal is decoded can be an unpleasant chirp.

Keeping frame synchronization

A digital transmission facility, such as a T1 or E1 line, carries multiple channels of information in structures called frames. Additional bits, called overhead bits, keep track of the frame boundaries and are used to determine which bits go with which channels. When first presented with a signal, T1 or E1 transmission equipment searches for the overhead bits. Once it has found them, it is said to be in frame and begins processing the channel data.

The transmission equipment continues to monitor the overhead bits to ensure that the frame alignment remains correct. When there are too many bit errors on the T1 or E1 line, the equipment declares itself to be out of frame, causing the circuit to go down. This condition is called loss of frame synchronization.

National and international standards authorities (ANSI and ITU-T) define certain methods, used by most T1/E1 equipment manufacturers, for keeping digital signals in frame. Equipment adhering to these standards can lose frame synchronization within seconds when one out of every 1,000 bits is in error.



Intraplex multiplexers, including this TDM 163 T-1 multiplexer, incorporate circuitry that allows them to reestablish frame synchronization in less than 18ms.

In standard channel banks used for many applications, it is desirable to have the T1 or E1 link go down altogether before the individual channels become unusable because of the bit errors. In broadcast and other real-time applications, however, it is important that the link stay up well beyond the point at which other equipment would drop the circuit. To accomplish this, Intraplex equipment incorporates a unique algorithm that maintains frame synchronization for hours even when the bit error rate is one in 1,000. This allows the circuit to stay up while the specialized technology described below recovers synchronization and mitigates errors, allowing transmission to continue uninterrupted.

Getting back in frame quickly

Bit errors sometime appear in bursts or brief periods of extremely high error rates. If the bit error rate is extremely high, even Intraplex multiplexers will eventually lose frame. The goal is getting back in frame as quickly as possible.

Some transmission equipment can take as long as three seconds to regain after an error burst. Intraplex

Continued on page 101

new products

By Deanna Rood

Open system interface for facility-wide storage of multiple applications on multiple platforms

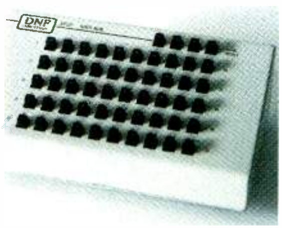
Discreet Logic

• MountSTONE: a software utility that allows any file stored on the STONE storage system to be transparently shared by multiple workstations running multiple applications, across platforms such as SGI, Apple Macintosh OS and Microsoft Windows NT; the applications can seamlessly share the files located on the STONE regardless of the file format; in addition, the files can be viewed locally by each open system and exchanged with the STONE storage; on-the-fly file format conversion from FLAME and FIRE is provided by MountSTONE to Discreet Logic Mac- and NT-based applications Illuminaire and D-Vision, and third-party applications like Softimage or Adobe Photoshop.

Discreet Logic, 10 Duke, Montreal, Quebec, Canada H3C 2L7; 514-393-1616; fax 514-393-0110; info@discreet.com; www.discreet.com
Circle (252) on Free Info Card

Instant access to stored video clips

DNF Industries



• Instant access system: a one-button, instant-access solution for retrieving video clips stored in disk recorders and video servers; the system is comprised of Shotlist software, the ST320 Shotbox and the ST300 VTR controller and features easy assignment of up to 200 clips to buttons on the Shotbox, easy viewing and modifying of assignments and naming clips as they are recorded in the server; users can design a clip-retrieval production system that suits their needs at a modest cost.

DNF, 9970 Glenoaks Blvd., Suite D, Sun Valley, CA 91352; 818-252-0198; fax 818-252-0199; //dnfindustries.com
Circle (253) on Free Info Card

Traveling wave tube

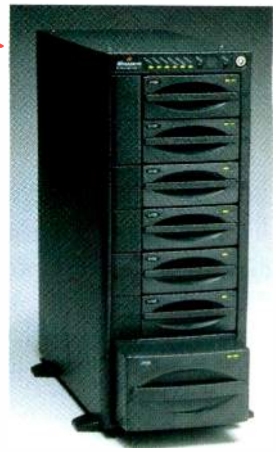
Litton Electron Devices

• L-5895: a conduction-cooled, high-efficiency helix traveling wave tube that provides a minimum CW power output of 125W over the frequency range of 14 to 14.5GHz; it features a metal-ceramic vacuum envelope, a dual-stage depressed collector and uses periodic permanent magnet focusing; the tube is ideally suited for satellite communications and meets all commercial requirements.

Litton Electron Devices, 960 Industrial Rd., San Carlos, CA 94070; 415-591-8411; fax 415-591-5623
Circle (254) on Free Info Card

Enterprise Ultra E-8 disk array enhanced with new host interface options

MegaDrive



• Enterprise Ultra E-8: two new host interface options are available for the disk array that are designed to enhance performance and connectivity with Silicon Graphics' workstations; the *Dual Single-Ended, Plus* starts with a standard Enterprise E-8 that is enhanced to allow up to eight 3.5-inch or four 5.25-inch drive modules on a single bus; it is recommended for use with the native single-ended Ultra SCSI bus in SGI's O2 and Octane systems; the *Dual Differential, Ultra Wide SCSI — Enhanced for SGI* also starts with a standard dual differential Enterprise E-8 that is optimized for use with SGI's Octane, Origin and Onyx2 systems using the SGI MSCSI four-channel XIO host adapter card.

MegaDrive, 9201 Oakdale Ave., Chatsworth, CA 91311; 800-TERABYTE or 818-700-7600; fax 818-700-7601; www.megadrive.com
Circle (255) on Free Info Card

Modular, cost-efficient ISDN broadcast product line

Intraplex

• IntraLink ISDN multiplexer and OutBack ISDN codec: offering an alternative for applications that don't require T1/E1 bandwidth, these products allow you to combine audio, voice and data transmission on a single ISDN circuit; these products allow flexible use of lower-cost ISDN services for a wide range of applications, including contribution and distribution of program audio, and interfacility intercom communication, as well as data transmission for call screening, automation system control and LAN connection; IntraLink is a space-efficient unit that supports connection and management of up to six individual BRIs in a three-rack unit, while allowing personnel to monitor and manage multiple channels and codecs from a single point via a PC; the OutBack is a compact, easy-to-use ISDN codec that supports MPEG Audio Layer II and G.722 coding and is ideal for remote program feeds.

Intraplex, 3 Lyberty Way, Westford, MA 01886; 508-692-9000; fax 508-692-2200; sales@intraplex.com. www.intraplex.com
Circle (266) on Free Info Card

Ancillary data features enhance the DVA184C

SyntheSys Research

• DVA184C: five screen views have been added to this serial digital component analyzer to enhance its ability to analyze the ancillary data portion of the SDI stream and to analyze AES/EBU digital audio and other types of auxiliary data accompanying the video signal; the new screen views include embedded packet summary, embedded packet details, embedded audio control, embedded audio PCM data and embedded audio waveform; other updates to the DVA184C include CE-certified chassis, a larger LCD color display and touchscreen, more jitter analysis hardware features and complete remote control via modem.

SyntheSys, 3475-D Edison Way, Menlo Park, CA 94025; 650-364-1853; fax 650-364-5716; www.synthesysresearch.com
Circle (258) on Free Info Card

Dense wave division multiplexer system

Artel Video Systems

• MegaWav: a dense wave division multiplexer system for multichannel broadcast video transport, CATV supertrunking, multichannel interoffice trunking and high-channel density solutions; with MegaWav, you can optically multiplex up to nine optical digital datastreams on a single fiber allowing easy expandability for operators without the cost of installing additional fiber; the MegaWav platform supports all of the Artel video, audio and data transport products.

Artel, 237 Cedar Hill St., Marlborough, MA 01752; 508-303-8200; fax 508-303-8197; www.artel.com
Circle (256) on Free Info Card

Multiplicity router

Lighthouse Digital Systems

• OZ: featuring a new routing design, this product eliminates the need for multiple routers to perform time code, machine control and analog and digital audio; the OZ allows you the choice of routing analog-to-analog audio, digital-to-digital audio and digital-to-analog audio asynchronous or synchronous all from one chassis; time code and machine control can also be added to the same chassis; in addition, the system can perform bit-rate conversion to link all source material to a house clock; a maximum of 16 outputs can be assigned to delay audio signals with up to 1,000ms of delay for each output.

Lighthouse Digital Systems, P.O. Box 1802, Grass Valley, CA 95945; 800-323-8289 or 916-272-8240; fax 916-272-8248; litehs@oro.net; www.litehs.com
Circle (259) on Free Info Card

Single AMP solution to dual adjacent-channel broadcasters

Acrodyne

• Adjacent Channel Technology (ACT): a transmitter that is capable of passing adjacent digital and analog channels through a single high-power amplifier; it allows you to take care of your NTSC/DTV needs today, as well as your future higher-power digital needs; ACT employs advanced tetrode and Diacrode amplifiers that are uniquely suited to carry dual NTSC/DTV adjacent-channel signals and the NTSC and DTV power contributors can be manipulated for numerous power trade-offs within 104kW peak envelope power; multiple tube configurations offer increased power output.

Acrodyne, 516 Township Line Rd., Blue Bell, PA 19422; 800-523-2596 or 215-542-7000; fax 215-540-5837
Circle (257) on Free Info Card

NTSC/PAL encoder
Matthey Electronics

• CDD-3101: this serial digital video interfacing product converts composite analog signals from NTSC/PAL directly into serial digital 4:2:2 D-1 datastreams; a single extended Eurocard offers high-quality three-line adaptive comb filter decoding with 10-bit internal processing; six decoders can be accommodated in a standard 19-inch 1RU subrackframe and optional analog or digital audio functionality can be added to provide embedded audio onto the serial outputs.

Matthey, P.O. Box 499, 133 Boway Rd., South Salem, NY 10590; 914-763-8893; fax 914-763-9158
Circle (260) on Free Info Card

Character generators
Videonics

• PowerScript Studio: this new member of the PowerScript family of advanced stand-alone PostScript video character generators features enhanced capabilities for broadcasters and video production houses; the PowerScript Studio models share the same creative features and high-quality character generation performance of the base PowerScript model, with the addition of timing controls for the key output, including color subcarrier phase, horizontal delay and key delay adjustments; model PS-1000-S has composite and Y/C video inputs and outputs while model PS-1000-SC adds analog component inputs and outputs, in addition to composite and Y/C; both models are available in NTSC and PAL versions.

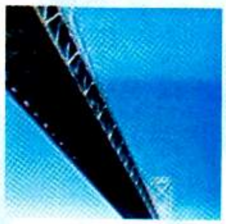
Videonics, 1370 Dell Ave., Campbell, CA 95008; 408-866-8300; fax 408-866-4859; info@videonics.com; www.videonics.com
Circle (263) on Free Info Card

New EditStation
Sony

• ES-7: the newest model of the EditStation is a hybrid system supported by Sony's DVCAM format, using the same 5:1 compression algorithm as DVCAM VTRs; it introduces virtually no compression artifacts to the video signal, and the system's digital path through QSDI ensures complete digital signal throughput; the ES-7 allows true A/B roll edits with one source VTR by using the hard disk as the B-roll source feed; the ES-7 also enables editors to composite text and graphics over live video, instead of on the computer screen of the editor.

Sony, 1 Sony Dr., Park Ridge, NJ 07656; 800-635-SONY
Circle (261) on Free Info Card

Virtual light processors for sports and ENG remotes
Haplotec



• VLP series: a real-time virtual image processing system that simultaneously corrects for loss of detail due to shadow and brightness, while improving image clarity and sharpness; it is ideal for sports and ENG applications, as well as normal on-location video production where considerable video footage is lost due to sunlight and shadow problems; the VLP 2000 adjusts light content in ideo images point-by-point and is useful in situations where improper sun angle can cause image flatness; the technology used in the VLP series also has the ability to compensate for and retain video information that would normally be lost in the transition from one medium to another; models are available in analog and CCIR 601.

Advanced Media Solutions (Haplotec's sales representative), 1710 Zanker Rd., San Jose, CA 95112; 408-573-9000; fax 408-573-7076; justin@haplotec.com
Circle (265) on Free Info Card

HDTV metal tape
Maxell

One-inch HDTV metal tape: a tape designed for use with digital VTRs that conform to BTA Hi-Vision Studio Signal Standard VTA S-001 that specifies a frequency bandwidth of 30MHz for full Hi-Vision signal recording at a total bit rate of 1.188Gb/s; it is available in 24-, 33-, 48- and 64-minute recording times and the tapes feature a low error rate due to a high level C/N ratio that results in crystal clear HDTV reproduction; the HDTV tapes incorporate a high-performance binder system and ceramic armor metal particle coating for a stronger and more durable magnetic layer; an extremely thin ceramic layer encapsulates each magnetic particle improving the tape's physical characteristics and corrosion resistance. ■

Maxell, 22-08 Route 208, Fair Lawn, NJ 07410; 201-794-5922; 201-796-8790; www.maxell.com
Circle (262) on Free Info Card

Continued from page 93
multiplexers incorporate circuitry that allows them to re-establish frame synchronization in much less time, typically less than 18ms.

Eliminating noise through error mitigation

When digital lines are used for general data transmission, each data segment is checked for errors upon receipt and bad segments are retransmitted. Unfortunately, this approach doesn't work for real-time audio transmission. What's needed is some way to deal with errors as they happen.

To avoid "on-air" disruptions, Intraplex equipment augments error detection with DSP-based digital error mitigation. Error mitigation is used when the original data cannot be recovered exactly, but can be approximated sufficiently well to hide or mask the error. Our linear audio modules, for example, encode the audio using a 16-bit linear A/D converter. Calculations are performed on each 16-bit sample to come up with a two-bit code, and these two bits are added to the end of the sample for a total of 18 bits.

At the receive end, the module performs the same calculation on the 16 audio bits and checks the result against the original code. If they don't match, the sample has an error.

When an errored sample is identified, state-of-the art digital signal processing is used to interpolate over the bad sample, in effect, "averaging" the audio from the samples immediately before and after the bad one, and inserting the result in its place. Given that each sample represents only about 30ms of sound, this provides an extremely effective method of masking errors. If there is a series of errors and the effect of interpolation on the audio might be deleterious, the output is momentarily muted, again keeping unpleasant noise from getting on the air.

The bottom line

Theory aside, what's the effect of enhanced transmission robustness in the real world? The chief engineer at a major radio station in Chicago, using Intraplex T1 multiplexers for his STL, reported that his phone company called him to apologize for a period of severe T1 signal degradation — even though he had perceived no loss of quality in his broadcast signal during this period.

Digital audio has the potential to maintain a clean, dynamic signal throughout the air chain, regardless of distance or medium. With properly implemented transmission robustness and digital error mitigation techniques, this potential is fulfilled. ■

Robert L. Band is manager, technical communications for Intraplex, Inc., Westford, MA.

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Fluid Heads and Tripods

The silky, smooth action of each Miller Fluid Head is the product of the finest quality cast and machined parts functioning together in a fluid environment. They are engineering masterpieces, built to operate under extreme conditions. They're engineered to exceptionally fine tolerances and their mechanisms are protected effectively against ambient moisture and dust.

Miller 20 -Series II Fluid Head

- Dynamic fluid drag control
- Sliding/quick release camera platform
- Weighs 4 lbs. – handles up to 22 lbs
- Counterbalance system compensates for nose heavy or tail heavy camera configurations and permits fingertip control of the camera throughout the tilt range
- Includes independent pan and tilt locks, bubble level, dual pan handle carriers and integrated 75mm ball levelling

Miller 25-Series II Fluid Head

- 100mm ball level fluid head • Robust, lightweight, low profile design
- Quick release camera platform • Weighs 7lbs.–handles up to 25 lbs.
- Multi-step fluid drag system and integrated counterbalance system provide ultra-smooth, repeatable pan-and-tilt fluid control and finger-tip camera balance for ENG camcorders, industrial CCD cameras or small studio cameras

#601-Lightweight Tripod

- Weighs 4.5 lbs., supports up to 30 lbs
- Minimum height down to 24", maximum height to 57"
- Extremely portable, folds down to 33"
- Engineered from thermoplastic moldings, diecast alloy and hard anodized tubular alloy
- Fast, one turn, captive leg locks
- Includes 75mm (3") ball levelling bowl

#649-2-Stage Tripod

- Two extension sections on each leg. Operates at low levels as well as normal heights without the use of mini legs
- High torsional rigidity, no pan backlash
- Weighs 6 6lbs., supports 50 lbs • Very portable, folds to 27"
- Includes 75mm (3") ball levelling bowl

System 20 #338—Miller 20 Head, 601 Lightweight Tripod, On Ground Spreader
System 20 ENG #339—Miller 20 Head, 649 2-Stage Aluminum, On Ground Spreader
System 25 #500—Miller 25 Head, 611 Lightweight Tripod, On Ground Spreader
System 25 ENG #502—Miller 25 Head, 641 2-Stage Aluminum, On Ground Spreader

Vinten

Vision SD 12

Pan and Tilt Head with Serial Drag

The Vision SD 12 head features "Serial Drag" pan and tilt system. System consists of a unique, permanently-sealed fluid drag and an advanced lubricated friction drag. You achieve the smoothest pans and tilts regardless of speed, drag setting and ambient temperature.

- Patented spring-assisted counter-balance system permits perfect "hands-off" camera balance over full 180° of tilt.
- Instant drag system breakaway and recovery overcome inertia and friction for excellent "whip pans".
- Consistent drag levels in both pan and tilt axis.
- Flick on, flick off pan and tilt caliper disc brakes.
- Greater control, precision, flexibility and "touch".
- Touch activated, time delayed illuminated level bubble.
- Working conditions from as low as -40° up to +60°C
- SD 12 weighs 6.6 lbs and supports up to 35 lbs.

Vision Two Stage ENG and LT Carbon Fibre ENG Tripods

The ultimate in lightweight and innovative tripods, they are available with durable tubular alloy (Model #3513) or the stronger and lighter, axially & spirally wound carbon fiber construction (Model #3523). They incorporate torque safe clamps to provide fast, safe & self-adjusting leg clamps.

- "Torque Safe" requires no adjustment. Its unique design adjusts itself when required, eliminating manual adjustment and maintenance and making for a much more reliable clamping system.
- New hip joint eliminates play and adds rigidity
- They both feature 100mm levelling bowl, fold down to a compact 28", and support 45 lbs.
- #3513 weighs 6.5 lbs • #3523 CF (Carbon Fibre) weighs 5.2 lbs

Vision 12 Systems

Vision 12 systems include #3364-3 SD 12 dual fluid & lubricated friction drag pan/tilt head, single telescoping pan bar & clamp with 100mm ball base.

SD-12A System
- SD-12 pan and tilt head
- 3518-3 Single stage ENG tripod with 100mm bowl
- 3363-3 Lightweight calibrated floor spreader

SD-12D System
- SD-12 pan and tilt head
- 3513-3 Two-stage ENG tripod with 100mm bowl
- 3314-3 Heavy-duty calibrated floor spreader

VIN-5ST and VIN-10ST

- Compact & lightweight, they maintain Vision performance and quality
- Provide total stability and durability with payloads up to 33 lbs.
- Ideal for the latest generation of dockable and one-piece camcorders
- Compatible with all Vision accessories

VIN-5ST includes Vision 5LF head, single stage toggle clamp tripod, spreader and soft case
VIN-10ST includes Vision 10LF head, single stage toggle clamp tripod, spreader and soft case

QUICK DIAL 74

Canon

IF+ Series 1/2-inch & 2/3-inch Zoom Lenses

Canon's IF+ family of lenses are engineered to meet the needs of the next generation of broadcasting while meeting the standards of today. Besides having the widest wide angle lens available, the IF+ lens series have wider angles at shorter M.O.D. (Minimum Object Distance), provide higher MTF performance and incorporate Hi-UD glass for reduced chromatic aberration. In addition to superb optics they're all designed with Canon's "Ergonomic Grip" for fatigue-free shooting over an extended time. IF+ lenses are your assurance of unsurpassed quality and performance for today and tomorrow.

J15ax8B

A next generation internal focusing lens with the shortest MOD and widest angle of any standard lens, the J15aX8B IRS/IAS is a standard ENG lens that lets you shoot in tight or restricted areas at the closest mimimum object distance ever possible and capture more of the subject. It incorporates all the great features of IF+lenses including a built-in 2X extender, high MTF performance, Hi-UD glass, square lens hood and Canon's "Ergonomic Grip".

J20ax8B IRS/IAS

Excellent for ENG, sports and production, the J20aX8B IRS/IAS lets you squeeze in shots from 8mm and still take you all the way out to 320mm with its built-in extender. Incorporates all IF+ features, plus is the only lens (besides the J9aX5.2B IRS/IAS) with aVari-Polar lens hood, enabling rotation of attached filters

JVC GY-X2B 3-CCD S-VHS Camcorder

- Newly designed three 1/2" CCD image sensors deliver 750 lines of horizontal resolution and superb signal-to-noise ratio of 62dB
- Micro-lens technology provides exceptional sensitivity of F8.0 at 2000 lux and LOLUX mode lets you shoot with almost no light! Shoot superb footage with excellent color balance at a mere 1.5 lux
- Variable Scan allows flicker-free shooting of a computer screen
- Full Time Auto White circuit lets you move from incandescent to fluorescent to outdoor lighting without changing white balance or the filter wheel
- Quick Record Mode - when turned on the camera is set to the auto iris even if lens is set at manual. Also activates Automatic Level Control and Extended Electronic Iris which provides both variable gain and variable shutter. Shoot continuously from dark room to bright outdoors without having to adjust gain, iris or ND filter.
- Dual output system allows camera output to be connected directly to an external recorder

NEW! KY-D29 3-CCD Color Video Camera

One of the most sensitive cameras ever developed, the KY-D29 sets the standard for 3-CCD cameras and is also ideally suited for today's digital recording formats. With a sensitivity F11 at 2,000 lux, the KY-D29 can shoot in light as low as a remarkable 0.35 lux. It also offers a signal-to-noise ratio of 65 dB (with its DNR function on), and delivers 850 lines of horizontal resolution. The exceptional resolution and sensitivity of the KY-D29 are achieved by three new 760,000 pixel 2/3" interline transfer (IT) CCDs, the highest pixel count in the industry.

All-New Digital Signal Processing

- Advanced 14-bit Digital Signal Processing (DSP) and 3-dimensional Digital Noise Reduction (3D DNR) circuitry make this camera ideal for acquisition with todays popular digital formats, especially JVC's revolutionary new Digital-S.
- DSP within the camera provides astonishingly crisp, high-quality images, while minimizing analog distortions and noise. DSP also makes the camera more flexible and easy to use. It even smoothes the transitions between gain and white balance settings so that viewers won't notice sudden changes of settings while the tape is rolling
- Digital signal processing is enhanced with new 3D digital noise reduction circuitry to make it even more practical. By mixing multiple frames to cancel out random noise, then using motion detection to minimize lag, JVC's exclusive 3-D DNR produces dramatic results, far superior to any other DSP camera.

Super LoLux for Extremely Low Light Shooting

- Incredible new Super LoLux technology allows you to obtain a broadcast-quality picture in light as low as 0.35 lux. This extra-ordinary low light capability is the best ever achieved and is made possible by utilizing JVC's exclusive LoLux dual pixel readout technology (increasing gain by 6 dB without introducing noise) while at the same time doubling the pixel readout integration time to 1/30 second.

Versatile Docking Capability

- Extremely high quality 4:2:2 digital recordings can be made by docking the KY-D29 to JVC's Digital-S BR-D40 dockable recorder. This digital combo produces recordings far superior to any component analog camcorder, or 4:1:1 digital camcorder. The KY-D29 also docks directly to JVC's BR-DV10 DV-format and BR-S422 S-VHS dockable recorders and can dock to Betacam SP recorders using an adapter.

Features for a Wide Range of Applications

- The KY-D29 is loaded with a wealth of high-performance features, making it ideal for a wide range of broad cast and professional applications. Built-in continuous auto black (CAB) continuously takes a black balance setting, and full-time auto white for continuous compensation of color temperature changes, balance the camera in real time, all the time. This allows you to concentrate on getting the shot, and not on adjusting the camera.
- Because different shooting situations require flexibility, the KY-D29 offers selectable vertical resolution. In the Standard Mode, the camera produces 380 TV lines of vertical resolution. However, in the "V-Plus" high vertical resolution mode, the camera puts out 420 TV lines of vertical resolution, allowing you to increase vertical resolution without sacrificing sensitivity or lag, while maintaining 850 TV lines of horizontal resolution.
- Focusing is easier than ever with Accu-Focus. By momentarily decreasing depth of field, fast & critical focus is achieved instantly.
- Commonly used features can be activated without having to scroll through layers of menus. Features such as shutter control, variable scan, black stretch, black compress, CAB, iris modes, Accu-Focus, DNR and zebra are all menu-free. And for those times when events move so fast it prevents you from making any settings whatsoever, the KY-D29's Full Auto Shooting (FAS) mode controls all of the camera's requiring you control only the focus, zoom and trigger.
- Other camera features include a built-in time/date, built-in zebra level selection switch, an f-stop display in the viewfinder, and a "battery remaining" display for Anton Bauer battery packs. A special Black

Panasonic

Broadcast & Television Systems

AG-DP800H SUPERCAM

S-VHS 3-CCD Digital Signal Processing Camcorder

- Three high-density 380,000 pixel CCDs with half-pitch pixel offset achieves 750 lines of horizontal resolution, S/N ratio of 60dB and sensitivity of f8 at 2000 lux. Additionally the Frame Interline Transfer (FIT) CCDs minimize vertical smear even in very bright illumination.
- Digital Signal Processing circuitry provides four valuable benefits
  1) Consistently reliable up-to-spec performance.
  2) Fine adjustment of a wide range of parameters.
  3) Memory storage and instant recall of specific settings.
  4) More flexible and higher quality image processing, easier maintenance.
- Super High Gain mode allows shooting under illumination as low as 2 lux while retaining detail and color balance.
- Synchro Scan function allows flicker-free shooting of computer monitors. Electronic shutter increments can be set variably from 1/61 seconds to 1/253 of a second.
- Built-in internal time code generator lets you record with SMPTE LTC/VITC (Longitudinal/Vertical Interval) time code
- Two Hi-fi stereo audio channels with a dynamic range of 80 dB, as well as two linear audio channels with Dolby NR.
- Has a 26-pin connector for convenient backup recordings using an additional VCR equipped with a 26 or 14-pin connector
- Phantom power can be supplied to an optional mic. Power can be switched off to prevent battery drain when not in use.

wDP-800H "LS" Package:
- DP-800H Supercam 3-CCD camera head with 1.5" electronic viewfinder and Anton Bauer Gold Mount battery plate
- Fujinon S14x7.5 BRM 14:1 servo zoom lens
- CC-S800 soft carrying case
- WV-QT700 tripod mounting plate

DP-800H "XL" Package:
- DP-800H Supercam 3-CCD camera head w/1.5" electronic viewfinder and Anton Bauer Gold Mount battery plate
- Fujinon S14x7.5 BRM 14:1 servo zoom lens
- CC-H800 Thermodyne hard shelf carrying case
- WV-QT700 tripod mounting plate
- Two Anton Bauer Digital Trimpack 14 batteries
- Anton Bauer 2-position quick charger

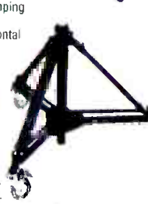
QUICK DIAL 72

sachtler

VIDEO 14/100 FLUID HEAD

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

HOT POD TRIPOD SERIES



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

ENG TWO-STAGE TRIPOD SERIES

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

NEW! Sachtler CADDY systems

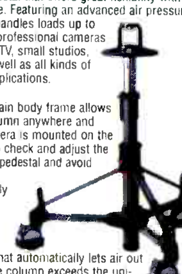
Now Sachtler quality is available to low budget users. The price of a CADDY system includes the new 7-step dampened CADDY fluid head, ultra-light but rugged carbon fiber tripod, lightweight spreader and either a soft bag or cover. The CADDY fluid head features an adjustable pan arm, 7 step adjustment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

CAD 01 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

Libec MATTHEWS

P100 Portable Pneumatic Pedestal



The P100 is a small size pedestal that offers great flexibility without taking up too much space. Featuring an advanced air pressure system, the P100 smoothly handles loads up to 66lbs., easily accomodating professional cameras used in a studio. Ideal for CATV, small studios, event and wedding video as well as all kinds of industrial and institutional applications.

Air Pressure System:

- Air pump attached to the main body frame allows air to be pumped into a column anywhere and anytime – even while a camera is mounted on the pedestal. This allows you to check and adjust the air pressure while using the pedestal and avoid over-filling of air.
- Air pressure can be gradually adjusted by discharging air through a bleed valve when too much air has been pumped into the column. There is also a relief valve that automatically lets air out when air pressure inside the column exceeds the uniform value, bringing it below the uniform value.
- Large double wheel 5" casters allow the P100 to move smoothly and quickly. Wheels and caster axles are easily fixed by the double stopper system.
- A track lock mechanism locks the wheels of the pedestal so that it only moves in a desired position.
- Cable guards prevent the casters from rolling over and becoming tangled in camera cables when the tripod is moved around in a studio.
- Large steering wheel affords greater ease in handling when shifting columns up and down or when moving the pedestal.
- Maximum and minimum height is 31" to 61". By attaching the optional LA-100 Low Angle Adapter to the dolly for shooting at low angles. (Height from the ground to mount is only 10").
- The column and dolly can be quickly disassembled for convenient transport. The column weighs 18 lbs. and the dolly 16 lbs.

H80 Professional Fluid Head

A premium fluid head, the H80 incorporates a patented drag control system that provides the smoothest pan and tilt available.

- Unlike conventional drag systems that have click stops at predetermined points, Libec's Continuous Drag Control System provides infinite control of drag tension allowing smooth, rapid movements as well as very slow movements
- Continuous Counter Balance Control System provides optimum camera balance with tilt angles of + 90° or -90°
- Designed to withstand the most demanding environments, the H80 is fully operational even in temperatures as low as -22°F.
- H80 supports up to 37 lbs. and has a 100mm claw-ball to simplify camera leveling.

H70 Professional Fluid Head

The H70's patented counter balance mechanism supports various operating configurations including stand-alone cameras, camcorders and studio cameras with large viewfinders. Perfect balance can be obtained with settings from 0 to 3, depending on camera weight (from 15 to 33 lbs.) and tilt angle.

- Sliding balance plate features a locking mechanism and allow a total of 4" (100mm) of travel for camera balance. Has a 100mm claw ball.

SEVEN-DAY CUSTOMER SATISFACTION GUARANTEE

VIDEO and PRO AUDIO

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B&H
PHOTO - VIDEO - PRO AUDIO

QUICK DIAL 74

NRG

POWER VEST SYSTEM

The Power Vest combines the comfort and convenience of a photo-journalist style vest with the power of NRG's highest capacity power belt. Available in two styles, the **Field** model is designed for use in a field production environment, while the **Event** model is for shooting events where style is everything. The Field model is ruggedly constructed from black high density weatherized ballistic nylon and has an open-cut style that makes it comfortable to wear in a variety of climates. Also has a highly adjustable design to fit almost any physical proportion.

- Internal and external pockets for blank tapes and accessories, a clear insert window for a press pass or business card, D-rings for cables and microphones, and an integral padded camera rest on the right shoulder.
- Cleverly concealed inside the vest is your choice of 12-volt 86 watt hour or 13.2-volt 95 watt hour nicad cell packs.
- A control box on the front features dual power outputs (dual cigarette, dual XLR or mixed).
- 7-stage "fuel-guage", charge status indication and auto-reset short/overload protection.

The **Event** model is very similiar to the **Field** except in place of rugged fabric and pockets it features shoulder to sternum black satin tux fabric. Worn under a suit coat, the **Event** model is indistinguishable from a formal dress vest and it still retains interior and low exterior pockets. Both vests include 300-series charger (12 hrs.) and can be used with the optional Intelliquick Fast Charger (2 hrs.).

POWER CAN SERIES

For powering single or multiple pieces of 12v DC equipment for extended periods of time, nothing beats the power and convenience of NRG's Power-Can Series. It integrates an ultra-high capacity, high-discharge-capable UPS type lead acid power cell, a world-wide fast charger, and computer-controlled monitoring system with display—in a single, rugged package. Connect up to four pieces of equipment simultaneously. From a midnight emergency scene to a wedding reception in the park, the Power-Can delivers ample power for extended running time.

- Recharge in 8-10 hours by simply plugging the Power-Can into any source of AC power (90-250v AC).
- LCD display shows discharge/charge status, voltage etc.
- An optional "Power Dolly" allows the Power-Can to be rolled for easy transport.
- Available in 18, 28 and 40 amp versions, each Power-Can has either four cigarette lighter connectors, four 4-pin XLR connec-

HORITA

BSG-50
Blackburst/Sync/Tone Generator

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

- 6 BNC video/pulse outputs
- Now available: 6 blackburst, 4 sync, 2 subcarrier
- Each sync output individually settable for composite sync, composite blanking, H-drive, or V-drive
- Separate buffer for each output–maximum signal isolation
- 1KHz, 0dB sinewave audio tone output, locked to video
- Outputs can easily be configured to meet specific user and equipment needs **$269**

CSG-50
Color Bar/Sync/ Tone Generator

- Generates full/SMPTE color bars, blackburst and composite sync signals
- Built-in timer can automatically switch video output from color bars to color black after 30 or 60 seconds. Easy and convenient for producing tape leaders and striping tapes with color bars and black.
- Front panel selection of full-field or SMPTE color bar patterns or colorblack (blackburst) video output.
- Includes crystal-controlled, 1KHz, 0dB audio tone output.
- Outputs: video, sync, ref frame, 1 KHz, 0dB
- Audio tone switches to silence and color bars change to black when using 30/60 second timer
- Fully RS-170A SC/H phased and always correct. No adjustment required **$349**

WE STOCK THE FULL LINE OF HORITA PRODUCTS INCLUDING:

- **WG-50** - Window Dub Inserter
- **TG-50** - Generator/Inserter
- **TRG-50** - Generator/Inserter/Search Speed Reader
- **TRG-50PC** - Has all of the above plus RS-232 control.
- **VG-50** - VITC Generator, LTC-VITC Translator
- **VLT-50** - VITC-To-LTC Translator
- **VLT-50PC** - VITC-To-LTC Translator / RS-232 Control
- **RLT-50** - Hi8 (EVO-9800/9850)TC to LTC Translator
- **TSG-50** - NTSC Test Signal Generator
- **SCT-50** - Serial Control Titler "Industrial" CG, Time-Date Stamp, Time Code Captioning
- **SAG-50** - Safe Area, Convergence Pattern and Oscilloscope Line Trigger and Generator

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QUICK DIAL 72

GLIDECAM INDUSTRIES

V-16 AND V-20
Professional Camera Stabilization Systems

The GLIDECAM V-16 and V-20 Camera Stabilization Systems 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. Designed primarily for professional video and 16mm motion picture cameras, the Glidecam 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. With either of the "V" series stabilizers you'll be able to offer the type of professional shooting techniques that were previously available only to clients with full budgets. 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.

The Glidecam Support Vest

The lightweight and comfortable Support Vest can be adjusted to fit a wide range of operators. High endurance, closed cell, EVA foam padding and integral T6 aluminum alloy create a vest which can hold and evenly distribute the weight of the Glidecam V-16 and V-20 mesystem across the operator's shoulders, back, and hips. For safety, quick release, high impact buckles allow the vest to be removed quickly.

The Three Axis Gimble

A free floating, precision Gimble incorporating Integrally Shielded Bearings creates the super-smooth and pivotal connections between the front end of the Dyna-Elastic Arm and the Camera Mounting Assembly. The Three Axis Gimble provides the operator with finger tip control over fluid tilting, panning and rolling. A locking mechanism allows the Gimble to be placed at varying positions on the Central Support Post. Moving the Gimble effectively adjusts the Systems Center of Gravity. The upper portion of the Sled's central support post includes guide markings. These markings allow for accurate gimble positioning.

The Dyna-Elastic Arm

The Exoskeletal, Dyna-Elastic Support Arm is designed to counteract the weight of the combined camera and Camera Mounting Assembly by employing high carbon alloy springs. The arm may be boomed up and down, as well as pivoted in and out, and side to side. It is the combined booming and pivoting action of the arm which creates the shock absorption necessary for ultra-smooth camera movement and mobility. The spring force is field adjustable to allow for varying camera weights. For safety, a Dual-Spring design is employed to reduce spring failure damage.

QUICK DIAL 74

lowel

ViP Video Lighting System

Designed for video, ViP systems provide 55 to 500 watt capabilities, powered by AC or DC. Mount one on-camera, on-stand, or hand hold it. Some ViPs feature adjustable beam angles. All are light weight and convention cooled.

V-light

Efficient enough to light a small room yet small enough to fit in a large pocket, the V-light provides a broad key light, back light or fill light (with umbrella or gel)

- Extreme wide-angle multi-use halogen source
- Mounts on stand, clamps, boom, wall, window, door-top
- 500 watt, AC powered (lamps not included)

i-light

Battery powered light provides excellent fill light, eye-light, or high-lights, with good contrast control for news and documentary shooting

- Small and lightweight (18 oz.) for on camera use
- Multi-use 6:1 focusing range with i-100 lamp (lamps not included)
- 55 or 100 watt (12/14 volts DC)
- Includes cig. lighter connector or optional 4-pin XLR

Pro-light

Can be used as a low-level key or accent light, fill light (w/diffusion), backlight or background light.

- Multi-use halogen, focusing/tilting controlled with one hand.
- 125 or 250 watt AC, 100 watt 12 volt, or 200 watt 30 volt DC
- Optional cigarette, 4-pin and 5-pin XLR connectors
- Lamps not included

Tota-Light

Provides a base or bounce light, backlight, or background light. Use it with an umbrella or gel frame with a diffusion kit. It is an ideal fill light or small soft key or illumination for copy work.

- Multi-use halogen source with 360° no-yoke tilting
- Choice of 300, 500, 650, or 750 watt AC lamps (not included)
- Gull-wing reflectors close compactly for storage and travel

Omni-Light

Produces the ideal key or back-light, and with diffusion or an umbrella, it becomes a great soft fill source. With accessories, hand-hold the Omni, camera mount it, or choose from a wide variety of mounting systems.

- Multi-use halogen source provides a non-crossover beam
- Choice of optional quick-change Super-Spot Reflector for exceptionally long throws at all voltages
- Choice of lamps: 420 or 500 watt 120v AC, 650 watt 220/240v AC, 250 watt 30 volt DC, 100 watt 12 volt DC (lamps not included)

DP System

Only 3.9 pounds the DP Light offers a very powerful key, backlight, or background light with or without diffusion. When used with its umbrella or diffusion it provides a soft key, fill, or side light. It includes a #1 reflector for an 8:1 focusing range and a large cool-operating hand grip and knobs

- Multi-use halogen source with 170° no-yoke tilt ng
- Choice of 500, 750, or 1000 watts 120 volts; 650 or 1000 watts 220/240 volts (Lamps not included)

Complete line of Lowel lights, lighting kits and accessories in stock ..Call

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anton bauer

Logic Series DIGITAL Gold Mount Batteries

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

DIGITAL PRO PACS

The 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

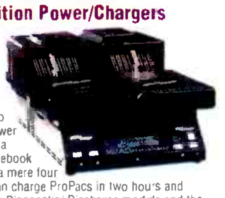
DIGITAL TRIMPAC

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

InterActive 2000 Power/Chargers

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 all 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 bundles all Power/Charger features in the ultimate professional power system.

Dual 2702/2401
Two-Position Power/Chargers

The DUAL 2701 (70 watt) and 2401 (40 watt) are sleek, rugged and 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. Their compact, lightweight package design makes them the ultimate travel Power/Chargers. They can also be upgraded with the Diagnostic/Discharge Module and/or with the Expansion Charge Modules to charge up to six batteries of any type.

PROFESSIONAL VIDEO TAPES

QUICK DIAL 71

Fuji

Professional Grade VHS
PG-30 ... 2.29 · PG-60 ... 2.49 · PG-120 ... 2.69

Superior Grade Double Coated VHS
SG-30 ... 3.39 · SG-60 ... 3.99 · SG-120 ... 4.49

H471S S-VHS Double Coated
ST-30 ... 6.99 · ST-60 ... 7.49 · ST-120 ... 7.99

M221 Hi 8 Double Coated

Metal Particles		Metal Evaporated	
P630HMP	4.99	E630HME	8.39
P660HMP	6.49	E660HME	10.49
P6120HMP	8.49	E6120HME	13.99

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.) ... 8.29 · 23M ... 9.99 · 33M ... 12.99
63M ... 22.49 · 64L (Lg.) ... 23.99 · 94L ... 34.99
123L ... 46.99

maxell

Hi8 Metal Particle (XRM)
P6-120 XRM ... 6.59

Broadcast Quality Hi8 Metal Particle
P6-30 HM BQ ... 5.39 · P6-60 HM BQ ... 6.09
P6-120 HM BQ ... 7.99

P/I PLUS VHS
T-30 Plus ... 1.69 · T-60 Plus ... 1.99 · T-90 Plus ... 2.09
T-120 Plus ... 2.19 · T-160 Plus ... 2.69

HGX-PLUS VHS (Box)
HGXT-60 Plus ... 2.69 · HGXT-120 Plus ... 2.99
HGXT-160 Plus ... 3.99

BQ Broadcast Quality VHS (Box)
T-30 BQ ... 5.49 · T-60 BQ ... 6.19 · T-120 BQ ... 7.39

BQ Professional S-VHS (In Box)
ST-31 BQ ... 7.19 · ST-62 BQ ... 8.09
ST-126 BQ ... 8.39 · ST-182 BQ ... 17.49

Betacam SP
B5MSP ... 15.75 · B10MSP ... 17.75 · B20MSP ... 19.75
B30MSP ... 20.50 · B60MLSP ... 29.75 · B90MLSP ... 46.49

Panasonic

Mini DV Tape
AY DVM-30 ... 9.95 · AY DVM-60 ... 11.99

DVCPRO
AJ-P12M (Medium) ... 10.99 · AJ-P23M ... 12.99
AJ-P33M ... 15.99 · AJ-P63M ... 29.99
AJ-P64L (Large) ... 29.99 · AJ-P94L ... 49.95
AJ-P123L ... 64.95

SONY

Hi-8 Professional Metal Video Cassettes
P6-30 HMPX ... 4.59 · P6-30 HMEX ... 7.99
P6-60 HMPX ... 6.59 · P6-60 HMEX ... 11.49
P6-120HMPX ... 8.89 · P6-120HMEX ... 15.49

Hi-8 Metal Evaporated Editor (HMEAD)
E6-30 HMEAD ... 10.49 · E6-60 HMEAD ... 14.89
E6-120 HMEAD ... 20.19

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 ... 3.59 · T-60BA ... 3.99 · T-120BA ... 4.79

MQ Master Quality S-VHS (In Box)
MQST-30 ... 7.49 · MQST-60 ... 7.99 · MQST-120 ... 8.39

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) ... 14.99 · BCT-10M (small) ... 15.99
BCT-20M (small) ... 17.99 · BCT-30M (small) ... 18.99
BCT-30ML ... 21.49 · BCT-60ML ... 27.99 · BCT-90ML ... 41.99

Mini DV Tape
DVM-30EXM w/Chip ... 15.99 · DVM-60EXM w/Chip ... 19.95
DVM-30EX "No Chip" ... 12.95 · DVM-60EX "No Chip" ... 14.99
DVM-30PR "No Chip" ... 9.95 · DVM-60PR "No Chip" ... 12.95

Full Size DV Tape with Memory Chip
DV-120MEM ... 29.95 · DV-180MEM ... 34.95

PVD Series Professional DVCAM Tape
PDVM-12ME (Mini) ... 24.50 · PDVM-22ME (Mini) ... 26.95
PDVM-32ME (Mini) ... 29.50 · PDVM-40ME (Mini) ... 31.95
PDV-64ME (Standard) ... 39.95 · PDV-94ME (Standard) ... 44.95
PDV-124ME (Standard) ... 49.95 · PDV-184ME (Standard) ... 59.95

CORPORATE ACCOUNTS WELCOME

Circle (59) on Free Info Card

QUICK DIAL 74

Panasonic

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, 8 background colors available)
- Digital effects: strobe, still, mosaic, negative/ positive, paint, monochrome, strobe, trail, and AV synchro
- Real-Time compression - entire source image is compressed inside a wipe pattern
- "Scene Grabber" – move a pattern while upholding the initially trimmed-in picture integrity.
- Non Additive Mix (NAM): selects between A and B sources, passing only the signal with the highest luminance value
- Fade-in and fade-out video, audio, titles individually or synchronously faded.
- Down stream keyer with selectable sources from character generator or external camera
- 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.

BT-S1360Y

13" Color Video Production Monitor

The BT-S1360Y is a full-function, professional 13" production monitor with a wealth of features. They include, superb 420-line horizontal resolution, S-Video input and output, advanced automatic white balance circuitry, blue-only mode, underscan and pulse-cross. All this, housed in a rugged, rack mountable metal-hybrid cabinet. So, for long-term reliability in any professional application, the BT-S1360Y is the ideal choice.

- Incorporates advanced, proprietary white balance circuitry that stabilizes white balance to provide outstanding picture performance automatically.
- S-Video input and advanced video circuit technology provides a remarkably sharp picture with over 420 lines of horizontal res.
- External sync inputs and outputs provide for synchronization with other equipment fed with the same sync signal.
- Blue Only mode plus Chroma selection provide a monochrome image for fine adjustment of contrast, brightness, chrominance & hue.
- Pulse Cross – displays horizontal and vertical intervals at the center of the screen so you can examine data in the blanking area and also sync/burst timing
- Two sets of video/audio inputs and outputs.
- Underscan –shrinks the scanned area of the picture tube approximately 5% enabling the entire active picture area to be displayed. Lets you detect intruding camera and mike booms.
- Switchable color temperatures of 6500°K (broadcast standard) or 9300°K (for pleasing picture).
- Built-in speaker and headphone jack.
- Rack-mountable with optional BA-131 brackets.

BT-S 1360Y Olympic Demo Special!

We have a limited stock of BT-S1360Y monitors that were used by Panasonic exclusively at the 1996 Olympics in Atlanta. Used only by Panasonic engineers in broadcasting the summer games, these monitors are like new.

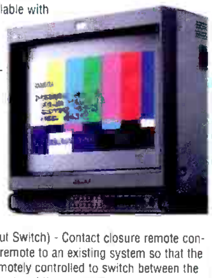
Demo Special $599

($400 less than our regular selling price on this monitor)

SONY

PVM-14N1U/14N2U & 20N1U/20N2U

13" & 19" 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. Four models, the PVM-14N1U/20N1U are designed for simple picture viewing, the PVM-14N2U and 20N2U add RGB input and switchable aspect ratio for more sophisticated applications.

They Feature:

- 500 lines of resolution to match DV, DVCAM and DVCPRO recording capabilities.
- Beam Current Feedback for color temperature stability
- They handle four worldwide color systems: NTSC, NTSC 4.43, PAL, and SECAM.
- On screen display in five languages. Picture adjustments (chrome, phase, contrast, brightness) and setup adjustments (volume, aspect ratio) are displayed as easy-to-read on screen menus.
- Built-in speaker for small audiences without the expense of an external sound system.
- Closed captioning is available with the optional BKM-104 Caption Vision Board.
- Designed with a sturdy metal cabinet for stability, durability and rack mounting. The 13-inch series mount in a 19-inch rack with the MB-502B Rack Mount Bracket. The 19-inch monitors with the SLR-103A Slide Rail Kit.
- **PVM-14N2U/20N2U Only:**
- Remote Control (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.
- With the PVM-14NU2 and PVM-20N2U Series, the aspect ratio is switchable between 4:3 and 16:9 simply by pressing a button.

PVM-14M2U/14M4U & 20M2U/20M4U

13" & 19" 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 use an aperture grille dot pitch of 0.25mm to 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.
- Beam Current Feedback Circuit • 4:3/16:9 switchable aspect ratio.
- Each has two composite (BNC), one S-Video and component input (R-Y/B-Y, analog RGB) for flexibility. For more accurate color reproduction, the component level can be adjusted according to the input system. Optional serial digital interface kit BKM-101C (video) and BKM-102 (audio) for SMPTE 259M component serial digital input.
- True multi-system monitors they are equipped to handle four color system signals: NTSC, NTSC 4.43, PAL, and SECAM.
- External sync input and output for synchronization with other equipment. Can 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).
- Underscan and H/V delay capability. In underscan mode the entire active picture area is displayed, allowing you to view the entire image and check the picture edges. H/V delay allows viewing of the blanking area and sync/burst timing.
- Using color bars as a reference, Chroma/Phase setup mode facilitates the complex, delicate procedure of monitor adjustment. Especially convenient when used with computer-based editing systems.
- On-screen menus for monitor adjustment/operation.
- Parallel remote control and Tally via 20-pin connector.
- Sub control mode allows fine, on-screen adjustment of the center "detent" value of the contrast, brightness, chroma and phase knobs.
- PVM-14M2U/M4U mount in a 19-inch rack with the MB-502B Rack Mount Bracket. The 20M2U/M4U monitors mount with the SLR-103A Slide Rail Kit.

QUICK DIAL 8

SENNHEISER

Condenser Microphones

Unlike traditional condenser microphones, the capacitive transducer in Sennheiser condenser microphones is part of a tuned RF-discriminator circuit. Its output is a relatively low impedance audio signal which allows further processing by conventional bi-polar low noise solid state circuits. Sennheiser microphones achieve a balanced floating output without the need for audio transformers, and insures a fast, distortion-free response to audio transients over an extended frequency range. The RF-design yields exceptionally low noise levels and is virtually immune to humidity and moisture. The comparatively low RF-voltage across the elements of the transducer also eliminates arcing and DC-bias creeping currents. Sennheiser employs RF-technology to control residual microphone noise. Optimizing the transducer's acoustic impedance results in a further improvement in low noise performance. Sennheiser studio condenser microphones operating according to this RF-principle have proven their superior ruggedness and reliability in the past decades under every conceivable environmental condition.

MKH 40 P48U3

Cardioid

- Highly versatile, low distortion push-pull element.
- Transformerless RF condenser, high output level.
- Transparent response, switchable proximity EQ. Recommended for most situations, including digital recording, overdubbing vocals, percussive sound, acoustic guitars, piano, brass and string instruments, Mid-Side (M-S) stereo, and conventional X-Y stereo. Vocals when used with a pop-screen.

MKH 60 P48U3

Short Shotgun

- Short interference tube RF condenser.
- Lightweight metal alloy, transformerless, low noise, symmetrical capsule design.
- Smooth off-axis frequency response. Handles extremely high SPL (135 dB), ideal for broadcasting, film, video, sports recording, interviewing in crowded or noisy environments. Excellent for studio voiceovers.

Digital Multi-Track Recording

TASCAM DA-88

- ATF system ensures no tracking errors or loss of synchronization. All eight tracks of audio are perfectly synchronized. It also guarantees perfect tracking and synchronization between all audio tracks on all cascaded decks - whether you have one deck or sixteen (up to 128 tracks!)
- Incoming audio is digitized by the on-board 16-bit D/A at either 44.1 or 48KHz. The frequency response is flat from 20Hz to 20KHz while the dynamic range exceeds 92dB.
- Execute seamless Punch-ins and Punch- outs. This feature offers programmable digital crossfades, as well as the ability to insert new material accurately into tight spots. You can even delay individual tracks to generate special effects or compensate for poor timing.

SONY PCM-800

- Flawless sound quality, outstanding reliability and professional audio interfacing with AES/EBU digital I/O and XLR analog I/O connections.
- Combines audio functions such as precise auto punch in/out digital cross fade technology, external synchronization with SMPTE/EBU time code and selectable sampling frequencies of 44.1 and 48kHz.
- Shuttle dial for precise tape control, variable speed playback of 6% in 0.1% increments and a flat frequency response from 20Hz to 20kHz.
- Operate up to 16 PCM-800's in perfect sync with optional RCC-S1 sync cables, for up to 128 channels of digital audio recording.
- Optional DABK-801 Sync Board provides SMPTE/EBU time code generation and chase sync. It locks to the incoming time code with subframe accurate offset— ideal for audio-follow-video applications. Also synchronizes to external video reference signal.
- Optional RM-D800 provides comprehensive remote control over all PCM-800 functions. The RM-D800 can control up to six units for up to 48 channels of digital audio.

ALESIS adat xt

8-Track Digital Audio Recorder

An incredibly affordable tool, the ADAT-XT sets the standard in modular digital multitrack recording. With new features and enhanced capabilities, the ADAT-XT operates up to four times faster than the original ADAT, offers an intelligent software-controlled tape transport and provides onboard digital editing and flexible autolocation.

- Onboard 10-point autolocate system provides quick access to multiple tape locations. Four specialized locate points make your recording sessions quicker and easier.
- Includes remote control with transport and locate functions, offers a footswitch jack for hands-free punch-in.
- Advanced transport software continuously monitors autolocation performance and the head constantly reads ADAT's built-in sample-accurate time code—even in fast wind modes.
- Dynamic Braking software lets the transport quickly wind to locate points while gently treating the tape.
- Servo-balanced 56-pin ELCO connector operates at +4dB to interface with consoles with +4 dB bal/unbal inputs/outputs. Also unbalanced -10dB inputs/outputs (phono connectors).
- Has an electronic patch bay built-in so it can be used with stereo and 4-bus consoles.
- Make flawless copy/paste digital edits between machines or even within a single unit. Track Copy feature makes a digital clone of any track (or group of tracks) and copies it to any other track (or group) on the same recorder. This allows you to assemble composite tracks for digital editing.

QUICK DIAL 731

ANTEX StudioCard

4-Channel Digital Audio Card for Windows

The next generation in digital audio for the desktop, StudioCard is a premium-quality digital audio adapter with advanced features, studio-quality specs and professional connections. Unmatched in quality, flexibility and expandability, it features 4 tracks of audio sound and real-time digital mixing capability, making it the ideal board for musicians who want digital multitracking and mixing on their PC, or producers looking for a versatile board for post-production digital audio editing and uncompromised audio quality. StudioCard is Windows 95' plug and play compatible plus includes drivers for Windows NT as well.

- Key to StudioCard's amazing sound is the marriage of a low noise analog I/O section and high quality A/D and D/A converters. A PCI-based 32-bit memory mapped board, it delivers less than 0.003% total harmonic distortion and 92dB dynamic range. Plus, a PLL-based sample clock generator that can be locked to an assortment of clock sources.
- Incorporates a programmable 32-bit 40 MHz DSP and pro connections like 4 independent balanced analog I/Os (+4dBu or -10 dBV) and AES/EBU or S/PDIF digital I/O. It also offers a MIDI port with deep buffers and time stamping. No matter which type of equipment you have StudioCard will integrate into standard studio environments.
- Compatible with film, video or MIDI. StudioCard offers synchronization via SMPTE, MTC, word and pixel clocks, and composite video. Plus, the StudioCard not only reads SMPTE timecode, but generates it as well.
- Unique to the Antex design is StudioCard's multiple adapter capability. This means you can install multiple StudioCards in a single computer for up to 16-track recording. Start with one StudioCard today - add more StudioCards tomorrow. Also included is an on-board SPx expansion connector for plugging in optional daughtercards for compression or enhanced DSP operations.

VIDEO and PRO AUDIO

VISA · MasterCard · DISCOVER NOVUS · AMERICAN EXPRESS Cards

Announcing our relocation on September 2, 1997 to a larger expanded facility at 420 Ninth Avenue (Between 33rd & 34th Streets) New York, N.Y. 10001

B&H PHOTO - VIDEO - PRO AUDIO

QUICK DIAL 72

KNOX VIDEO

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

Video/Audio Matrix Routing Switchers

nox's family of high performance, 3-channel routing switchers are extremely versatile, asy-to-use and very affordable. Housed in an ultra-thin rackmount chassis hey accept and route (on the vertical interval) virtually any video signal, ncluding off-the-air and non-timebase corrected video. They also route alanced or unbalanced stereo audio. The audio follows the video or ou can route the audio separately (breakaway audio). Each of the witchers offers easy manual control via front panel operation. They can lso be controlled remotely by a computer, a Knox RS Remote Controller, r by a Knox Remote Keypad via their RS-232 port. Front panel LEDs ndicate the current routed pattern at all times, and an intenal battery holds nd restores current apterns in case of power interruption. Totally versatile, Knox switchers are ideal or applications such as studio-feed control and switcher input control, plus they have an internal timer allowng timed sequence of patterns for surveillance applications as well.

- Accept and routes virtually any one-volt NTSC or PAL video signal input–including off-the-air and non-timebase corrected –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 (breakaway stereo audio), 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 allows easy manual operation.
- Can also be controlled via RS-232 interface with optional RS Remote Controller or Remote Keypad.
- Internal timer allows manual or automatic timed sequence of patterns —ideal for surveillance applications
- 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 600 ohms and handle the full range of balanced audio up to +4 dB with professional quick-connect, self-locking, bare-wire connectors.

nova SYSTEMS, INC.

StudioFrame

Modular Video Processing System

The Nova StudioFrame Series is a modular, flexible, digital/analog signal processing system. It is designed to efficiently and effectively combine a wide variety of individual function (or processor) boards such as A-D and D-A converters, video signal encoders and decoders, audio and video distribution amplifiers and frame synchronizers into more complex function groups, all in one equipment mainframe. The scalable nature of the StudioFrame design allows it to be easily reconfigured and/or upgraded as today's video standards and requirements continue to evolve. The system is based on two rackmount frame models (the SF-3 and SF-1) allowing up to thirteen front loading processor boards and thirteen rear mounted passive interface cards to be accommodated in a single chassis. Both the StudioFrame SF-1 and SF-3 chassis are designed to meet the most stringent broadcast requirements. The SF-3 is a thirteen slot, 3RU chassis while the SF-1 is a 4 slot, 1RU chassis. All studio cards as well as the two chassis' are backed by a two year warranty on parts and labor with guaranteed 24-hour turnaround service. The units are ruggedly constructed to endure studio rackmount, production van and DB (Outside Broadcast) mobile applications. A universal power supply operates at either 110 or 240 VAC, 50/60 cycle. DC operation is optionally available as is a redundant supply with automatic switchover. Dual exhaust fans maintain proper airflow and cooling. "Hot swappable" front card loading allows power-on removal/insertion of individual processing modules without disturbing others in the system. All cabling can remain in place while you service" any module. An intelligent "centerplane" provides power, sync, timing and data distribution, facilitating expansion to more complex, more cost-effective signal processing functions.

NovaASD/NovaSDA

Analog to Serial Digital & Serial Digital to Analog Converters

Components of the Nova StudioFrame series, the NovaASD and the NovaSDA incorporate the latest digital video processing techniques for high speed A-D and D-A signal conversion. They are designed to meet the most stringent broadcast requirements and their "hot swappable" front card loading facilitates servicing without disturbing other cards in the system. The NovaASD is ideal for for interfacing analog video signals with digital video formats and the NovaSDA for interfacing serial digital signals with

SDA-1 Serial Digital Component to Analog Component Converter
- SMPTE 259M 4:2:2: Serial Digital Component (D1) input.
- Equalized and reclocked serial digital component output
- Analog component video (Y, R-Y, B-Y/YUV), RGB or RGB/S outputs
- 10-bit D/A converters
- Output level control
- NTSC and PAL compatible

SDA-2 Serial Digital Component to Composite and S-Video Converter
- SMPTE 259M 4:2:2: Serial Digital Component (D1) input.
- Equalized and reclocked serial digital component output
- Dual composite & dual S-Video outputs
- Color bar output selectable
- 10-bit D/A converters
- Output level control
- NTSC and PAL compatible

SDA-3 Serial Digital Composite to Analog Video Converter
- SMPTE 259M Serial Digital Composite (D2,D3) input.
- Equalized and reclocked serial digital composite output
- Four analog composite video outputs
- Color bar output selectable • 10-bit D/A converters

ASD-1 Analog Component to Serial Digital Component Converter
- Analog component video (Y, R-Y, B-Y/YUV), RGB or RGB/S input
- Dual SMPTE 259M 4:2:2 Serial Digital Component (D1) outputs
- 10-bit D/A converters
- Picture positioning control
- NTSC and PAL compatible

ASD-2 Analog Composite and S-Video to Serial Digital Component Converter
- Analog composite and S-Video input
- Dual SMPTE 259M 4:2:2 Serial Digital Component (D1) outputs
- 10-bit D/A converters
- NTSC and PAL compatible

ASD-3 Analog Composite to Serial Digital Composite Converter
- Analog composite video input
- Dual SMPTE 259M 4:2:2 Serial Digital Composite (D2/D3) outputs
- 10-bit D/A converters
- Input gain adjustment

NovaMNR Median Noise Reducer

The NovaMNR is a StudioFrame card that eliminates impulse and transmission noise, cleans up satellite, microwave and fiber feeds and fills in CDDEC and time-based corrected videotape drop-outs. It features full bandwidth, uncompressed 10-bit digital processing for ultimate video transparency as well as analog composite inputs and outputs.

- Eliminates "sparklies", those black and white dots that sometimes appear on remote video feeds. The NovaMNR incorporates a proprietary adaptive three-dimensional median filter that analyzes pixels from several fields of video and replaces the impulse noise with uncontaminated, clean video.
- Universal drop-out compensation replaces missing video information, whether it is from a time-base-corrected VCR source or the decoded output of a CODEC feed. The NovaMNR effectively fills in drop-outs with replacement video from the surrounding pixels and previous video field.
- Control's are accessible locally or remotely. A three position threshold switch (off/low/high) adjusts system noise sensitivity while a bypass/operate switch is also included. Both switches are remoteable via RJ-11 jack.
- Also available in PAL and PAL-M versions.

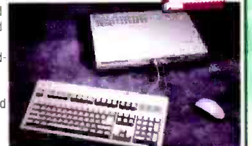
NC-8 RGB/Component to Composite/S-Video Encoder

- 10-bit processing, 8-bit D/A conversion
- Zero insertion delay, frame of memory
- Two composite and one S-video output
- Analog RGB (Sync on Green or all three), RGB/Sync and YUV (Betacam) inputs. Also available with looping inputs
- Variable luminance notch filter
- Y and C pre-comb filtering for maximum encoding performance
- Remote serial control • Output level control
- Color bar output selectable
- Designed to meet the most stringent broadcast requirements.
- "Hot swappable" front card loading facilitates servicing without disturbing other cards.
- Available in PAL and PAL-M versions

VIDEONICS PowerScript™

QUICK DIAL 74

Animated Postscript Character and Graphics Generator



The most advanced character generator ever designed for video production, multimedia and industrial applications, PowerScript delivers the huge range of titles and graphics supported by PostScript display technology, plus animation, effects, transparency and color keying. It features two GPI inputs, anti-aliased, 17.5 ns (nanosecond) pixel resolution and 4:2:2 broadcast-quality video. It also offers high-speed RISC processing to provide real-time Level 2 PostScript imaging and fast rendering—even with the most complex images. The PowerScript works stand alone or with a computer, has a built-in TBC, offers a powerful and intuitive interface, and is suitable for the desktop or can be rackmounted.

Powerful Character Generator
- Choose from 35 built-in fonts or download PostScript fonts from your PC. PowerScript's high-speed RISC processor provides real-time PostScript imaging.
- Characters can be rotated at any angle, scaled to any size, stretched horizontally or vertically.
- Styles include variable bold and italic, underline and shadow (drop shadow, variable displacement and opacity). Each character can be adjusted separately.
- Text can be positioned anywhere on the screen or automatically centered, vertically or horizontally. Left, right, top, bottom and center justification is also provided.
- Characters are automatically kerned, using the font's standard kerning information. Spacing is highly flexible with variable word and letter spacing and line spacing (leading).

Intuitive User Interface
- Built-in real-time object-based drawing tool and text editor—no computer or software required. Design can be done ahead of time and displayed later, or can be done on the fly
- Supplied keyboard and mouse are used with easy on-screen menus to place and modify graphics and text.
- Change fonts, colors, and other characters instantly.

Transparency and Colors
- Characters can be made transparent (0-100%) over video, other characters and graphics with 64 levels of transparency.
- Opaque characters can use over 4,000,000 colors, transparent characters can use over 8,000.
- Different colors can be used for fill and outline (variable width) as well as each letter and each graphic.

Roll, Scrawl, Animation, Effects
- Variable speed roll, crawl and push (slide) in all directions.
- Every text object, graphic and logo can be animated. Complex animations include having elements follow paths, bounce, etc.
- Elements can change outline and/or fill color, transparency, position as they move and results are displayed in real time.
- Move individual characters in different directions; make colors change; flash words, make letters and words bounce; spin a letter across the screen. Use fades and wipes to transition between titles and video or between two pages of titles.

Backgrounds and Graphics
- Titles can be placed on solid color, patterned or graduated backgrounds, or they can be genlocked to incoming video.
- Lines, squares, rectangles, ovals and circles can be created and placed anywhere on the screen. Each graphic object can use a different color, transparency, rotation, size, fill and outline.

Imported Logos and Graphics
- Accepts most PostScript or PCX format graphics without modification. Imported images can be any size and can be scaled, skewed, and rotated when placed on screen. Transparency and anti-aliasing can be defined when graphic is generated.

Expansion Capabilities

Although PowerScript operates on its own, you can still add peripherals and connect to a computer or network. Two PC-card slots allow the addition of non-volatile flash-RAM and Ethernet cards. RS-232 port allows connection to desktop computers for added storage and downloading of fonts or graphics from a PC

QUICK DIAL 72

LEADER

Manufacturing test and measurement equipment for over 40 years, Leader Instruments is the standard which others are measured against for reliability, performance, and most important—cost effectiveness. Before a product is brought to market, an exceptional degree of energy and effort go into its design. Prototypes are built and tested to withstand environmental and other factors far exceeding actual operating conditions. These include high humidity, extremes of heat, cold, shock and vibration. Manufacturing quality is built in every step of the way and only the finest parts are used. At each production run, subassemblies are separately tested before they are integrated into the finished product, then each product is tested again. This is why less than half of 1% of all Leader products are ever returned for warranty repair or adjustment

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 Waveform Monitor, 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 display, 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.

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

Models 5872A offers all the operating advantages of the 5870, except for the following: SCH is deleted from the 5872A (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.

ALL ITEMS ARE COMPLETE WITH ALL ACCESSORIES AS SUPPLIED BY MANUFACTURER

Continued from page 92

switcher to control remote devices as if they were built-in. For example, the 5000 can control an external Pinnacle Alladin DVE by just adding a software driver. The Alladin's control screen can be viewed on the switcher's monitor and all of Alladin's functions can be controlled using Alladin commands. Another example is adding Chyron's Winfinit! software to view and control a Chyron CG over the network, including any Max!, Maxine! or Infinit!.

The ECHOlab 5000 provides 100% non-stop operation because all live switcher functions are managed by a dedicated real-time co-processor. A redundant power supply is also available.

The use of computers has spread most rapidly in applications where computers add new capabilities and save money. A computerized switcher does both. An ECHOlab 5000 switcher with built-in Pinnacle DVE and networking costs less than half the price of most comparable switcher DVE combos.

In addition to lower equipment costs, studios using the 5000 may require fewer equipment operators because it enables the switcher operator to control multiple devices.

Modular for growth

The 5000 is all modular. The computer resides separately, so you can start without one and add it later. Analog studios can even start with a 5000 control panel mated to an analog frame, and upgrade later to digital by just swapping frames.

The back panel accepts eight different I/O modules, so most studio devices can connect to it. It's the first switcher to support any combination of digital and 10-bit analog I/O, including digital component, digital composite, analog component, analog composite, Y/C, RGB and soon digital FireWire. These I/O modules convert all signals to 10-bit ITU-R 601 component digital. It's like having a rack of affordable converters built into the back of the switcher.

The ECHOlab 5000's modular I/O also enables an easy upgrade to HDTV. The switcher's other components are designed to handle the higher data rates of HDTV, so an HDTV upgrade will just mean swapping a few I/O modules for upcoming HDTV I/O modules.

The ECHOlab 5000 switchers are the first Windows NT-based video switchers. With their networking and built-in DVE, CG, clip-store and still-store, they bring the power of open computing technology to a live broadcast switcher. ■

Ken Swanton is president of ECHOlab, Inc., Burlington, MA.

All ECHOlab switchers can be seen at www.echolab.com.

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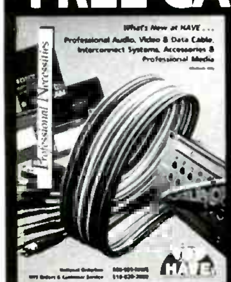

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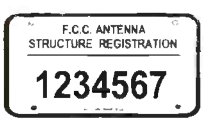

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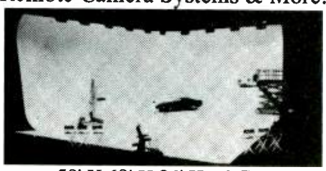

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Maintenance Engineer

NBC seeks an individual with 5+ years of extensive TV station or network maintenance experience to troubleshoot/repair broadcast systems equipment (on-air studio/master-control environments). This will include graphics hardware (still stores, paint systems), state-of-the-art switchers and effects generators, routing systems, automation, servers and microwave receive-transmit equipment.

Must be current with DTV and HDTV systems theory/technology, and able to work independently and with operations personnel in a fast-paced environment.

Qualified candidates should submit resume to: **NBC Employment, Dept. ME, 3000 W. Alameda Ave., Burbank, CA 91523.** Equal Opportunity Employer.

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HELP WANTED

SALES ENGINEERS

Thomson Broadcast, a leading provider of professional broadcast equipment, has immediate opportunities for experienced sales professionals in the Midwest, New York, and Mid-Atlantic areas.

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THOMSON BROADCAST

MAINTENANCE TECHNICIAN Television maintenance engineer. Troubleshoot, repair, install studio/microwave/transmitter equipment. Rotating on-call duty. Clean driving record. Ability to work unsupervised. Salary $16K-$25K D.O.E. KTVQ-TV ENGINEERING, P.O. Box 2557, Billing, Montana 59103. E.O.E.

MANAGER, ENGINEERING Reporting to Director of Engineering, responsibilities include reliable performance of studio, remote and transmitter technical facilities; maintaining up-to-date knowledge of technical facilities and operating practices; planning, organizing, and controlling budgets, including long-range forecasting of equipment, purchases and operating budgets. Supervise Transmitter and Maintenance Technicians. 5 years experience as engineering manager for a broadcast facility. Please send resumes to KCNC-Human Resources 1044 Lincoln St., Denver, CO- 80203. EOE/MF.

TCI-NDTC, NY is seeking qualified applicants for the following position. MAINT TECHNICIAN. Min Qual: Assoc. degree in electronics or equivalent. Five years experience in repair and maint. of broadcast equipment. Must be flexible. Desired Quals: Knowledge of analog and digital equipment, SONY Vtrs, Alamar automation. Transmission experience a plus. Drug and background check will be required for employment. Successful applicants needing special accommodation for interview should inform manager at time of contact. Send resume with salary requirements to: TCI-NDTC, 17 Battery Place, Suite 232, NY, NY 10004. Attn: HR. No phone calls. EOE.

UPLINK ENGINEER Frontline Communications is in need of engineers to construct, maintain and operate satellite uplink trucks. Travel is required. Send resume to: Frontline Communications, Attn: Gary Britt, 12770 44th St. N., Clearwater, FL 33762 or Fax to: (813) 571-3295. EOE/Drug Free Work Place.

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CHIEF ENGINEER Eastern Washington Fox Affiliate seeks Chief Engineer with 3+ years of hands-on UHF transmitter experience in TV broadcasting. Some travel involved. Send resume and salary expectations to GM, KAYU-TV, P.O. Box 30028, Spokane, WA 99223 or fax to (509) 448-1223. EOE.

DIRECTOR OF ENGINEERING A midwest television station is looking for a Director of Engineering. 5 to 10 years engineering management experience preferably in TV. Thorough knowledge of analog and digital. Must have a proven track record in budgeting and administration of same. We offer an competitive benefits package. Please send resume to: Classified Ad Coordinator, Broadcast Engineering, Dept. 788, 9800 Metcalf, Overland Park, KS 66212-2215.

BROADCAST ENGINEERS WSBT Inc. has the following positions available: **Chief Engineer** - Requires a minimum of five years radio and TV engineering experience including supervisory and budgetary responsibilities and thorough understanding of FCC rules. **Transmitter Engineer** - Oversees the operation and maintenance of AM/FM/TV transmitter site and requires five years experience on AM Directional, FM and UHF TV transmitters. Send resume and cover letter to Human Resources, WSBT Inc., 300 W. Jefferson Blvd., South Bend, IN 46601. EOE.

MAINTENANCE ENGINEER: Top 50 market television station seeking a qualified maintenance person. This person must have a strong background in Beta, Macs and PC computers, Digital electronics and be a good trouble shooter. Must be a self starter and highly motivated. Send resume to the following address: WSMV-TV Att. Mike Nichols, 5700 Knob Road, Nashville, TN 37209. EOE.

NEWSROOM MAINTENANCE TECHNICIAN Ideal candidate will have several years experience in television news maintaining ENG & RF equipment. FCC General License & experience with RF coordination required. Experience with SNG uplinking highly preferred. Hours include weekends & nights. Send resume and cover letter **(no calls/faxes)** to Brian C. Smith, Asst. News Dir., WPVI-TV, 4100 City Line, Suite 800, Philadelphia, PA 19131. EOE

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HELP WANTED

NBC 25, AN NBC AFFILIATE has an excellent opportunity for an experienced television maintenance engineer to join our growing operation. Primary job responsibilities include component-level repair of video tape recorders, cameras, switchers, ENG equipment, etc. The ideal candidate will have strong computer skills, along with networking expertise utilizing Novell and/or Windows NT software. Minimum of 2 years of broadcast maintenance experience is required. SBE certification, a FCC General Class License and/or prior transmitter maintenance experience a plus. Drug screen required. Send resume and salary requirements to NBC 25, Dept. Z, 13 E. Washington St., Hagerstown, MD 21740, Attn: Jim Stanley. Fax or e-mail are accepted. (Fax #301-733-1735) E-mail to jstanley@nbc25.com. EOE M/F

E.I.C. (Engineer in Charge) TV REMOTE TRUCK/ ENGINEER OPERATOR, WXXI Rochester, New York. Supervise and coordinate all technical aspects of remote operations including camera and audio placement and set-up. Requires Associates degree or equivalent experience; minimum five years in remote production with thorough knowledge of production techniques. Maintenance engineering background a plus; valid driver's license and good driving record, CDL Class A Tractor Trailer Driver's License desirable; excellent communications skills and high energy level, ability to work unusual hours and at various locations; ability to work on ladders and other forms of production rigging. Send resume and cover letter to WXXI Human Resources Dept., PO Box 21, Rochester, New York 14601. WXXI is an equal opportunity employer.

MAINTENANCE ENGINEER: WTVY-TV (CBS) seeks a television broadcast maintenance engineer. The candidate is expected to install and repair television equipment to the component level. Knowledge of VHF transmitters, microwaves, and computer systems is a plus. Must be able to work as team member as well as independently. Ability to work all shifts, including early morning, nights and weekends is an absolute must. This is a hands-on position. NO CALLS PLEASE. Send resume, salary history and references to: Clyde Walker, Engineering Manager, P.O. Box 1089, Dothan, AL 36302. Fax (334) 793-3947. Benedek Broadcasting Corporation/WTVY-TV is an Equal Opportunity Employer.

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RADIO CHIEF ENGINEER Chief Engineer wanted for Tucson, AZ radio stations. Should have experience as radio Chief or Assistant Chief Engineer and with the installation and maintenance of broadcast RF systems. Skills should also include the installation and maintenance of radio studio and computer based station automation and digital audio production systems. Experience maintaining Dalet station automation systems and CNE or CNA certification a plus. Send resume to Randy Price, Journal Broadcast Group, 720 E. Capitol Dr., Milwaukee, WI 53211, fax (414)967-5540, E-mail price@journalbroadcastgroup.com. Journal Broadcast Group is an employee owned and equal opportunity employer.

MAINTENANCE/REMOTE ENGINEER. Repair and adjust television/radio equipment, assist in construction of new equipment or modification of existing facilities, and frequently assist remote production team in an engineering capacity at remote site. Back-up driver for mobile unit. FCC Radiotelephone Operator License, General Class or other certification and background in analog and digital troubleshooting required. Television UHF and FM radio transmitter experience desirable. Possess valid Florida CDL Driver License or obtain within three months of employment and have driving record acceptable to WMFE insurance provider. Resume to: Personnel, WMFE, 11510 E. Colonial Dr., Orlando, FL 32817. Position open until filled. EOE.

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E-Mail address:
ssimon@pacbell.net

Sue Horwitz
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FAX: (213) 965-1059
E-Mail address:
76345,2624@compuserve.com

EAST
Josh Gordon
210 President Street, Suite #4
Brooklyn, NY 11231
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FAX: (718) 522-4751

EAST/MIDWEST
Joanne Melton
1775 Broadway, Suite 730
New York, NY 10019
(212) 641-5270
FAX: (212) 459-0395

INTERNATIONAL
Richard Woolley
Tony Chapman
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JAPAN
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By Paul McGoldrick

Sony and telecines

Last month, we noted the entry of Sony into the telecine market and we promised some information about how they are going about making their product innovative. The first engineering prototype was demonstrated at the ITS Forum in Beverly Hills in July after a teasing at NAB in the corner of the "not-released" Sony display at Ballys. Sony's entry into a specialist niche makes you wonder about their needs at Sony Pictures and what plans they have for the future of the huge ex-Columbia Pictures inventory.

Paul McGoldrick

From an engineering viewpoint there is a bit of déjà vu about the equipment co-mingled with some extremely clever '90s implementations. The first telecines I worked on were camera systems made by Pye TVT (later acquired by Philips). They were monochrome, vidicon channels and the majority were used for news film; often that film was spliced together seconds before broadcast and the quality of some of the cement joints left a little to be desired. Rank Cintel changed all that with the flying-spot scanner of a smoothly moving film, although providing headaches for 30Hz and standards conversions.

The Sony channel is an intermittent-gate machine with what amounts to a camera. It is pin-accurate without using pins; it has noise-free color balance; and it can replicate the action of the original film camera. The prototype unit was running at 30fps, but the production machines will have rates of 23.98, 24, 24.98, 25, 29.97 and 30fps. The output is currently the HDTV production format of 1,920x1,080, 10-bit GBR or color-difference, and the production unit will have downconverters for 525/59.94 and 625/50. All the processing is at 16-bit linear at 74MHz, while the sampling is 12-bit log at 74MHz.

Lamphouse control and corrections

From a xenon lamp, the light is split and narrow bandpass-filtered to give a good reduction of on-die crosstalk; each of the light paths has a shutter and the whole lamphouse has a shutter. The light level is shutter-controlled through each of the RGB paths and this, clearly demonstrated, gives a color-balance control that does not change the signal-to-noise ratio. The light is recombined in an integrating sphere where it bounces around and exits in an evenly illuminated square. The exposed film is detected by three two-million-pixel CCD arrays. Exposure time is considerably less than a picture frame period so that the shutters (each color plus the master) are shut during the motion of the film to the next frame.

Stability of the film in today's world of compressed video is important. If the compression scheme has to cope with movement between frames — of material that should be steady — it loses the capacity to cope well with the images that really are moving frame-to-frame. There are no actual pins for registering the film in this telecine, but it is, nevertheless, controlled over a distance of eight sprocket holes. Instead of moving the film to the correct horizontal and vertical position, the optical path is moved. The position of the sprocket holes is determined by a capacitive-sensing system that uses the film as a dielectric. The more of the sprocket hole that is between the plates, the lower the capacitance, and a glass plate in the light path is controlled in both axes by the error readings. As it tilts, it moves the light path and the operator can even rotate the image.

A neat design. The concerns are that the market is demanding film-to-data of higher than HD resolutions; the tension on the film in the gate at 300g may be marginal with some older stock and poor edits; the control of the film over eight film perforations is enough for normal wear and tear, but for the resurrection of damaged stock it may not be enough.

Be there

This is the year that DTV has become real; real dates(?), real standards(?), real good intentions(?). Well, if you want to hear what I think about it all, you'd better be in Chicago Dec. 3-5 when *BE's* 4th annual Digital Television Seminar gets going at the Westin Hotel.

My chat will be called "Digital Dirt." Enough said? At the same time, there will be intelligent guys from companies like Grass Valley, Sarnoff, Miranda, CBS, TBS, Sony, Tektronix and even *BE's* editors. If you're a technical director, manager or a chief engineer, you need to be there. If you're in engineering and involved at an installation level, you probably should be there. See p. 85 for more information. ■

Paul McGoldrick is a free-lance writer and consultant based on the West Coast.

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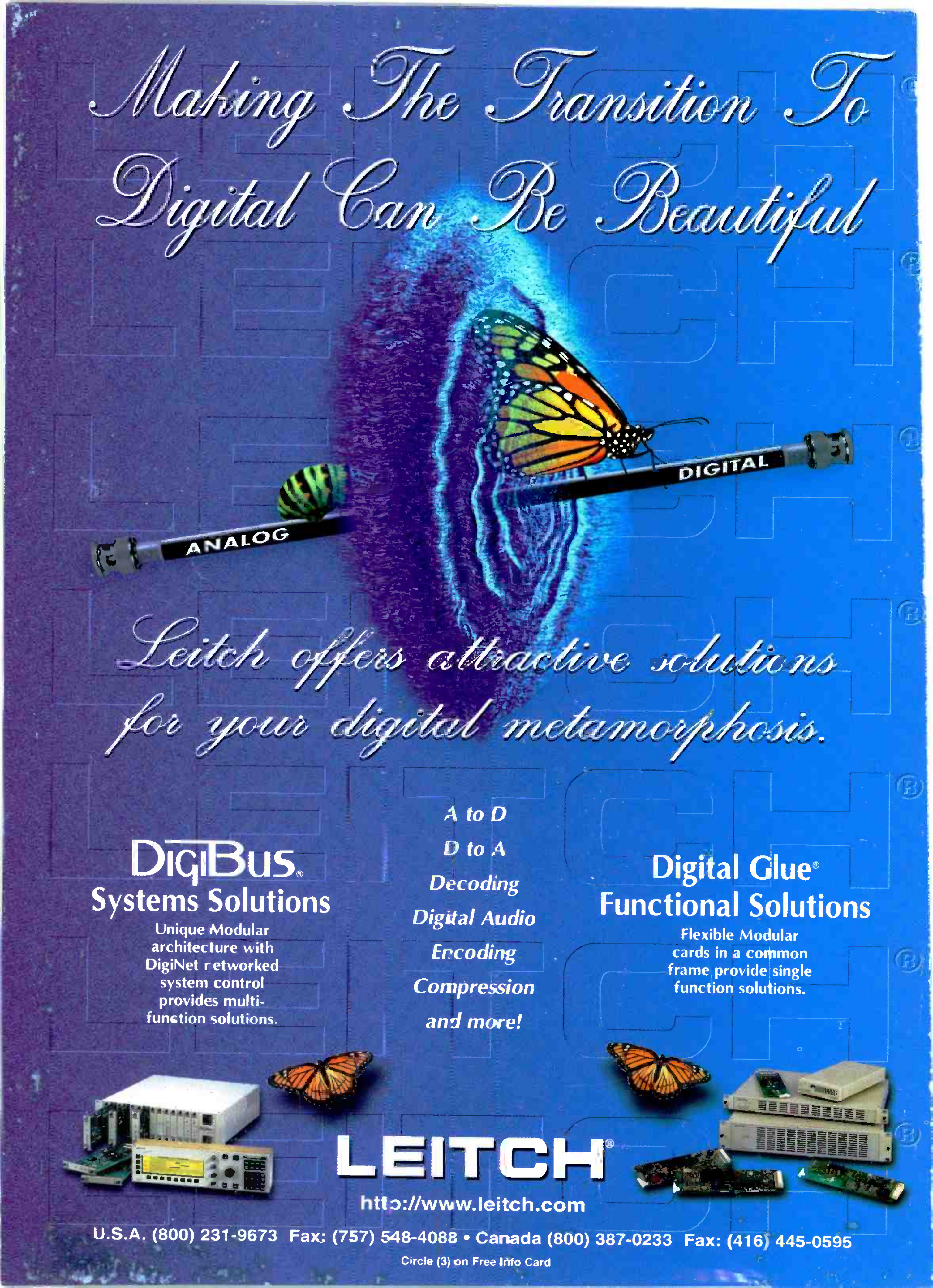

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