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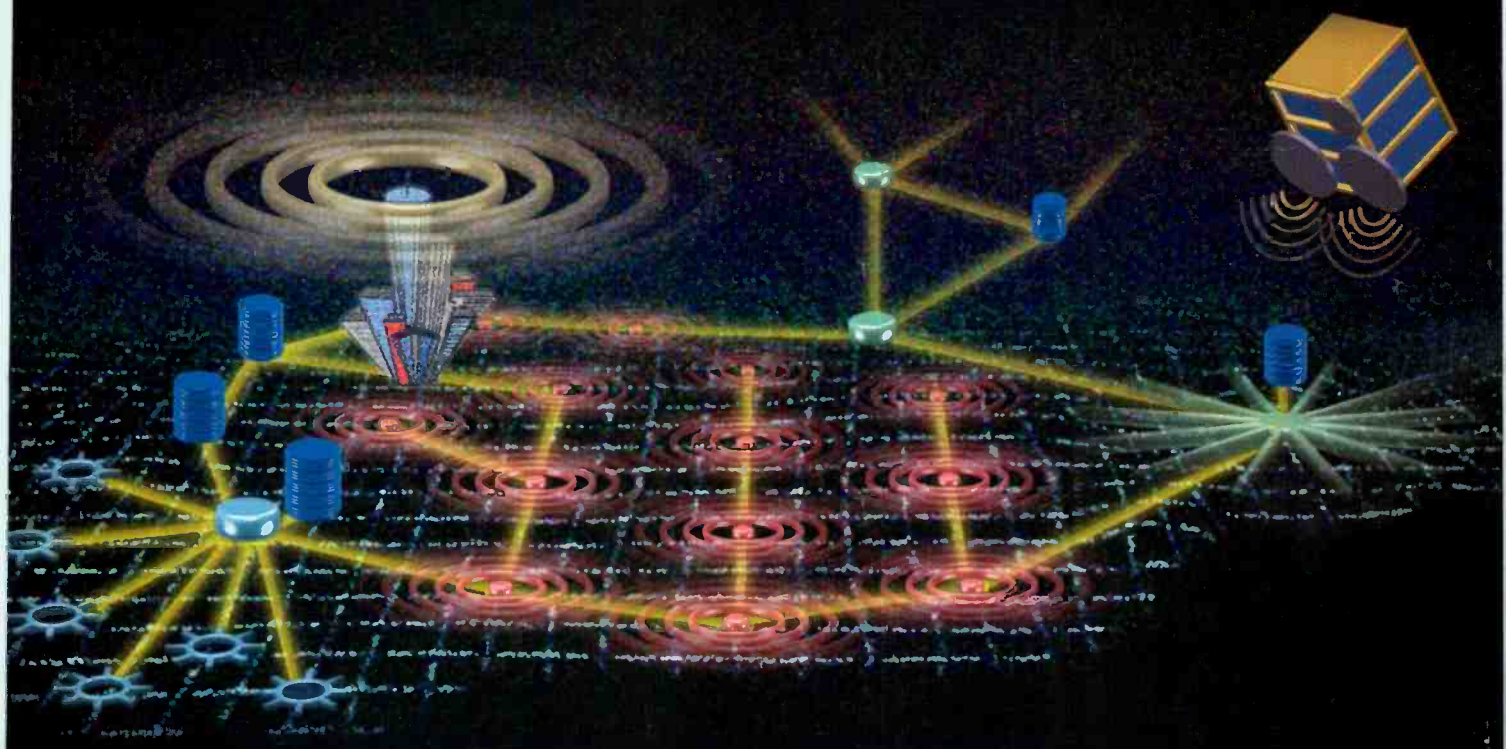
Broadcast ENGINEERING

THE JOURNAL OF DIGITAL TELEVISION

The future of broadcast



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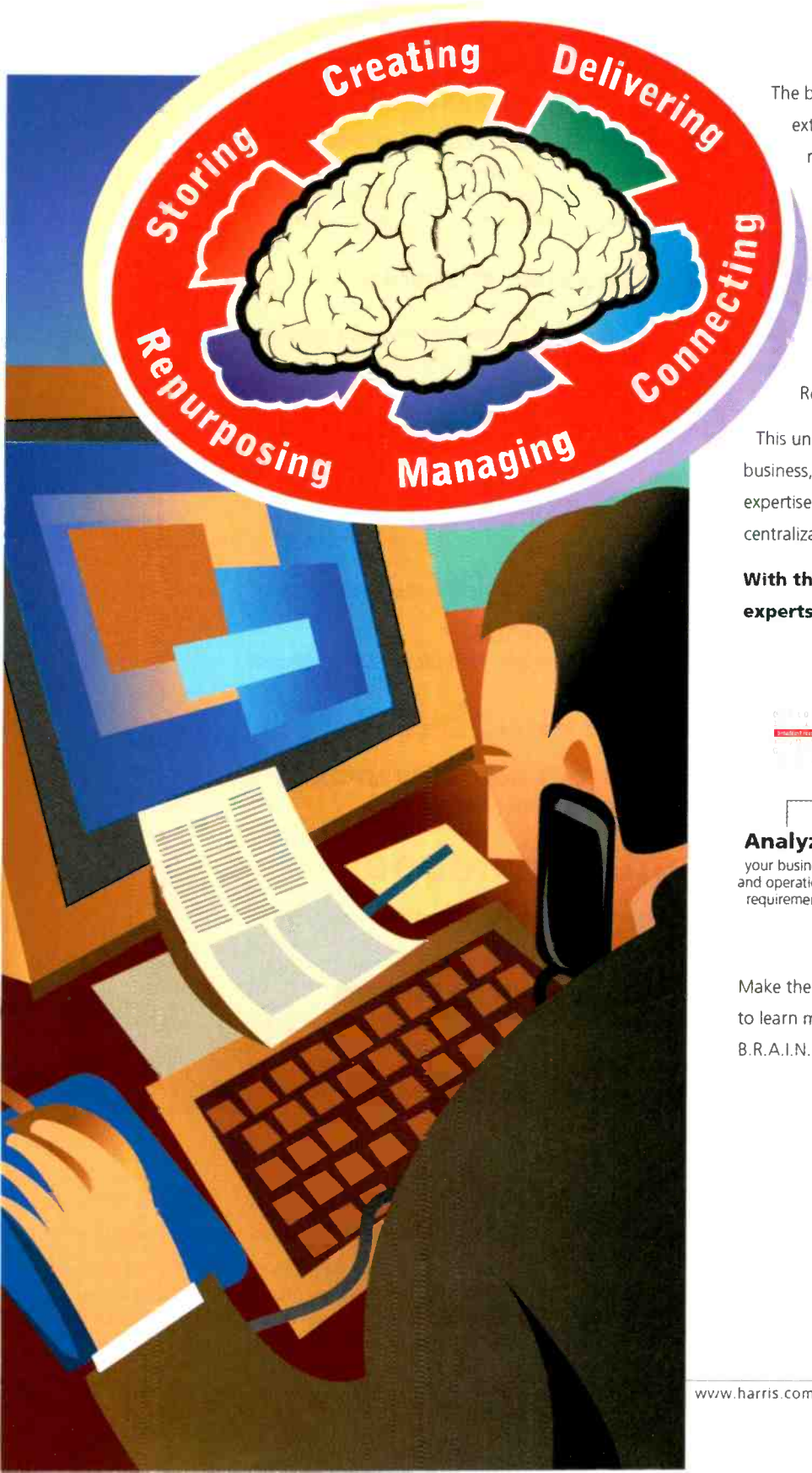

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ON THE COVER: This month's cover illustrates a convergence of video, computing and telecommunications affecting broadcasters in the emerging digital world by changing the way digital media content is created and distributed. Original artwork courtesy Craig Birkmaier.

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A great triple play.

The new AJ-D455 DVCPRO Studio Editing VTR.

The first VTR to offer record and playback in DVCPRO, standard DV and Mini-DV, as well as playback of mini and standard DVCAM tapes. This full-featured VTR offers versatile digital interfaces: level-adjustable AES/EBU digital audio in/out and optional SDI and IEEE-1394 (FireWire®) in/out. The AJ-D455 even allows for data conversion between DVCPRO and DV/DVCAM formatted IEEE-1394 links, providing a truly seamless approach to multi-format editing.

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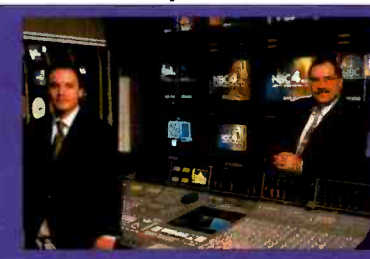
FREEZE FRAME

A look at the technology that shaped this industry

A station of firsts



What TV station lays claim to being dedicated in 1955 by then vice-president Richard Nixon? It was also the site of the famous Nixon/Kennedy debates. It claims to be its city's first stereo broadcaster and its first DTV station. You can win a *Broadcast Engineering* T-shirt with the correct answer. Enter by e-mail. Title your entry "Freezeframe-December" in the subject field and send it to: bdick@primediabusiness.com. Correct answers received by Jan. 17, 2001, are eligible to win.

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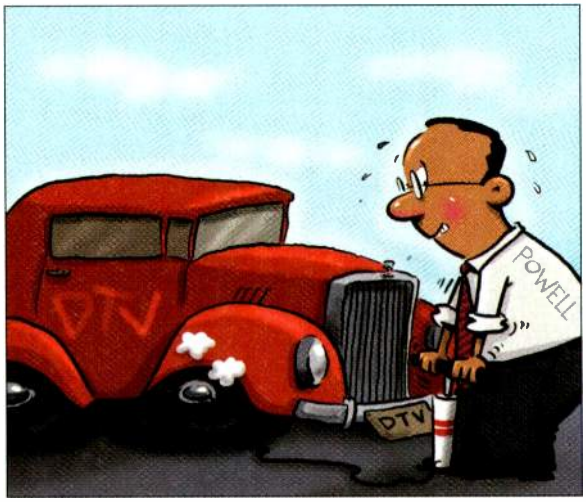
On the road again

It looks like FCC Chairman Michael Powell is finally putting some air back in the nation's DTV system. He's managed to not only speak openly in support of the value of DTV, but also get his commission to approve steps to help broadcasters get their DTV stations on the air. What a novel idea!

The commission's Nov. 8 action made several significant changes to the DTV rules. These are a welcome change from Kennard's anti-broadcaster approach.

Most important is the change that allows stations to build less than maximum broadcast facilities. Stations no longer need build a transmission system that replicates their entire grade B analog service area before 2005 or lose interference protection for the unserved area. Now, stations can build a lower-power facility and serve their community of license while still receiving interference protection to the fully allocated service area. This will allow stations to initiate DTV broadcasts with less expensive systems and build out to full power as the DTV transition continues.



Stations that have already been granted a construction permit for full-power operation can modify it and build only what's necessary to cover the city of license.

Stations with core DTV channel assignments also have more time to decide which channel they want to use as their post-transition DTV channel. Stations can also operate their DTV systems less than full time.

While the commission refused to issue a blanket extension of the May 2002 DTV construction deadline, it agreed to consider financial hardships on an individual basis.

The serious unanswered question is what a bunch of low-power TV stations will do to the predicted receive situation. Previously, DTV coverage predictions were based on full-power operation. With many, perhaps most, stations operating with a few kilowatts of RF, what will that mean to the 85 percent rule? Will the 85 percent coverage areas be calculated on actual coverage at the low power levels? Will sufficient viewers even be able to receive these low-power transmissions? With the hassle many have encountered in receiving high-power stations, what happens when the level is 20dB lower? Even our DTV receive guru, Pete Putman, and his custom antennas may have a problem trying to pick up a 1 kW transmitter at 20 miles.

Clearly, the FCC must take the next step and mandate DTV cable carriage. A recent report by the Merrill Wise Group (MWG) shows that cable has plenty of spectrum to provide digital carriage. However, it's going to take FCC action to get cable to devote a single megahertz to free DTV carriage.

Despite the commission's unwillingness to tackle cable's DTV roadblock, I'll give Powell credit. He's taken a big step to support broadcasters' efforts to implement DTV.

Brad Dick

Brad Dick, editorial director

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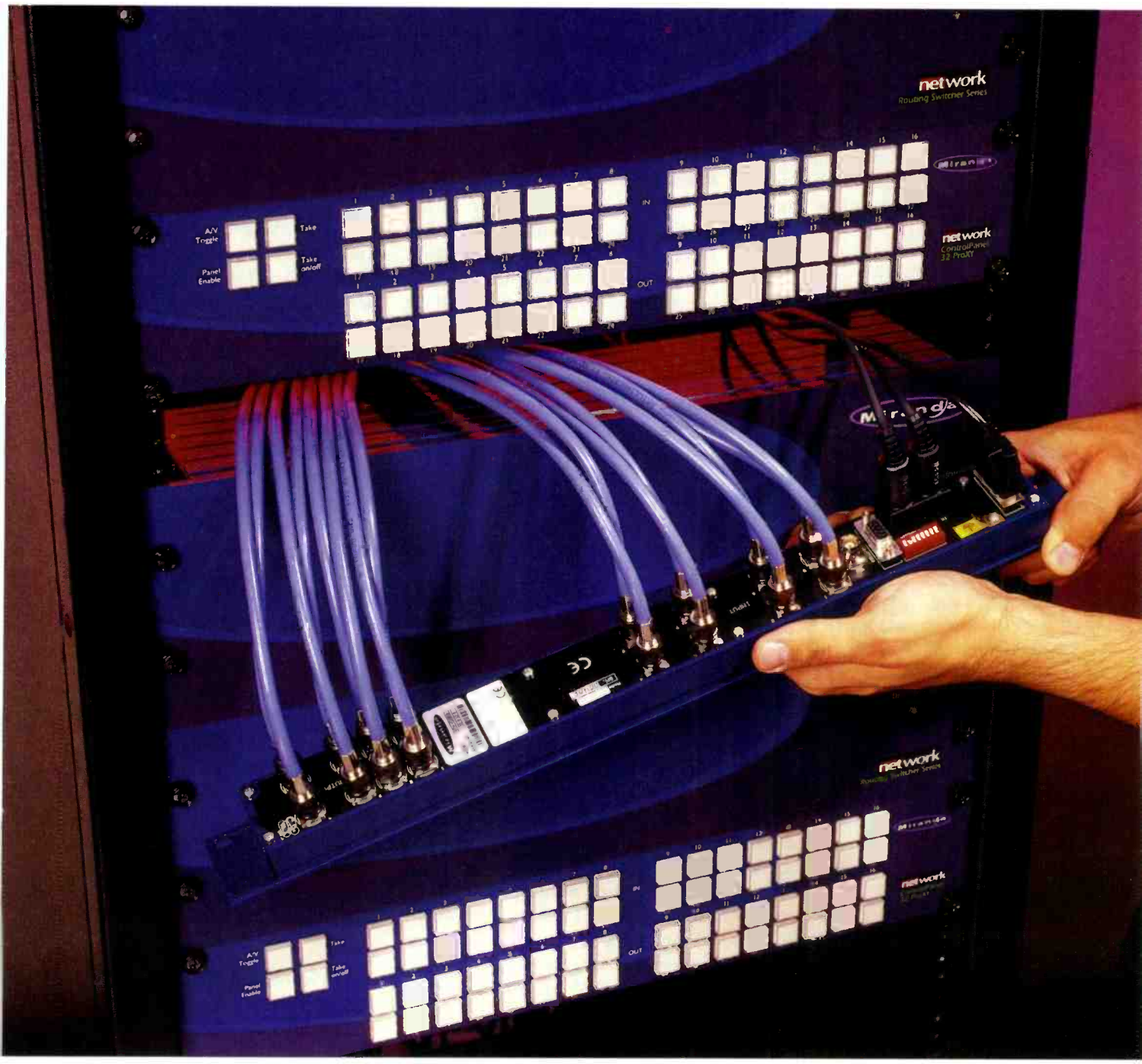

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Reader Feedback

It works!

I consider myself the lucky one to get the un-built Heathkit color TV that had been sitting in the basement of one of your readers for 25 years. Ah, the memories it brought back! As usual, I was a little nervous when the "moment of truth" came and I poised my finger over the power button. It worked! No sparks or flames. I wish I could afford a Plexiglas cabinet so I could admire its innards full time.

They don't make 'em like this any more.

RAY CARLTON

To John Luff:

We are using "do-it-yourself" metadata by writing data inside the active video (two lines at the top of the screen). The data comes from sensors mounted on the camera. Unfortunately, this is not very attractive when viewed in underscan mode.

Can this drawback be avoided by using SMPTE 315-1999 to carry the ancillary data? Do you know of any hardware that will support the read/write functions for data using this standard?

DAVID LANDELLE
VANVES, FRANCE

John Luff responds:

David:

The most complete reference to SMPTE 315M is the standard itself, available from the SMPTE at www.SMPTE.org. Use of SMPTE 315M is only possible when using SMPTE 259M (270 Mbit component digital video). SMPTE uses the ancillary data capacity that is present during the horizontal and vertical intervals where video is not encoded. There are explicit rules on how to implement private or public use of this capacity, though in practice you may use it in any way you wish if the video will not be exchanged with other users. The capacity is quite large, as video only occupies about 216 Mbits of the space available. Even if the maximum number of embedded audio channels is included (eight AES pairs) there remains a prodigious amount of capacity in the 270 Mbit signal.

JOHN LUFF
AZCAR

The first "CG" was built by AB Dick and called the Videograph.

Recent Freezeframe winners

The answer to this Freezeframe question begins as a good history lesson from readers Alan Schoenberg of Controlware Communications and Jim Wulliman, former SBE Ennes executive director.

The first "CG" was built by AB Dick and called the Videograph. According to Wulliman, the device used a Dictograph dictation recorder for the external memory and a teletype keyboard.

Schoenberg writes that the device was originally marketed by Visual Electronics, with CBS taking over the manufacturing of the CG when Visual went out of business. Using the Videograph as a beginning, CBS created the CBS Vidifont. About the same time, RCA Canada was marketing a CG called the Divcon, which produced a dot matrix display.

The original AB Dick design was later modified by another team of engineers who added new functions and formed a company that launched the CG under the new name of Chyron. The product was called the Chyron 1.

In February 1982, *Broadcast Engineering* carried an article describing ABC's work in developing what was still called the "CBG" — Character/Background Generator.

Originally, the network wanted to be able to display the 1972 election results using computer-generated white numbers and characters matted over a blue slide. The system used a Varian computer. An Arvin still store, which allowed the use of prerecorded oval shapes for backgrounds, was added for the 1976 elections.

Planning for the 1978 elections began with ABC approaching a company called Dubner Computer Systems. The result was the CBG-1. It was now possible to create an ABC election graphic in a mere 18 seconds! The next model, the CBG-2, used an Intel 8080, eight-bit processor and with its 48k memory could now generate the same background in only two seconds.

And the rest is history.

August Freezeframe winners:

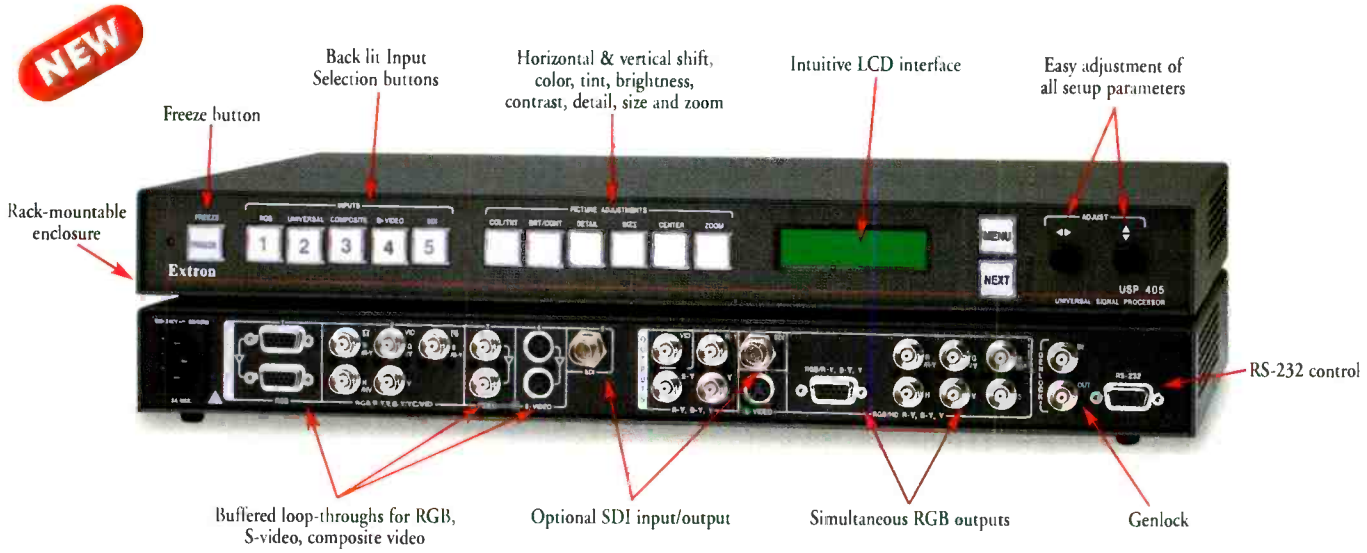
Alan Schoenberg, Controlware Communications

Jim Wulliman, SBE

Augusto Villaseñor, Globecomm Systems

Murray Bevitz, Bell Atlantic

Harvey Caplan ■



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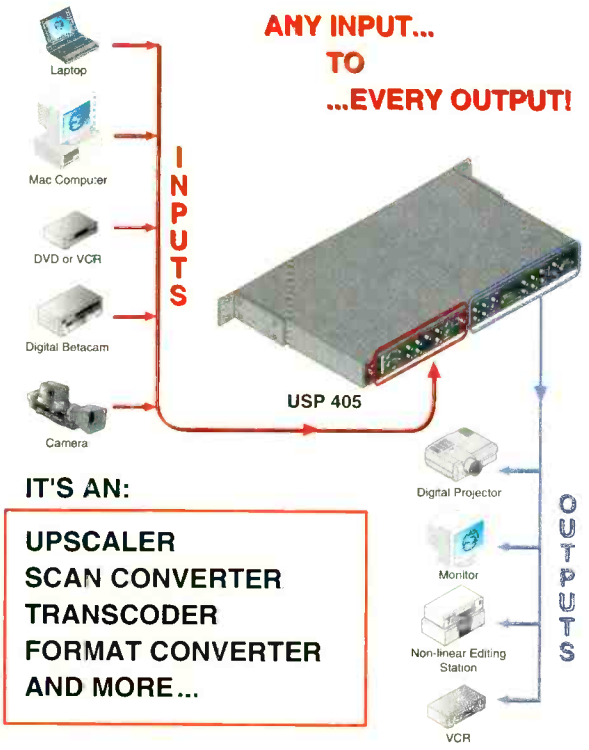

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News

PBS with commercials?

BY LARRY BLOOMFIELD

In a three-to-one vote in mid-October, the FCC made what could end up being a landmark decision. The FCC said that anything less than the substantial majority of the public broadcasters' new digital capacity may contain advertising, just like their commercial counterparts. There's one stipulation – the government gets a five percent cut of the gross commercial revenues.

In the public statement accompanying the ruling, the commission cited computer software distribution, data transmissions, Teletext, interactive materials, aural messages, paging services, audio signals and subscription video as examples of the services that may be offered as supplements to the digital TV signal. There's nothing keeping public broadcasters from running sitcoms, game shows or even soap operas, with commercials, on one or more of their sub-channels.

In the Report and Order, the FCC ruled that the statutory prohibition against broadcasting of advertising on non-commercial educational (NCE) television stations applies only to broadcast programming channels. It does not apply to any ancillary or supplementary services carried on their excess DTV channels.

The government gets a five percent cut of the gross commercial revenues generated by advertising on public television.

Commissioner Michael Copps disagreed with the decision to allow public television to put commercials on their digital spectrum, saying that public and commercial television services should not converge until they become indistinguishable.

John Lawson, president of America's Public Television Stations (APTS), claimed the revenue would be used to provide a new generation of digital educational services.

Rep. Billy Tauzin (R-LA), who chairs the House Energy and Commerce Committee, expressed concern about what he called "creeping commercialization." Tauzin's spokesperson Ken Johnson said the Congressman will likely ask the agency to tighten its definition of substantial majority.

Tauzin, Rep. Edward Markey (D-MA) and Rep. Richard Burr (R-NC) sent a letter to FCC Chairman Michael Powell asking the commission to reconsider its move.

The FCC concluded that NCE licensees are not exempt from the statutory requirement to pay fees on revenues generated by remunerative use of their excess digital capacity, even when those revenues are used to support their mission-related activities. Beginning in 2002, NCE licensees will be required to report to the FCC on Dec. 1 of each year on their use of their digital channels during the 12-month period ending the previous Sept. 30. Stations must then remit fees of five percent of gross revenues received during the reporting period for feeable ancillary or supplementary services provided on their digital bitstreams.

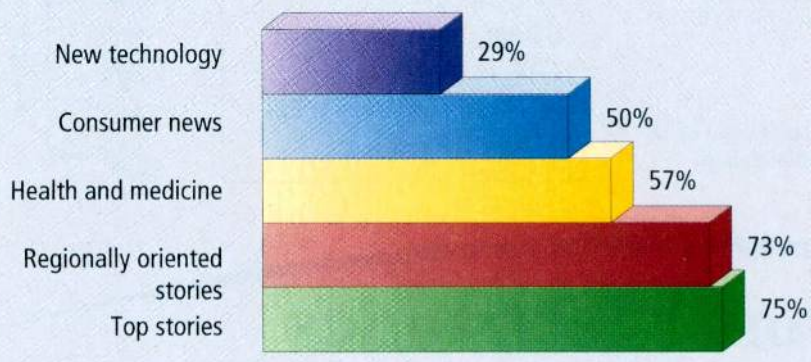
For more information, see the FCC's

FRAME GRAB

A look at the issues driving today's technology

Local news ranks top for stations

News execs rank local angles best



SOURCE: CONUS Communications' survey of 102 news executives www.CONUS.com

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Web site at: http://www.fcc.gov/Bureaus/Mass_Media/News_Releases/2001/nrmm0111.html. ■

Don't delete the commercials!

Viacom's CBS, Disney's ABC, General Electric's NBC and other media companies filed a multi-million dollar suit against ReplayTV and its owner SonicBlue in late October. The companies took legal issue with ReplayTV for providing a feature that many viewers have been using on their VCRs since VCRs first hit the market.

The companies fear that advertisers will be unwilling to pay for advertising that Replay's AutoSkip feature can make invisible to viewers, thus possibly eliminating the source of payment for copyright owners. This raises the question of whether CBS, ABC and NBC will bring lawsuits against VCR manufacturers for the same reasons.

These companies are also concerned that Replay's latest model will allow users to share video over local area and wide area computer networks, not to mention the Internet. According to sources at SonicBlue, it is a personal transaction allowing users with ReplayTV 4000 recorders to share files. Video is not posted to the Internet or shared with unknown users.

ReplayTV's "Auto Skip" feature has sparked concerns among media companies, including CBS, ABC and NBC.

Ironically, ReplayTV was awarded a Technological/Engineering Emmy Award for its digital video recorder technology by the National Academy of Television Arts and Sciences (NATAS), which includes some of the same people who are suing Replay. ■

Congress pushes FCC

Rep. Billy Tauzin (R-LA), who chairs the House Energy and Commerce Committee, held a meeting in late October on how to speed up the DTV transition. In attendance were Rep. John Dingell (D-MI), Rep. Fred Upton (R-MI), chair of the House Telecommunications and Internet Subcommittee, and Rep. Edward Markey (D-MA).

specific suggestions for broadcasters and to discuss Congress' role in the transition.

In 1997, Markey set a time frame of January 2002 for TV sets to have the capability to display digital signals. With the new impetus, the time frame might pack more weight, allowing consumers to reap the benefits of the superior digital technology.

FCC Chairman Michael Powell said, "The DTV transition is a massive and complex undertaking. Although I'm with reviewing the ongoing transition to DTV and making recommendations to the commission concerning priorities to facilitate the transition and promote the rapid recovery of broadcast spectrum for other uses.

Joining Chessen will be members from the Cable Bureau, the Mass Media Bureau (MMB), the Office of Engineering & Technology, and the Office of Plans & Policy (OPP). An ad hoc advisory group, consisting of FCC staff from the Consumer Information Bureau, the Office of the General Counsel, the MMB, the OPP, and the International Bureau, was created to assist the task force. The key member missing is a real-world broadcaster! ■

The key member missing is a real-world broadcaster!

The broadcast industry was represented by NAB president Edward Fritts, NCTA president Robert Sachs, CEA president Gary Shapiro, the president of the Motion Picture Association of America, Jack Valenti, and former FCC head Richard Wiley.

According to Tauzin's spokesperson, Ken Johnson, the group discussed a wide range of issues, including digital must-carry, the transition deadline and copy protection, and will meet again in a few weeks to offer

often asked what the FCC is going to do to 'fix' the DTV transition, I believe that a big part of the problem is the unrealistic expectations set by the 2006 target date for return of the analog spectrum." This is unlikely to hold much weight with many on Capitol Hill.

The FCC has established a task force headed by Mass Media Bureau Associate Chief Rick Chessen in an effort to kick-start the seemingly stalemated transition. The task force is charged

Send questions and comments to: larry_bloomfield@intertec.com

IN ADDITION

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Birkmaier joins BE staff

Craig Birkmaier

The *Broadcast Engineering* staff is pleased to welcome industry veteran Craig Birkmaier as a contributing editor in the area of new media. Birkmaier brings more than a decade of valuable experience in the television industry to his new role. He has hosted and moderated OpenDTV forums at the past two NAB conventions to allow broadcasters to discuss issues relating to the digital transition. He has also worked to develop new tools for television production.

In addition to bringing his expertise and perspective to *BE*, Birkmaier will be managing special projects for PRIMEDIA Business Magazines and Media. He began by organizing the DTV conference, sponsored by *Broadcast Engineering*, *Millimeter* and *Video Systems* magazines, which was held Nov. 28-30 in Atlanta. The conference included an OpenDTV Forum on industry consolidation and centralcasting. ■

Echostar makes bid for Hughes' DirecTV

BY LAURA COLLINS, ASSOCIATE EDITOR

DBS provider Echostar is in the process of acquiring General Motors' Hughes Electronic division and its DirecTV satellite service for $25.8 billion. The goal of the merged company is to provide competition for cable television by delivering video entertainment and broadband data services, especially to underserved rural markets. After the merger, Hughes would maintain a majority shareholder position while Echostar would gain management control of the new company. The combined company will use the EchoStar name and adopt the DIRECTV brand for its services and related products.

Credit Suisse First Boston and Deutsche Banc AG provided $5.5 billion of the financing needed for the acquisition. Additional funding came from the personal funds of Echostar Communications' founder, chairman and CEO Charlie Ergen.

Echostar is awaiting approval for the deal from regulators over the next 10 to 12 months. The FCC has established an intra-agency team to review the proposed merger, led by Kenneth Ferree, head of the FCC's Cable Services Bureau.

The merger between Echostar and DirecTV would create the second-largest pay television platform in the nation, with more than 16.7 million subscribers, and the potential to gain eight million more over five years. The new company would control between 80 and 90 percent of the DBS market. ■

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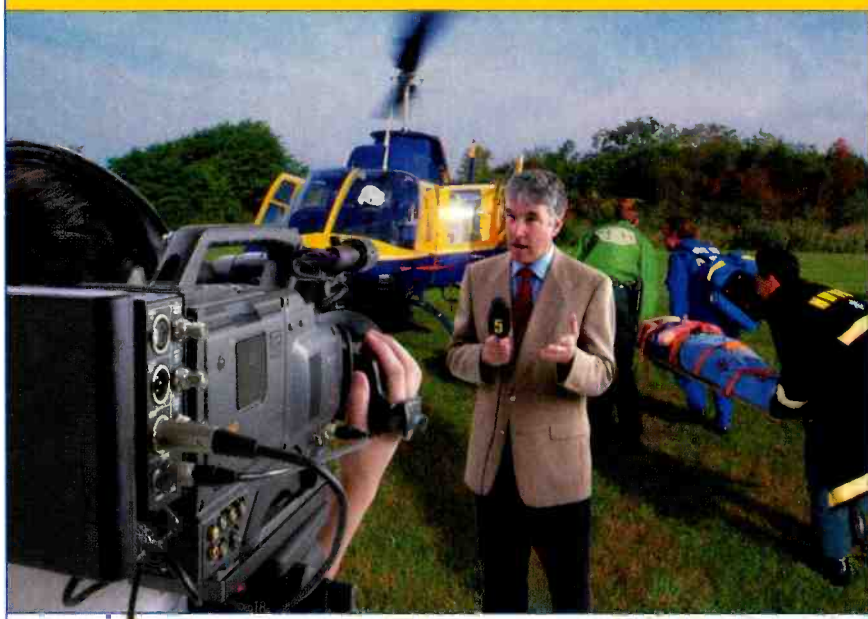

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FCC clarifies satellite must-carry rules

BY HARRY C. MARTIN

The FCC has issued an order on reconsideration of the satellite TV must-carry rules adopted in 2000. The 2000 rules require satellite carriers to carry upon request all local television broadcast station signals in local markets in which the satellite carriers carry at least one television broadcast station signal by Jan. 1, 2002. The FCC did the following on reconsideration:

- Upheld the requirement that satellite operators carry the entire primary video, accompanying audio, and closed-caption and most other data contained in the vertical blanking interval.
- Denied a request that the FCC require broadcast stations to deliver a higher-quality signal to satellite carriers than is required for cable carriage.
- Denied a request that the FCC require television stations to pay any new or additional costs to deliver a good quality signal if the carrier moves its receive facility.
- Denied a request that satellite carriers be allowed to require subscribers to purchase additional equipment, such as an additional satellite dish, to gain access to must-carry signals.
- Held that satellite carriers may offer local signals to their subscribers on an à la carte basis, and that doing so does not necessarily violate the statutory prohibition on discriminatory pricing or provision of access to broadcast stations. However, the FCC ruled that most stations should be offered to subscribers at the same or a nearly identical price. Prohibited discrimination would occur if a carrier offered some local stations in a package, while offering others on an à la carte basis.
- Denied a request that the FCC modify its noncommercial educational (NCE) carriage rule by limiting a satellite carrier's carriage obligation to only one qualified NCE station per DMA, with additional NCE stations carried on a voluntary basis, rather than requiring satellite carriers to carry all non-duplicative NCE stations.
- Denied a request that the FCC permit satellite carriers to include local NCE stations in the calculation of the four-percent public interest set-aside requirement under the Satellite Home Viewer Improvement Act.
- The FCC also ruled that, in regard to required signal strength at satellite uplink or signal relay points, if upon receipt of a must-carry demand letter a satellite carrier has a reasonable basis for believing that the station does not provide the required signal quality, the carrier must state that in a response letter to the broadcaster. If there is a reasonable basis for a carrier's concern, then the burden is on the station to pay for signal testing.
- The commission also clarified the timing requirements associated with disputes over signal quality filed at the FCC, ruling that form letters by carriers which assert that the station's must-carry election letter failed to "prove" a good quality signal are invalid responses and do not trigger a window for filing a complaint at the FCC. The station involved should respond by providing signal strength evidence and stating that the carrier has failed to meet its obligations under the rules.

In summary, the commission has clarified important issues, but the potential for significant disagreements between carriers and stations remains.

Dateline

Feb. 1, 2002, is the deadline for biennial ownership reports for broadcast stations in Arkansas, Kansas, Louisiana, Mississippi, Nebraska, New Jersey, New York and Oklahoma.

FCC relaxes DTV build-out requirements

The FCC has deferred indefinitely its deadline for stations to replicate their entire Grade B NTSC analog service areas with their DTV signals or face loss of interference protection. The previous replication deadlines were Dec. 31, 2004, for commercial stations and Dec. 31, 2005, for NCE-TV. Stations now will be allowed to construct facilities that serve only their communities of license without loss of interference protection to their entire allotted service areas.

The deadline for stations with both analog and digital channel assignments in the DTV core to elect which channel they will use after the DTV transition also was delayed. The commission stated that, with the more graduated approach, stations would have more time to increase power and gain experience at the higher power levels before having to choose which of their two channels would provide the better DTV service.

New dates for analog replication, maximization and channel election will be established during the FCC's next periodic review of the DTV transition.

The FCC refused to grant a blanket extension of the DTV construction build-out date, currently set at May 1, 2002, for commercial stations and May 1, 2003 for noncommercial stations. However, the commission is preparing a standard form to use for extension requests. That form will be due to be filed at least 60, but no more than 90, days prior to the applicable construction deadline. For the first time, the commission stated that it will, in limited circumstances, consider financial hardship as a basis for extending the DTV construction deadline. ■

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

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Facility design: Broadcast vs. Webcast

BY MARK SIEGEL

There are plenty of similarities between designing a Webcast facility and designing a broadcast facility, but there are also many differences that require careful consideration.

Historically, broadcasters are more familiar than Webcasters with a technical facility's power and environmental requirements. Webcasters are not quite as familiar with electrical or HVAC issues, for example, and most have never had experience in broadcasting. On the other hand, most broadcasters have minimal background encoding multiple simultaneous streams of content, which, in modern Webcast facilities, can number from at least 10 to as many as 500.

When considering the construction of a Webcast facility, planning is crucial to make sure everyone is headed in the right direction. A business plan defines where a Webcaster's business is today and where it wants to go in the future, and ensures that the facility is off to a good start.

Of course, the bulk of this planning comes down to economics. Of primary economic concern to a Webcaster is the cost of each individual information path or stream. In contrast to a broadcaster, who might transmit only one stream of information, a Webcaster might need to transmit 250 simultaneous streams. How much equipment should you dedicate to processing each stream? When considering this question, you must be both creative and conservative.

In contrast to a broadcaster, who might transmit only one stream, a Webcaster might need to transmit 250 simultaneous streams.

Webcast facilities generally use equipment identical to broadcast facilities up to the point where the data hits the encoder. Webcasters also often use traditional routing switchers, video processors and conversion equipment. For example, NaviSite.com, a 10,000-square-foot facility that has hosted many high-profile Webcasting projects, uses traditional A/V routing equipment to route standard analog signals to a digital capture machine where the signal is encoded in Real, Windows Media and QuickTime formats.

Webcasters often use unique routing equipment for monitoring and routing to multiple encoders from a single destination. Because facilities such as NaviSite are dealing with so many streams, they need to monitor each encoding process from a single location. This monitoring process is simplified using a centrally located PC, keyboard and mouse.

The front-end master-control equipment at the NaviSite.com streaming facility in Andover, MA, includes auto-levelers, phone couplers, audio and video routing systems, and video monitors. Photo courtesy of NaviSite.com.

Broadcast facilities are designed so that all measurements, signal testing and confirmation of quality are performed before the signal hits the transmitter. Webcasting, on the other hand, is unique in that test and measurement takes place after encoding.

Differences are also found in the area of noise reduction. The data streams used by Webcasters operate at a much lower bit rate than those used by broadcasters. Unlike broadcasters, Webcasters cannot encode high-bandwidth chroma and luminance signals, so the Webcaster's encoder can work with a lower bit rate.

Automation is more sophisticated in Webcasting than in broadcasting, and is necessary for efficiency. Since Webcasting involves multiple streams, there are many more devices to be controlled. In a manual bay system, 15 to 20 people would be required to

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manage 200 streams of content. Traffic and scheduling systems are more complex, as well. Real Broadcast Network (RBN), for example, broadcasts 3000 streams per day. To streamline operations and improve efficiency, each operator in this facility has complete control of all RBN operations from his or her desktop workstation.

Perhaps the most substantial difference between the broadcasting and Webcasting facilities is future expansion. Growth in broadcasting is certainly more predictable than in Webcasting, where explosive growth can happen at a moment's notice. Traditionally, there is a 30 percent growth factor figured into the construction of a new broadcast facility. In Webcasting, the growth factor considered in initial implementation often approaches 300 percent. Obviously, planning ahead of time for facility infrastructure growth is a must. This covers everything, particularly real estate, HVAC, electrical issues, router upgrades and satellite expansion.

The key in designing both types of facilities is to plan for the greatest projection, build for current needs, and set

Webcasting is unique in that test and measurement takes place after encoding.

milestones for growth so you can forecast the upgrade. With a Webcast facility, it comes down to the design of one path. Everything in a Webcast facility goes through the same path, so, whether the streamed content is created originally within the facility, taken from pre-recorded material, or from a satellite, everything goes through the same path before hitting the encoder. This is a much simpler process than in a broadcast facility. In a Webcast facility, you simply multiply the initial path. This means you can pre-wire a facility for growth and easily add those devices to the path when needed.

The most pertinent components for expansion are always related to patching and routing. A router must have the flexibility, overhead and real estate to integrate the equipment necessary for expansion. That makes the planning of rack space very important. In a streaming facility destined for growth, it's absolutely vital to leave a sizeable amount of empty rack space to accommodate expansion in a hurry.

Broadcast facilities, historically, aren't blessed with a tremendous amount of real estate, which makes growth more difficult. In addition, they have much larger operating systems. In Webcasting, everything is controlled from a PC, so moving dedicated control panels and monitoring devices around is not an issue. Expansion needs to be simpler in Webcasting because of the potential for explosive growth. Webcasting technology has proved to be a positive for the broadcast industry in terms of growth because manufacturers continue to develop better and more efficient control systems. ■

Mark Siegel is vice president of business development of DST.

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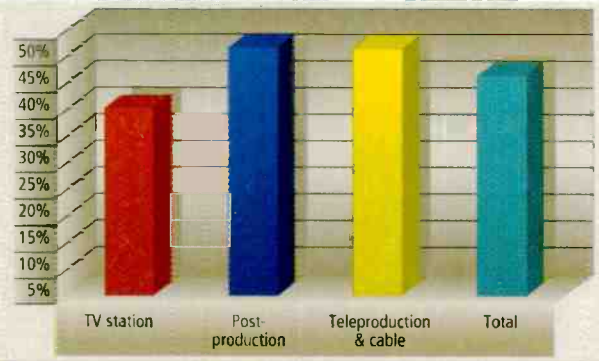
By the Numbers

BY BRAD DICK, EDITORIAL DIRECTOR

In the last part of our series on the industry's building plans, we focus on streaming technology. Certainly this was the hottest issue a year ago. Since that time, reality has taken hold and the hot Internet stocks, companies and issues have taken a decidedly downturn. Even so, what we're seeing in the broadcast industry is a continuing interest in this arena.

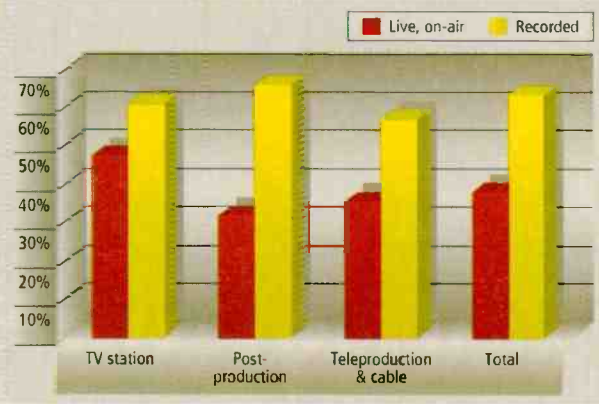
Does your station stream audio/video?

Surprisingly, TV stations were the lowest of the three response categories in streaming. Only one-third of all TV stations are streaming audio/video to the Web. That doesn't mean they don't have a Web presence, just that they may not provide real-time or stored content for playout. Many TV stations have static Web sites, those without streaming capability. About the same higher percentage of both teleproduction/cable and post-production facilities and cable facilities use their Web sites to highlight the content they develop. Hence, they have content they want to show off. Broadcasters are behind the curve.



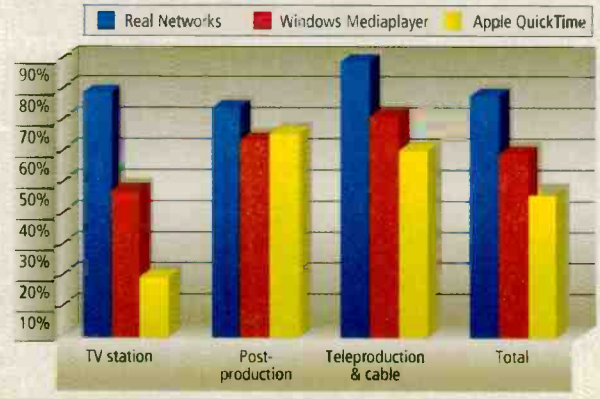
Is your stream live or recorded?

Not surprisingly, TV stations have the highest percentage of live streaming content. Only about one-third of production facilities and cable provide live material. Overall, just under two-thirds of the facilities that responded to the survey provide recorded or locally-produced content.



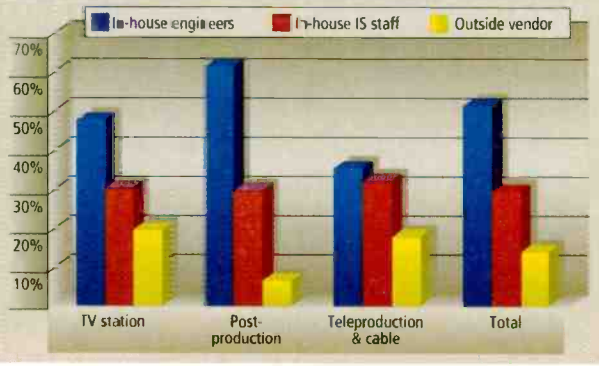
The battle over formats

It's a three-way race when it comes to media players. Real Networks is on top with almost 80 percent penetration. Windows Mediaplayer is second. Third is Apple QuickTime. Note that for the cable and production sites, three times as many use QuickTime as do broadcasters. That may have to do with the use of Macs as content generation devices at these facilities.



Who's responsible for fixing it?

Overall, half of the installations rely on the in-house engineering team to maintain the Internet technology. A surprising 62 percent of the production facilities rely on in-house engineers. Only a third of the cable and teleproduction facilities rely on in-house engineering staff. Overall, about one-fifth of the facilities use an outside vendor for Internet maintenance.



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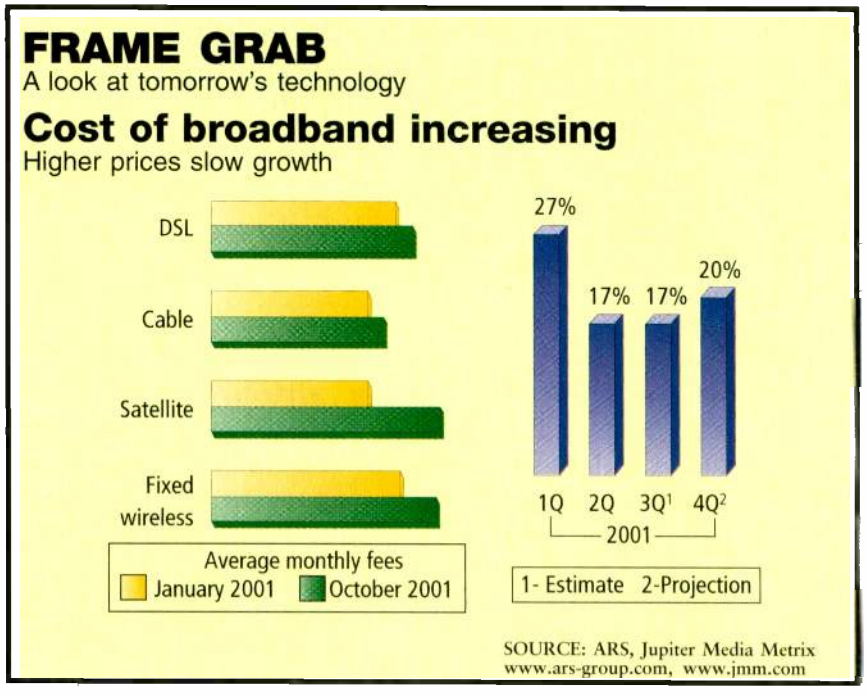
Audio sampling

BY MICHAEL ROBIN

For the most part, the mechanisms of the natural world around us, including sound, operate in the analog domain. And so the transducers used to convert sound into electrical signals (microphones) and vice-versa (loudspeakers) are analog as well. A microphone produces an electrical signal with an infinite number of amplitudes which can be amplified to a suitable level for further processing such as mixing, recording, transmission and reproduction. The chain of devices that amplify, process and carry the electrical signal from the source (the microphone) to the destination (the loudspeaker) – and the wires that connect them – can be thought of as a medium. Unfortunately, the devices in this medium introduce inherent, undesirable impairments (linear distortions, nonlinear distortions and noise) that degrade the quality of the signal. The impairments contributed by each device are additive – that is, they accumulate. Thus, the number and individual performance of the devices in the medium determine its overall performance. This puts a limit on the number of devices through which an analog audio signal can pass before the impairments become unacceptable.

The impairments contributed by each device in a medium are additive.

However, it is possible to eliminate many analog signal-handling difficulties by digitizing the electrical signal before sending it through the medium. Digital audio systems convert the original analog signal to a binary digital signal which has two well-defined states: zero and one. Undesirable electrical impairments affect the digital signal just as they affect the analog signal, but they have no effect on the information the digital signal carries as long as the device receiving the signal determines that the binary signal levels are within the threshold values for the "zero" and "one" states. Such systems restrict message distortion to the analog-to-digital (A/D) and digital-to-analog (D/A) conversion processes, thereby improving the transparency of the medium. The medium remains transparent as long as it maintains a certain level of signal-to-noise ratio (SNR), beyond which the "cliff effect" occurs and the transmission shuts off. This article examines some of the basic audio analog-to-digital conversion concepts, emphasizing the sampling process.



Sampling considerations

Sampling is the first step towards digitizing audio signals. It consists of measuring the amplitude of the analog audio waveform at periodic intervals, T. The main concern is to represent the original analog values with adequate precision. The measurement accuracy depends on the frequency at which the audio signal is measured, or sampled. Here's where Nyquist and Shannon have their say. The sampling frequency must be at least twice (preferably more than twice) the highest audio frequency being sampled.

The sampling process consists of multiplying the analog audio signal with a stream of repetitive pulses – a pulse amplitude modulation (PAM)

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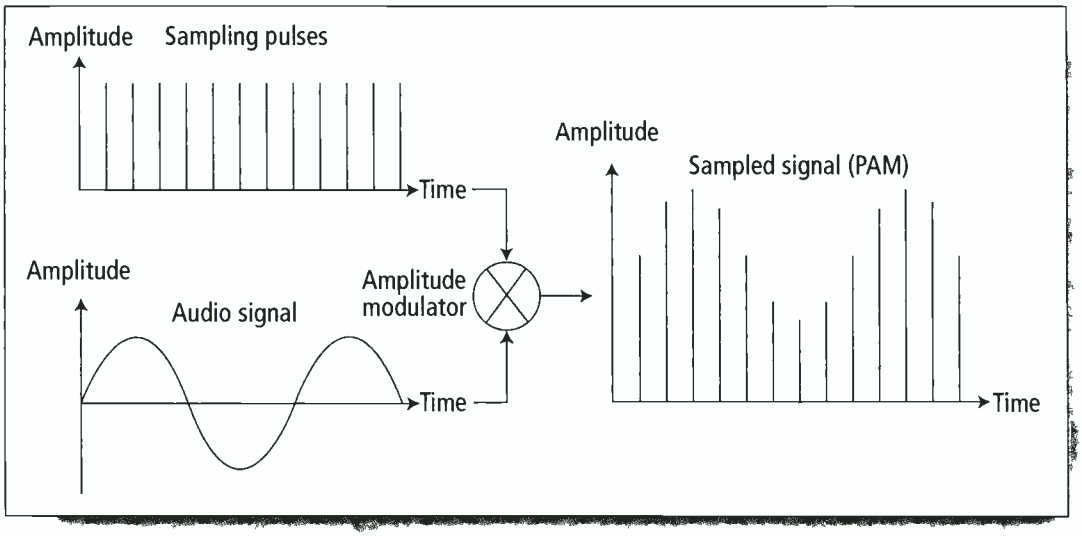

Figure 1. The sampling process results in a pulse amplitude modulation

process. Figure 1 represents this process in the time domain and Figure 2 represents it in the frequency domain. In this idealized case, the sampling frequency (F_s = 1/T) is considerably higher than the sampled frequency and the sampling pulse duration is close to zero.

Telephone audio signals with a maximum frequency of about 3.4 kHz are sampled at 8 kHz. Some early British approaches to carry digitized television audio on the tip of the horizontal sync pulses used a sampling frequency of 32 kHz with a maximum audio baseband of 15 kHz.

For historical reasons, CD recordings use a sampling frequency of 44.1 kHz. In the early 1980s, when CDs made their appearance on the market, the U-MATIC videotape format was adapted to record digital audio. A special adapter processed the digitized audio into a 3 MHz bandwidth analog video signal, which could be recorded on U-MATIC tape. For the process to work, it was necessary that there be a relationship between European 625/50 scanning frequencies, North American 525/59.94 scanning frequencies and the speed of the rotating record head. The adopted 44.1 kHz audio sampling frequency met this requirement so long as the North American playback VCR ran at 525/60 instead of 525/59.94. Sampling 20 kHz bandwidth audio signals at 44.1 kHz yielded a small frequency gap that permitted the use of a reasonably priced and reasonably performing anti-aliasing filter. Even so, many purists claim that a 20 kHz low-pass filter gives rise to overshoot, ringing and related audio distortions, which, to some, are unacceptable. For this and other reasons, studio audio operations are carried out at a 48 kHz sampling rate. Using both sampling frequencies in a studio environment requires sample-rate converters. In addition, in a television studio, the audio sampling frequencies have to be coherent (derived from the same master clock) with the video sampling frequencies.

With higher-level signals, the quantizing errors are uncorrelated with the signal and perceived as random noise.

Quantizing considerations

The next step in analog-to-digital conversion is quantization. In this process, the samples are assigned a binary number approximating their sampled value. Quantizing divides up the sampled voltage range into 2^n-1 quantizing intervals, where "n" is the number of bits per sample (the sampling resolution). For example, an 8-bit system can identify 2^8 (256) discrete sampled signal values (255 quantizing intervals). The amplitude of such a signal can occupy the entire quantizing range. However, low-amplitude audio signals would be quantized with considerably fewer discrete levels, re-

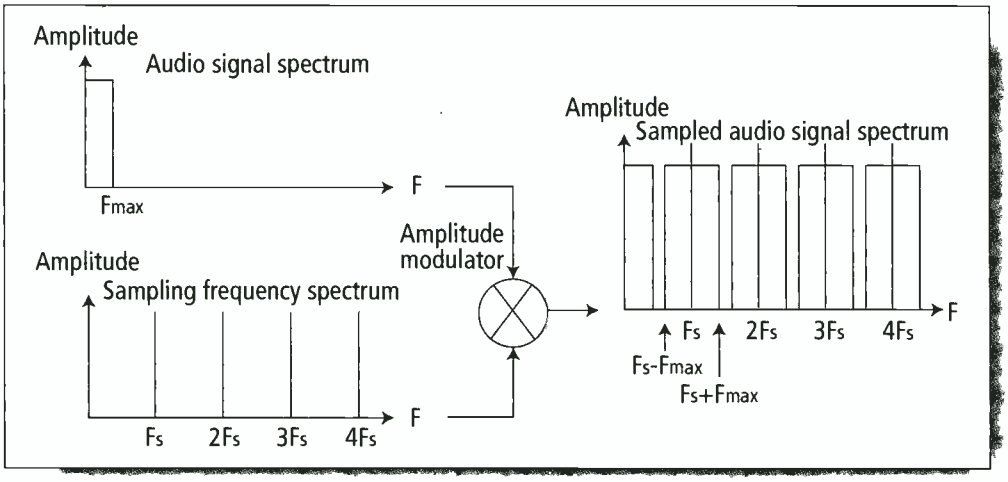

Figure 2. Modulation spectrum

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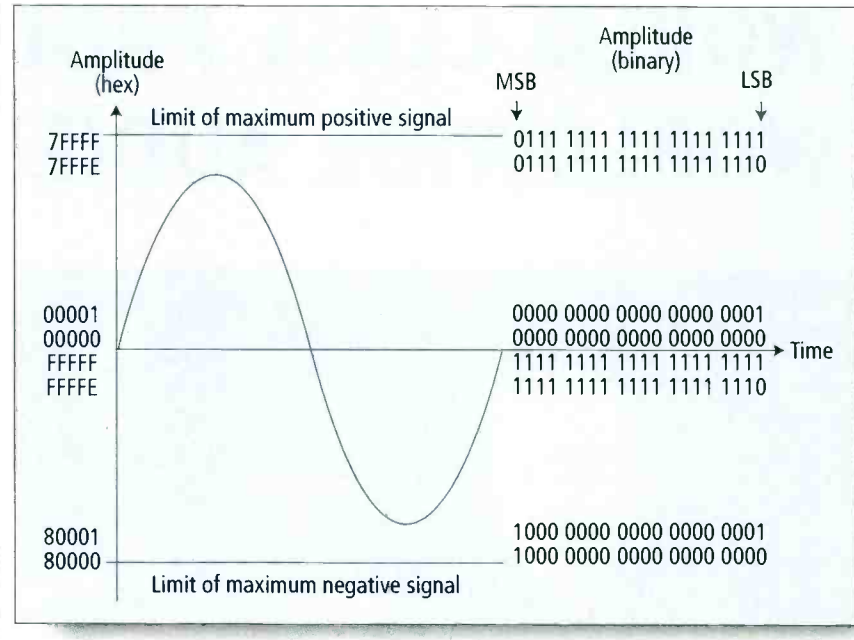
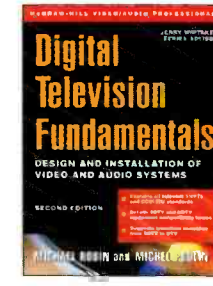


Figure 3. Twenty-bit example of two's-complement binary coding

sulting in significant quantizing errors. These quantizing errors are correlated with the signal and perceived as distortion. With higher-level signals, the quantizing errors are uncorrelated with the signal and perceived as random noise. One can reduce quantizing errors by increasing the number of bits per sample, increasing the sampling frequency (oversampling), or both. Early digital audio equipment (e.g., CD technology) uses 16 bits (65,535 quantizing intervals). Current high-quality studio equipment uses 20 bits (1,048,575 quantizing intervals) or 24 bits (16,777,215 quantizing intervals) per sample. The formula expressing the SNR of a digital audio system is SNR (dB) = $6.02n + 1.76 + 10 \log_{10}(Fs/2Fmax)$, where n is the number of bits per sample, Fs the sampling frequency in Hz and Fmax the maximum baseband frequency in Hz.

An audio signal is bipolar, which means that it deviates above and below a "midway level" of 0 V. The signal's amplitude indicates by how much the positive and negative excursions deviate from the midrange value, and a digital representation of the signal must take this into consideration. One method, called offset binary, shifts the range of the converter such that the positive and negative voltages of an audio signal are represented by binary numbers that are only positive. A similar approach is used in component digital video, where the bipolar B-Y and R-Y analog color-difference signals are shifted up by 350 mV. The offset binary approach creates difficulties in some digital audio processes, such as mixing, because it can lead to an overflow, which is unacceptable. An alternate approach, called the "two's complement," allows for negative values. Figure 3 shows a 20-bit example of two's-complement binary coding. Here, zero starts at midrange and the maximum positive signal value is 7FFFF(HEX). The maximum negative value is 80000(HEX). The most significant bit (MSB) indicates the sign, "one" for negative and "zero" for positive. ■

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



The Second Edition of Michael Robin's book may be ordered directly from the publisher by calling 800-262-4729. It is also available from several booksellers.

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Fiber optics for broadcast

BY BRAD GILMER

The implementation of fiber optics is a dark art. At least, that's the way it seemed a few years ago. Making a good fiber connector involved epoxy, heaters for curing, microscopes and not an inconsiderable amount of magic incantations.

Fortunately, new connectors have been developed, installation methods have been simplified and, overall, it is a much simpler world.

Building your first fiber network, whether for broadcast or computer applications, can be a bit daunting. But following a few simple guidelines can help transform the task into an enjoyable learning experience.

If you are a product engineer, there are a number of choices you need to make regarding fiber diameter, mode, laser and so on. The standard for several years has been 62.5 micron cable used at 850 nm. New developments are pushing the core diameter down to 50 micron for single-mode fiber, and pushing the wavelength up to 1550 nm. These changes allow a designer to get longer lengths and more data down a given fiber path.

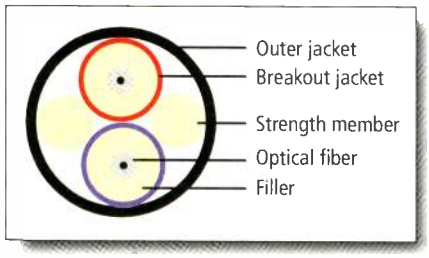

Figure 1. Belden multi-fiber, indoor-use cable

There are major differences between multi-fiber cable optimized for outdoor use and cable designed for indoor distribution.

A single-fiber cable suitable for indoor use contains a single fiber strand with a tight buffer surrounding it. The result is a robust cable that can be terminated directly without any special considerations. A broadcaster may choose to employ this cable as a jumper between a desktop graphics system and a wall plate. These cables can also be obtained in "Siamese" zip-cord pairs.

Fiber has a big advantage over wire in areas of high electromagnetic interference, impulse noise and lightning.

Figure 1 illustrates a multi-fiber, indoor-use cable. This design contains two or more tight buffer cables surrounded by a common outer jacket. An important difference between this cable and a cable intended for outdoor use is that the outer jacket can be stripped away to reveal two fiber cables that are ready to be terminated.

Figure 2 shows the cross section of a cable designed for outdoor use. There are several significant differences between this cable and the one shown in Figure 1. First, the outdoor cable contains a number of fibers separated by a loose buffer tube. This tube slides over the fibers, lubricated by a gel. Several fibers are contained in each buffer tube. Second, the individual fiber strands are not surrounded by a protective jacket. This saves space in the cable, but requires a breakout kit to terminate the cable. Third, the jacket on the outdoor cable is much more robust (different chemical composition) than that used on indoor cable, and is treated to resist water and ultraviolet radiation.

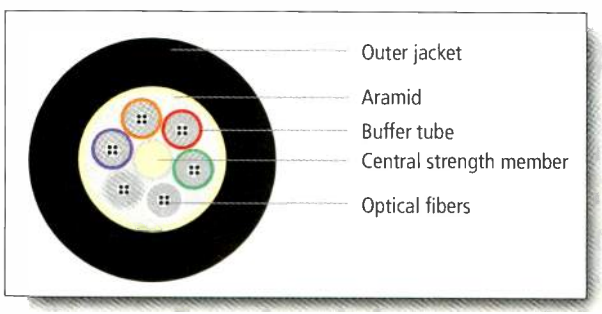

Figure 2. Belden multi-fiber, outdoor-use cable

Usually when going from outdoors to indoors, a transition of some sort is required. This involves breaking out the individual fiber strands from the loose buffer tube and connecting them to a panel. The other side of the panel is connected using indoor cable.

Figure 3 shows a typical breakout kit. The kit converts the loose-buffer-tube, multi-fiber cable to a number of tight-buffer-tube, single-fiber cables that can be terminated with the appropriate connector. The tight-buffer cables are much more rugged and will withstand the environment of a broadcast facility much better than the individual strands of a loose-tube cable.

If you are concerned about terminating fiber cables yourself, don't worry. It's much easier than it used to be. Companies such as 3M, Siecor and others now make crimp connectors and splices for fiber that allow you to terminate fiber easily and inexpensively. If you were not all that great at making splices in the past, you can probably do better with these. Signal loss ranges from .5 dB to 1 dB per connector. A connector kit costs about $350, and connectors are about $6 each.

Gone are the days of the old bi-conic fiber connectors, when alignment was a real problem. The new FC connectors always mate correctly with very little effort. With a little practice, you should be able to terminate a fiber in under a minute.

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You should also be aware that there are hybrid fiber connectors for outdoor use that allow the broadcaster to run both fiber and conventional wire cable in a single cable. There is also a four-fiber connector made specifically for broadcast applications.

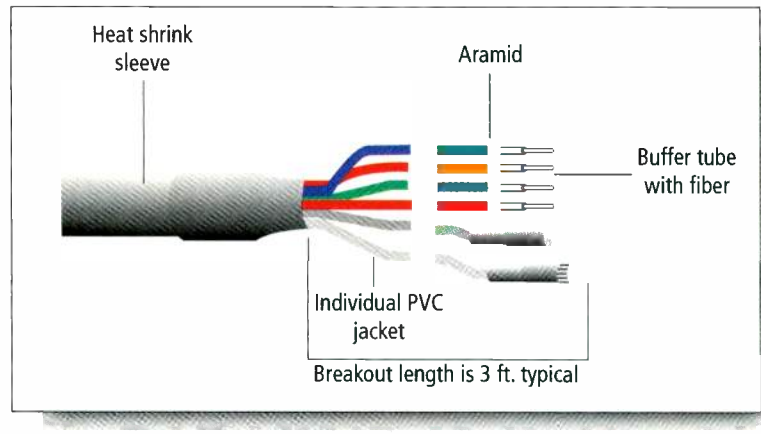

Figure 3. Fiber-optic breakout kit

If you have ever taken a tour of a large fiber installation, probably one of the first things you noticed was the large number of ducts running all over the building. Fiber-optic ducts are specially designed to carry fiber-optic cables and protect them from damage. They have carefully designed curves and openings that protect the cable from stress and excessive bending that could degrade the performance of the cable, or possibly break it. Your decision to use ducting will be based on the amount of fiber you are installing, and whether the fiber is concentrated in a central area. In any case, be sure your installation avoids bending the fibers beyond their rated radius. Even if you do not break the cable, you may increase losses significantly if you exceed manufacturers' specifications. There is also a chance that you will experience catastrophic glass failure years later.

Fiber-optic guidelines

- Use the right cable to prevent maintenance headaches down the road.
- Use breakout kits and termination panels to avoid cable damage and downtime.
- Keep the installation clean to ensure a clear connection.
- Avoid unnecessary transitions to prevent loss in connectors.
- Run more fiber than you need to avoid additional installation costs later on.
- Run multiple fiber types to allow flexibility.
- Talk to the manufacturer to learn more.

Fiber for office networks

What about fiber's place on the desktop in the television environment? It is true that fiber connectivity will give you the greatest potential for speed but, so far, it is primarily used behind the scenes. Here's why. First, it costs about $200 per line for fiber line, terminations, wall plates and jumpers. Second, fiber media can be damaged easily. The cables are better than they used to be, but it is difficult to protect a fiber cable in an office environment. Third, fiber terminations are sensitive to dirt. If you leave a fiber termination uncovered, and reconnect the cables before you clean both surfaces, you may end up with a connection that is noisy at best. Fourth, gigabit Ethernet is now a commodity item, and multigigabit, wire-based technology is on the horizon.

However, fiber has a big advantage over wire in areas of high electromagnetic interference, impulse noise and lightning. If you continually have a problem with lightning destroying the NIC card at the end of a long run of 10BaseT cable, you might try switching to fiber. Another advantage is distance. Single-mode fiber can be used in runs up to 100 kilometers, where 10BaseT and 100BaseT are limited to 100 meters. ■

Brad Gilmer is executive director of the AAF Association and president of Gilmer & Associates, a broadcast consulting firm.

IN ADDITION

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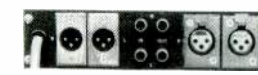

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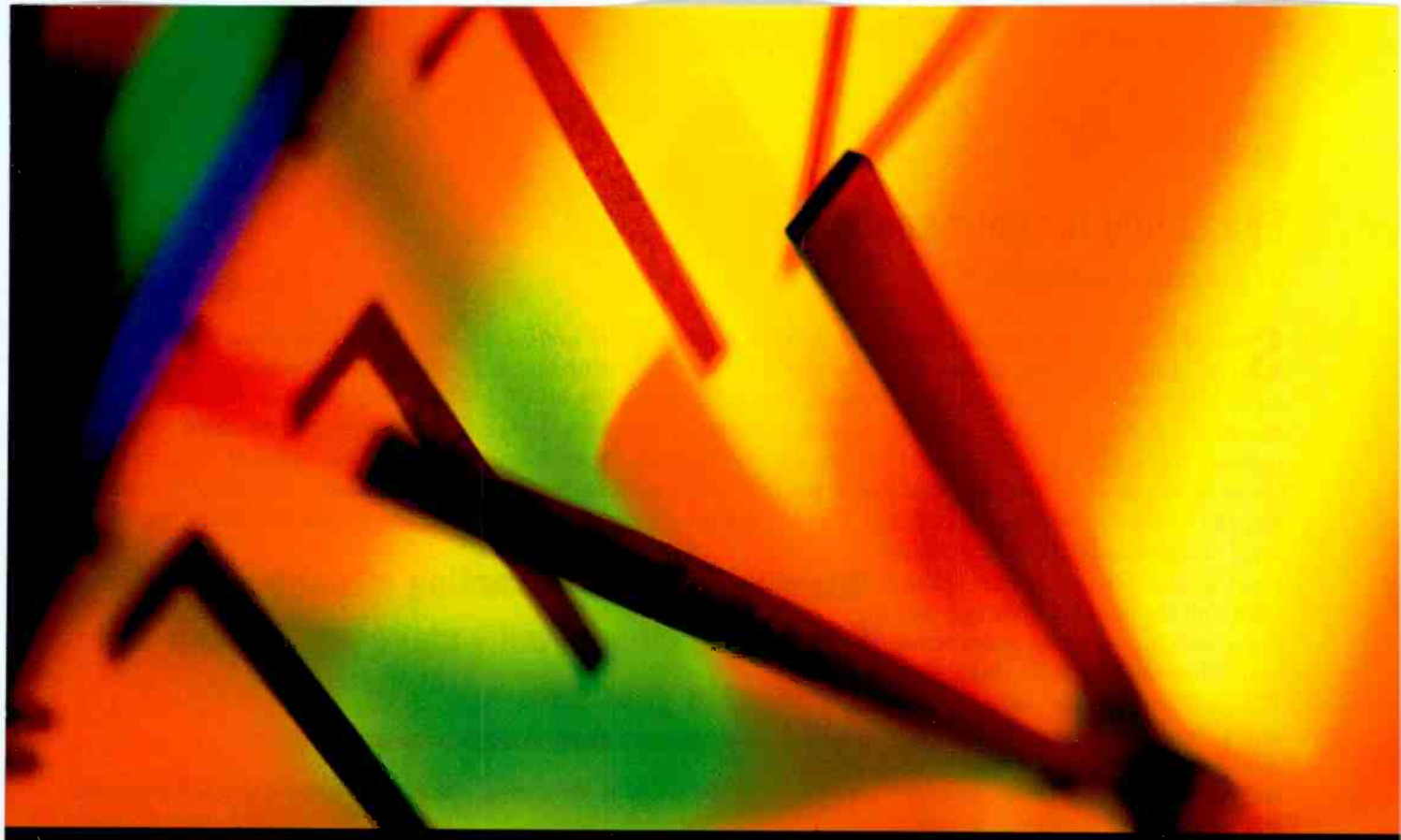

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Eye candy for your senses

BY STEVEN M. BLUMENFELD

Since this is the last streaming column of the year – just in time for the holiday season – I've broken out my wish list. Now this is not your ordinary list, not the list of goodies I am going to give to my wife and kids. No, this is the list of things I really want – things that will make my many hours on the network magical again.

With all the gazillion Web sites out there, how do you make yours stand out? What will be special about your Web environment that attracts users and potential customers to your locale? To find the answer, look to high-end retail marketing. Create an environment. Create a place that represents your company, your content and, most importantly, your customers.

From a technology standpoint, you need to bring to bear a lot of resources. First, decide what type of environment you need. Is it a straight text-based site (informative but not very appealing), or is it a 3D immersive site (very engaging but can limit access because of the high-bandwidth bells and whistles)?

For my wish list, I lean heavily on the bells and whistles. An immersive site on my list will undoubtedly incorporate the latest in interactive 3D graphics. Macromedia's Flash would be my choice for building this "world." I would possibly go as far as using QuickTime VR to build 360-degree images that my customers could navigate.

A site on my list would also have to incorporate video/audio streaming technology – a system that can display dynamic streams specifically tailored to each user's display platform with personalized information.

When it comes to attracting attention, interactive menus really make people stop and investigate your site.

OK, so this is just a wish. I have seen a few sites that incorporate some of these technologies, but putting it all together and offering it to users is another thing. For now, let's talk about what is possible. Certainly, pretty pictures make your site look better. A lot of sites use frivolous graphics for backgrounds that may add color and imagery but add nothing to functionality. Adding QuickTime or other video makes your site more interesting, and might even give some of your users their first taste of interactive TV.

Have you thought about interactive menus? They may not be as fancy as video or audio but, when it comes to attracting attention, interactive menus really make people stop and investigate your site. An excellent example can be seen at the Whitney Museum's bitstream exhibit (www.whitney.org/bitstreams). Other favorites of mine have to be the soft drink sites. 7 UP's site (www.7up.com) is very well done with interesting mouse overs. The holiday theme on the Coca Cola site (www.coke.com) is a nice touch. The menu items have a distinct sound, and you can actually make music by running your pointer over the ornaments. My new favorite is actually Pink Floyd's site called Echoes (www.pinkfloyd.co.uk). Its content is interesting, its use of Flash is innovative, and it rewards viewers with easy-to-understand navigation.

Soft drink companies are often especially adept at using graphic elements and Flash to create an environment, as demonstrated by the holiday theme of the Coca-Cola site (shown above). Photo courtesy Coca-Cola.

Macromedia Flash is the perfect tool to create such Web sites. Flash uses the power of vector graphics to animate Web sites. Flash, if used properly, can grab the attention of Web users, most of whom are used to static, boring Web content. Another benefit of Flash is that, typically, users spend more time at Flash-enhanced Web pages than regular old HTML sites. Uniqueness is a great attribute of Flash. The ability to have transitions and sound has an incredible effect on Web users who, naturally, make judgments about your company from the look and feel of the Web site.

Flash is the key to designing and delivering low-bandwidth animations,

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presentations and Web sites. It offers scripting capabilities and server-side connectivity for creating engaging applications, Web interfaces and training courses.

Unfortunately, the Flash interface is not the friendliest. Unlike the venerable HTML form commands such as pull-down menus, radio buttons and check boxes, Flash makes you create your own. Then you have to figure out how to communicate with them through variables. The upside is that you can be creative and make actions look and feel like anything you want. Making communications work between Flash files and CGI scripts is important to any interactive site. Without CGI interactions, users couldn't search databases, receive external data or interact with other programming. This involves writing action scripts to dynamically read in multiple variable names, then "write" the action movies to your current movie based on the variables returned from your CGI script.

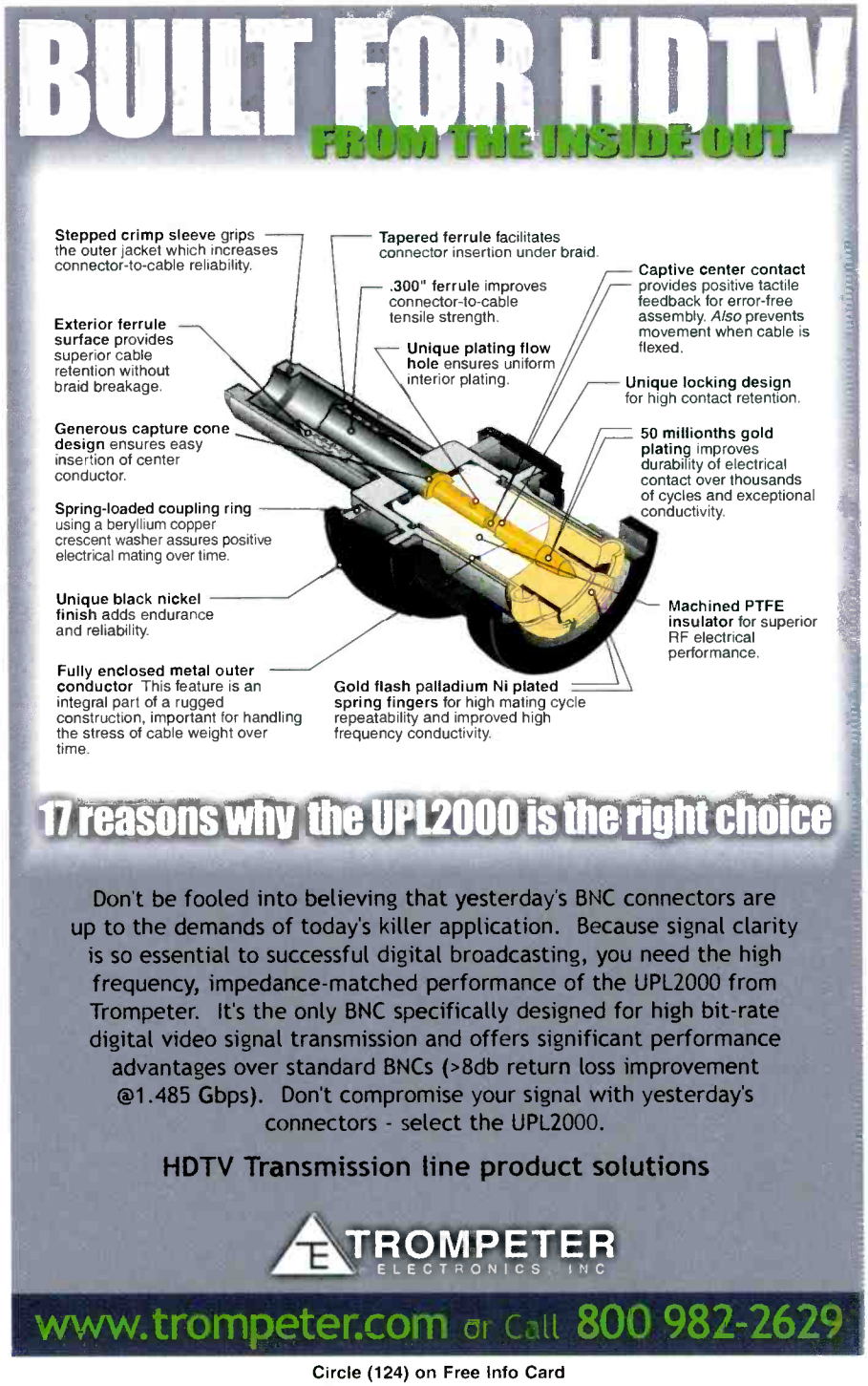
Flash, if used properly, can grab the attention of Web users, most of whom are used to static, boring Web content.

Variables within your "movie" will have an action that will be sent to your script using either the GET or POST feature. Variables from your script can be sent back to the Flash movie. Problems arise quickly when you have multiple action buttons, each in the same movie, each posting to the same CGI script. Flash doesn't know which one required the response and which ones didn't, so it posts all variables in that movie clip to the script. To fix this, each action must be put in a new movie clip. Each movie clip should contain its own URL to interact with your CGI and must be put in the main movie. This allows each action to post only its variable to a script of your choice. It also allows multiple actions displayed at the same time to post their contents to different scripts.

Performing simple data transfer to a CGI script is not obvious. The action commands are not as easy to use as the "FORM" HTML tags. Regardless, since Flash offers unique effects, Web designers are advised to work around any problems because the results are worth it.

There are many sites that show off the power of interactivity on the Web, incorporating streaming video, images and sounds, graphics and animations. Interestingly enough, my fantasy sites are starting to appear in various configurations across the Net. As Web site designers combine these technologies into a single site, watch out as new opportunities open up and the sites start attracting a different kind of customer. ■

Steven M. Blumenfeld is currently the vice president of advanced services for America Online.



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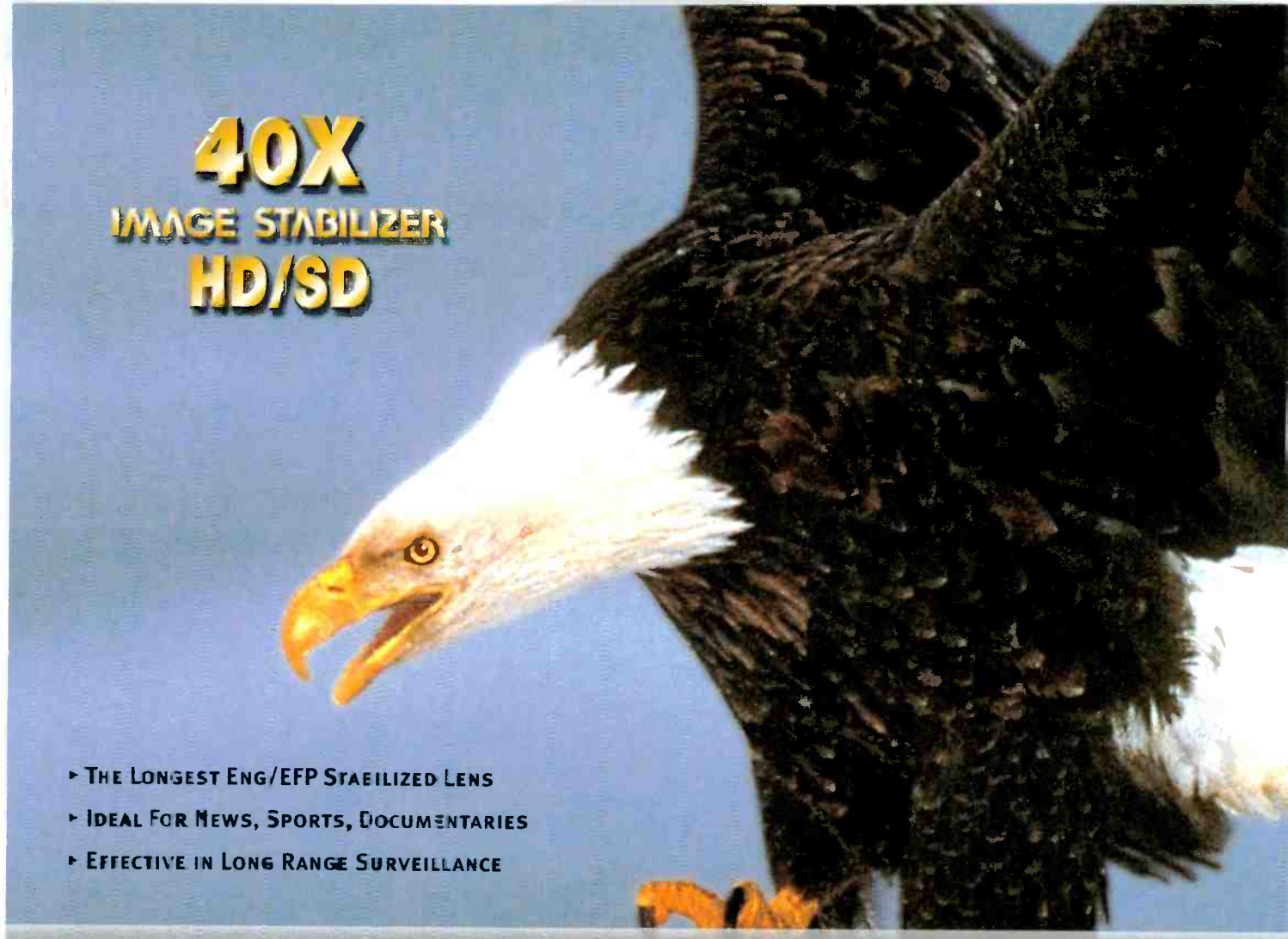

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THIRTEEN/ WNET's *new* 5.1 AUDIO SUITES

Two Genelec 1037 surround speakers rise out of wings attached to either side of the producer's desk, in order to preserve both the integrity of the studio's sweet spot and the traditional position of the producer's desk. Photos courtesy Walters-Storyk Design Group. Photos by Robert Wolsch.

BY DAN DALEY

An example of what public broadcasting's relationship with the rest of the entertainment universe might be in the future can be found at Thirteen/WNET, the PBS flagship station in New York City. The station generates an estimated 35 percent of PBS's content in the United States, including "Great Performances," "Nature," "American Masters" and the arts show "EGG."

Over the summer, the first of two new digital audio recording, editing and mixing suites opened at WNET's Manhattan operations center, which occupies several floors of a 10-story West Side office building. The second was set to open by November. The suites were a joint venture between WNET and Cool Beans Digital, a commercial music production and post company headed by producer/composer/audio consultant Peter Fish and chief engineer John Arrias.

WNET provided the space and the capital to build two control rooms,

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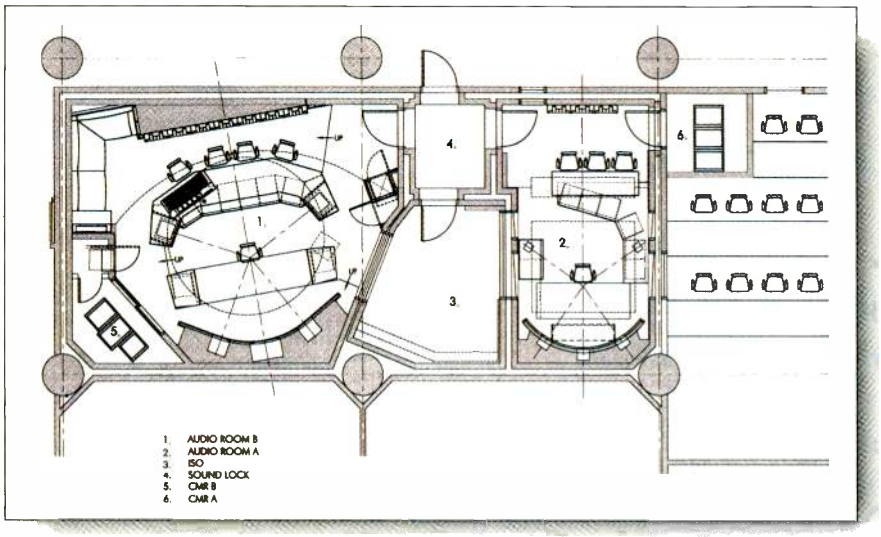

The original audio control room and voice-over booth in WNET's facility became the first of the two new digital audio suites. WSDG side-loaded the new control rooms to increase the amount of space available.

equipped with a pair of Neve Libra digital consoles and fitted with Genelec speakers for 5.1 surround monitoring and mixing, as well as a comprehensive array of other digital and analog audio gear. Cool Beans contributed additional technology and its experience with the workings of the market, handling the bookings and scheduling and day-to-day operations of the new facility.

There was a precedent for this arrangement; seven years ago WNET established a similar joint venture on the video side with production/stage management company Chelsea TV and post-production outfit Betelgeuse.

In the instance of the new digital audio suites, the goals of the two companies were complementary. WNET needed better audio facilities and was tired of going out of house for certain services, and Cool Beans needed more space than the three studios they already had.

WNET's existing audio facilities at the Manhattan operations center were limited: an audio control room dedicated mainly to on-air work, and largely centered on the frequent live pledge drives common in public broadcasting. It was adjacent to a small voice-over iso booth and a video control room. But there was available space to be culled from these and other areas of the building to put in new digital audio facilities, particularly after a high-definition video editing suite that had been set up in temporary quarters in that area moved into its newly completed space. The original audio control room and voice-over booth would become the first of the two new digital audio suites.

> WSDG faced the usual issues of designing technical operations in the vertical universe of Manhattan office buildings.

Walters-Storyk Design Group was chosen to design the new suites, based on a hierarchical agenda. WNET's needs, including on-air broadcasting for pledge drives and special events, mixing for the station's signature series, and digital multichannel surround audio mixing, were specified as primary, but Cool Beans' needs were also given high priority. These included the ability to quickly do audio scoring and post production for the independent production company's specialties, such as commercial spots, theme music for programming such as "The CBS Evening News," "The Rosie O'Donnell Show," and promos for the Sci-Fi Channel and HBO. This joint venture allowed WNET to do high-quality original music and effects in-house, in a world-class digital audio 5.1 suite, and gave Cool Beans space to work.

Design considerations

WSDG faced the usual issues of designing technical operations in the vertical universe of Manhattan office buildings. The three existing rooms were not configured correctly for conversion into two control rooms and an iso booth. To make better use of the space and to keep the individual spaces connected, WSDG side-loaded the control rooms, which nearly doubled the amount of space available. They installed the Neve Libra console facing the wall on which a large plasma video monitor was to be hung, a virtual window into the studio and anywhere else in WNET's studios that the tie-lined video lines were routed. The real window in each control room was placed to the left of the console and faced out on a newly redesigned isolation booth, one that had cable and visual connection to both control rooms, as well as to a broadcast control room. The team wanted to make the plasma screen

Public station Thirteen/WNET and Cool Beans Digital, a commercial music production and post company, teamed to produce the 5.1 audio mixing suite shown above, which met the needs of both companies for better, larger audio facilities. Image by Alex Dixey.

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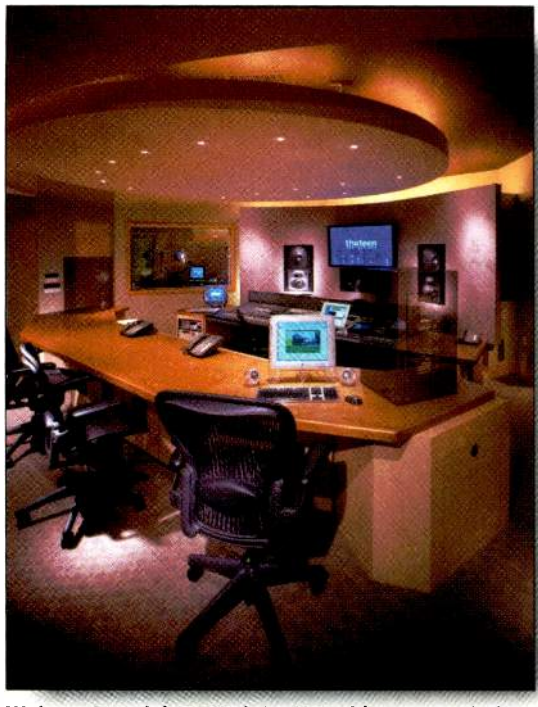

Walters-Storyk installed the Neve Libra console facing a large plasma video monitor and placed the real window in each control room to the left of the console, facing the newly redesigned isolation booth.

the focus of the room, since in television the focus should be on a screen.

The decision to side-load the rooms also made it easier to position the 5.1 surround speaker array. This allowed WSDG to stick to the EBU specification for monitor placement, one of the goals of the project. One challenge that presented itself was that one of the audio engineers wanted the speakers exactly 7.5 feet from his center monitoring position, with the widely implemented 30-degree arc from the front array and 120 degrees for the surround speakers. However, the control rooms were intended for broadcast and post, and required a producer's position in the rear of the room. WSDG solved the issue by placing the two Genelec 1037 surround speakers — the front array was made up of a pair of Genelec 1038s, a Genelec 1038C center speaker and 1094 subwoofer — on motorized lifts that rise out of wings fitted to either side of the producer's desk. This arrangement maintained the integrity of the sweet spot, but kept the producer's position in its traditional location.

Acoustically, Storyk's mission was helped by the fact that the studio spaces were already atop a floated concrete slab floor, which was simply recut as needed to fit the new studio configuration. The noise generated by the air-conditioning system, which in the low-ceiling environment of an office building and with the control room's newly lowered noise floor would be that much more noticeable, was addressed with additional packing and an acoustical "cloud" hung in the control room to act as both a diffuser for A/V noise and an aesthetic mask for the ducting. Rear-wall full-frequency diffusion is accomplished with RPG 734 diffusers. The geometry of the room handles the rest of the mid-frequency diffusion, since the room is wider than it is deep, and the walls angle outward from the front. This helps handle the bursts, so less absorption is required.

Throughout the design and building process, the team kept track of the interconnectivity between spaces and equipment. The process was simplified somewhat, because a Citibank IT operation originally used the floors WNET occupies, and the computer flooring left behind greatly facilitated wire runs. The studio's Digidesign Pro Tools system was put onto a network, allowing it to be used from either room and to access the facility's server-loaded sound effects libraries. Using hard disk media recording also allowed WNET to opt for mini-machine areas in each control room, with tie lines to the station's main technical operations center.

WNET is now nicely positioned to handle 5.1 digital surround broadcasting in the future. But the real story remains the hybrid business model that was the genesis of the new studios. The rate structure is more complex than might be found in most broadcast operations — WNET sets its own rates for its internal clients, while Cool Beans independently negotiates its creative fees with both WNET and its other clients. The long-term benefit of the arrangement between WNET and Cool Beans is that it will keep the studios busy and allow for maximum return on their investment. Maybe in the long run, the arrangement will cut down on pledge drives and leave more time for Great Performances. ■

Dan Daley is a widely published journalist covering the pro audio industry.

The real story remains the hybrid business model that was the genesis of the new studios.

Design team

Architecture and acoustic design: Walters-Storyk Design Group – John Storyk, Beth Walters, Scott Yates
Electric and lighting design: Robert Wolsch Designs
HVAC design: Marcy Ramos
Construction: Ernie Gabriele, M&D Carpentry
Thirteen/WNET's vice president/technology officer Ken Devine

Equipment list

RPG diffusers
TBC consoles
192-input Neve Libra digital mixing console
ProTools 24-I/O AVXL
Genelec 1038 5.1 surround monitoring system
Pioneer 50" HD plasma screen
ADC patchbays
Synclavier 24-output audio workstation
Roland XV5080
Roland VP9000 Variphase digital vocal processor
TC Electronic System 6000
Neumann, AKG, Audio-Technica, Electrovoice, Shure microphones
Dolby E encoder/decoder
Grass Valley Series 7000 router

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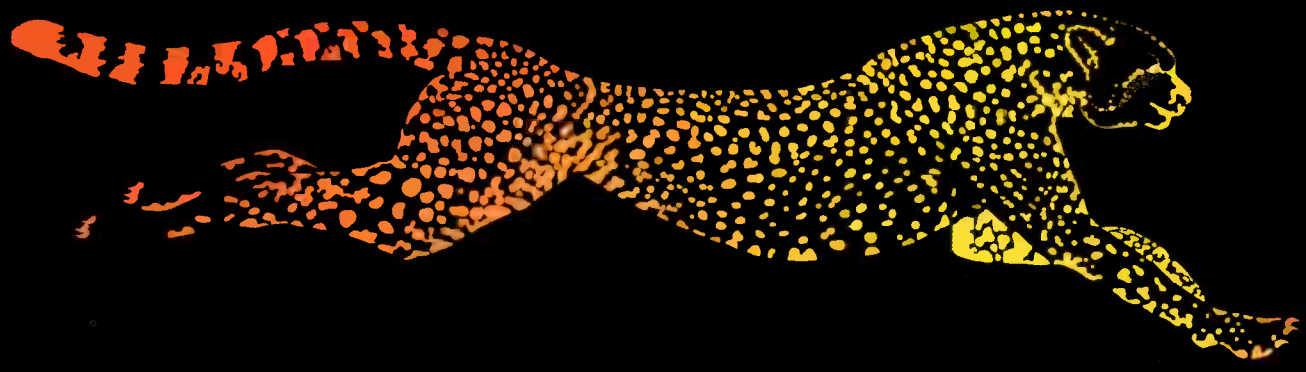

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Maintenance: Yes, it works—Fix it anyway!

BY DON MARKLEY

Even occasional readers of this column know by now that the author is highly in favor of regular preventative maintenance. Although modern equipment is far more reliable than older systems, simple housekeeping and checks of operating parameters will lower downtime even further and improve overall physical plant reliability. That, in turn, decreases the shouting at the station, improves employee evaluations and generally makes for a smoother running operation.

A few recent events observed by the author have reminded all involved that careful checking of everything will pay off in the long run. In the first of those events, an FM antenna failed on the first really cold night of the season. It was found that a bolt holding an inner connector together had backed all the way out of the threads, causing the connection to be completed only by being held together by previously applied pressure. The first time that the line cooled enough to cause the inner conductor to contract slightly, the connection was broken and the system failed.

In this instance, the bolt had been installed initially but had not been sufficiently tightened. The tower was observed to have a significant amount of high-frequency vibration. No dampers were installed. The vibration simply caused the bolt to slowly back out until it fell free into the center conductor. It should be pointed out that this was not an economy model antenna but from one of the major manufacturers. The entire problem could have been avoided if all bolts were carefully checked for tightness before the system was installed on the tower. The moral of this story is that it pays to carefully check every piece of equipment before it is installed. Even the best of companies sometimes leave a bolt loose, a cable not supported or a bracket not secured.

Even the best of companies sometimes leave a bolt loose, a cable not supported or a bracket not secured.

In the second event, an old bugaboo reared its ugly head again. An FM antenna system failed. Upon inspection, the problem was water in the antenna due to a failure of the pressurization system. That is the type of problem that consultants love. The failure is massive and total, the problem is easy to find and the repair is quick. That all makes for an easy fee that would have been avoided by some simple checks.

Pressurization systems are often neglected as they don't make any obvious calls for attention unless pressure warnings are installed. Even then, faults can go undetected. In one instance, the author was advised by the station that the transmission line had been continuously under pressure and didn't leak at all. In fact, the same bottle of nitrogen had been in use for more than five years and the pressure was constant at five pounds. When the gas line was broken at the transmission line, the reassuring hiss of escaping nitrogen was noticeably absent. The problem was found to be a blocked filter in the output of the regulator. The five pounds of pressure existed only in the regulator itself. The removal of about a pint of water from the transmission line at

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A look at the consumer side of DTV

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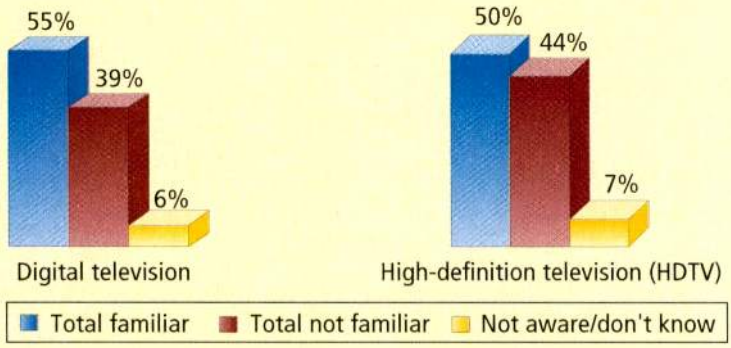

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the drip loop returned the system to normal. It is highly recommended that a pressure gauge be installed using a tee fitting right at the connection to the line. That ensures a more accurate measurement of the pressure in the line even if someone has placed a corner of the transmitter on the pressure hose.

There are a number of causes for the water-in-the-line problem. Older dehydrators have a tendency to continue to maintain airflow even when they have long since ceased to remove the moisture from the air. In other words, they very efficiently, albeit slowly, pump water into the transmission line. As a simple check of the air quality, an additional desiccant cylinder can be purchased and placed in the line at the output of the dehydrator. That makes for a simple way to ensure that the moisture is removed from the system. If air is moving and the color doesn't change, all is well. It helps if the staff isn't color-blind and actually looks at the cylinder now and then.

The problem can also be eliminated by using a nitrogen generator. Such units are now available at a reasonable price for large systems. They don't make much sense financially for a little single-line system but are very good when several lines or when large lines are involved. These systems were originally designed to maintain a positive nitrogen gas pressure in the fuel tanks of helicopters in combat situations. As fuel was consumed, nitrogen filled the empty space instead of fuel vapors. If a bullet penetrated the fuel tank, there was no atmosphere inside the tank that would cause an explosion. After lengthy testing on transmission lines at a television station near their plant, the manufacturer decided to enter the broadcast market to broaden their sales possibilities. These systems do a good job, as do the current crop of air dehydrator systems from the major manufacturers. The point here is that it is still necessary to check the system regularly, whether it is a dehydrator, a nitrogen system or a simple nitrogen tank and regulator.

The third event that caused widespread headaches concerned a bolt falling from a tall tower. According to standard practice, structural bolts on towers are normally equipped with components that will prevent them from coming loose. One problem is that occasionally they still get loose. More prevalent is the problem that items attached to the tower often don't have similar precautions taken and are more likely to shed parts of various size. Bolts are commonly installed with the head down so that they will fall free if the nut comes off – making them easy to spot during a tower inspection. The bad part here is that they will fall regardless of what or who may be in the vicinity of the tower itself. In this instance, a station staff member had the bad luck to be walking near the tower and was struck by the falling bolt. Now, let the trumpets sound to announce the entry of the parade of personal injury lawyers, OSHA officials and inspectors, local building inspectors and authorities. Those in the northern parts of the country know not to park near the tower during icing conditions. They also know not to go outside anywhere near the tower when it is shedding ice. However, most people don't think about the shedding of mechanical pieces.

Here, about the only thing a station staff member can do is to have annual inspections of the tower by a competent tower crew. While that helps, the occasional failure of a tower or tower attachment component is going to occur.

To that end, a number of steps need to be taken. First, make sure that your insurance policy covers damage or injury due to falling objects from the tower.

Second, bring the station fully into compliance with the requirements of OSHA for maintaining a safe work area. At the least, a Hazard Assessment should be prepared and posted prominently for the station staff. *Everyone* at the station should be required to read the document and sign it to acknowledge its contents.

It is highly recommended that you contact the area OSHA office and ask them to visit the site to advise you of any further steps that you must take to comply with their regulations. If you contact OSHA and ask for their help before any problem actually occurs, the atmosphere will be much more pleasant than when the ER personnel are removing an FM bay from a passerby. OSHA is a little different in this regard. In this case, they are from the government and they really are here to help you. On the other hand, if they advise you of necessary steps to be taken and risks to be avoided, it is highly recommended that you comply. If you don't and an accident occurs, you are now playing in the area of willfully allowing something to happen that you could have avoided. Get the checkbook ready. ■

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

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Using microphones

BY DAN DALEY

The transition to digital is necessitating a transformation in the industry's infrastructure. The microphone will remain the one analog link in the chain. The good news is that today's microphones are all set to make the transition to digital broadcasting. Developed for the music market, microphones with the dynamic range and noise floors required in a digital environment are already in use.

Due to the audio requirements for DTV, it is reasonable to expect that stations and networks will have to start using better microphones across the board. In fact, if there is one overarching consideration for microphone usage in a digital broadcast landscape, it is that microphones of higher sensitivity will increasingly come into regular use in systems that will be less tolerant of noise than ever before. As noise floors fall and gain is able to increase in a digital audio environment, audio engineers will have to become more aware of ambient noises in the studio.

The process of reconciling noise and sensitivity already is under way, led, interestingly enough, by the increased prominence of live music on television today. For instance, CBS' "The Late Show with David Letterman," which features live music from the CBS Orchestra, already is using hand-held versions of Audio-Technica 4055 and 4054 studio microphones. Such mics are studio staples, but until now have been relatively rare in broadcast.

Today's microphones are all set to make the transition to digital broadcasting.

Wireless tips

Wireless transmitters will remain vulnerable to hazards including metal, which can absorb or deflect radio waves, and moisture, which is often detectable by crackling. One preventative measure is that when placing small wireless microphones, make sure there is no conductive material in contact with them.

Part of any activity programming is getting the sound closer to the source. Lavalier miking can make this easier.

Techniques

Microphone systems will have to adapt, and even the microphones themselves will evolve to some degree. (There have been assertions of so-called "digital microphones" over the last few years, but the reality is that some manufacturers are integrating the A/D converter into the microphone itself.) But in terms of microphone techniques, most that worked well in the analog age will translate seamlessly to the digital era.

One area that will see some significant change is in the broadcast of multichannel sound. Not only does digital television offer the bandwidth to do it, but audiences who are accustomed to 5.1 and 7.1 audio in public and home theaters will likely demand it. Will that simply be an extension of stereo? We will see.

Stereo broadcasts have been in use for some time, mainly for music, but increasingly to add dramatic effect to other types of programming, including ENG. The most commonly used approach to getting stereo on location is the X-Y approach, using either cardioid or supercardioid polar patterns. (See Figure 1.)

The setup is basically a pair of similar mics crossed at an angle between 60 and 120 degrees. The degree of the angle determines the spread of the stereo image, and starting at an even 90 degrees is a good reference point. Digital television's greater bandwidth and lower noise floor may tempt audio engineers to make wider images. However, beyond 120 degrees, the X-Y technique will begin to create a hole in the center of the image and a loss of mono compatibility.

Less common in broadcast—although that will likely change in the digital era — is the M-S (mid-side), a technique that employs one microphone, typically a cardioid, as its M or mid component and one bilateral (figure eight) microphone as the S or side component. (See Figure 2.) They are resolved into a conventional X-Y stereo signal by a sum and difference matrix network producing an M+S and M-S output.

The greatest benefit to the M-S approach is its absolute mono compatibility. This works because when you sum the left and right channels,

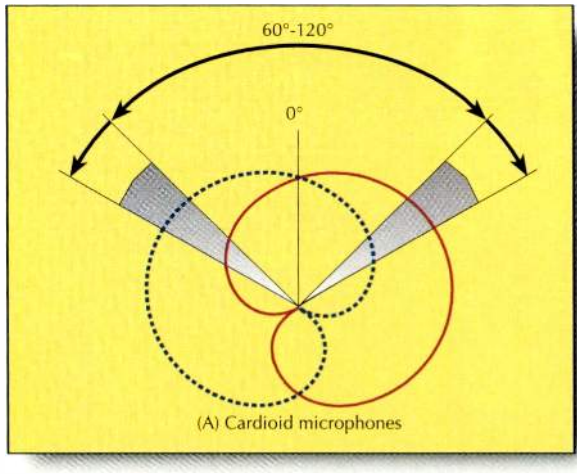

Figure 1. The X-Y microphone placement technique is simple yet effective in producing stereo sound. The two (preferably matched) mics are crossed at an angle between 60 and 120 degrees.

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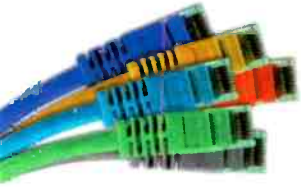

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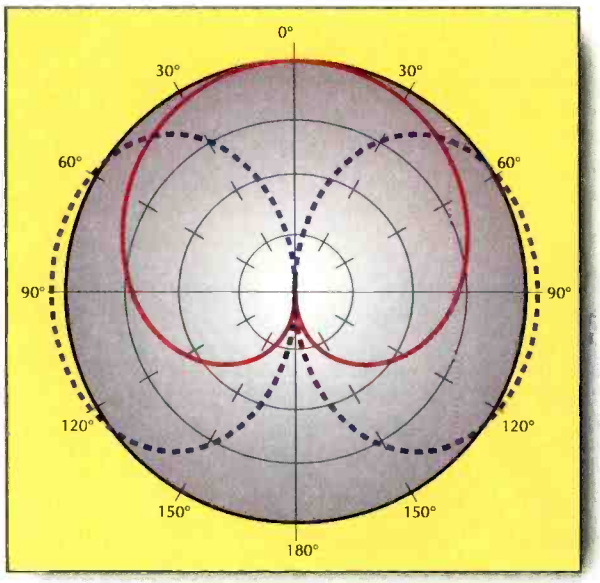

Figure 2. The M-S technique employs one microphone, typically a cardioid, as its M or mid component and one bilateral (figure eight) microphone as the S or side component. The stereo signal is created through a sum and difference matrix network producing an M+S and M-S output.

only the mid component remains. This also significantly reduces the ambient audio component because the side signals are nulled and the mid component is on axis with the centerline of the signal source. Thus, the listener gets natural-sounding, location-specific audio but the voice component is never crowded off center stage.

A few field sound engineers have reported success using one of a few new microphones that have a dual-capsule stereo matrix built in, such as the Shure VP-88. It is a bit too elaborate for most news stories, but very useful for others, where, for instance, cars moving across the screen can be buttressed by the sound moving too. It is not a big jump from stereo to surround in that context, and these same techniques can be applied to multichannel audio, especially the M-S technique, which can provide the information for a matrixed L-C-R array. Another consideration would be to use either X-Y or M-S techniques for the stereo or surround channels, and use a dead-on mono source, such as a shotgun, for the center channel.

If human nature and the entertainment industry have taught us anything, it is that if something can be done, it will be done. As DTV provides a more sophisticated and high-resolution canvas for broadcast audio, engineers and program producers naturally will want to push the edges of what the format can accommodate. But the best advice is for broadcast to always keep the center channel paramount. Even in multichannel music recording and mixing, after much experimentation on the subject, the consensus seems to be that the center channel is the best one for conveying critical, direct information, whether it is a song lyric or a line of dialogue or news copy. The other channels — stereo or surround — will always play a supporting role. ■

Dan Daley is a widely published journalist covering the pro audio industry.

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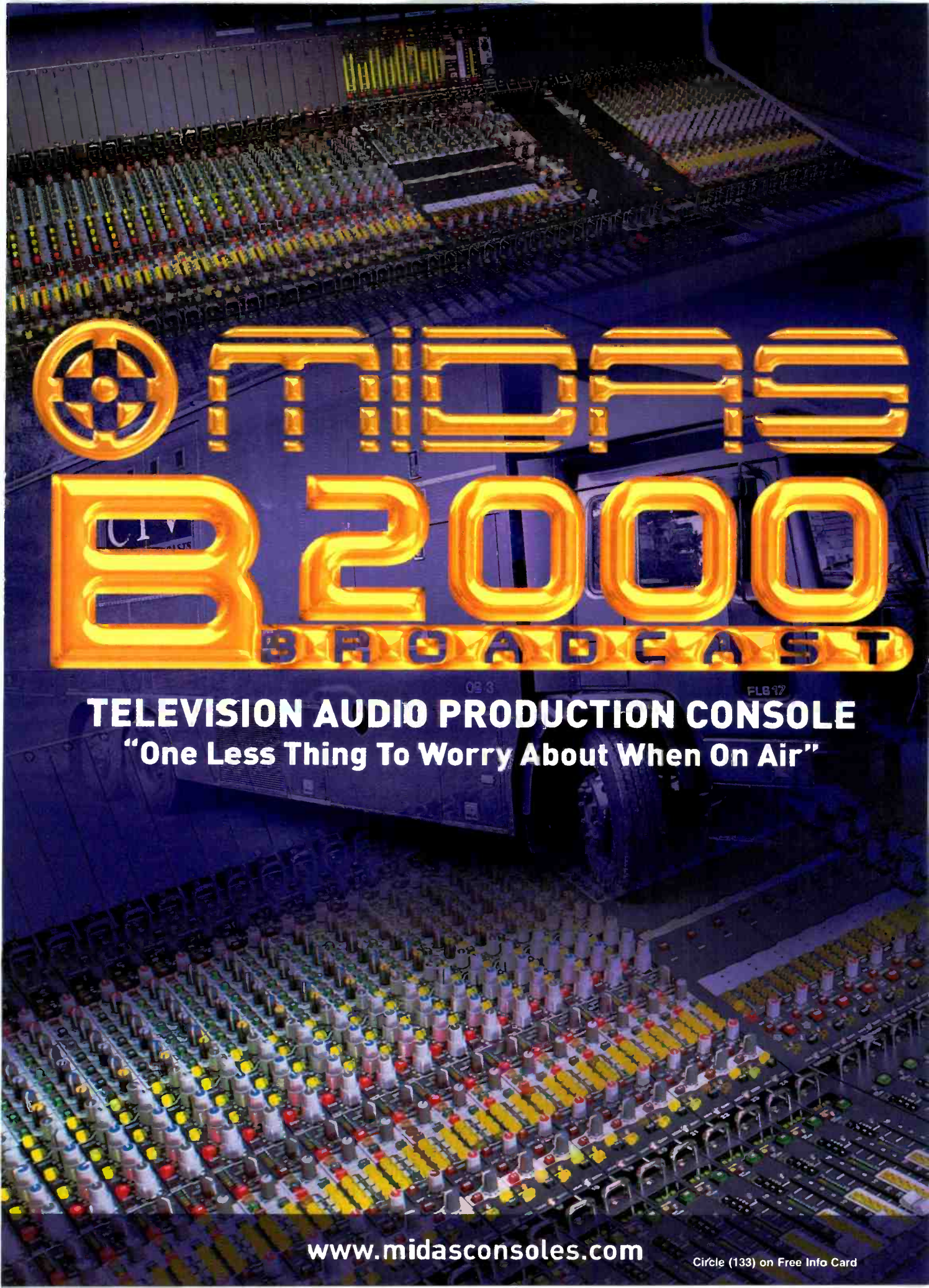
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The future of broadcast

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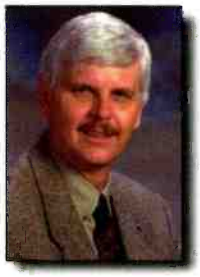
BY CRAIG BIRKMAIER



U.S. consumers are embracing digital television – but will broadcasters be left holding the old analog bag? Broadcasters in the United States, and around the world for that matter, face an uncertain future. The industry is facing economic contraction with root causes that extend well beyond the current global economic recession.

More than 25 percent of U.S. homes have upgraded to the multichannel DTV services offered by cable and DBS. Yet only 1 percent of U.S. homes have purchased an HDTV-capable digital television display, and only a tiny fraction of those have invested in a receiver for DTV broadcasts.

And while there are widespread discussions about emerging business models for DTV broadcasting, broadcasters appear to be hunkering down to protect the lucrative analog NTSC franchise. At the same time, via the NAB and other lobbying organizations, they are pressuring the FCC and Congress for mandates to force DTV upon competitors and consumers, who may not care whether free-to-air broadcasting survives.

More than 85 percent of U.S. homes now subscribe to a multichannel TV service – some analysts project that this number will grow to 90 percent within three years.

Given these realities, who could blame broadcasters for wanting to gaze into the proverbial crystal ball to see what the future holds?

Looking ahead

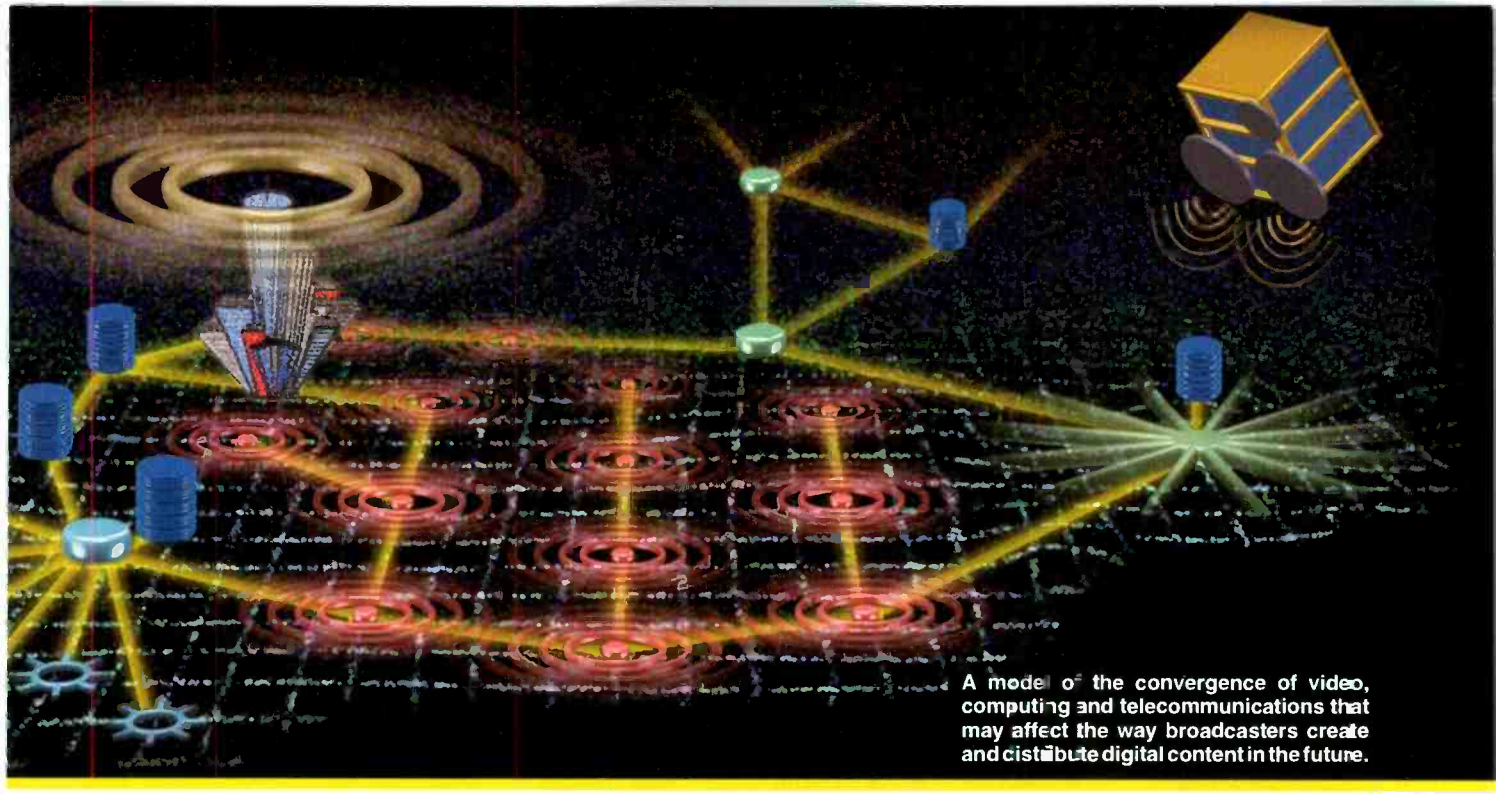
As we look to the future, we have assembled a collection of visions from some of the people who are trying to build the new infrastructure for digital television. Gary Shapiro and Mark Cuban provide a domestic perspective on the DTV transition, while Andy Ioannou and Robert Henderson add a global perspective from the UK, considered by some analysts to be leading the transition to DTV.

This author brings more than a decade of experience gazing into the crystal ball. Over that decade one thing has become crystal clear: There are no technical barriers to this transition. Anyone with enough time to analyze the evolution of digital technology can predict with a fair degree of accuracy how technology will influence the design and evolution of the convergent digital information infrastructure. Anyone can see the rapid growth of the competitive digital infrastructures that are replacing analog mass media.

The barriers to the DTV transition are political and competitive. They are wrapped up in decades of political gerrymandering with the communications industries, outdated communication and copyright law, layers of bureaucratic regulation, and the influence of some of the most powerful lobbying organizations in Washington. Perhaps the most daunting challenge, however, is that broadcasters, having lived in a protected world for decades, appear to lack the desire to compete.

This sentiment was echoed recently in comments solicited on the third anniversary of the DTV transition at www.ilovehdtv.com/anniversary.html. "One thing that has been missing is excitement from most of the broadcasters," stated Mark Richer, executive director of the Advanced Television Systems Committee. According to him, broadcasters need to seize the opportunity presented by digital, whatever its problems, because "there is absolutely no future in analog. You can't be an LP record in a CD world. You can't even be a VHS cassette in a DVD world."

One can hardly blame broadcasters for their complacency. Profit margins in the top 25 markets typically exceed 25 percent to 30 percent. Unfortunately, in smaller markets profit margins are typically in single digits, and



A model of the convergence of video, computing and telecommunications that may affect the way broadcasters create and distribute digital content in the future.

many have taken a big hit because of the slump in the ad market, reductions in affiliate compensation and declining ratings. Now they are faced with major capital investments to broadcast DTV next year.

The barriers to the DTV transition are political and competitive.

The specter of massive consolidation is rearing its ugly head, as the FCC and the Federal Appeals courts prepare to deal with the network ownership caps that currently limit network/group ownership to stations that serve 35 percent of U.S. homes. At the same time, with *centralcasting* it is easy to extrapolate a shift that has given a new face to regional broadcast centers operating out of the nation's top 25-50 markets. "Local stations" in smaller markets may become little more than an automated satellite operation with a small sales staff and production/news operation.

There is, however, an alternative, as difficult as it might be for broadcasters to see. The technology exists for free-to-air broadcasting to compete effectively with cable and DBS.

Creating "open" local markets

There is tremendous irony in the fact that most U.S. households *pay* for advertiser-supported TV. I pay Cox Cable approximately $35 per month for 60 analog TV channels, virtually all of which are advertiser supported.

Cox Cable has a local Gainesville studio and an operations center with a server that inserts commercials into 39 of the channels they deliver. What would happen if the terrestrial broadcast spectrum were used to deliver 60 (or more) channels of advertiser-supported programming in the free-and-clear?

This could well be the future of DTV, if broadcasters worked together to field a competitive multichannel service. But it would require a major shift in the currently proposed DTV business model, along with updated technical standards for a platform that would support both free and premium television and data services.

What would be needed to bring this vision to fruition?

Enhanced spectral efficiency. Single-frequency networks would be required to improve spectral efficiency, allowing operation at lower power levels and on-channel repeaters. These networks would also enable mobile and portable reception. It is important to keep in mind that this is unique to DTV broadcasting – cable and DBS require "fixed" receivers.

A common transmission infrastructure. Rather than licensing individual stations, it would be preferable to operate the transmission infrastructure as a utility, responsible for building and maintaining the networks. Regional operation would permit cost shifting so that profits from the large markets could be used to build infrastructure in the smaller, less profitable markets. The utilities would create an open market for bits; legacy broadcasters would have guaranteed access, but the markets would be open to new entrants. Rather than auctioning the spectrum, the government would license the utilities and share in the profits after the infrastructure is built out. Many existing broadcast facilities could become part of this infrastructure; transmission assets would be transferred to the utility in return for credits for the delivery of bits.

A common platform and service infrastructure. As is the case with cable and DBS today, a common infrastructure for conditional access, billing and customer service would be required. This overhead would naturally be assumed by the transmission utility. Likewise, they would handle the management of bit feeding the network, so that the same operational economies of scale enjoyed by cable and DBS could be leveraged.

A common consumer platform. This platform would leapfrog existing DTV standards, utilizing next-generation

compression and interactive media technologies. The platform would support interactive services and the delivery of both SDTV and HDTV content at significantly lower bit rates. Most importantly, it would include local cache storage. Via local caching a variety of information-on-demand services would be enabled, including news, weather and sports on demand, and a wide range of directory services. Off-hours would be used to pre-load caches with services including premium programs and movies that would be available on demand (cached VOD).

Local niche programming. Existing broadcasters would become local content brands, and would create the services that drive local commerce.

Recently Echostar announced that it would acquire DirecTV and other holdings of GM Hughes, merging DirecTV and Dish into a single service. The announcement created an immediate uproar about decreased competition, most of which was instigated by the cable industry and its supporters. They understand that the merged companies will be in a far better position to compete. Concerns were also expressed about the creation of a new monopoly for multichannel TV services in rural markets. But the growth of DBS must come from head-to-head competition with cable in the larger urban markets; rural customers have little to fear if there is effective competition.

What better way to create competition than for broadcasters to field a viable competitive offering that would give consumers a third choice?

That's an idea with a future! ■

Craig Birkmaier is a technology consultant at Pcube Labs, and hosts and moderates the Open DTV Forum.

Devoted to DTV

BY GARY SHAPIRO

In its first three years on the market, DTV has built a solid foundation fortified by tremendous progress in the last 12 months. One million DTV products were sold in 2001. From the early days of black-and-white and then color TV, to more recent introductions like Direct Broadcast Satellite (DBS) and DVD, passing the million units per year sales milestone has set products on their way to becoming household staples.

TV manufacturers are still leading the DTV charge, offering more than 300 models of DTV products (up from 200 models just a year ago) including integrated sets, digital monitors and set-top receivers at affordable prices. More than half of all projection sets sold last year were digital models, an indication of consumers' recognition of HDTV's value as the price gap between digital and analog narrows. The 2002 International CES will feature even more new DTV products at still lower prices.

We have learned a lot about the DTV consumer over the past three years. CEA found through DTV owner and consumer surveys conducted in 2001 that great strides have been made in increasing consumers' awareness of digital television. An example of this is consumers' familiarity with digital television vocabulary, particularly the terms "digital TV," "high-definition TV," and "HDTV." More importantly, we found that a majority of consumers expect to be able to watch their favorite programs in high-definition, receive high-definition programming through cable and satellite providers, and be able to record programs on their VCR. This underscores the fact that broadcasters and content providers will have to embrace the transition to digital TV for it to be a true success.

Just as critical to the transition as broadcast devotion to HDTV is cable carriage.

Programming will continue to be a key to DTV adoption in the coming years. The FCC has mandated that by May 2002, all commercial stations in the United States must begin broadcasting on their digital channels. While progress on this front has been slow, it is likely that more than half the stations, reaching more than 95 percent of the nation's households, will meet that deadline. This means that, despite enormous challenges, the majority of broadcasters, like the TV manufacturers, will have done their part to make the digital transition a reality.

On the content delivery front, DBS delivery of HDTV continued to grow on both DirecTV and Dish Network including feature films and sports events. Broadcast networks stepped up the pace as well in 2001 with significant strides in their digital offerings, so that by year-end the CBS and ABC primetime schedules were predominantly HDTV. Visionary entrepreneurs like Paul Allen and Mark Cuban, who saw the potential of other technologies before most, have also taken a lead in DTV – Allen with a hi-def cable channel (ASCN) in Oregon and Cuban with HDNet from Dallas on DirecTV. These and other signs point toward 2002 being the year that DTV takes firm hold in millions of American homes.

Just as critical to the transition as broadcast devotion to HDTV is cable carriage. This must be the year that cable operators across the country step

As consumer awareness of DTV products grows, DTV is beginning to take firm hold in millions of American homes. Photo courtesy Philips.

up to the plate and allow access to the growing roster of digital HDTV programs for the two-thirds of Americans who receive their television through cable. Pioneers like Cablevision in New York, Comcast in Philadelphia, Action Sports in Oregon and the few others that deliver HDTV to their subscribers cannot carry an entire industry through this transition.

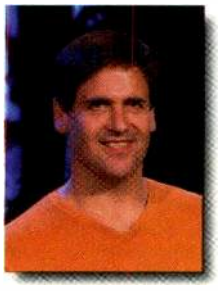
We've made progress addressing the challenges surrounding copy protection, cable carriage and compatibility, and we'll continue to encourage industry, government and consumers to turn on digital television. In one program, CEA and the NAB are working together to introduce a consumer marketing program in the first quarter of 2002, which involves local retailers, broadcasters and DTV manufacturers all promoting the common theme that DTV is here, it's real and it's exciting.

We're bullish about DTV in 2002. We expect unit sales to double to more than two million, with a value of $3.5 billion. And as the inventory of HDTV programs increases, we expect the percentage of DTV receivers and integrated sets to grow quickly as well. The record of success thus far is impressive by any standard, and the growth curve continues to reinforce what we've said all along – that digital broadcast represents the future for American television and that when you show digital programming, the American public will embrace it. ■

Gary Shapiro is president and CEO of the Consumer Electronics Association (CEA).

Devoted to HDTV

BY MARK CUBAN



My view on the transition to DTV, and in particular HDTV, is very simple: It's inevitable.

To paraphrase Bill Gates, technology always takes longer to get here than we expect, but it always has a bigger impact than we expect, and HDTV will be no different.

There are a lot of people out there saying there won't be a transition. That there is no way we'll get to 85 percent in six years. My response is who cares. That may be the magic number for TV stations and the government, but in reality it's meaningless. HD will start having an economic and social impact on us long before that number is reached.

We are already to the point where it's a mistake for those purchasing a big-screen TV not to purchase one that is HDTV capable. The incremental cost for a satellite/ATSC tuner is falling quickly, and will continue to fall. Retailers are starting to realize this and for the first time are actively showing HD content on their showroom floors from channels like HDNet. Consumers are seeing this and coming to the realization that high-definition content isn't something that is way out there in the future.

Eighty-five percent may be the magic number for TV stations and the government, but in reality it's meaningless.

They can enjoy watching HD here and now, with content from HDNet, CBS, ABC and some NBC, and they are buying HDTVs with tuners in record numbers. Most importantly, in those households, there is not a 150-channel universe. In those households, they will watch programming in HD over the middle of the pack programming of any other network.

HDNet, the first national network to deliver all of its programming in high definition, uses the mobile production unit shown above to bring HD content, including NHL sports, to consumers. Photo by A. Kaye.

The number of consumers in this category is growing, and will continue to grow. TV stations and networks that don't broadcast in high definition at its highest quality will be relegated to the furthest reaches of the remote controls, while those that do will reap the benefit of huge numbers in the expanding number of HD households. Long before we hit 85 percent, the ratings for HD-enabled networks will grow at the expense of the non-believers. The picture quality challenged will find themselves in an ongoing battle for a shrinking market in a world of expanding choices, while those broadcasting in true HD will reap the financial rewards.

Beyond the marketplace itself, the government should be ashamed of its efforts. To have the opportunity for a financial windfall for our nation and to be doing nothing to attain it is questionable at best. How hypocritical of our leaders is it to be talking about mandates, yet our government doesn't even support HD or DTV? Why do we not see C-SPAN in HD? Why do we not get feeds from the Rose Garden in HD? Why is government-originated programming not in HD? Any news organization can downconvert. When the government starts practicing what it preaches we will all see things happen a lot more quickly in our industry. Until then we should bring the hypocrisy to the forefront. ■

Mark Cuban is the founder of HDNet and owner of the NBA Dallas Mavericks.

Zen and the art of station automation

BY ANDY IOANNOU

At the dawn of the age of television, Daryl Zanuck, movie industry icon and head of 20th Century Fox, declared "Television won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a plywood box every night." Zanuck's rigid views about the side of the entertainment business he was in kept him from seeing where it was going.

Looking back, Zanuck's lack of insight on this aspect brings a smile. But while much has changed in our industry, we still have blind spots that keep us from seeing what *could be* instead of what *is*. One of these blind spots has to do with technology.

Despite the dizzying rate of technological innovation during the last two decades of the 20th century, the adoption rate of leading-edge broadcast technologies lags. Many stations haven't significantly changed the way things are done since the 1970s.

New technologies have been adopted, but the resulting changes have generally been more incremental than revolutionary. This is because it takes more than new broadcast technology for stations to make a quantum leap forward. New kit and software can only get you so far: Operational changes that reflect the rapidly evolving competitive landscape of digital television are required. To remain viable, broadcasters must embrace a new business model that reflects the fragmentation of their audience and offers the ability to target multiple market niches simultaneously.

You say you want a revolution...

While I'm not advocating change just for its own sake, sometimes it takes a revolution to bring it about. We're on the threshold of a revolution that will alter the way broadcasters operate. Back in the old days content was broadcast over one of three networks. Since then, we've added cable and satellite as content delivery channels. From a broadcasting perspective, the market becomes increasingly fragmented with each new delivery channel. Now we have the Internet, and broadcasters are trying to figure out how to respond to it — as well they should, since it's here to stay.

What about the Internet? Technically, what broadcasters need to focus on is Internet Protocol (IP), not the Internet. IP is a new transport mechanism for broadcasters that represents the potential to increase or at least maintain revenue streams. It is part of the evolution of broadcast.

Whether broadcasters embrace or reject IP as a transport for their content, this much is clear: Availability and cost of bandwidth, as limiting factors to IP broadcasting, will soon go away. When they do, and the content is available via this method (using either a push or pull model) consumer demand for delivery of content through these pipes will increase. How do broadcasters position themselves to view IP as an opportunity, not a threat? Station automation solutions put all content on a server, making it simple to serve content up through an IP pipe, or any pipe, to rapidly cater to changing viewer patterns.

It takes more than new broadcast technology for stations to make a quantum leap forward.

Yesterday

The biggest threat to the future of almost any enterprise is the complacency that assumes tomorrow will be like today, and today will be like yesterday. Broadcasters must assume that their station's market will change, but broadcast's history shows resistance to change. We were happy broadcasting in black and white until NBC and RCA broke from the pack. We saw similar internal debates over broadcasting in stereo. Now, the area of resistance is digital broadcasting. What does a broadcaster do with all these new channels?

Perhaps the easiest way a broadcaster can exploit these new channels is to create a "favorites" channel for soaps, game shows or sports for rebroadcasting previously aired content. Such an initiative doesn't take much in the way of resources or capital. Timeshifting represents another use for a new channel that doesn't require the creation of any new content.

Applications like the BBC's interactive coverage of Wimbledon (broadcast from the area shown above) provide one option for generating revenue using the new channels made available by DTV. Photo courtesy Omnibus.

Interactive TV is another possible use. For example, the BBC broadcast this year's Wimbledon interactively using a station automation system. Viewers had the option to see the spool feed, or select a view from any of Wimbledon's six courts. New broadcast technology allows stations to be nimble in this regard.

Most broadcasters agree that there is a far keener focus on money in the business now. It's all about ROI and doing more with less, or more with the same – a reflection of an increasingly fragmented and competitive market. In this environment, new broadcast technologies provide a means to compete more effectively, to be very agile with respect to changes, and to be well positioned to take every opportunity that comes about. ■

Andy Ioannou is CEO of OmniBus Systems.

The future of interactive TV: A view from the front lines in the UK

BY ROBERT HENDERSON

At NDS we have often heard the opinion expressed that the UK leads the field in interactive television development and deployment. In some ways this may be true, but when traveling to conferences overseas I have seen interactive television applications that leave the UK far behind. More notable examples include the deployment of interactive TV advertising campaigns on digital satellite in France, MHP deployments on Digital Terrestrial in Finland, TV Chat services on Digital Satellite in Spain, fully integrated interactive TV drama in Australia and what I would call interactive communities in the United States – for example, the Enhanced TV service developed by NBC for its Saturday morning TNBC block of programming. The United States is also a unique market in regards to two-screen interactive TV experience, whereby the synchronized interactive application is delivered to the PC, for example, interactive "Who Wants to Be a Millionaire."

I'm not saying that the UK is not at the leading edge and that there is nothing to be learned from this country, but if you only look to one market for guidance – and this includes North America – you can get left behind. You may develop an interactive television technology the market no longer wants (or can afford). You also may not be able to deliver the interactive television service your customers really want, because you never saw the potential demand for it.

So, after two years of interactive television deployment in the UK, is there anything that can be learned from what has happened here? And can the current shifts in interactive strategic thinking prove valuable in North America? Yes, on both counts.

Where the UK has excelled in interactive television is in squeezing the very best out of first-generation interactive television software and the cost-effective, small memory footprint, set-top boxes currently deployed in 5.4 million Sky digital households. For the recent series of "Big Brother", just over five million viewers voted for contestant eliminations directly through their TV remote control; on a regular basis 50 percent of viewers who watch soccer coverage on Sky digital choose to watch the game in interactive mode. This service enables the viewer the choice of watching the game from different camera angles around the pitch, the ability to watch edited highlights while simultaneously watching the live game and to call up a whole range of live match statistics.

QVC viewers can purchase the goods they see onscreen directly through the set-top box. And viewers of the BBC's interactive version of "Walking with Beasts" are able to call up the original storyboards developed for the program segment they are watching live and also access message boards to discuss the program. None of these applications need high-end set-top boxes or next-generation interactive TV software.

It has taken two years to get to the stage where millions of TV viewers now eagerly interact with their televisions. During that time program makers and developers of interactive platforms have established several guidelines for the successful development and deployment of interactive television services:

Not all TV programming needs to be enhanced.

Understand the medium: This is television, not the Internet. It's all about entertainment and emotion. Understand the culture of your viewer: Learn why they watch TV and what they do while watching TV and use that knowledge as basic level strategy for the development of your interactive service.

Understand what content viewers most want from television: Use interactive television technology to enhance that content and improve the viewing experience. This increases loyalty and reduces churn.

Keep your viewer in the broadcast experience: Do not lead them to a virtual channel or "walled garden" where they miss out on the TV program they want to watch. The UK's most popular interactive service, "Big Brother", only offered viewers two options: "Select a video stream" and "Vote."

Content in context is king: Not all TV programming needs to be enhanced. In the UK no one wants to do an interactive version of "West Wing" because doing so will take away from the compelling content.

Interactive sports coverage enhances the viewing experience by giving viewers options, such as watching the game from different camera angles or viewing live match statistics. Image courtesy NDS.

Leverage your most successful, trusted brands first: Successful interactive television services are event-driven—whether it be Wimbledon, the MTV European Music Awards or "Who Wants To Be A Millionaire" — not technology-driven.

Monetize it: Make it profitable within 12 months (although market forces are currently demanding ROI within three months).

Finally, make sure the technology you use is robust, scalable, synchronous in the broadcast stream, doesn't slow under heavy usage or crash the set-top box, is fast enough for screens of enhanced information to be displayed almost instantaneously on-demand, and is dynamically linked to the databases of the content originator. A lot to ask? No. Interactive applications from NDS and BSkyB matching these criteria have been deployed successfully on the Sky digital platform for years now. ■

Robert Henderson is an interactive TV analyst with NDS.

Weather Systems

BY LARRY BLOOMFIELD

The history of weather in broadcasting dates back to 1912, when Charles Herrold, inventor of a mechanical radio called the Arc Fone, began broadcasting for the people of San Jose, CA. This service continued until the outbreak of World War I, when the government forcec all experimental radio off the air.

With the resumption of broadcasting after WWI, weather information became an integral part of radio. That legacy has carried on into television today. A multi-million dollar industry has developed, offering devices and services to help broadcasters bring current weather information to their viewers.

Key technologies

There are three key technologies involved in the display and presentation of weather on television: radar, satellites and computers. The application of these elements in each market varies depending on local conditions and budget considerations.

The first line of weather data comes from "weather sticks." Some of these small weather monitoring stations can measure over 35 different parameters. They are located through the country and can be found along roadsides as small posts. Weather sticks can be had for just under $600 and go up in price from there, depending on available features.

Some broadcasters buy these units and become part of the automated surface observation systems (ASOS) that are sprinkled nearly everywhere, including most airports. The information from this extensive network is collected by the National Weather Service and used to create a report that forecasters use to determine weather

patterns. Some of these stations also offer a video output option.

In addition to doing weather from the studio, some stations also do live shots from the field using ENG equipment. Real-time weather readings from the field

local weather conditions.

Stations can also go to the National Weather Service for raw data, radar and satellite pictures to incorporate in their weather coverage. This information, as well as that from weather satellites, was

After WWI, weather information became an integral part of radio. That legacy has carried on into television today.

lend credibility to not only the weather, but the entire news operation. A portable weather station can be useful for these kinds of shots. Hurricane storm trackers have used these kinds of mobile weather monitoring instrumentation packages to broadcast readings from the eye of a hurricane to the National Hurricane Center in Miami, FL, while letting local viewers know of current conditions. This equipment can also be used to keep a station's Web site updated with the latest

originally distributed on a need-to-know basis only. Now anyone with a computer can connect directly to the National Oceanographic Atmospheric Administration (www.noaa.gov) and access weather radar and satellite images from nearly anywhere. Although this raw data is used by most computerized

weather systems, it is often supplemented by a station's own private radar system when weather conditions change rapidly.

Stations located in areas where weather events are volatile should consider having their own weather radar system. The installation of a station-owned radar system requires a great deal of on-site preparation. All radar systems must be type accepted by the FCC, and each station must apply for and receive an FCC license. The task then becomes getting the signal back to the studio from what is usually a remote location that overlooks the coverage area. Radar systems are also available that measure the Doppler Effect, the compression and expansion of wave fronts as they move toward or away from a given point.

Selecting graphic systems

When considering technical options, there are a number of questions that need to be answered. Systems have come a long way since the days when the weather person had to write backwards

Graphic systems can be used to create a variety of effects to add interest to weather coverage. WSI's Skycast is an example; the system automatically generates realistic animations depicting future weather conditions over recognizable skylines and landmarks. Image courtesy WSI Corp.

from the rear side of a Plexiglas map or magnetic clouds and lightning bolts graced a map mounted on a metal wall. Most computer-based weather graphics services today offer a core of similar products. The distinctions come in the extras each has to offer. How fancy does your station want to get?

As you make your decision, consider the data source for the system, and how often it is updated. Another consideration is the level of customer service provided by the manufacturer. Don't be afraid to call stations already using the system you are considering to gain information to aid in your decision.

Real-time weather readings from the field lend credibility to a station.

Be sure to choose a system that will render images that can be put directly on the air or your Web site without requiring you to doctor them first. Also keep in mind that the weather talent may not have a high level of experience with the equipment, and will need a system that is user-friendly.

Once you have chosen a system, you still need a graphics source. Most of the raw data, radar and satellite picture information used will come from the National Weather Service via satellite to a dish on the station's roof.

Few stations try to do weather without a chroma key wall. Some considerations in the use of a chroma key wall are proper lighting and the color of the clothing worn by the talent. It is also important to place monitors strategically around the key wall set so the talent won't look like they're watching some other show.

An additional factor to consider is redundancy. This is an important and often overlooked issue. If your community depends on your station for life-saving weather reports, don't let them down because one component or another failed.

If you don't have the technical staff or people you can rely on for competent pre-wiring, you may want to consider using a turnkey service for installation of the equipment. If the implementation of the weather system is to be a gradual one, then priorities have to be set so that you get the key ingredients up front and also add to the system later in an organized manner.

Graphics programs are available that enable stations to present weather in creative ways. Weather Central's WalkOnWeather, for instance, uses a real-time composite of camera, key and computer animations to place the weather talent in the scene.

As new graphics technology is integrated into your facility, don't be surprised if your staff must make an effort to learn about the system. Engineers, especially in smaller markets, will be required to learn about the aesthetics of weather maps and graphics in order to tie all the available data to a specific forecast. Although a GM doesn't typically look to engineers for artistic considerations, don't forget that engineers did nearly everything in the early days of television. There might just be a bit of that legacy still in our bag of tricks.

Stations located in areas where weather events are volatile should consider having their own weather radar system.

So when the GM decides to improve your station's weather coverage, realize that engineers face new challenges with the advent of multicasting. Those extra channels will have to be filled with something, and weather might help pay the bills. ■

Like WISC-TV in Madison, WI, many stations have "weather centers" from which they keep their viewers updated. Often times the weather graphics equipment is on display as part of the set. Photo courtesy Meteorlogix Inc.

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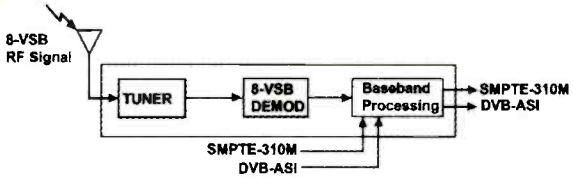

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- Outputs : SMPTE-310M, DVB-ASI
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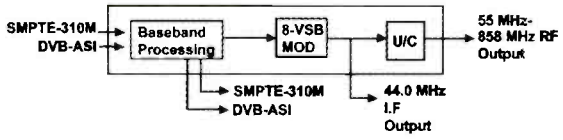
- PSIP Update(VCT, Station ID, Major CH No, Minor CH No)
- Simultaneously Converts
  - 8-VSB RF to DVB-ASI and SMPTE-310M
  - DVB-ASI to SMPTE-310M
  - SMPTE-310M to DVB-ASI
- Alarm & Status
- RS232C Remote Control



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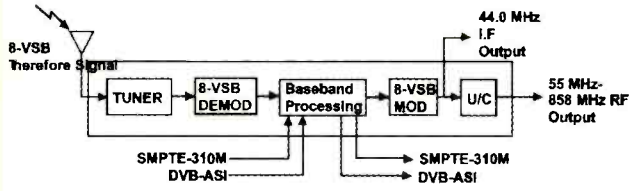
- PSIP Update(VCT, Station ID, Major CH No, Minor CH No)
- Simultaneously Converts
  - DVB-ASI to SMPTE-310M
  - SMPTE-310M to DVB-ASI
- Alarm & Status
- RS232C Remote Control
- Built in 23 stage PN Generator for BER testing
- PLL Lock Detector indicates MPEG2 valid
- SNR : 37dB Typical



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- PCR Correction
- PSIP Update(VCT, Station ID, Major CH No, Minor CH No)
- Simultaneously Converts
  - 8-VSB RF to DVB-ASI and SMPTE-310M
  - DVB-ASI to SMPTE-310M
  - SMPTE-310M to DVB-ASI
- Alarm & Status
- RS232C Remote Control
- Built in 23 stage PN Generator for BER testing
- PLL Lock Detector that indicates a valid MPEG2 signal

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Applied Technology

Panasonic's variable-frame-rate camcorder

BY DAVID WISWELL

In the early days of moviemaking, before the advent of "the talkies," there was no standard frame rate for capturing images on film. Cameras were hand cranked, and cameramen needed a steady, experienced hand to crank the film through the camera at a constant speed.

To record sound on film properly, film had to be cranked at a constant speed, and it had to be faster than 16 frames per second. Stanley Watkins, a British engineer working for Western Electric, decided that 24 fps would do the trick. Thus, since the advent of talking pictures in the 1920s, cinematographers have captured images on film and played them back at a standard frame rate of 24 fps.

One new professional camcorder capable of multiple-frame-rate videography is the Panasonic DVCPRO AJ-HDC27V. The camera portion of this high-definition camcorder employs a simple technique for overcrank and undercrank shooting. It is important to note that only the camera portion of the camcorder operates at multiple frame rates. The recorder portion of the camcorder operates as a standard 720p, high-definition VTR, recording images at 60 fps.

How it works

The camera portion of this camcorder can be set to any one of 33 frame rates: 4 fps to 33 fps in single-step increments, and 36, 40 or 60 fps. When set at 60 fps with no shutter setting, the camera's exposure time is automatically set to 1/60th of a second and each frame is recorded once by the recorder section of the camcorder. The image motion blur is controlled by combining the variable frame rate with the variable shutter speed. Combining the two controls gives cinematographers film-like control of the HD video. Whenever the camera's frame rate is set lower than 60 fps, exposure time increases proportionally and redundant frames are recorded onto tape. These redundant frames are used to maintain a constant flow of exactly 60 fps to the recorder section.

When used in, say, a 24 fps environment, the camcorder can be set to a higher frame rate to achieve slow-motion effects, or it can be set to a lower frame rate for fast-motion and time-lapse effects.

Predicting and reproducing frames

The camcorder marks each image with a time code user bit. Each time a new video frame is acquired by the camera, it is marked as an "active frame." If a frame is recorded more than once just for the sake of the recording process, it is marked as an inactive frame that can be dropped, if necessary, when editing or converting it to a different DTV format.

Only active video frames are stored on disc, thereby reducing the cost of storing HD footage on the processor's hard disc.

Panasonic has demonstrated a processor that automatically extracts the active frames and drops the inactive frames. The processor ingests 720p60 video with user bits over a standard HD-SDI input. The images are stored on disc in their original compressed state exactly as recorded in the camcorder. The output video can also be transferred over SDTI or SDI if desired.

Only active video frames are stored on disc, thereby reducing the cost of storing high-definition footage on the processor's hard discs. The processor records each marked active frame in an AVI file on the internal hard discs. After the video file is built, it reads out at the desired frame rate by re-inserting the appropriate number of inactive frames. ■

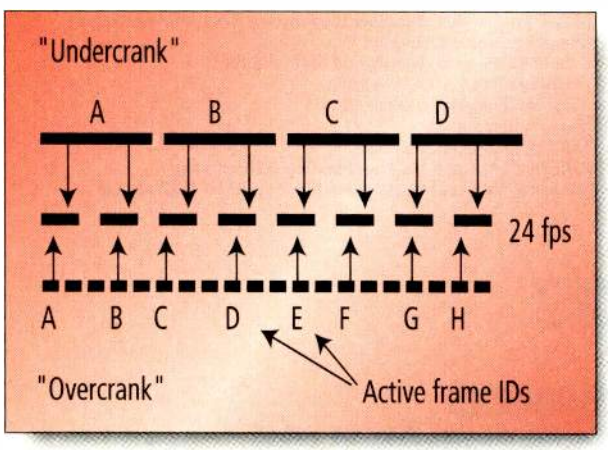

Figure 1. The results of overcranking or undercranking video at a display rate of 24 frames are shown above.

David Wiswell is group manager for Panasonic Broadcast and Television Systems Company.

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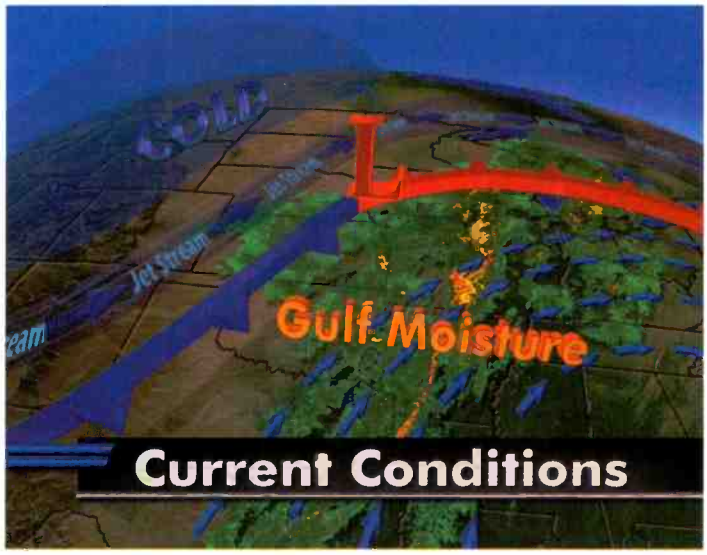

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New standards in cable connector technology

BY RICHARD A. CERNY

The SMPTE standard for mobile fiber-optic interconnection is finally a reality, and fiber seems to be everywhere. Although it's hard to believe, it has been more than 20 years since fiber optics first emerged in live remote television production. The first fibered remote events occurred in 1980 at the Democratic National Convention aired by ABC News and at the Winter Olympics in Lake Placid. Both of those events used rack-mounted optical transmitters and receivers comprising fixed video and audio links between static locations. In 1981, the first true mobile fiber remote broadcast took place when CBS News covered the second space shuttle landing at Edwards Air Force Base. That's when the fun began.

The very first fiber-optic cables made in the 1970s, funded by the U.S. Army, were jacketed with Kevlar-reinforced, tightly extruded polyurethane, which is a tough, resilient material. While these cables were quite rugged, they were nearly impossible to strip without breaking the hair-thin glass fibers.

Electronically, the fiber-optic transmitters and receivers have graduated from AM to FM to digital modulation. Optically, we have advanced from low-power LED sources to efficient laser diodes. Signal transmission now employs time-division and wavelength-division multiplexing instead of the noise-prone analog subcarrier audio techniques used in the past.

Shown here, a four-channel hermaphroditic connector from Delphi, which was approved as the SMPTE standard all-fiber connector.

Today's systems handle virtually every signal found in remote broadcasting.

When the telecommunications industry made a wholesale changeover from multimode to single-mode fiber in 1981-82, a number of more efficient connectors emerged, including AT&T's threaded, keyed biconic plastic connector, which was succeeded in the mid-1980s by their keyed, bayonet-style ST connector. The ST's ceramic ferrule ensured nearly perfect, repeatable intermating of either multimode or single-mode fibers and became an important connector for premises applications.

For most field applications, a multifiber cable is required. Typical are the four-fiber and 12-fiber tactical military cables used in network news and sports remotes. Terminating these cables with ST connectors means fanning out the cable into up to a dozen vulnerable, individual fiber arms. Inevitably, these relatively flimsy breakout arms get damaged. Thus comes the need for the multifiber connector.

At Telecast, we realized early on that the viability of our business depended on a reliable multifiber connector, and in the early 1990s, there were only a few companies working on such a product. Packard-Hughes developed a line of so-called hermaphroditic connectors for the U.S. Army, and these connectors were literally battlefield proven. The fit with Telecast's mission was obvious: These connectors were intended to be deployed quickly under rigorous conditions by semi-skilled troops and survive in virtually all environments.

A major feature of these connectors was the fact that they could never be deployed in the wrong direction; they were genderless. Unlike a triaxial cable, which has a male end and a female end, half of the hermaphroditic connector's contacts are male pins, and half are female sockets. The fibers within the cable cross over from pin on one end to socket on the other. Therefore, both ends are identical, and the cable will always be pulled in the proper direction. Because the two ends directly intermate, there is no need for couplers or barrels between cables. The Delphi connectors are rated for thousands of repeated matings without damage.

Spurred in large part by the burgeoning demand for high-bandwidth digital television, the role of fiber optics in mobile field production is growing rapidly. The assemblage of all the right parts was a joint effort by several key manufacturers. The creation of the standard was the result of years of field experience by hundreds of forward-thinking broadcast professionals. And now, the long-awaited definition of the standard fiber-optic connector points in a clear direction for broadcasters and venue owners alike. ■

Richard A. Cerny is the president of Telecast Fiber Systems.

IN ADDITION

To learn about the changes in cable construction and the evolution of fiber, visit our Web site at www.broadcastengineering.com, and click on Applied Technology.

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Television automation

BY JOHN LUFF

There was a time in radio broadcasting when decisions were made on the spur of the moment about what the day's programming would consist of. Disc jockeys still have some autonomy today, but the consolidation in the broadcast business has probably limited that as well. Due to increased complexity, the broadcast schedule has become the ruler of the day. And as the cost of doing business has risen in our industry, automation has become one of a few areas explored in an effort to curb labor costs.

In the television business, true automation has not been possible for very long. Skilled technicians were once needed to load and cue quad tape. At that time, automation was at most a way to start devices that were highly manual in nature. No time code existed to permit cueing under computer control, and running a quad tape without a technician to adjust it would have been a recipe for disaster. Until modern microprocessor-based systems became available, automation tended to be quite proprietary to manufacturers of robotic videotape playback systems and master control switchers. How things have changed!

For a simple automation requirement, "server automation" is available for under $20,000 that can process air logs from most traffic systems, ingest material from videotape recorders, and control server playout and a simple cuts-only switcher for output of the assembled program stream. Such a system, however, will not get you through the DTV transition without upgrades.

For more complex requirements, you can purchase a system that adds to the number of controlled devices. As that number grows, so does the cost and, to a degree, the complexity.

Automation has become one of a few areas explored in an effort to curb labor costs.

When picking an automation system, one must consider the initial cost and decide whether to use software that is licensed and requires an annual license renewal cost or a product with a one-time fee and a maintenance fee for upgrades and manufacturer support.

Device control can be handled with control hardware in the PC running the system or with stand-alone device control engines that receive commands to find, cue and play media from the central system. The latter then operate autonomously to execute the command and report back when they have accomplished the task. Some manufacturers' device engines have storage for a number of events, which allow the system some independence in the event of LAN/WAN difficulty.

The control language is generally based on a protocol developed by either SMPTE or one of a small number of manufacturers that have developed proprietary solutions that have been offered as open standards to the industry.

Some automation systems use separate computers for individual software-controlled operations. For instance, one program and computer may be used for media preparation, another computer may run the master database of media and events, and a third might control the air schedule itself.

Evaluating automation options should be done in concert with the business side of the station. The capabilities of traffic to support output in a form useful to a specific automation system is important. While cost is always important these days, if centralized operations are in your future you should bring in experts from other parts of the company, or outside experts, to ensure that the decision is one that will work for the long haul. Listen carefully to arguments from automation vendors about traffic interface, brand and topology for servers, and archive and asset management strategy; but in the end, broadcasters know their own operations best and should heed their own advice. ■

John Luff is vice president of business development for AZCAR.

Encoda provides asset management solutions that create integrated workflows for every type of facility, as well as new media operations.

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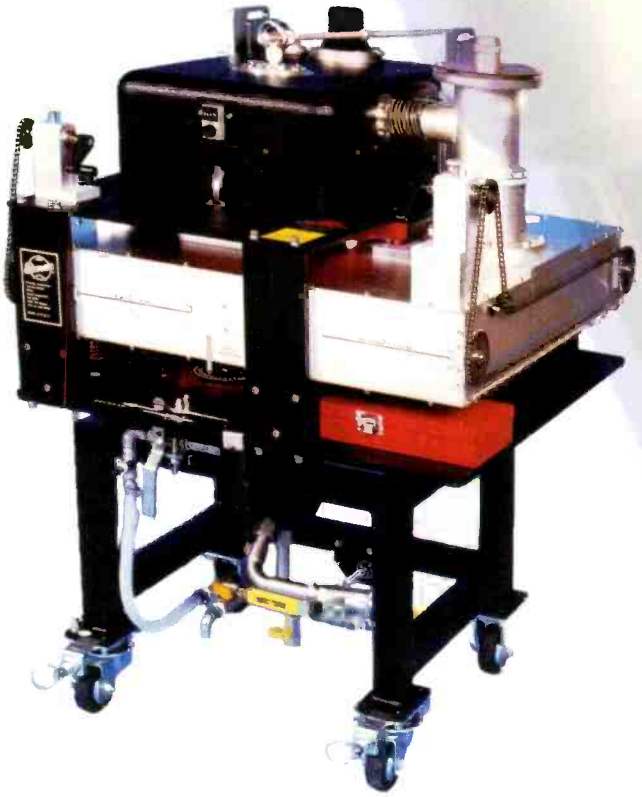

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DSR-250 3-CCD DV & DVCAM

Introducing everything you need in an event camera and more. The new completely digital DSR-250 from Sony is a high image quality reduced size camcorder which has been optimized for shooting events and parties. Every feature you could want is included in this revolut onary acquisition tool.

- **1/3 inch x three 380K pixel** (effective 340,000 pixels) **CCD's** allow two scanning modes: 480 progressive (still) or interlaced (for video) • One touch auto focusing in manual focus mode.
- **530 lines of horizontal resolution.**
- **Switchable aspect ratio** 4:3 (TV mode) or 16:9 (Movie mode)
- **DXF-801 high resolution 1.5" black & white viewfinder** (same as on DSR500/1 & DXC-D35) enables easier focusing. Automatically switches from 4:3 aspect to 16:9.
- **58mm lens** with **12x optical zoom**.
- **Records in DVCAM or DV,** standard tapes or mini. Up to 270 minute recordeding in DV mode onto a 184 min. DVCAM tape.
- Manual or automatic functioning: Focus, Iris, Shutter-speed, Zoom, Gain (3 positions and memory).
- **Flip out 2.5" 200,000 dot LCD monitor,** finally available on a professional camera • Time date stamp.• Soft shoulder pad.
- **Advanced optical stabilization** allowing for a high quality digital zoom out to 24x, with a maximum digital zoom out to 48x
- **Assignable time code** (Rec Run, Free-run, User-bit)
- 16 bit 2 channel audio recording, or 12 bit 4 channel
- **Digital in/out** (IEEE1394) and **analog in/out.**
- **Still image capture onto memory stick** – Upload graphics from memory stick or USB adapter, software included
- Phantom 48V power • Built in speaker • Directional microphone in pro mic holder. 2 XLR audio inputs
- **Wireless remote .**
- **Built in edit controller.** Equipped with an i.LINK interface, allowing camcorder to serve as edit player or recorder
- External 12V supply/Connection for light. The DSR-250 is equipped with light output (DC 12 V, maximum 30 watts)

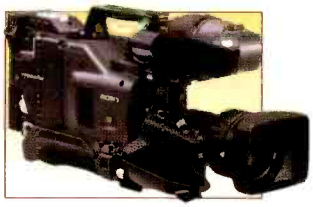
DSR-300A
3-CCD Digital (DVCAM) Camcorder

The affordable DSR-300A actually extends operational convenience with a range of new features and peripheral products. Remarkably compact and lightweight, the improved DSR-300A provides high mobility without compromising picture quality and can be held comfortably on your shoulder through the longest shoots and gives videographers the ability to acquire their footage quickly and easily.

- The DSR-300A has three 1/2" IT Power HAD CCDs to deliver 800 lines of horizontal resolution, 62dB S/N ratio and high sensitivity of F/11 at 2000 lux
- With built-in 26-pin VCR interface, they can feed composite or S-Video output signals to an external recorder for parallel or back-up recordings. VCR recording modes including Parallel, Internal (only) and External (only) are selected via the trigger switch positioned on the operational panel
- LSI Digital Signal Processor (the very same one used by the DXC-D30 cameras) for a high signal-to-noise ratio of 62 dB.
- Both mini cassettes (PDVM series) and standard cassettes (PDV series) can be used with the DSR-300A. With PDV-184ME (standard), a maximum recording time of 184 minutes can be acheived. They can also play back tapes recorded in the consumer DV format
- For operational convenience while shooting, the Time Code is superimposed on the viewfinder screen or MONITOR OUT screen, even during playback
- DXF-801 viewfinder featuring variable peaking, 3 level tally light and a white LED light with 2 levels of intensity to illuminate the lens setting. • IEEE1394 i.Link (out only)

DSR-500WSL
2/3" 16:9 3-CCD (DVCAM) Camcorder

The DSR-500WS camcorder gives the video journalists the ability to acquire footage quickly and easily because the required functionality and performance was packed into this camcorder. In the meantime, the next generation widescreen TV's have been introduced and the demand for video material in widescreen (16:9) has greatly increased not only in broadcasting, but also in the event production and corporate communications market. To meet this demand , Sony offers this Widescreen Digital Camcorder. The DSR-500WS offers outstanding picture quality by adopting full Digital Signal Processing and three 2/3-inch (520k) Power HAD WS (Wide Screen) CCDs which are specifically designed for a 16:9 aspect ratio, switchable to 4:3 full screen. The camcorder extends the mobility, operational convenience and system flexibility with a range of peripheral products. Built-in digital output of the i.LINK interface for backup and simple field editing is just one example. Technological advances in Sony DSP and CCD Technologies, many powerful options and a convenient low price-point make the DSR500WS a formidable tool for a wide range of applications.



DXC-D35/D35WS
Dockable (DVCAM) Camcorder

The DXC-D35/ D35WS cameras are designed to the highest specifications, providing unprecedented video quality in this price range. The DXC-D35 is at home in the studio or field, docking directly to a host of backs including Betacam SP and DVCAM, as well as studio backs and viewfinders. The highly adjustable picture means that these cameras are ideal for capturing detail in low or changing light, as well as compensating for peoples skin flaws while keeping the rest of the image sharp. DXC-D35WS is switchable 4:3 to wide screen 16:9 ratio.

The DXC-D35WS camera is the latest Sony digital camera designed to the highest technological standards. With the proven Sony DSP technology combined with Sony high performance 16:9 CCD's. This high standard was previously held by the DXC-D30 series now being replaced by the NEW DXC-D35 series. DXC-D35 series feature a new Prism Assembly, new Pre Amplifiers, new DSP Software and a new Digital Encoder resulting in astounding performance. The DXC-D35WS camera fully interfaces with Sony's CCU-TX7 Wideband Component Triax System. It provides 8 set-up files (3 user) as a stand alone. 16 additional scene files (all user settable)are available when combined with the RCP-TX7 remote control panel. The DXC-D35WS is equiped with three 2/3" IT Power HAD CCD's switchable between 16:9 and 4:3 aspect ratio's. The camera docks to DSR-1 DVCAM and DNV-5 Betacam SX recorders for digital video recording, or PVV3 and BVV-5 Betacam SP recorders for analog recording.

- 880 TV lines of resolution for DXC-D35
- 850/800 TV lines for D-35WS • Two REC tally lamps
- DXF-601W New Viewfinder Switchable 16:9 to 4:3
- VF lens light with on/off switch • 3 level Tally light
- Display characters on/off switch • Take Tally
- Horizontal and Vertical peaking • Die cast aluminum
- Better flare compenstation • DynaFit shoulder pad
- Lower minimum illumination (0.25 lux with HyperGain)
- Better color reproduction at high gain
- Improved dark detail and contrast • New preamplifier, prism and encoder • Better performance at overloads
- Reduced noise at Gain Up • Variable color temperature adjust
- Adjustable 4:3 safety zone when at 16:9
- New HyperGain mode of 42dB gain
- Aspect ratio select from Main Menu

JVC

GY-DV500U
1/2-inch 3-CCD Professional DV Camcorder

The GY-DV500 combines the convenience and cost-effectiveness of Mini DV with the performance and features you need. Incorporate three 1/2-inch 380,000 pixel IT CCDs for superior picture performance (equivalent to 750 lines of resolution) superb sensitivity of F11 at 2000 lux and minimum illumination of 0.75 lux (LoLux mode). Rugged construction with a rigid diecast magnesium housing, Extremely portable, compact and light weight (lesss than 11 lbs. fully loaded). Additional features like the menu dial and Super Scene Finder assure ease-of-use and shooting flexibility, while the IEEE1394 and RS-232 interface allow integration into various non-linear and post-production systems. A professional camcorder in every sense, the compact, lightweight GY-DV500 redefines acquisition for corporate, educational, cable and broadcast production, as well as wedding videography and multimedia applications.

GY-DV550U
1/2" 3-CCD DV Camcorder

Introducing the Versatile GY-DV550 from JVC. Designed by professionals, for professionals, the GY-DV550 is the world's first DV camcorder to offer studio camera capability. Thanks to the built-in 26-pin interface, you can connect the GY-DV550 to a CCU for remote-controlled studio operation or backup recorder in the field. But that's not all. It also comes with pool feed input/output, so you can transfer image data back and forth to another camera or cameras, making it ideal for special shooting situations such as press conferences, exclusive interviews, and sporting events. Record isolated camera views (ISO-Cam) during a live multi-camera shoot, making it ideal for parallel shooting at live concerts and other events. Naturally, we've made sure the GY-DV550 is equipped with all the other capabilities you need, including a standard 1/2-inch bayonet mount for use with a great diversity of professional lenses, bidirectional IEEE 1394 (NTSC), two 48 kHz 16-bit digital PCM audio channels, and a built-in SMPTE or EBU timecode reader/generator, as well as XLR microphone inputs, audio outputs, headphones output, and both composite and Y/C outputs. Maximum versatility, top-level performance, and superior cost-efficiency make the GY-DV550 the smart solution for producers who need a camcorder capable of doing double-duty in both the studio and the field.

Ready for EFP remote control (RM-LP57/LP55) The EFP remote connects directly to the GY-DV550 for precise control over the video parameters

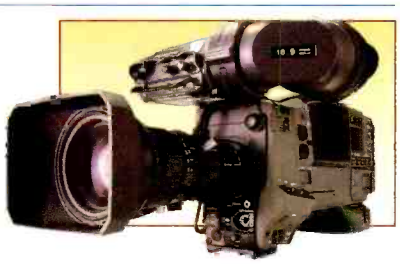
Return video output for Tele-Prompter Tele-Prompter capability assures full support for studio program production

Genlocking function To meet the demand for systemization, the GY-DV550 is equipped with a genlocking function that includes SC lock to assure high-resolution pictures

State-of-the-art 1/2" 3-CCD image pickup incorporates three 1/2" 380,000 (NTSC)/440,000 (PAL) pixel interline-transfer CCD's. Each CCD is equipped with highly advanced circuitry that eliminates vertical smear when shooting bright lights in a dark room. Lag and image burn are also reduced to indiscernible levels, while high sensitivity of F11 at 2000 lux assures creative flexibility and simplifies lighting requirements.

Panasonic

AJ-D610WA
2/3" 16:9 IT-3CCD DVCPRO Camcorder



The AJ-D610WA is an affordable DVCPRO camcorder which combines three high sensitivity 2/3" IT CCD's with digital component technology, to create a true broadcast recording. The AJ-D610WA is switchable between 16:9 and 4:3 aspect ratios. A built-in PCMCIA card slot makes it quick and easy to adapt the camera to different shooting conditions. Features Super Gain, Super Iris, and Digital Signal Processing (DSP). The AJ-D610WA can operate with a minimum illumination of 0.5 lux (F1.4, +36 dB Gain), and resolves 750 lines of resolution

- The AJ-D610WA has three high density (520,000 pixels) 2/3" CCD's. The CCD's feature a large light collecting area that gives the camera a S/N ratio of 63 dB plus a sensitivity of f 11.0 @ 2000 lux.
- The Digital Signal Processing (DSP) helps to deliver a very high quality picture. The user has the ability to adjust different parameters of the camera to accomodate any situation.
- A PCMCIA card slot is built into the operator side of the camera, allowing the set-up (DSP) data to be saved. The saved set-up data can be used to reset the camera parameters
- The optional AJ-YAP900P Picture Link Board is part of an exclusive Panasonic production data information system which stores shot logging in camera memory and records it on tape during the eject cycle. The logging information can be read by Panasonic's newsBYTE DVCPRO native nonlinear news editing system
- Exceptional resolution of 750 horizontal lines.
- A Super Gain feature is available to boost gain by a full +30 dB or +36 dB for high quality shooting in low light, making it possible to shoot as low as 0.5 lux (f1.4, +36 dB).
- An optional Digital Triax for studio or mobile use is available. • A six speed electronic shutter (1/100 to 1/2000 sec) features Synchro Scan to match the frequency of a comuter monitor.

Pickup Device: 2"3" IT Power HAD 100) 16:9 x 3
Picture Elements: 1038(H) x 504 (V)
Filters: Clear, 5600K + 1/8 ND, 5600K, 5600K + 1/64 ND

SONY

DNW-9WS
2/3" 16:9 IT-3CCD Betacam SX Camcorder

Equipped with three 2/3 inch 16:9/4:3 switchable Power HAD 1000 16:9 IT CCD's.
Designed as a cost effective camcorder to help bridge the transition from 16:9 to 4:3, yet it still maintains a high performance and high mobility.
The DNW-9WS weighs less than 14 lbs. including a battery, tape, viewfinder and lens. Includes an integrated slot for the optional WRR-855A wireless audio receiver.

SONY

QUICK DIAL 72

DSR-1500
DVCAM Studio Editing Recorder

DVCAM becomes more and more flexible with the introduction of this brand new, half-rack width studio editing deck. The DSR-1500 boasts studio editing function capability in a compact size. The new DSR-1500 incorporates the same innovative, high standard technology featured in the DSR-2000.
The space-saving size makes the DSR-1500 ideal for installations in OB vehicles and desktop editing systems.

- SDI interface ensures a migration path to Digital Betacam™, Betacam SX™ and SDI-based systems.
- SDTI(QSDI) and i.LINK IEEE-1394 interfaces enable a high quality, virtually lossless transfer with DV compression based systems.
- Compatibility to consumer DV (SP mode only) and DVCPRO 25 format recordings in addition to DVCAM, automatically accommodate all cassette sizes without the need for an adapter.
- Analog input interface board which includes component, composite and S-Video is also available as an option.

DSR-1600/1800
DVCAM Studio Editing Player/ Player Recorder

The DSR-1600 is a **studio editing player**, and the DSR-1800 is a **studio editing recorder**.
Both incorporates innovative technology at an affordable price. Excellent playback of all DV based (25 Mbps) formats and cassette sizes is possible without the need of an adaptor. A jog/search dial is standard, including jog audio. A variety of option boards are available for SDI, SDTI, and i.Link outputs.
They both provide two selectable audio channel modes: Two channels of 16-bit (48 kHz) Four channels of 12-bit (32 kHz), PCM Digital Stereo recording is used in both modes to ensure superb audio performance with a wide dynamic range and excellent signal-to-noise ratio.
• Automatically adjust for playback of any DV based format, including DV (SP only), DVCAM or DVCPRO 25.

DSR-2000
DVCAM Editing Recorder

The DSR-2000 is a highly flexible DVCAM studio deck designed for demanding ENG editing. It can playback all DV (25 Mbps) based formats, including two consumer DV formats (Standard and Long Play), as well as all types of DVCPRO tape as an editing source, without any mechanical tape adapters. Equipped with audio/video pre-read editing and includes a Jog/Shuttle dial that allows two-machine editing. A SMPTE standard MPEG SDTI-CP interface option is available for the DSR-2000 to output an MPEG stream in addition to the optional i.LINK interface. This allows the OSR-2000 to seamlessly link to Betacam SX and other MPEG-based video equipment by means of SDI, i.LINK and MPEG SDTI-CP.

DSR-11
Compact DVCAM VTR

Compact desktop DVCAM recorder. This VTR provides a powerful and cost-effective option for NLE editing systems. Provides basic VTR features, along with an i.LINK (IEEE1394) interface and is compatible with both NTSC and PAL color systems. Designed to be used in either a horizontal or vertical position; A footprint of only 2 3/4" in the vertical position.

- The DVCAM format uses 8-bit component digital recording at 25 Mbps, with Intra-frame 5:1 compression, 500 lines of resolution and 4:1:1 color sampling. A 15 micron track pitch provides superior picture quality, superb multi-generation capability and production flexibility. Two 1/4" ME cassette sizes are available: Standard and Mini.
- Plays and records either a DVCAM format signal or a DV format signal. • Both Mini and Standard size cassettes can be used with the DSR-11 without the need of an adaptor
- Play or record in either the NTSC or PAL color systems.
- Equipped with a 4-pin i.LINK (IEEE-1394) interface, for lossless transfer of digital video and audio information with other IEEE-1394 equipped devices. The single 4-pin i.LINK cable can be connected to MAC or PC based NLE systems or to another VTR for degradation-free editing.
- DV EE (electronics to electronics) Out: Analog input signals can be converted into digital signals, and can be simultaneously output from the i.LINK interface.

UVW-1200/UVW-1400A
Betacam SP Player • Player/Recorder

The UVW-1200 and UVW-1400A are non-editing VCRs which deliver Betacam SP quality and offer features for a wide range of playback and recording applications. RGB and RS-232 interface make them especially ideal for large screen, high quality video presentation, scientific research and digital video environments.

- Ideally suited for work in computer environments, because RGB signals can be converted into component signals and vice versa with minimum picture degradation.
- 25-pin serial interface allows external computer control of all VCR functions based on time code information. Baud rate can be selected from between 1200 to 38,400 bps.
- Built-in Time Base Stabilizer (TBS) locks sync and subcarrier to an external reference signal as well as providing stable pictures. High quality digital dropout compensator further ensures consistent picture performance.
- Equipped with two longitudinal audio channels.
- Auto repeat of entire or a specific portion of the tape.
- Built-in character generator can display VTR status, time code, self-diagnostic messages, set-up menu, etc
- Both read LTC Time Code) and UB (User Bits). The UVW-1400A also generates LTC and UB (Free-Run/Rec-Run).
- Control of jog, shuttle, playback, record, pause, FF and REW with the optional SVRM-100A Remote Control Unit.
- Composite and S-Video as well as component via BNCs which are switchable to RGB output. The UVW-1400A has two switchable sync connectors and a Sync on Green.
- Built-in diagnostic function and hour meter.

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

The UVW-1600 and UVW-1800 are the other half of the UVW series. They offer the superiority of Betacam SP with sophisticated editing features. They feature an RS-422 9-pin interface, built-in TBCs and Time Code operation. Inputs/outputs include component, composite and S-Video. **All the features of the UVW-1200/1400A *PLUS*—**

- Optional BVR-50 allows remote TBC adjustment.
- Two types of component output; via three BNC connectors or a Betacam 12-pin dub connector.
- RS-422 interface for editing system expansion.
- Frame accurate editing is assured, thanks to sophisticated servo control and built-in time code operation.

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

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

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

VPL-CS4
SVGA LCD Multimedia Projector

Personal ultra-compact portable projector that goes anywhere and sets up quickly, and delivers bright, clear images. Quiet operation, elegant design and numerous practical features make it ideal for a wide range of uses.

- **Handy and portable:** The VPL-CS4 is ultra-compact and lightweight, weighing only 5 lbs. 5 oz. Images with a brightness of 1000 ANSI lumens are projected with excellent picture quality from three 0.7-inch, true SVGA (800 x 600) resolution LCD panels. Its small size and low weight make it easy to carry in its supplied carrying bag.
- **Quiet operation:** Fan noise is reduced with a new air discharge system, with the exhaust positioned at the front of the unit. • **Credit Card Remote**
- **Digital Zoom:** 4 times Digital Zoom. picture Freeze.
- **Digital Keystone Correction:** up to 15 degrees can be digitally corrected from the On-Screen Display or the supplied remote control unit.
- **APA** (Auto Pixel Alignment): a single-button press and play operation, the display is correctly sized and adjusted for optimum picture performance.
- AV inputs: S-Video, RCA video, 15-pin VGA, audio mini
- NTSC/PAL/SECAM • 10.8"x2.5"8.4" • 5.3 lbs.

PROFESSIONAL VIDEO TAPES

QUICK DIAL 71

FUJI

Professional Grade VHS

PG-30	2.29	PG-60	2.39	PG-120	2.59

Broadcast Grade VHS Box

BGR-30	3.49	BGR-60	3.99	BGR-120	4.69

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	4.49			E630HME	7.69
P660HMP	6.29			E660HME	10.49
P6120HMP	8.49			E6120HME	13.99

M321SP Metal Betacam (Box)

05S	10.99	10S	11.99	20S	12.99
30S	13.99	60L	20.99	90L	32.99

DP121 DVC PRO

12M (Med.)	7.49	23M	8.79	33M	10.99
63M		19.99	66L		22.50
94L		30.99	126L		39.99

maxell

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	HGX™-120 Plus	2.99
HGXT-160 Plus			3.99

BQ Broadcast Quality VHS (Box)

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

BQ Professional S-VHS (In Box)

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

Betacam SP

B30MSP	13.49	B60MLSP	19.99	B90MLSP	27.95

Panasonic

Mini DV Tape

AY DVM-30	6.49	AY DVM-30 (10 Pack)	ea. 5.99
AY DVM-60	6.99	AY DVM-60 (10 Pack)	ea. 6.49
AY-DVM80	12.99	AY-DV123EB	20.95

DVCPRO

AJ-P12M (Medium)	7.99	AJ-P24M	9.99
AJ-P33M	11.49	AJ-P66M	19.49
AJ-P66L (Large)	20.99	AJ-P94L	29.99
AJ-P126L			38.95

SONY

Hi-8 Professional Metal Video Cassettes

P6-30 HMPX	4.79	E6-30 HMEAD	6.99		
P6-60 HMPX	6.79	E6-60 HMEAD	9.99		
P6-120HMPX	8.99	E6-120HMEAD	13.99		

PR Series Professional Grade VHS

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

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

T-30BA	3.69	T-60BA	4.19	T-120BA	4.99

MQ Master Quality S-VHS (In Box)

MQST-30	7.49	MQST-60	7.69	MQST-120	7.99

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

KCS-10 BRS (mini)	8.99	KCS-20 BRS (mini)	9.99
KCA-10 BRS	8.99	KCA-20 BRS	9.49
KCA-30 BRS	10.69	KCA-60 BRS	14.99

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

KCS-10 XBR (mini)	9.79	KCS-20 XBR (mini)	11.29
KCA-10 XBR	10.29	KCA-20 XBR	11.79
KCA-30 XBR	13.29	KCA-60 XBR	17.39

BCT Metal Betacam SP Broadcast Master (In Box)

	Single	10 Pak/Ea.	50 Pak/Ea.
BCT-5M (small)	10.99	9.99	9.19
BCT-10M (small)	11.49	10.29	9.79
BCT-20M (small)	12.99	11.49	10.99
BCT-30M (small)	13.49	12.49	11.99
BCT-30ML	13.49	11.89	–
BCT-60ML	20.99	19.99	18.99
BCT-90ML	30.99	28.99	27.99

PDV Mini Series Professional DVCAM Tape (w/memory chip)

	(1)	(10) Ea.		(1)	(10) Ea.
PDVM-12ME	14.49	13.49	PDVM-22ME	15.19	14.49
PDVM-32ME	15.49	14.99	PDVM-40ME	16.99	16.49

PDV Series (Standard) **Professional DVCAM Tape**

PDV-34ME	24.99	23.99	PDV-34N	20.99	19.49
PDV-64ME	27.99	26.99	PDV-64N	24.99	26.99
PDV-94ME	32.99	31.49	PDV-94N	29.99	28.49
PDV-124ME	38.49	37.49	PDV-124N	32.99	31.99
PDV-184ME	46.49	44.49	PDV-184N	39.99	38.99

Mini DV Tape

DVM-30EXM w/Chip	12.79	DVM-60EXM w/Chip	16.99
DVM-30EX "No Chip"	11.99	DVM-60EX "No Chip"	12.99
DVM-30PR "No Chip"	7.99	DVM-60PR "No Chip"	9.75

Full Size DV Tape with Memory Chip

DV-120MEM	24.99	DV-180MEM	26.99

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- 60GB of ATA/100 storage
- CD-RW rewritable CD writer
- Final Cut Tutorial CD
- Mitsubishi Diamond Pro 2060 22" Monitor
- Apple Care-three year warranty
- Complete System integration and testing

$4,499.95

Great System
Includes:
- Apple G4/867 Computer
- Final Cut Pro version 2.0 editing software
- 60GB of ATA/100 storage
- Total of 256MB of memory
- DVD/CD-RW SuperDrive
- Artel Boris Graffiti CG Program
- Final Cut Tutorial CD
- Mitsubishi Diamond Pro 2060 22" Monitor
- Apple Care-three year warranty
- Complete System integration and testing

$5,499.95

Best system
Includes:
- G4 with 867 MHz Processor
- Final Cut Pro 2.0 Editing Software
- 150GB (2x75) of ATA/100 storage
- Sonnet Tempo Raid 66 IDE Controller
- Total of 640MB of memory
- DVD/CD-RW SuperDrive
- Artel Boris Graffiti CG Program
- Final Cut Tutorial CD
- Mitsubishi Diamond Pro 2060 22" Monitor
- Apple Care-three year warranty
- Complete System integration and testing

$6,294.95

DVD Authoring system
Includes:
- G4 with 800 MHz Dual Processor, 80GB Hard Drive.
- DVD-R/CD-RW SuperDrive
- Total of 512MB of memory
- 150GB (2x75) of IBM ATA/100 storage
- Sonnet Tempo Raid 66 IDE Controller Card
- Matrox RTMac Realtime Capture Card
- Final Cut Pro 2.0 Professional Editing Software
- Apple DVD Studio Pro DVD authoring software
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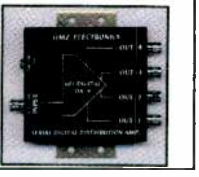

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EOM

Single-frequency network hype

BY PAUL MCGOLDRICK

It seems that whatever the FCC says about 8-VSB and COFDM, the issue is not going away. I am not qualified to compare the modulation systems together in the field, but others have quite clearly demonstrated the robustness of COFDM over the 8-VSB system, particularly in multipath situations.

I am also perverse enough to believe that some of the strange things manufacturers of "correction" ICs have said in press releases puts them into the shadowy area of vaporware. After all, if you don't understand the basics of video in what you write, why should I believe you understand how to correct RF intangibles?

That aside, there was a recent survey of broadcast TV stations by SCRI International that indicates that, after excluding the 18 percent who were unsure, 45 percent were interested in using COFDM to some extent or another. Of those stations, a healthy 53 percent wanted to go there directly. Considering that the major supporters of COFDM own a considerable number of stations, we probably shouldn't be surprised by the results.

The latest wrinkle in pushing COFDM is the single-frequency network (SFN) system, where a number of stations broadcast on the same frequency in the same way that cellular phone cells operate. With the robustness of the modulation standard, proponents say, SFNs are a handy way to achieve wide coverage, fill in pockets of poor coverage and save the spectrum. These are all very laudable goals, but most of the proponents don't appear to fully understand the technology.

If we go back a couple of years, there was a wonderful apolitical "Position Paper" issued by PBS in support of continuing the implementation of the 8-VSB system. "Raising this fundamental issue of modulation systems now in the light of there being very little technical justification for it is extremely risky ... any hope of funding for the public television transition to DTV will disappear." There are no doubts where that is coming from, but the paper does include justification for the continuation of 8-VSB with its supposedly better noise immunity and statements that suggest the multipath performance isn't really that bad and that the system needs less power for the same carrier-to-noise. It does mention the large SFNs in use in Europe but rather avoids describing the technology.

Single-frequency networks are a handy way to achieve wide coverage, fill in pockets of poor coverage and save the spectrum.

But what's involved? The DVB DTTB design parameters include a guard interval (NOT a band), which is what provides the major resilience against delayed multipath signals. But building an SFN just based on the timing protection of the guard interval would not buy much. The spacing between transmitters would be quite small – which might be OK in a city, but impractical for a larger network. Other things can be done to protect for multipath at larger distances, such as varying the polarity of the transmitters, changing radiated powers, changing antenna patterns and re-timing the transmitters as needed.

The only real limitation with SFNs is that the same programming must be carried, although each carrier can have multiple programs.

I also have heard people say that an SFN is only really useful at UHF because transmission is so stable. Not so. There are DTV broadcast SFNs at VHF frequencies, and the technology also has been in use in digital radio broadcasting from 200 MHz to 1500 MHz with different modulation schemes. This is important because SFNs are not limited to COFDM. They may be easier to engineer for that modulation scheme, but they should be usable for 8-VSB as well if time was spent on the "hows."

Why do I think that? Well, the SFN isn't exactly a new idea. Mr. H. L. Kirke joined the BBC in 1924, and in the early 1930s, he became the first head of research at the corporation. Apparently a very practical man, he guided many developments in broadcasting in short waves, 405-line television, noise-canceling microphones and a technology known as the Simultaneous Broadcast (SB) system – a topic that for many years was an item in the induction course for all new BBC employees.

The SB system uses the same medium-wave frequencies many times over across the country, all carrying the same AM programming. Yes, there are places where the signals interfere with one another, but the network was so carefully engineered that those places are generally only occupied by sheep.

I don't have a favorite between 8-VSB and COFDM any more; we are too far down the road to turn back. We have to make it work just as we can make 8-VSB SFNs work if we want them. ■

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