SEPTEMBER 2006

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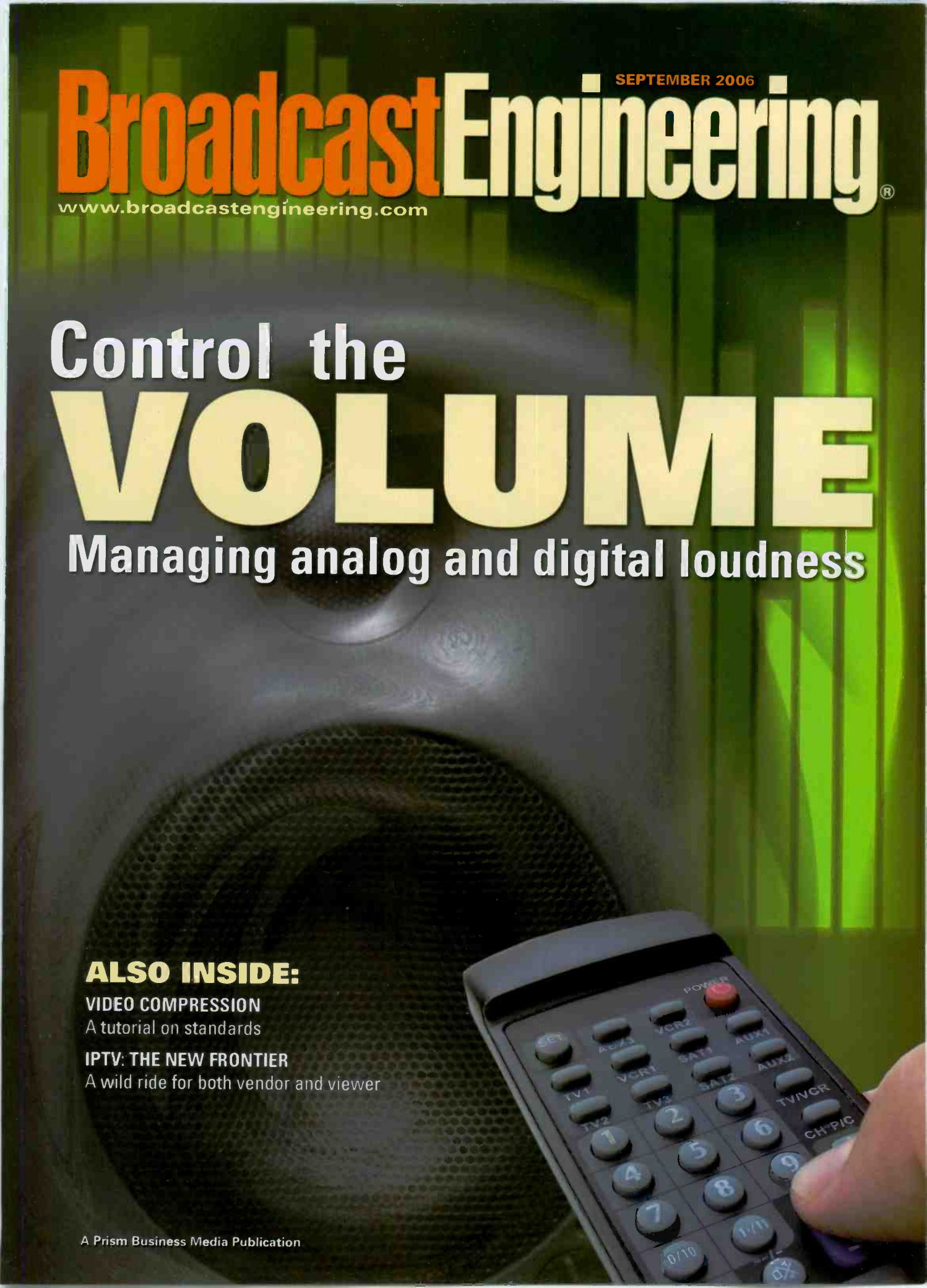

ALSO INSIDE:

VIDEO COMPRESSION
A tutorial on standards

IPTV: THE NEW FRONTIER
A wild ride for both vendor and viewer

A Prism Business Media Publication

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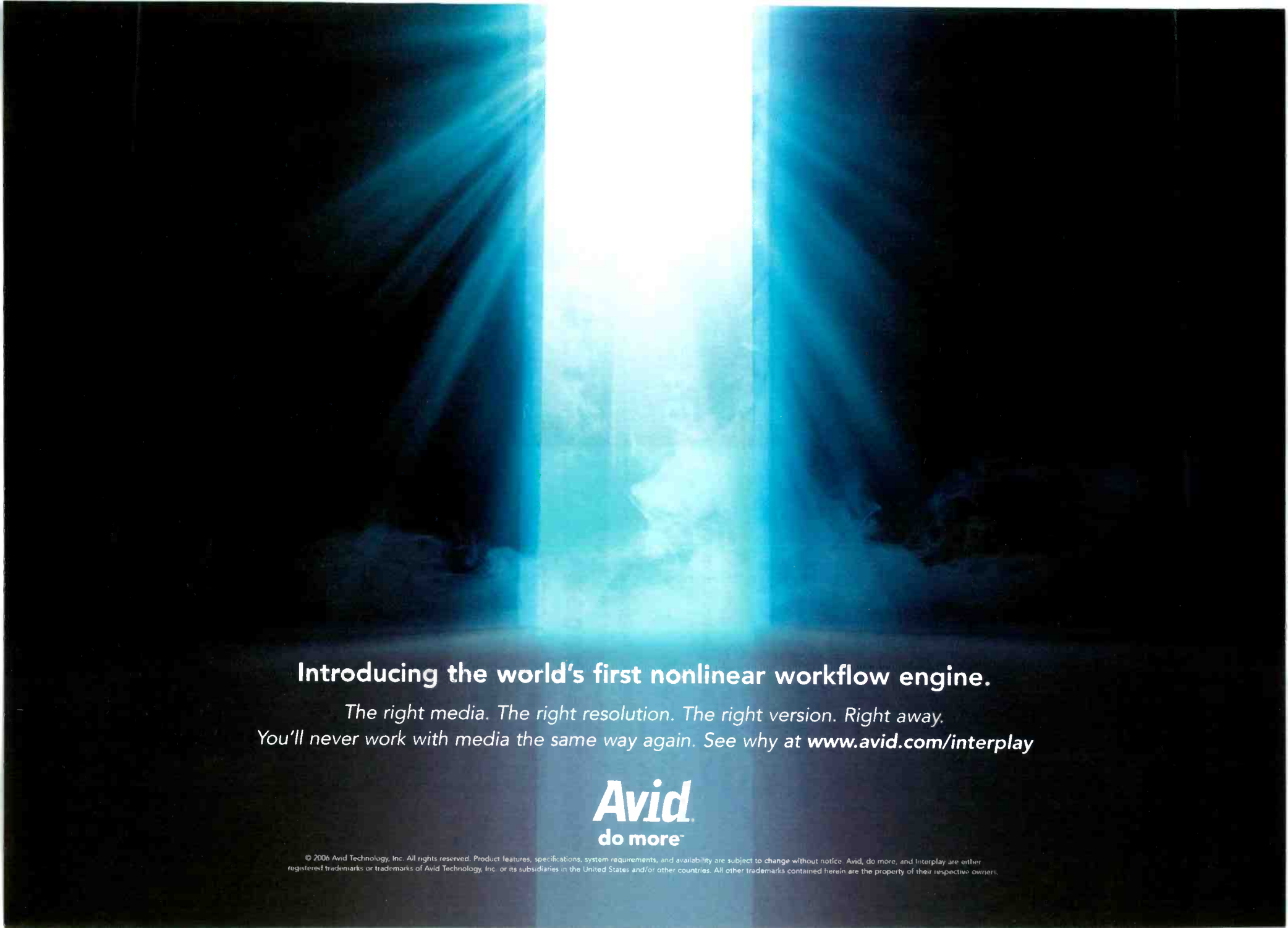
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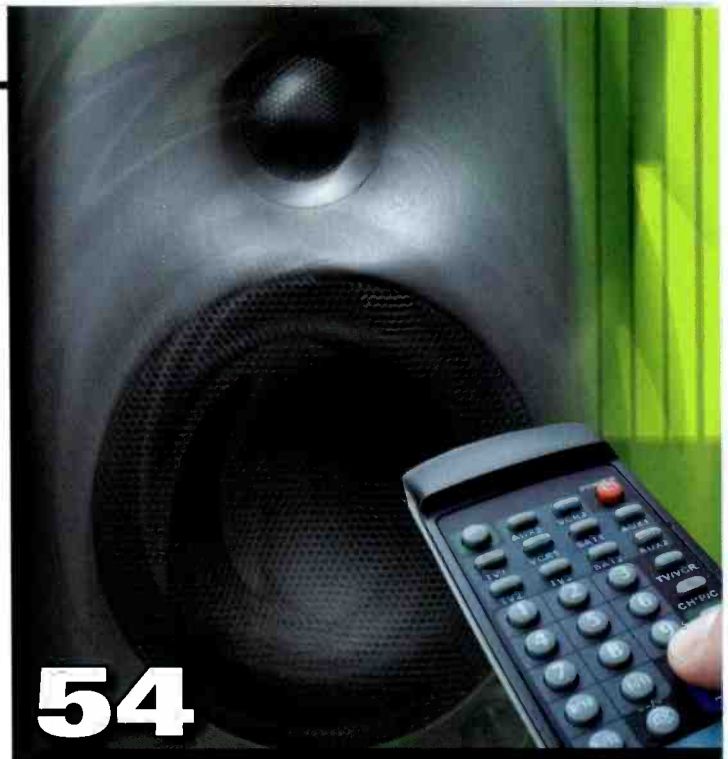

ON THE COVER:
Complaints about audio levels are often caused by improper settings in set-top boxes. Cover concept and image design by Robin Metheny, Art Director.

THIS MONTH'S FREEZEFRAME QUESTION

When two DTV stations share the same channel, what is the general formula for calculating the pilot offset, which will reduce interference? The question comes from Jerry Whitaker's new book, "Mastering Digital Television."

Foffset = ?

Readers submitting winning entries will be entered into a drawing for *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "Freezeframe-September" in the subject field, and send it to: editor@prismb2b.com. Correct answers received by Nov. 1, 2006, are eligible to win.

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FIELD REPORTS

TECHNOLOGY IN TRANSITION

NEW PRODUCTS

DEPARTMENTS

MAY'S FREEZEFRAME ANSWER

Q. An MPEG-2 transport stream is always _____ bytes long.

A. 188.

MAY WINNERS:
Tim Costley, Mark Everett, John L. Harris, Sam Kahill, Dennis Majewicz, Rich Lohmueller, Kenneth Munene, Hilton Powell, Don Rhodes, Karl Wright

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Please, sir, I want some more

Looks like America's OTA viewers may soon be repeating Oliver Twist's line from the Charles Dickens classic, begging for more than TV table scraps.

The National Telecommunications and Information Agency (NTIA) released its proposed rules in late July, for handling the distribution of over-the-air set-top box (STB) coupons. The $40 coupons are part of the government's plan to retake the analog spectrum from broadcasters. Consumers without digital TV sets or those who don't subscribe to cable or satellite (i.e., multichannel video programming distributors, or MVPDs) will literally be in the dark if they don't trade these coupons for an STB.

There are currently between 16 million and 21 million households that rely exclusively on OTA broadcasting. All of these households will either need to buy new DTV sets, subscribe to an MVPD or get an STB. It is this third option NTIA is charged with addressing.

Despite what may be the government's best intentions, when stations pull the plug on that big, ol' analog transmitter on Feb. 17, 2009, millions of viewers will think their stations went off-the-air. Millions of television sets will go permanently dark because of this mandate, and viewers may blame the broadcasters.

Let's look at NTIA's proposed solution. Viewers can apply for the free STB coupons beginning Jan. 1, 2008, until March 31, 2009. They can apply for the coupons via mail, Internet or telephone, and the coupons will expire three months after issuance.

A few key points: First, only two coupons per household are allowed. Viewers with more than two TV sets will have to pay for additional STBs for other TVs.

Second, anyone with either satellite or cable service won't qualify for the STB coupons. The NTIA proposal states, "... households that receive cable or satellite television service [will] not be eligible even if they have one or more analog-only television receivers not connected to such service." In other words, folks with a spare TV in the guest bedroom or basement connected to an outside antenna are out of luck. They'll have to foot the STB bill on their own.

The third issue is one that many, if not most, viewers will find confusing. The STBs will be little more than an OTA digital receiver with composite, RF and stereo audio outputs. While the converters will support closed captioning, EAS and parental control, and will come with a remote control, they will not receive cable or satellite signals. And the converters will not provide an HD output.

Unfortunately, despite NTIA's $5 million advertising budget, many viewers will wait until their TV sets go dark to do anything. And they will probably not understand that the STBs don't provide HD.

Now consider the vendor's place in this food chain. If the boxes are "worth" $40, the gross markup in selling them must be less than 20 percent, which would be around $8 per STB. After deducting marketing, stocking, customer service, returns and what appear to be monumental dealer documentation requirements, will major stores even participate in the giveaway?

The consumers with TVs left in the dark will be saying, "Please, sir, I want some more." But with such a slim profit margin on STB sales, the consumer electronics industry will be thinking, "Screw the convertor boxes; we want to sell DTVs."

What do you think?

Write to me at editor@prismb2b.com. BE

Brad Dick

EDITORIAL DIRECTOR

Send comments to: editor@prismb2b.com

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FOR THE CHANGING FACE OF TELEVISION

Digitizing audio

Michael Robin,

I enjoyed your explanation of digitizing audio in the May 2006 issue of *Broadcast Engineering*. However, I have a couple questions: Where does the 44.1kHz sampling rate come from? Why not, for example, 42kHz or 44kHz?

Harry Smit
Netherlands

Michael Robin responds:

Digital audio bit rate is about 1Mb/s per audio channel. Early digital audio equipment had difficulties storing these signals. To solve the problem, video recorders, such as Sony U-matic, were adapted to store audio samples by creating a pseudo video waveform, which conveyed binary as white and black.

The sampling frequency of such a system requires a simple relationship to the field frequency and field structure of the related TV standard. The result is an integer number of samples to be stored on each usable TV line in the field. The allowable audio sampling frequencies in a pseudo video system are obtained by multiplying the field frequency by the number of active lines in a field and by the number samples in a line.

In the 525/59.94 video, assuming 490 active lines or 245 lines per field and storing three samples per line, the sampling frequency is 59.94 x 245 x 3 = 44.0559kHz. In the 625/50 video, assuming 588 active lines or 294 lines per field and storing three samples per line, the sampling frequency is 50 x 294 x 3 = 44.1kHz. There is a 0.1 percent difference between these two frequencies. For some purposes, recordings made at one rate can be played back at the other. The equipment used to make CD masters is video-based and thus determines the sampling frequency.

Essentially, the VCRs are run at 525/60 — not at 525/59.94 — and the resulting sampling frequency is 60 x 245 x 3 = 44.1kHz. This is how 44.1kHz became the sampling frequency of a compact disc.

Gamma correction

Can you provide information on gamma correction for a PAL system?

Rex Manilofia
Spectrum Management
Solomon Islands

John Luff responds:

NTSC and PAL analog composite television form the base of much legacy technology. NTSC is specified in SMPTE 170-1999, and PAL is specified in ITU-R BT.470. The precise details of BT.470 can be purchased online at *www.itu.org* for 25 CHF (about $25). SMPTE standards are available at *www.smpte.org*.

Gamma was enshrined in our standards to account for the nonlinear response of a CRT. With many new display technologies, the transfer characteristics are different; however, we need to continue to provide pictures with gamma applied in order to be compatible with legacy displays. Every new display must account for this fact with internal processing prior to display.

NTSC is specifed with a gamma of 2.2, while PAL is specified with a gamma of 2.8. However, according to many experts, including Charles Poynton (see Poynton's "Technical Introduction to Digital Video," published by John Wiley & Sons), 2.8 is unrealistically high. ITU-R BT.709 specifies the colorimetry in use in much of the television industry, including HDTV systems, and uses a somewhat more complex transfer curve with a short linear segment near black. BT.709 specifies a power function with an exponent of 0.45, which is about equivalent to a gamma of 2.222. In practice, both NTSC and PAL today are more likely to be encoded using Rec. 709 colorimetry and transfer functions than the original specifications of decades ago.

DTV acronyms

Editor:

Sometimes it's hard to know all of the new broadcast abbreviations and terminology. Does *Broadcast Engineering* have an updated glossary of DTV?

Alfredo Flores Félix
Tele-Emisoras del Sureste, S.A. de C.V.
Villahermosa, Tabasco, México

Editorial Director Brad Dick responds:

Broadcast Engineering does not maintain a database of acronyms. However, here are a few Web sites that provide definitions to unfamiliar terms: *http://acronyms.thefreedictionary.com*, *www.acronymfinder.com* and *http://isp.webopedia.com*. BE

Test Your Knowledge!

See the Freezeframe question of the month on page 6 and enter to win a *Broadcast Engineering* T-shirt.

Send answers to editor@prismb2b.com

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The IPTV buzz

Telcos may have found a video distribution sweet spot. But will broadcasters feel the sting?

BY CRAIG BIRKMAIER

If you think ...

... that IPTV is the acronym for Iowa Public Television, you probably live in Iowa and have never used the Internet.

... that IPTV means you'll be able to drop that expensive multichannel TV service in the near future, you probably spend a lot of time waiting for video to download to your computer.

... that IPTV is *the* future for multichannel TV services, you probably spend too much time attending Congressional hearings, or you may be a lobbyist for Verizon, AT&T or Bell South or a fortune teller.

Understanding IPTV

Type "Internet Protocol Television" or "IPTV" into an Internet search engine, and you'll get 30 million hits. It is difficult to find an acronym that has generated as much discussion, misunderstanding and hype as IPTV.

At IBC in Amsterdam, IPTV was on center stage, with a full day of papers and discussion panels. And, if you are a manufacturer of video products, chances are good that you are trying to figure out a way to promote existing products for IPTV applications.

While IPTV is one of a growing list of options for the distribution of video content, the reality is most video manufacturers don't have many offerings in terms of core IPTV technologies. This is because, fundamentally, IPTV is about delivering content as IP packets via a range of networks.

Broadcasters use IP networks in their facilities. And they are beginning to use the Internet to promote and deliver some of the content currently distributed via terrestrial broadcast and multichannel TV services.

Cable companies use some of their system bandwidth to provision IP-based broadband and VoIP services. They are expected to migrate their traditional video content to IPTV-based distribution as they upgrade from analog and digital tiers that currently multiplex several MPEG transport streams into a 6MHz channel.

Direct broadcast satellite is likely to lead the way for cable. These services are already digital — currently using MPEG transport streams. And they are introducing new IP-based services, including enhanced interactivity. DIRECTV and DISH Network are also bidding for terrestrial wireless licenses, which will likely be used to enhance these services with localized IP and telephony services.

It is difficult to find an acronym that has generated as much discussion ... as IPTV.

And then there's the sleeping giant, the continuously morphing telcos, who have been building their IPTV infrastructure for years, bringing fiber-optic cables to your neighborhood. Verizon offers its fiber-to-the-premises (FTTP) FiOS, with triple-play service. The company now has video franchises covering 3 million households in nine states and more than 100 franchise areas. AT&T (acquired by SBC) and Bell South will base its TV services on a hybrid network with fiber to neighborhood "routers" and existing copper lines for the last few hundred feet.

The competitive landscape

While many people use the term IPTV to describe the entire emerging landscape of television delivered via IP networks, others insist that IPTV

FRAME GRAB *A look at the issues driving today's technology*

Sales of set-top boxes are on the rise.
22.5 million units are estimated to be sold this year.

Total set-top boxes*
Sales to dealers

	Unit sales (millions)	Dollar sales (millions)	Average unit price
2001	7195	$1312	$423
2002	7185	$1223	$408
2003	11.263	$1757	$356
2004	17.577	$2355	$134
2005	18.169	$2387	$131
2006	22.529	$2782	$123

*Includes satellite receiver, DTV receivers and DVR/PVRs

Source: CEA

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— **Sean Richardson,** Manager
Audio Post Production
Starz Entertainment Group

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Web links

- Iowa Public Television; *www.iptv.org*
- *Broadcast Engineering's IPTV Update* e-newsletter; *http://enews.prismb2b.com/enews/broadcastengineering/iptv_update/current*
- Verizon FiOS TV; *www22.verizon.com/content/fiostv*
- Wikipedia on IPTV; *http://en.wikipedia.org/wiki/IPTV*
- An introduction to IPTV; *http://arstechnica.com/guides/other/iptv.ars*
- IPTV vs. Internet Television: Key Differences; *www.masternewmedia.org/2005/06/04/iptv_vs_internet_television_key.htm*
- The Real Meaning of IPTV; *http://www.businessweek.com/technology/content/may2005/tc20050520_4620.htm?chan=search*

refers only to the "walled garden" services now offered by the telcos that are competing against the well-entrenched cable and DBS systems.

There is a very good technical reason for this distinction. The ability to maintain the same level of image and service quality as cable and DBS is not easily achieved using traditional broadband services and the public Internet.

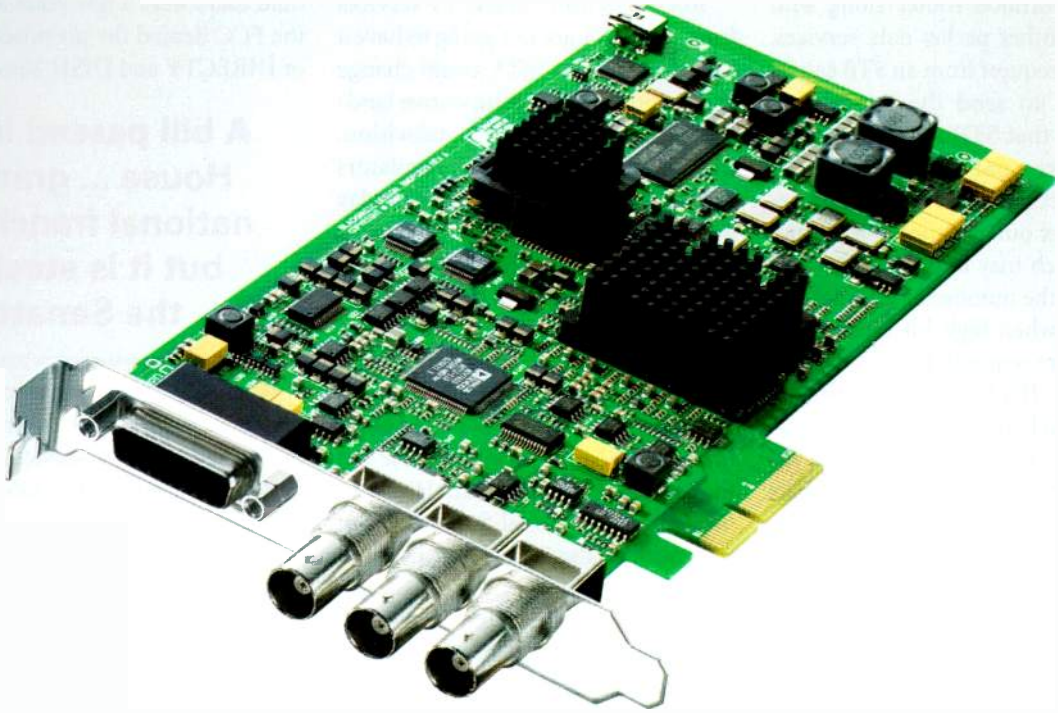
With the Internet, some of the packets may be lost as they are routed from the source (a server) to the destination, where the content is reassembled and presented. These lost packets are typically retransmitted to the destination. And all IP packets may not arrive in the same sequence as they were sent.

For most files (even downloaded IP media files), this is not a major concern. When the media is being streamed and viewed in real time, however, lost packets pose a problem, causing momentary loss of signal or picture/sound impairments.

The telco IPTV networks are designed to deal with these QoS issues. While broadband data may be part of the service bundle, it is better to think of telco IPTV systems as private networks with access to the public Internet. These networks treat the TV portion of the triple play in much the same way as traditional cable systems, assuring that most packets will arrive free of errors and on time. A forward error correction (FEC) layer is typically added to deal with the few packets that may be corrupt.

With FTTP systems, all of the video channels are typically delivered to every home, where the set-top boxes (STBs) pick out the IP packets needed to display a channel. These systems also use IP packets to deliver video-on-demand services, as well as the other components of the triple play

Blackmagicdesign



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— VoIP and broadband data.

Hybrid fiber/copper systems typically deliver all available channels to the neighborhood router along with VOD and other packet data services. A channel request from an STB causes the router to send the appropriate packets to that STB over an existing copper wire connection using DSL or ADSL technologies. These systems usually max out at about 25Mb/s per home, which may impose some limitations on the number of sets that can be served when high bit rate HDTV channels are requested.

Because IPTV networks already use IP packets, they can provide easier integration with existing in-home data networks. Verizon plans to offer a networked DVR accessible from other STBs in the home. The STBs will also have access to media files saved on personal computers in the home. Verizon will charge $19.95 per month for the Home Media DVR and $3.95 per month for standard definition "client" STBs.

You might think that IPTV services from the telcos are not going to have a huge impact, but IPTV could change some things on the competitive landscape of multichannel television. The cable guys are asking regulators to require these new entrants to play by the same rules that apply to cable franchises, i.e. the telcos must apply for and get a franchise for each market they want to enter.

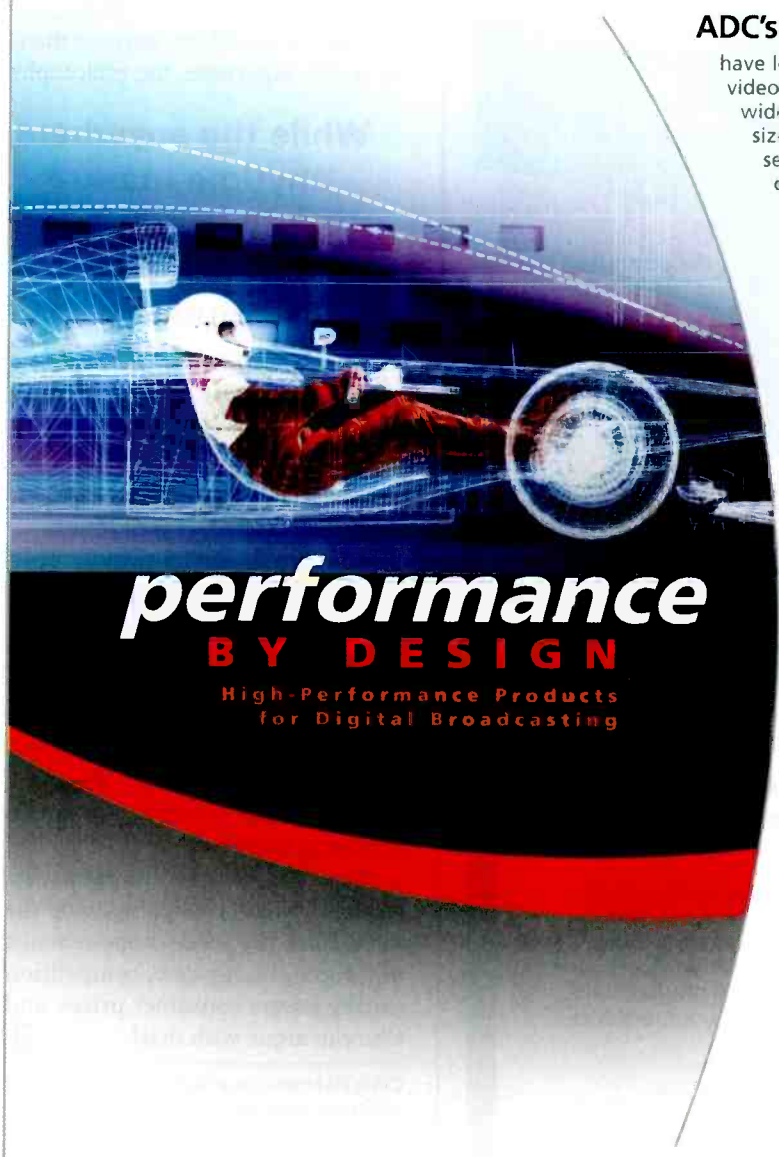
The telcos are working overtime in the nation's capital to get a national franchise law passed that would eliminate the need for local franchise authority. A bill passed in the House in June granted national franchises, but it is stuck in the Senate and may not pass this year.

Meanwhile, the DBS guys are bringing up the idea of a merger in Washington again. The second attempt is due to the premise that there are more competitive options now than there were a few years ago when the FCC denied the proposed merger of DIRECTV and DISH Network.

A bill passed in the House ... granted national franchises, but it is stuck in the Senate.

Who can blame everyone from wanting a piece of the action? The cost of multichannel TV services has been growing faster than the rate of inflation for more than a decade. The price competition expected from DBS hasn't really materialized.

So, yes, IPTV could one day be the distribution method of choice. Then



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again, maybe not, if the future follows past precedent.

Watching the back door

So why is there so much interest in IPTV? The obvious reason for concern is that the public Internet has shown itself to be a competitive threat to entrenched businesses of all kinds.

The media conglomerates have worked hard to try to control the evolution of the Internet. They have enjoyed considerable success in Washington, influencing copyright laws and a wide range of control mechanisms to protect their lucrative businesses from Internet competitors.

While these tactics were successful with lawmakers, they may have hurt the industry's position on a different front: public perception. The public seems to be awakening to the knowledge that these conglomerates can exert tremendous control over content creation and distribution. The idea that someday everyone will be able to access the content they want, anywhere at anytime, is the underlying rationale behind the IPTV buzz.

While the anywhere, anytime mantra is still vaporware, the philosophy is compelling. The Internet allows a growing number of content consumers to become content creators. Their podcasts and blogs are turning the traditional media world upside down.

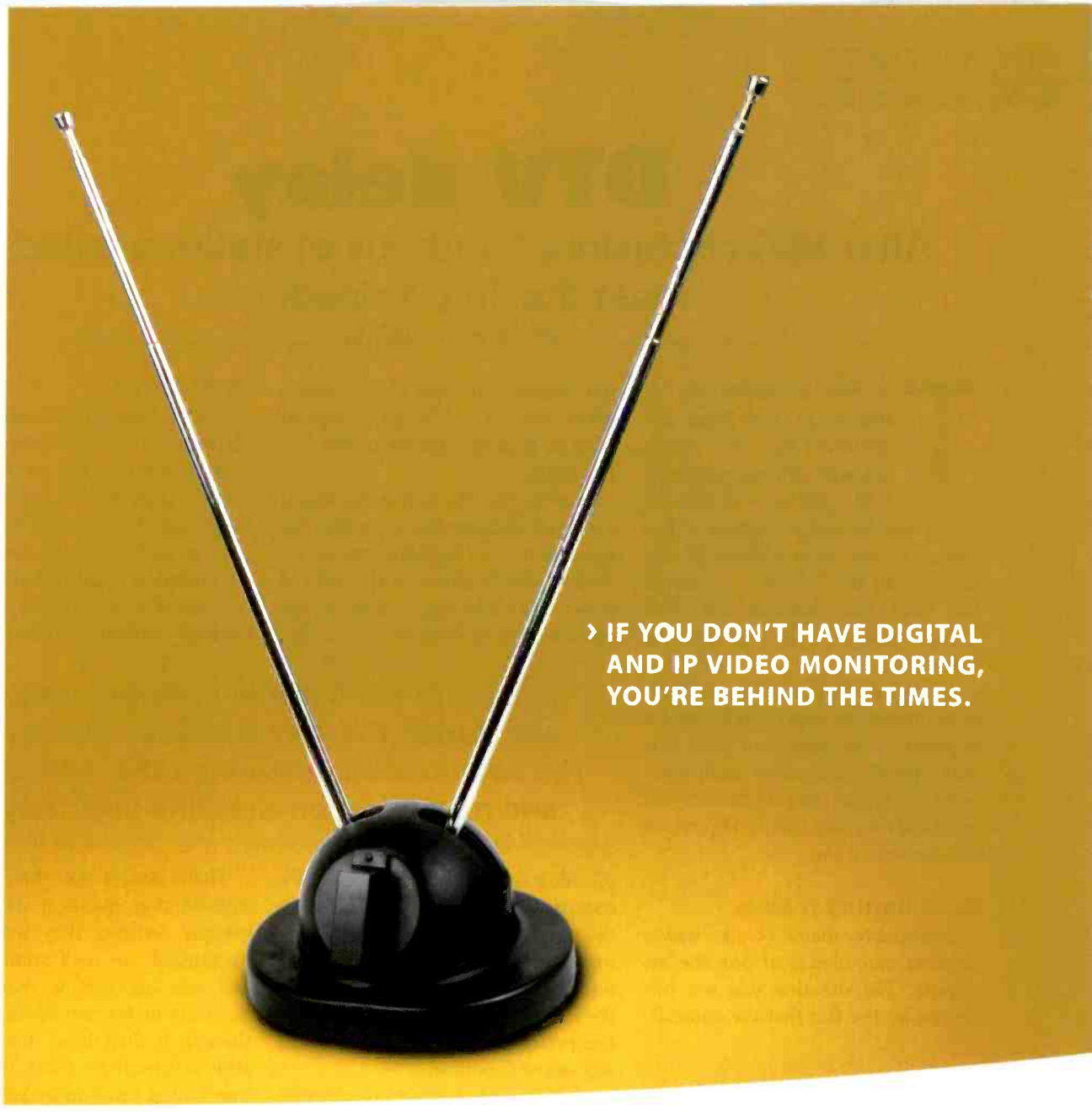
While the anywhere, anytime mantra is still vaporware, the philosophy is compelling.

Ironically, the industry that fought to control media distribution could be helping to make all of this possible. The triple-play service opens the door for new forms of competition. With broadband access to the Internet, a new world of IP media content is just a download away. Even streaming media coverage of real-time events is becoming tolerable.

IPTV has caught everyone's attention. Whether its going to be the cable killer the telco's hope remains to be seen. In any case, competition usually lowers consumer prices, and who can argue with that? BE

Craig Birkmaier is a technology consultant at Pcube Labs, and he hosts and moderates the OpenDTV forum.

Send questions and comments to: craig_birkmaier@prismb2b.com



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DTV delay

After FCC confusion, hundreds of stations failed to meet the July 1 deadline.

BY HARRY C. MARTIN

The July 1 deadline for all stations to commence operation of their DTV facilities with either replication or maximized facilities — or face the loss of interference protection — has passed. A significant number of stations — in the hundreds — could not meet that deadline and filed waiver requests by the extended July 7 deadline.

All such stations operating with reduced power were also required to file requests for extensions of their current Special Temporary Authorizations (STAs), as the commission had previously set July 1 as the expiration date for such STAs.

Contributing factors

Predictably, many of the waiver requests were filed at or near the last minute. The situation was not improved by the fact that the commission waited until June 14 to release a public notice describing the steps to meet or request a waiver of the July 1 deadline.

The FCC's public notice also caused confusion because it was unclear. For example, while the public notice indicated that stations with reduced power STAs needing a waiver of the deadline would have to file an application for extension of their DTV construction permits (in addition to the waiver request), FCC staff informally advised stations to file either one or the other, but not both. Also, the week before the deadline, the contact person listed in the public notice was out of the office.

Matters were further complicated by the fact the last day of the postponed filing window for Class A, LPTV and TV translator stations to seek digital companion channels nearly coincided with the replication and maximization deadline. Thus, many were trying to finish construction and file license applications for DTV stations, file modification applications for stations that elected to go back to analog facilities and operate with 80 percent replication facilities, and file companion channel applications — all at the same time.

In light of the flurry of activity, which occurred just before and during the July 4 holiday weekend, the commission postponed the replication and maximization deadline until July 7.

What next?

Now that the waiver requests are on file, based on last year's experience, it is likely that they will sit without action for some time. It has been mentioned that the commission is considering an item to penalize broadcasters who failed to build full-power facilities, but it is not entirely clear what the final contents of that item will be.

In light of the flurry of activity ... before and during the July 4 holiday weekend, the commission postponed the replication and maximization deadline until July 7.

There also is talk that the commission may question stations that initially certified they would build maximized or replication facilities and now are seeking modified authorizations for something less. The thought is that those stations made false certifications when they stated they would build more powerful facilities. Of course, the obvious response is stations initially believed they would need greater power levels, but after actual experience with lower power operations, discovered that the bigger facilities would be an unnecessary expense.

There has been little, if any, action on the waiver requests filed last year. The staff has been slow to act in the hope that stations will complete construction of their full-power facilities. BE

Harry C. Martin is the past president of the Federal Communications Bar Association and a member of Fletcher, Heald and Hildreth PLC.

? Send questions and comments to: harry_martin@prismb2b.com

Dateline

Oct. 2 is the filing deadline for renewal applications and EEO program reports for TV stations in Alaska, Hawaii, Oregon, Washington and the Pacific Islands. This deadline also applies to TV translators, LPTV and Class A stations in those states, although translators and LPTV stations that do not originate programming do not have to file EEO reports.

Oct. 2 is the deadline for TV stations in the following states and territories to file their biennial ownership reports: Alaska, Florida, Hawaii, Oregon, the Pacific Islands, Puerto Rico, the Virgin Islands and Washington.

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Get connected

Get the maximum performance and quality from your digital video interfaces.

BY ALDO CUGNINI

Long past are the days of simplistic, coax and BNC connections between video devices. In today's digital environment, each device must be properly interfaced, or the signal won't just be degraded; it's likely to be nonexistent. In order to lay some groundwork for our further discussions, let's look more closely at several key digital video interfaces.

CCIR 601 sets the digital stage

In 1982, the CCIR published Recommendation CCIR-601-1, now called ITU-R BT.601, a standard for encoding both NTSC and PAL television into an interchangeable digital form. Recommended Practice 601, usually just called Rec. 601, defines the digital encoding of the analog component video signal, which includes horizontal and vertical sync and blanking. Using a 13.5MHz sampling rate and the well-known 4:2:2 luminance/chrominance sampling structure, multiplexing the component video in the sequence C_B–Y–C_R–Y results in a data rate of 27 megasamples per second. While 8 bits of quantization were originally specified by Rec. 601, this was later extended to 10-bit precision to provide higher video performance.

Keep in mind that Rec. 601 is not a video interface standard, but a sampling standard. The electrical interfaces were defined by SMPTE as Standard 125M (for 525/59.94) and by EBU as EBU Tech 3267 (for 625/50). Both of these interfaces were subsequently codified into what is now known as ITU-R BT.656.

Keep in mind that Rec. 601 is not a video interface standard, but a sampling standard.

Because of the bandwidth limitations of digital processing at the time, these digital interfaces were parallel. The physical connection requires 11 twisted pairs (10 data signals plus synchronous clock) and 25-pin D-subminiature connectors. The twisted-pair balanced lines limit cable lengths to 160ft without equalization and up to 650ft with equalization. Video data is transmitted in NRZ (non-return-to-zero, where a "high" or "low" bit is simply encoded as a "1" or "0") form in real-time blocks, each comprising one active television line.

A higher 18MHz clock can carry 960 x 480 16:9 pictures and is specified in SMPTE 267M. A digital version of the composite NTSC signal — with sampling rate $4f_{sc}$ — was later specified in SMPTE 244M and provides a somewhat less-expensive interface, using the same connectors and electrical specifications.

While Rec. 656 does not specify the precise technology for the line drivers and receivers, any such components must be ECL-compatible. This means the balanced line drivers must have an output impedance of 110Ω, and the receivers must terminate the balanced lines in a 110Ω impedance.

While these interfaces may be treated with a certain amount of neglect, the ninth and 18th harmonics of the 13.5MHz sampling frequency fall exactly on the 121.5MHz and 243MHz aeronautical emergency channels. Therefore, the integrity of these connections is critical, especially from an RFI-emission standpoint.

SDI offers economy

It should come as no surprise that the use of parallel interfaces can be constraining in larger installations, where extensive cabling could have as much as a 10:1 impact on cost. For this and other reasons, serial digital video interfaces were developed. This allowed the use of less expensive 75Ω coax and standard BNC connectors.

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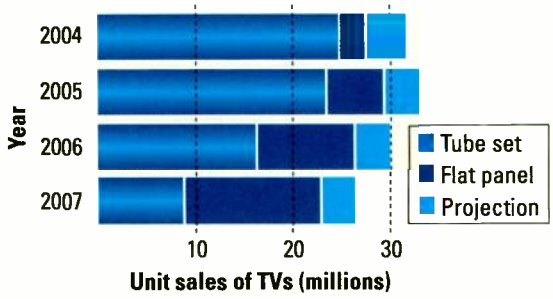

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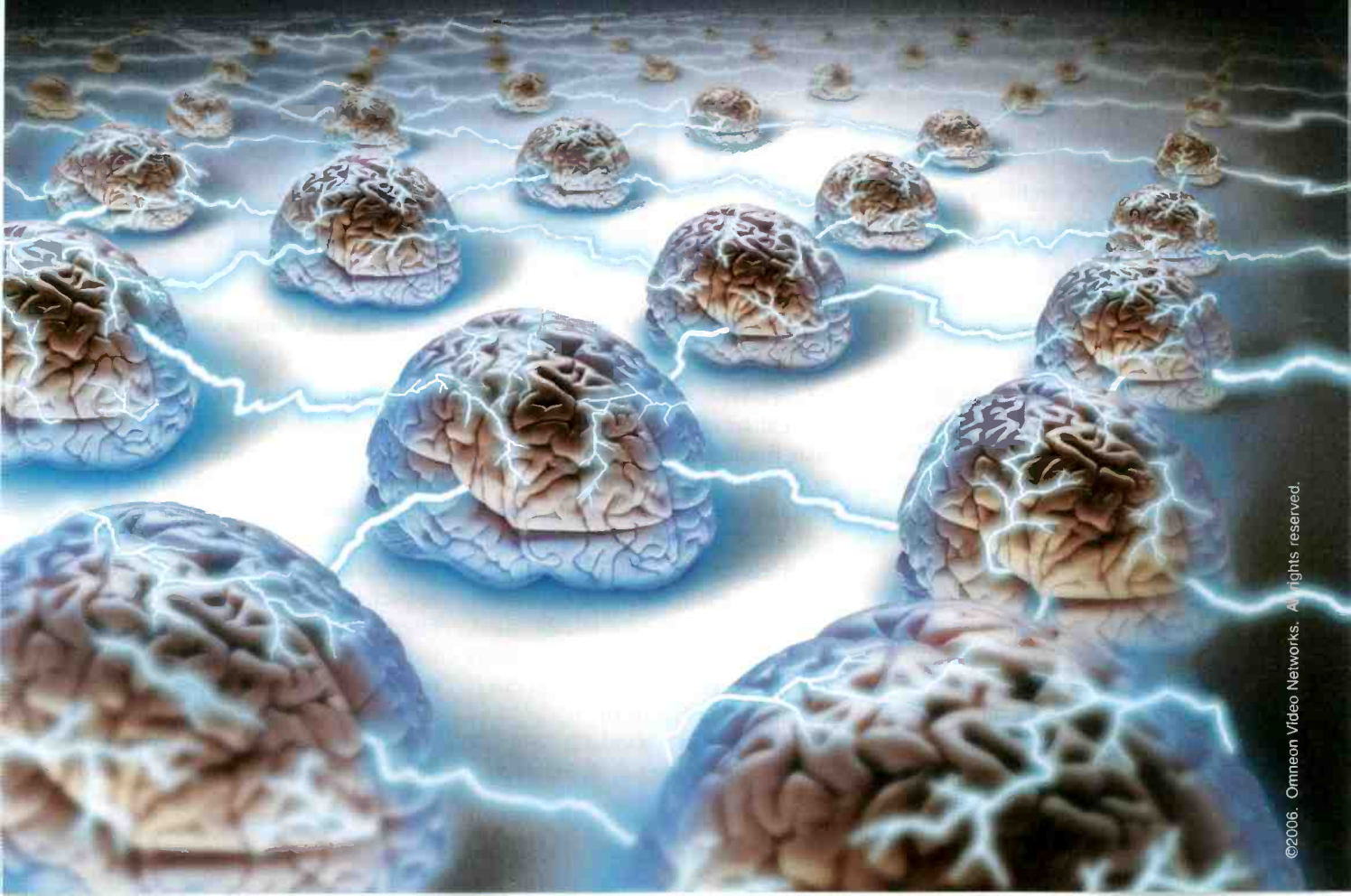


Editor's note

Broadcast Engineering's new "Transition to Digital" columnist, Aldo Cugnini, is a DTV consultant. He recently served as the project manager for Maximum Service Television (MSTV) during the MSTV/NAB Terrestrial Digital Converter Project. He also had a leadership role in the development of the "Grand Alliance" digital HDTV system, which led to the ATSC DTV system. Previously, he held technical and management positions at Philips Electronics' Research and Consumer Electronics Divisions and at interactive-television developer ACTV. He also worked on audio and RF systems at Broadcast Technology Partners and CBS Laboratories. In addition, he was an RF specialist at RCA Broadcast Systems.

In addition, Cugnini served on the board of directors of the Advanced Television Technology Center and has been awarded six patents in DTV and broadcasting, as well as issued an FCC First Class Commercial Radiotelephone Operator's license.

He received his BS and MS degrees from Columbia University and is the author of numerous industry reports, technical papers and publications, including a new section in the upcoming 10th edition of the NAB Engineering Handbook, "Worldwide Standards for Digital Television."

He is a joint recipient of a 1997 Engineering Emmy and *R&D Magazine*'s 1998 R&D 100 Award, and was a finalist in the 2005 IEEE-USA Congressional Fellowship program.

Further, Cugnini is a member of the Academy of Digital Television Pioneers, the IEEE and Eta Kappa Nu. He is a past member of the American Association for the Advancement of Science and the Audio Engineering Society. Finally, he is a musician by avocation. Write him at acugnini@prismb2b.com.

The first such interface, SDI, is still widely used, and was initially specified in SMPTE 259M as a means to digitally encode 10-bit 4:2:2 component and $4f_{sc}$ composite NTSC and PAL digital video signals. The bit rate for this data stream is 143Mb/s for NTSC, 177Mb/s for PAL, 270Mb/s for 13.5MHz sampled 4:3 component video, and 360Mb/s for 18MHz sampled 16:9 component video.

In order to eliminate the need for a separate clock, channel coding is employed in the form of scrambled NRZI (non-return-to-zero-inverted, where a "high" bit is encoded as a transition from "1" to "0" or vice versa, depending on the previous encoded bit). With such a scheme, a polynomial scrambling function ensures that the data stream looks random, with enough transitions to allow for clock regeneration from the stream itself. SMPTE 259M also supports four channels of AES/EBU digital audio when present in the NTSC data space. Depending on the type of cable used, a transmission distance of up to 980ft is possible, especially when equalizers are used. (See Figure 1.)

The related standard, SMPTE 294M, specifies serial digital encoding for 480p sources. A 4:2:2 video signal requires two SMPTE 259M links. A 4:2:0 signal can be carried on a single SMPTE 259M link at 360Mb/s. An HD-SDI version was standardized in SMPTE 292M and ITU-R BT.656. It supports up to 1.485Gb/s of uncompressed HDTV video.

SDTI compresses and quickens transfers

To handle compressed video, the serial data transport interface (SDTI) was developed and standardized in SMPTE 305. In order to provide backward compatibility with an existing SDI infrastructure, SDTI places the compressed bit stream within the space of normal active video on an SDI link, between the start of active video (SAV) and the end of active video (EAV). This provides 1440 10-bit words of data per video "frame" at 270Mb/s and 1920 8-bit words at 360Mb/s. The actual data payloads are 200Mb/s and 270Mb/s, respectively. Because these rates comfortably exceed those needed for even the most-demanding video quality, faster-than real-time video transfers are possible.

SDTI was designed to carry any valid data payload type registered

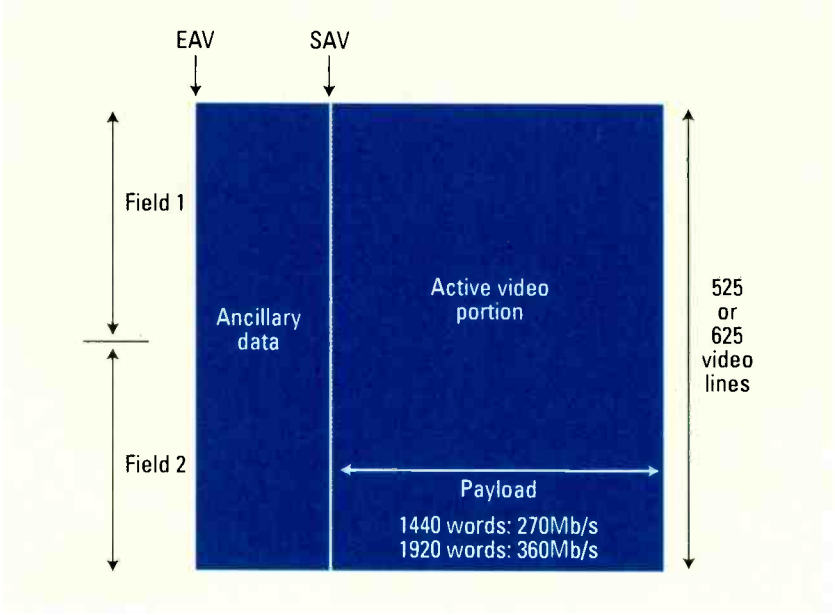
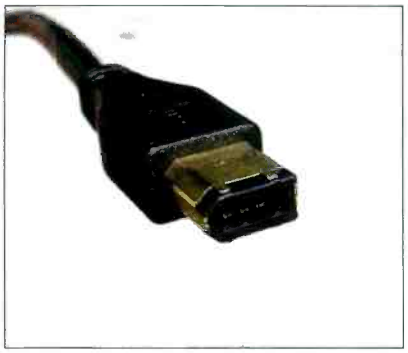


Figure 1. SMPTE 259M video timing. EAV marks the end of active video, and SAV marks the start of active video.

with SMPTE. This includes DVCAM, DVCPRO, Digital-S, Betacam SX, and, MPEG-2 program and transport streams. A 1.5Gb/s version, using HD-



An IEEE 1394 (aka FireWire or i.Link) cable offers a bidirectional connection terminated in a six-pin connector (shown here) or in a smaller four-pin.

SDI, has been standardized in SMTPE 348M. Because of the widespread interest in interfacing MPEG-2 and ATSC transport streams, a separate interface was developed that removed the need for encoding and decoding functions to extract the transport stream. This serial interface is outlined in SMPTE 310M and provides a direct, point-to-point connection between DTV devices.

A word is in order about the terms *synchronous* and *asynchronous*. There has been considerable confusion in their application to the various interfaces mentioned above. Both terms describe the relationship between two entities, i.e. source and destination. SDI and SDTI are both synchronous interfaces in that there is a common clock signal (or timing reference) between the source and destination devices to coordinate their transmissions.

Furthermore, the video contained within the SDI interface is synchronous with the SDI carrier. This means there is a fixed relationship between the video timing (based on 27MHz) and the SDI clock (270MHz).

However, video contained within a compressed bit stream within an SDTI transmission can actually be asynchronous with the SDTI carrier itself. This is because the video is compressed and the timing is defined by a program clock reference (PCR) within the bit stream. The actual video timing may be locked or unlocked with respect to the 270MHz SDTI clock.

There is always competition, and interfaces are no exception. The DVB-ASI protocol is equally as popular as the 310M interface. DVB-ASI was originally developed to allow cable headend equipment to transfer DVB/MPEG-2 signals.

MPEG-2 transport packets are carried at a rate of 270Mb/s in 188- or 204-byte packets, simplifying the requirements on interface equipment. The data bytes are 8B/10B coded, which produces one 10-bit word for

each 8-bit byte presented. The serial data is recovered by means of a unique 10-bit synchronization word that is prevented from occurring by the 8B/10B encoder. This code also provides error checking.

DVB-ASI was originally described in Annex B of ETSI EN 50083-9 and later updated by IEC 60728-9. Other variants include synchronous parallel and serial interfaces (DVB-SPI and DVB-SSI), as well as the use of optical fiber.

IEEE 1394 provides computer interfaces

Finally, we have a plethora of computer interfaces, one of which is finding wide use in professional applications — IEEE 1394, also known as FireWire (by Apple) and i.Link (by Sony). The bidirectional connection is made over two twisted pairs and an optional power-carrying pair. The cable is terminated in a small four- or six-pin connector.

When it comes to standards, the good news is that there are plenty of them. The bad news is that there are plenty of them.

In its simplest application, 1394 allows peer-to-peer device communication at 100Mb/s, 200Mb/s or 400Mb/s. Up to 63 IEEE 1394 peripherals can be connected in a hubbed network structure. A new IEEE 1394b specification supports 800Mb/s traffic on a nine-pin connector, as well as optical connections supporting up to 100m (330ft) in length and data rates up to 3.2Gb/s.

While SMPTE 396M has defined a standard method to carry DV-based video over 1394, various proprietary protocols have emerged to carry compressed video, audio and control. So, don't assume that because a device says it supports 1394, or another of its branded labels, that full compatibility is ensured.

When it comes to standards, the good news is that there are plenty of them. The bad news is that there are plenty of them. Be sure you understand how these professional interfaces operate and what your equipment needs to be properly connected to the rest of the world. BE

Aldo Cugnini is a consultant in the digital television industry.

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Video network protocols

A new protocol stack puts UDP over IP.

BY BRAD GILMER

While there are an endless number of Internet protocols, some of them are particularly suited for video networks. For real-time transmission of video over IP, let's look at the protocol stack used in the Pro-MPEG Forum's Code of Practice 3, which is currently undergoing standardization with the Society of Motion Picture and Television Engineers. (See Figure 1.)

IP over data link services, such as Ethernet for LANs or SONET for WAN, are ubiquitous for both data and video transmission. As we move up the protocol stack shown in Figure 1, we find UDP over IP, rather than the typical TCP over IP.

Note: Throughout this article, you will find references to Internet Engineering Task Force (IEFT) Request for Comment (RFC) documents. These are the defining documents for the protocols discussed in this article and can be found on many Web sites. (My favorite site is www.rfcs.org.*) In many cases, these documents are surprisingly readable and contain interesting information about the protocol.*

User Datagram Protocol

UDP (RFC 768) sends datagrams from one place to another. UDP is a core video networking protocol because it allows the creation of large packets. It does not require acknowledgement from the receiver, and it has low overhead. Nothing in UDP guarantees that packets sent across the network will reach the other end. In fact, UDP explicitly does not check to see that packets have been received.

UDP packet size varies, and in some cases, UDP packets can be quite large. Video applications may use this capability to increase efficiency, encapsulating large blocks of video data in a single UDP packet. However, some system administrators may block UDP packets because they hog all the available bandwidth and are unfair to other traffic on the network.

Real-Time Transport Protocol

RTP (RFC 3550) transmits real-time information over IP networks. RTP packets contain sequence numbers and timing information that receiving applications can use to correct errors, such as jitter and wander, which may have occurred in transmission across the network.

Forward error correction

FEC is not a protocol, but rather a technique that recovers lost data in real time. FEC allows receiving applications to reconstruct lost data on the fly rather than waiting for retransmission of the lost data. But nothing in life is free. FEC reconstructs errored packets by using additional data contained in the transmission stream. This additional data raises the total bandwidth required for a particular link. In typical applications, the overhead is 15 percent to 20 percent. FEC also introduces delay, which is unacceptable in some applications.

Many FEC schemes have been developed over the years. These schemes represent varying compromises among different variables, such as complexity, robustness, delay and overhead. In the case of the Code of Practice 3 implementation, a constrained version of RFC 2733 is employed.

In Figure 1, two other layers are shown — a compression layer and a user application layer. In the future, compression may not always be employed. This is because prices for bandwidth continue to fall and because compression introduces delay — an undesirable characteristic in broadcast applications.

Video applications have migrated from purpose-built hardware, such as tape machines and special effects boxes, to multipurpose computing platforms. These platforms incorporate networking as an integrated part of their overall applications, making video networking an increasingly important part of any facility's infrastructure.

Video applications have migrated from purpose-built hardware ... to multipurpose computing platforms.

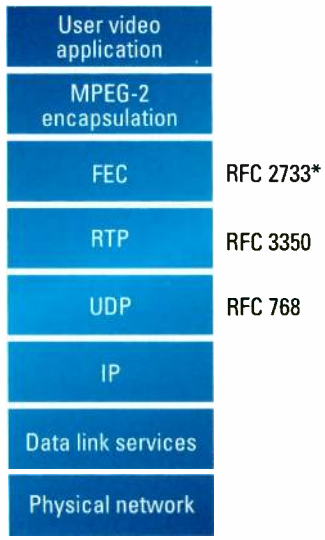
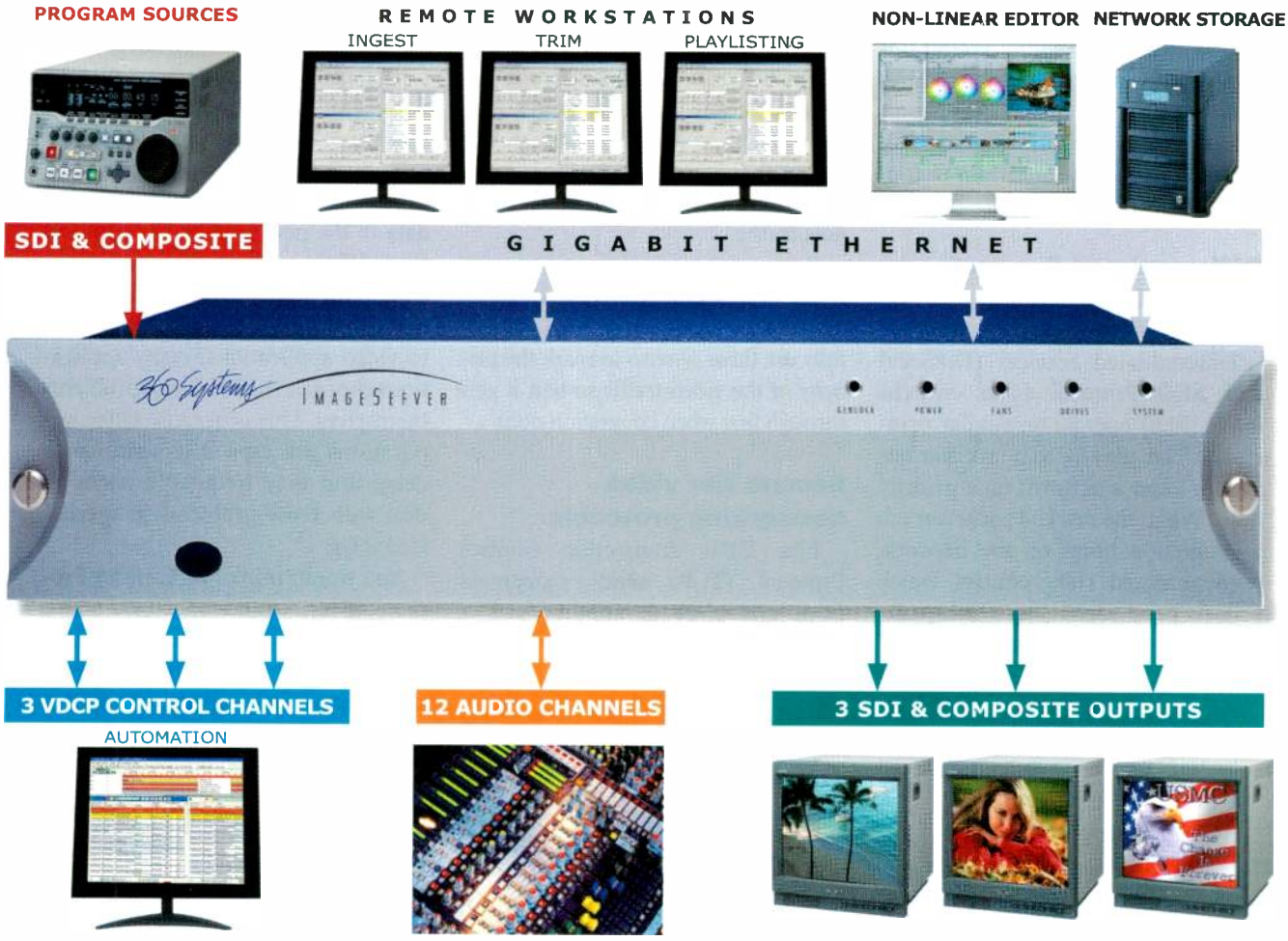


Figure 1. Protocol stack for live transmission of video over IP (as specified in Code of Practice 3, which is becoming an SMPTE standard). (*Code of Practice 3 limits some parameters and functionality of RFC 2733.)

Talk about intelligent design...



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Quality of service frameworks

QoS frameworks are collections of protocols, policies and procedures that, together, establish a level of service across a network. As you can imagine, QoS is an important part of video networks.

Differentiated Services and Multi-Protocol Label Switching

Differentiated Services (DiffServ) and Multi-Protocol Label Switching (MPLS) operate on similar principles. The idea is to mark packets as they enter a network on a priority basis. When the marked packets reach a congestion point on the network, predetermined rules control which packets get priority and which packets may be dropped from the queue.

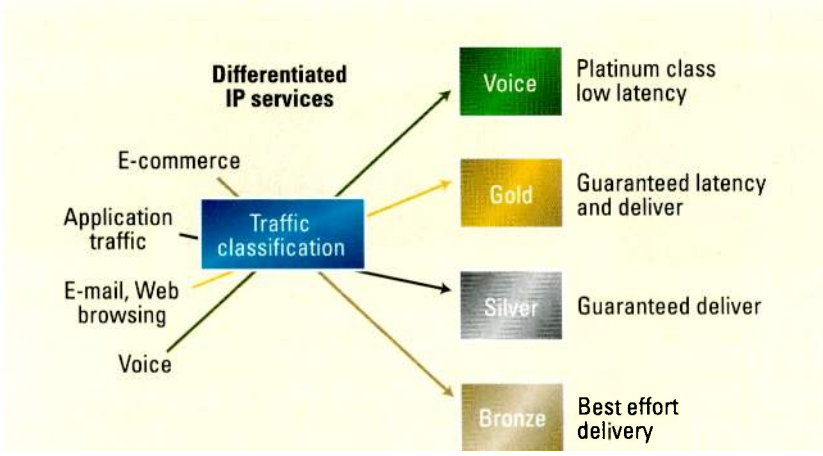

Figure 2. In the Differentiated Services protocol, packets from various applications are classified as they enter the network.

These frameworks have the potential to become an important part of video networks. The problem with them is that while they work conceptually, a particular session may not receive the desired high importance on the network. Figure 2 shows that voice traffic receives the highest classification, while e-commerce receives the lowest classification.

If you control your network from end to end, then you will not have any problem ensuring that your video traffic receives the priority it requires. However, if you are working with a public carrier, you may find that the carrier believes other traffic has priority. In Figure 2, there is not a classification for video, and it may be difficult convincing this public carrier that your video traffic is more important than telephone or other data traffic.

If you own dark fiber and you are trying to send both video and computer data across the fiber, you can successfully use these systems to mark the priority of the video traffic so that it gets through first when congestion occurs.

Second tier video networking protocols

Like UDP, Transaction Control Protocol (TCP) sends datagrams from one place to another over a network. One of the biggest differences between TCP and UDP is that TCP guarantees delivery of the data. TCP does this by stamping each datagram with a unique sequence number. It then looks for the receiver to acknowledge that it received the datagram. TCP also implements a number of rate control mechanisms to deal with rate limits imposed by the receiver and congestion issues on the network.

TCP is one of the most popular protocols on the Internet. However, it is not a core video networking protocol because in many video applications, it introduces unacceptable delay — especially in real-time applications.

TCP provides great functionality. For example, it requests the retransmission of lost packets and automatically puts packets in the order they were transmitted before handing the data to the next layer in the protocol stack. While recovery from lost packets and the ability to deal with packets that arrive out of order are important to video applications, many applications choose to handle these problems themselves. This is because video applications are especially sensitive to delay, and they frequently prefer to deal with these problems in specialized ways.

You would think File Transfer Protocol (FTP) would be a core video networking protocols, especially when moving video files. However, there are several reasons why FTP is not desirable for video applications.

As I said in my September 2005 column, "FTP has some characteristics which make it unsuitable for moving professional video files. First, many FTP applications have a file size limit of 2GB. Professional video files can be much larger than this, so this limitation can be a real problem. Second, FTP has rate control mechanisms that can interfere with transmission of large files."

Given fairly common network parameters, FTP guarantees the transfer of large files will fail. FTP works well for smaller files. This being said, it is clear why FTP is not a core video network protocol. BE

Brad Gilmer is president of Gilmer & Associates, executive director of the AAF Association and executive director of the Video Services Forum.

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The Cheetah DRS, PESA's newest multi-format audio router, uses patent pending distribution technology to route audio over Gigabit Ethernet with either a single CAT-5 or Fiber cable for multi-frame connectivity. This creates a Distributed Routing System (DRS) scalable from 64X64 (occupying 1RU frame in one location) up to 2048X2048 (in 36RU of space in one or many locations).

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Leverage your tech to support multidefinition master control switching.

BY MARTIN MOORE

The transition from 525/625-line standard definition to 720/1080-line high definition is well under way, spurred by the increased affordability of HD equipment at every point in the broadcast delivery chain. At the front end, the HDV videocassette format allows 720p and 1080i 16:9 acquisition at a prosumer price point. At the display end, respectably large LCD television receivers are now competing fiercely for customer attention in retail stores.

Broadcast equipment manufacturing has gradually migrated from dedicated hardware towards software. The hardware approach allowed potentially high reliability but commensurately high price and low flexibility.

Software-only products initially appear more attractive. They combine low price and high flexibility. But they are only as reliable as the platforms they run on.

If these platforms are in turn engineered down to a price for multirole applications (e.g., the ubiquitous personal computer under Microsoft Windows control), the software manufacturer cannot honestly claim to have total control over the final product.

There is a third option: firmware based on field-programmable gate arrays (FPGAs). A single-chip FPGA can deliver most of the functions associated with a computer microprocessor. The flexibility and inherently low cost of FPGAs allows dedicated products to be developed almost as easily as software while maintaining tighter control over the stability of the operating platform.

How to buy: Think modular

Turning technical generalities into a specific purchase plan is best achieved by carefully studying current operational process paths and then mapping your entire system from incoming lines right through to playout. This exercise clearly identifies single-points-of-failure and shows the extent to which a current system can be expanded without having to be pulled temporarily off-air.

The strength of a modular approach is the ease with which it can be rescaled ... or modified.

From that foundation, an expanded or entirely new process path can be mapped out on a module-by-module basis to incorporate each required additional function.

You may also find value in mapping out the process path of your entire organization. It is an extremely powerful way of identifying the strengths and weaknesses of any corporate structure.

Modularity is a valuable feature for today's television stations. Every designer plans and builds in a modular fashion but does not always pass the full power of that modularity on to the end user.

A multidefinition master control system should ideally be scalable from a simple SDI A/B switcher up to a full-blown mix/wipe/key/DVE/clock insertion master control combination by adding different modules. This makes the whole system flexible and configurable to individual clients' requirements. Equally important, it should be inherently easy to reconfigure to accommodate extra channels or a changing operational environment such as greater automation.

Figure 1 on page 38 outlines key questions for you to consider when planning a multidefinition master control switching system. Starting with the up-front considerations of audio and vision switching, it then works through the requirement options for automation, embedded audio, voiceover, downstream keying, and animated or static logo generation. Power supply redundancy and failsafe relay bypass then need to be factored in along with audio monitoring, file transfer interfacing, manual/motorized control panel facilities and so on.

Modular thinking does not necessarily mean you are obliged to implement modular solutions. However, the strength of a modular approach is the ease with which the system can be rescaled to match increased demand or modified to meet an unanticipated requirement.

Gearing up for 1080p

The most important decisions in any multidefinition system structure are at what points to down-res or up-res, and where to operate in dual-definitions. Don't forget to consider how the resulting process paths could impact overall operation if any one module or side-chain should fail.

With 1080p looking increasingly likely to become the worldwide standard for program origination, a cautious system integrator or station engineer may want to structure

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the entire master control system to operate at 1080p and leave all the down-res processing to the point immediately prior to playout. A well-designed modular system should allow the technical staff to make these judgments for themselves rather than them be limited by the rigidity of predefined hardware.

Multichannel presentation suites need fast and efficient control over channel branding logos, including the ability to handle static and animated artwork. Be sure the technology you select for your station can accommodate today's and tomorrow's needs.

Be sure the technology you select for your station can accommodate today's and tomorrow's needs.

Dual signal squeezeback processing with integrated keying is another valuable presentation tool. Consider, does your application need real-time delivery with picture-in-picture and image-squeeze applications? Do you need real-time horizontal and vertical resizing effects? While a modular approach is flexible, it's best to plan now for your ultimate needs so you'll be ready when those needs arise.

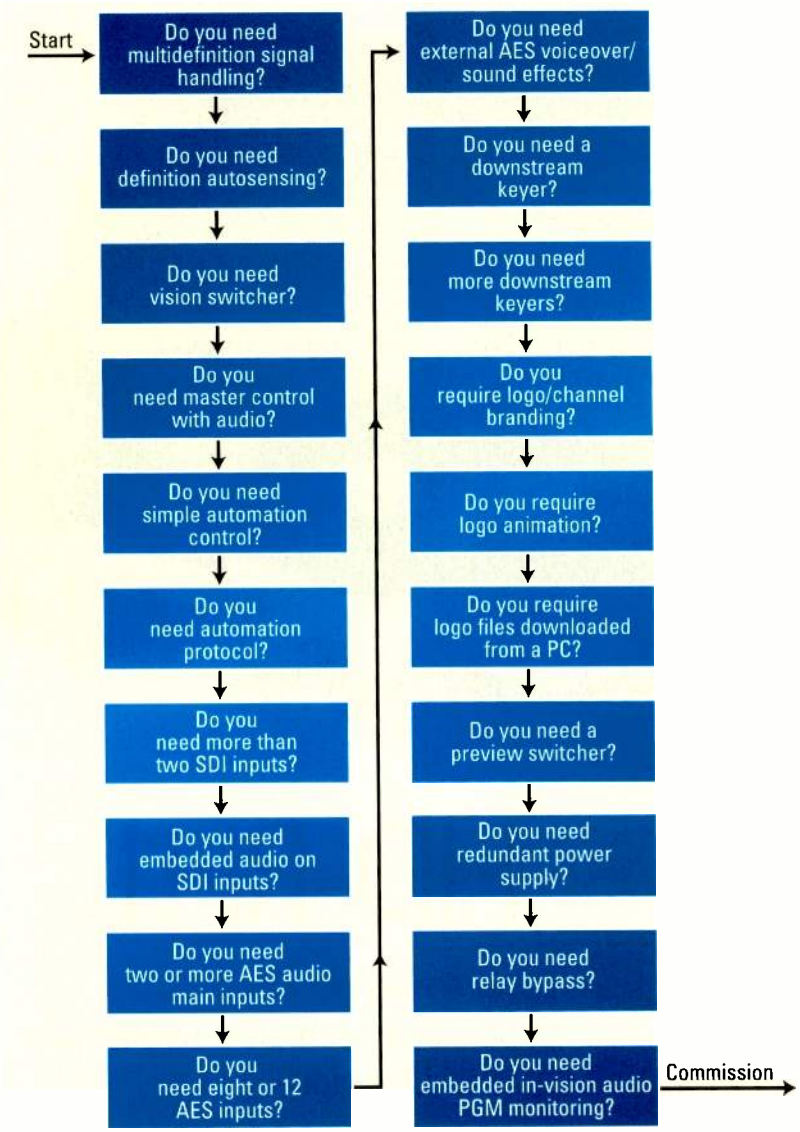

Figure 1. This source-resolution flowchart outlines key decisions to consider when planning a multidefinition master control switching system.

External controllability

The ability to control broadcast equipment from an external computer is particularly vital in the case of a master control switcher. Ideally, the system should permit a complete health check to be performed on new and existing installations, with automatic repair of any misadjusted parameters. Logging facilities should also be incorporated to assist integration with third-party automation systems.

IP-based fault-finding is increasingly taken for granted by systems integrators. It means that an engineer can check from a remote location individual modules all the way up to an entire network.

A long-term goal for this technology is the ability to monitor the whole system automatically using out-of-boundary sensing of key operation parameters. It can then trigger switchover to a standby channel or request a human response.

Maintaining signal legalization is perhaps as essential in high-definition production as in standard definition. In fact, it might be considered even more so given the ease with which HD audiences can see image artifacts when viewing on large-size picture displays.

This usually necessitates 10-bit processing in the legalizer, which enables the master control operator to ensure that the station's output is within the levels set for the target delivery chain or transmitter. Some features to consider include independent adjustment

HDCAM

"Sony was the only supplier to step up to the plate."

— Jason Taubman and Paul Bonar, Game Creek Video

HDemanding

Jason Taubman, VP of design for mobile production company Game Creek Video, faced contradictory demands. He tells us, "Some clients required the highest quality in 1080i and others demanded the same in 720p. Some venues only had fiber and some strictly triax. Sony was the only supplier to meet all these requirements in a single camera."

"We committed to the HDC-1500, Sony's 1080/60p camera before it was even a model number," says Paul Bonar, VP of engineering. "And Sony committed to us. Their engineers heard our input on the large lens 'sled,' which works like a charm. We gave them distressed cable to help design the triax adaptor, which is brilliant. And in service and support, Sony has risen to every challenge and met every need. We're now on our fifth consecutive truck with the HDC-1500, the best HD camera we've ever seen."

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The latest generations of 16:9 wall-mountable LCD and plasma screens are selling well. However, 4:3 displays will inevitably remain commonplace for many years. This means that you will have to handle multiple aspect ratios and be able to verify that the program remains within the visible screen area for each of your output channels.

Selected safe-area markers are normally superimposed onto the HDTV video feed, which can then be viewed on a monitor display without being visible on the main transmission output. Commonly used guidelines include:

- safe-action and safe-title areas;
- center markers (short and full screen);
- moveable horizontal and vertical cursors; coordinates indication;
- variable aspect ratio box; and
- edge blanking lines (analog and digital).

Preset aspect ratios should be switch-selected for all common film and television formats down to 4:3.

16:9 wall-mountable LCD plasma screens are selling well. However, 4:3 displays will inevitably remain commonplace for many years.

The multidefinition future

Program originators, post-production facilities and broadcasters in Europe, India, Latin America and Southeast Asia are following the United States' lead in introducing high-definition services. The transition will not be a straight switch from standard definition to high definition, but instead an expansion into multidefinition, meeting the demands of Internet-based broadcasting as well as terrestrial and satellite-based 525i, 625i, 720p and 1080i.

Multidefinition will be a standard requirement in television broadcasting for the rest of this decade and probably well beyond. Plan correctly now, and the transition will be easier for both you and your staff. **BE**

Martin Moore is the managing director for Eyeheight.

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WINK-TV

makes the digital transition in spite of Charlie and Wilma

BY KEITH STUHLMANN

The WINK-TV news set was designed for a 16:9 aspect ratio and features Panasonic monitors chosen for their display clarity under studio lighting conditions.

When the owners of WINK-TV, a CBS affiliate in Fort Myers, FL, assigned its engineering staff the task of totally upgrading its broadcasting capabilities, everyone involved realized there would be challenges. They did not, however, anticipate that the project would be put in jeopardy by serious hurricanes striking their six-county southwest Florida area in two successive years.

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The engineers knew that, under the best of circumstances, the integration of top-end equipment and new technology — without interrupting programming delivery — was a formidable task. The plan involved extensive construction to the CBS outlet's buildings, which also house nine radio stations. But this was put on hold due to the substantial damage from Hurricane Charlie throughout Lee and Charlotte counties in the station's Fort Myers/Naples metro market. Once the construction crews were available — after helping the 1 million residents affected by the hurricane — the project began.

Grass Valley digital routing and conversion equipment enables the satellite control center to distribute any satellite feed to any destination in the facility.

The plan

WINK — with the help of Professional Communications Systems (PCS) — would expand the facilities and make the transition to digital and HD. PCS was chosen because of its extensive experience in broadcast systems integration and understanding of digital transition issues.

Plans called for a rebuilding of WINK's master control and tech center operations. Walls had to be removed or relocated, the ceilings had to be totally removed with new ones installed, offices had to be relocated. The electrical and air conditioning systems had to be redesigned to accommodate the new equipment and heat loads.

WINK management focused on maximizing value within budgetary guidelines.

While cost is always important, the station's management focused on maximizing value within budgetary guidelines. In order for WINK to stay at the technological forefront, it needed to replace its old analog infrastructure with a digital one that would provide both SD and HD feeds through the facility and on to the air. Implementing an all-digital infrastructure was the logical path to take, and it was designed to allow content and workflow to move smoothly throughout the facility, as well as enabling a much easier implementation of HD and 5.1 audio.

Equipment integration

In the television facility's master control, tech center, production and server areas, top-of-the-line solutions were integrated with hundreds of new components that had to work with the legacy system. In the old analog infrastructure, the station's team had devised numerous workarounds to incorporate the expanding list of digital-only equipment (e.g., DVEs, servers, clip and still stores) to function in the analog world. And the need to transition to HD added to the complexity.

Regarding equipment, management wanted the components to be comfortable. The upgrade team was tasked with selecting equipment that would provide great performance, flexibility and reliability for many years, along with future upgradeability. An easy-to-implement plan was designed for future upgrades to new equipment, systems and technologies. Aging pieces would be replaced with new, digital equipment in stages throughout the integration.

Workflow elements

A Grass Valley master control switcher improves speed, ease and error-avoidance in multiple source management and feeds. The company's A/D and D/A conversion system adapts any signal format to be compatible with both existing and new equipment. A Grass Valley Encore-controlled Concerto routing system provides 128 x 128 ins and outs, which allow access to all sources from master control, production control, promotion/graphics, news, weather and the studio.

Aging pieces would be replaced with new, digital equipment in stages throughout the integration.

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to monitor the video and audio for the SD and HD feeds, including Dolby 5.1 audio. The HD feed pathway consists of a TANDBERG E5780 HD/SD encoder and a Microwave Radio Communications (MRC) TwinStream system for the studio-to-transmitter/transmitter-to-studio link (STL/TSL).

STL/TSL equipment from MRC enables the station to microwave out to the transmitter site and back to the studio on the same path. The STL and TSL each have two TwinStream D/A transmitters with a hot standby switching shelf.

A Miranda Kaleido virtual monitor wall subdivides large screens into programmed designs of many smaller images, reducing problems associated with rows and columns of individual monitors, including heat production. Two 50in Panasonic plasma screens are integrated into the Kaleido monitor wall.

WINK also has three 20in Ikegami HD/SD multiformat HTM2005R color monitors in the master control and operations centers for monitoring HD transmission. Four Sony 14in professional multiformat high-resolution SD PVM1415/1 monitors were installed throughout the centers.

HD is broadcast in Dolby 5.1 audio, which supplies surround-sound signals to home entertainment centers.

A Snell & Wilcox HD6300 upconverter provides signal upconversion.

Harris' Leitch LogoMotion storage and distribution system enables different logos for separate simultaneous programming outputs and notifications, such as weather updates and AMBER Alerts, and also the synchronizer processors that intake any signal format and provide for outputting in any format.

An ADC patch panel system isolates component malfunctions to keep the station's signal flowing when any individual component experiences difficulties.

HD is broadcast in Dolby 5.1 audio, which supplies surround-sound signals to home entertainment centers

The technical operations center accommodates all the tech equipment for both the HD and SD signal flows.

Grass Valley Encore control allows adjustment of dozens of Grass Valley components throughout the facility. The Tektronix SPG422 master sync/reference system replaced the legacy hardware. To their right is the master monitoring area.

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For its studio set, WINK chose Panasonic plasma monitors because of the high contrast ratio that performs well even under studio set lighting. A 50in Panasonic plasma screen in the master control room monitors the HD feed.

The installation included a new SPG422 master reference sync system from Tektronix with an ECO422D automatic changeover unit. The sync generators ensure complete synchronization of the SD and HD signals.

Design team

WINK-TV
- Keith Stuhlmann, dir. of eng.
- Glen Argirion, eng.

Professional Communications Systems (PCS)
- Rich Merriam, design eng., project mgr.
- Charles Ross, account executive
- Glenn Thomason, dir. of eng.
- Troy Pazos, installation mgr.
- Bill Blush, vp sales

Technology in action

- ADC PPV2224RS-S patch panel system
- Dolby 5.1 sound system
- Ikegami HTM2005R HD/SD monitors
- Grass Valley
  - 8964DEC A/D and 8964ENC D/A conversion system
  - Encore-controlled Concerto routing system
  - Master control switcher
- Harris Leitch
  - XPR-12 SAESC 12 x 1 bypass system
  - LogoMotion logo and emergency storage and distribution
  - DPS575 synchronizer processors
- Miranda Kaleido-K2 virtual monitor wall
- MRC TwinStream STL/TSL
- Panasonic plasma monitors
- Sony PVM1415/1 SD monitors
- Snell & Wilcox HD6300 upconverter
- TANDBERG E5780 encoder
- Tektronix
  - ECO422D automatic changeover unit
  - SPG422 master reference sync system
  - WFM601A and WFM601M SD scopes
  - WFM700 HD scope

In the master control center, from left to right, are the ENG, camera control area and master control system.

WINK's on-air master control center features a Grass Valley master control switcher and two 50in Panasonic HD plasma monitors fed by a Miranda Kaleido-K2 dual-head monitor wall processor.

Tektronix scopes are a combination of waveform monitor and vector WFM601A and WFM601M for SD, and a WFM700 scope for HD.

Added service to viewers

The upgrade has enabled the station to record both standard- and high-definition feeds from CBS. The HD feed is provided over the air and is fed, via fiber-optic cable with back-up, to the Fort Myers/Naples cable systems market. Seventy percent of prime-time HD is in Dolby 5.1.

For a smooth transition between HD and non-HD programming, WINK upconverts 480-line video scans to 1080 lines. The HD/SD simulcasting is interrupted during opportunities to distribute original HD

programming from CBS, as was done during this year's NCAA basketball tournament.

Shortly after the upgrade and construction were completed, the area was struck by Hurricane Wilma. Adversity provided the ultimate test for the new equipment and operations, offering a direct comparison of old vs. new.

Hurricane Wilma ... provided the ultimate test for the new equipment and operations, offering a direct comparison of old vs. new.

During the weather interruptions, WINK put all efforts into providing and keeping emergency information on its feeds. A large in-house power generator supplied electricity during an extensive power outage. Its generators never ceased during a week with widespread power failure. The station remained on-air, providing critical information to area residents and the governmental authorities' security and rescue forces. The FCC recognized WINK for its extraordinary efforts under great duress.

The new infrastructure provides the ability to route signals to and from any destination and to quickly get emergency information on the air, either in the form of "Push Back & Crawl" or "Live to Air," with graphics and other visual and aural information. It also enables HD programming to air with full 5.1 audio.

The result

Automation has been a key factor in the success of WINK's facility upgrade and the transition to digital. In addition to increased capacity, the station no longer has to deal with cumbersome workarounds.

Routing sources are more efficient, and the team enjoys a much improved workflow. The system's efficiency and communication speed also assist the staff in error-avoidance.

The transition was a long process with many roadblocks for the development team, but the end result has been successful. The rebuild has allowed WINK to continue honoring its commitment to the Southwest Florida region by being at the forefront in programming and providing better, faster news. BE

Keith Stuhlmann is WINK-TV's director of engineering.

Directional antennas

There are no criteria for low-power stations.

BY DON MARKLEY

Prior to the digital television evolution, directional antennas at full-power television stations were primarily used to transmit a signal over a desired area as opposed to provide protection to other stations. For example, a station with a transmitting antenna located within visual distance of the coast might use a directional antenna to place the signal over the land area and avoid wasting the signal over the water. The FCC permitted this if the antenna conformed to the guidelines in the rules and regulations.

In some instances, directional antennas provided protection to close-spaced stations or to radio-quiet areas. For grandfathered stations using directional antennas, this wasn't a major problem, but new stations were required to provide a detailed argument to get a construction permit. The situation improved when the FCC adopted the Longley-Rice propagation model for determining interference to television stations. But the precedent had to be pressed for variances to be granted.

Criteria

The commission created a strange set of criteria for directional antennas. The criteria focused more on the proposed service than physics.

A buildup of 1in of ice on the UHF antenna would have a greater effect on the pattern than the same buildup on a VHF antenna.

The maximum-to-minimum ratio of VHF TV antennas was set at 10dB. For UHF stations, the ratio was set at 15dB. If the station had a maximum effective radio power (ERP) of 1kW, all limits were off, and the station could do virtually anything.

With regard to low-power stations having no max/min limit, there is some obvious common sense involved. At that low-power level, variation in the antenna pattern won't cause a significant problem.

The 10dB to 15dB change between UHF and VHF is a bit more difficult to understand. Variations in the environment, such as ice or wind movement, cause more instability in the VHF pattern than the UHF. A buildup of 1in of ice on the UHF antenna would have a greater effect on the pattern than the same buildup on a VHF antenna. The clue here is to look at the ice buildup in terms of wavelengths rather than absolute size.

It is interesting to note that directional antennas in the FM service were permitted to have a max/min ratio of 15dB while the television antennas were only allowed 10dB. Perhaps ratios were added without reviewing or changing the older ones.

Another anomaly is FM antennas have a requirement that the change rate on the pattern cannot exceed 2dB per decade of azimuth. Television antennas do not have that limitation. However, there should be some degree of commonality in those regulations.

Low-power stations

When low-power television service came along, directional antennas were used to provide protection to other stations. Previously, they were used in the translator service, primarily to obtain good service over isolated communities from low-power transmitters. The directional antennas for translators and low-power television stations had no criteria. The stations chose their own rate of pattern

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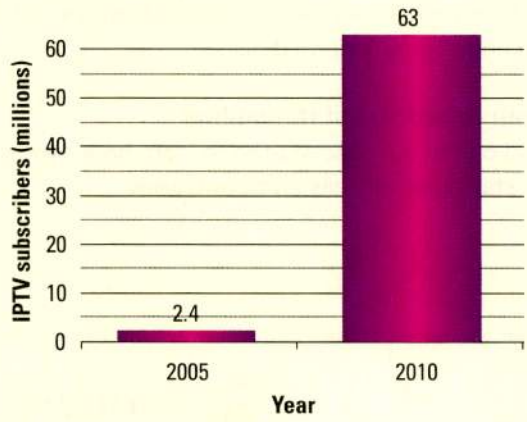

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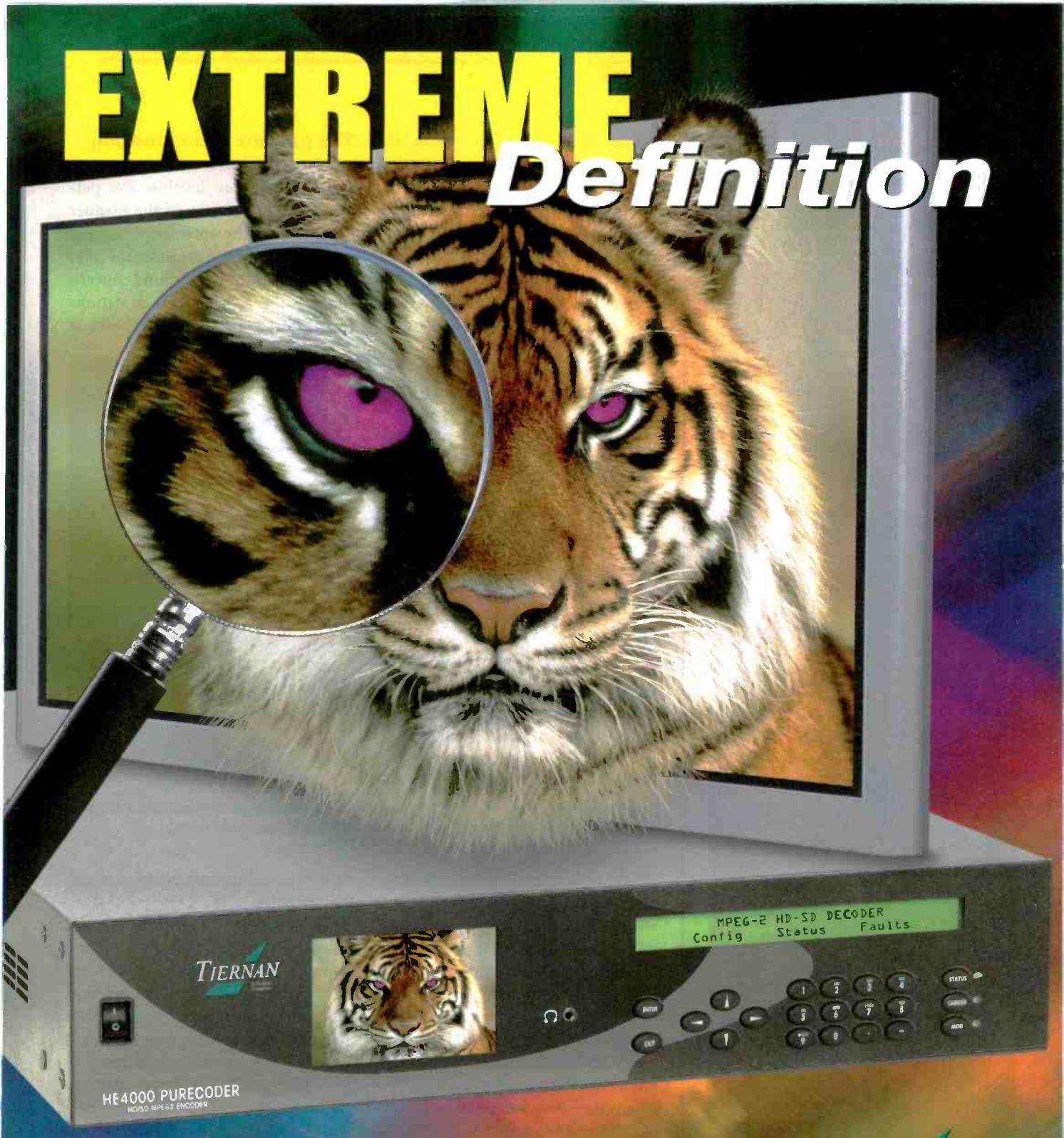

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change and the max/min ratio. No measurements had to be performed on the antenna to confirm the actual pattern with strictly theoretical values acceptable. Obviously, the 1kW ERP limits, which existed in the full-power service, were exceeded.

Remember, the first low-power stations were limited to 1kW transmitter power, which could reach 75kW or more ERP. Subsequent rule changes for low-power television and Class A stations permitted up to 150kW ERP. In other words, enough power was involved to cause interference if stations were not properly designed.

The lack of any criteria for low-power stations has caused some obvious abuse. I know a manufacturer that claims its system has a max/min ratio of 40dB and more than 180 degrees of azimuth. This is pure nonsense. Such a ratio cannot even be reached over a span from dish antennas — let alone a slot with reflectors.

Still, the rules permit such claims to be made without proof, so the commission's staff is helpless in these matters. Applicants are not required to prove that the antenna meets the criteria. They only need to show that the theoretical pattern would provide such protection.

The pattern and mounting of the antenna

The next issue involves the pattern to be presented and the manner of mounting the antenna. When the station's consulting engineer specifies an antenna, the calculations concern limiting the signal to other stations in an effort to prevent interference or limit it to an amount acceptable under the rules.

Radio Frequency Systems' PHP30C directional antenna at Mt. Wilson in Los Angeles uses a five-sided steel structure with antenna panels on three faces.

The engineer will normally attempt to use off-the-shelf patterns published by manufacturers. In some cases, none of those antennas do, so the engineer will contact the manufacturer and explain what is needed. The manufacturer will then modify a published pattern and provide that information to the engineer in both plotted and tabular form for the horizontal and vertical planes. The FCC application includes those patterns, along with a statement that the vertical plane pattern is identical for all values of azimuth (even though it often is not).

The directional characteristics of a television antenna are commonly obtained in one of two ways. Either the slots or the dipoles are arranged around a mast to obtain the pattern, or reflectors are used on a simple

radiating element. This usually involves slots in a row, down one side of a mast, with passive reflectors or parasitic elements attached to the radiators (usually dipoles). The power and phase relationships to the radiating elements are fixed by the factory and are not normally field-adjustable.

The antennas are simply installed, the voltage standing wave ratio is trimmed, and all is considered to be in order. The license application must only state that the antenna is pointed in the right direction.

If the desired antenna is a new design, the manufacturer will probably model it in an anechoic chamber. This means that the size and frequency will be scaled to permit the antenna to be a more workable size. The antenna will then be placed in a chamber that has no reflections from the sides, permitting the radiation to be measured without outside influence.

In the past, the full-scale antenna was placed on a range and the horizontal and vertical patterns were measured. The antenna was always used to receive the transmitted signal coming from a dipole or yagi at some distance.

My next statement might upset some amateur radio readers, but the truth is that antennas work exactly the same whether transmitting or receiving. Full-size test ranges are primarily gone. Many manufacturers believe the patterns can be satisfactorily measured with probes in the lab. That may be the case, but there is something positive about seeing the whole antenna move on big turntables with a plotter drawing the patterns.

This process is still used by ERI and Jampro for FM antennas. Anyone who has witnessed such measurements will confirm that even minor changes in antenna characteristics can largely affect patterns, especially, the size and placement of parasitic elements. **BE**

Don Markley is president of D.L. Markley and Associates.

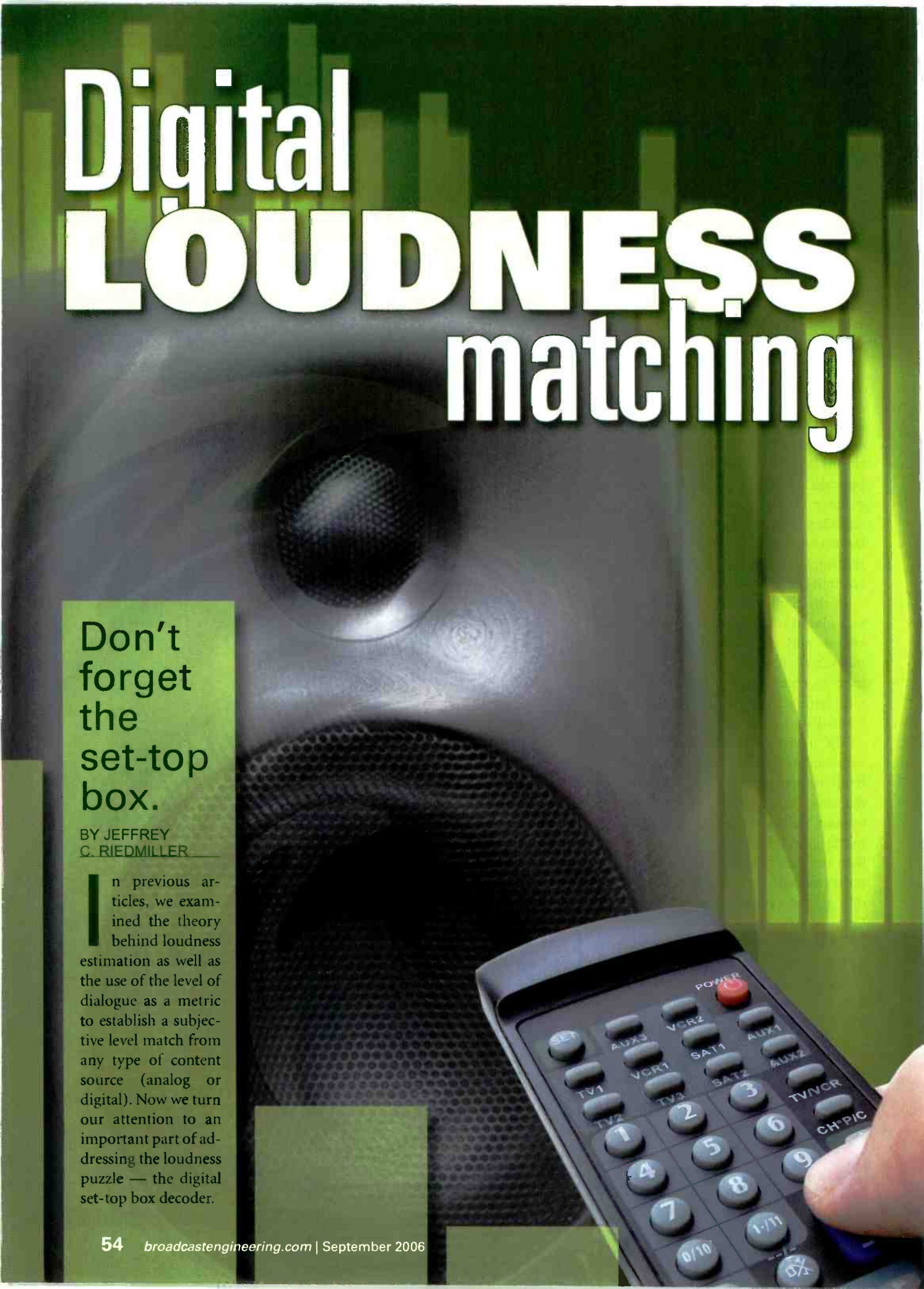
? Send questions and comments to: don_markley@prismb2b.com

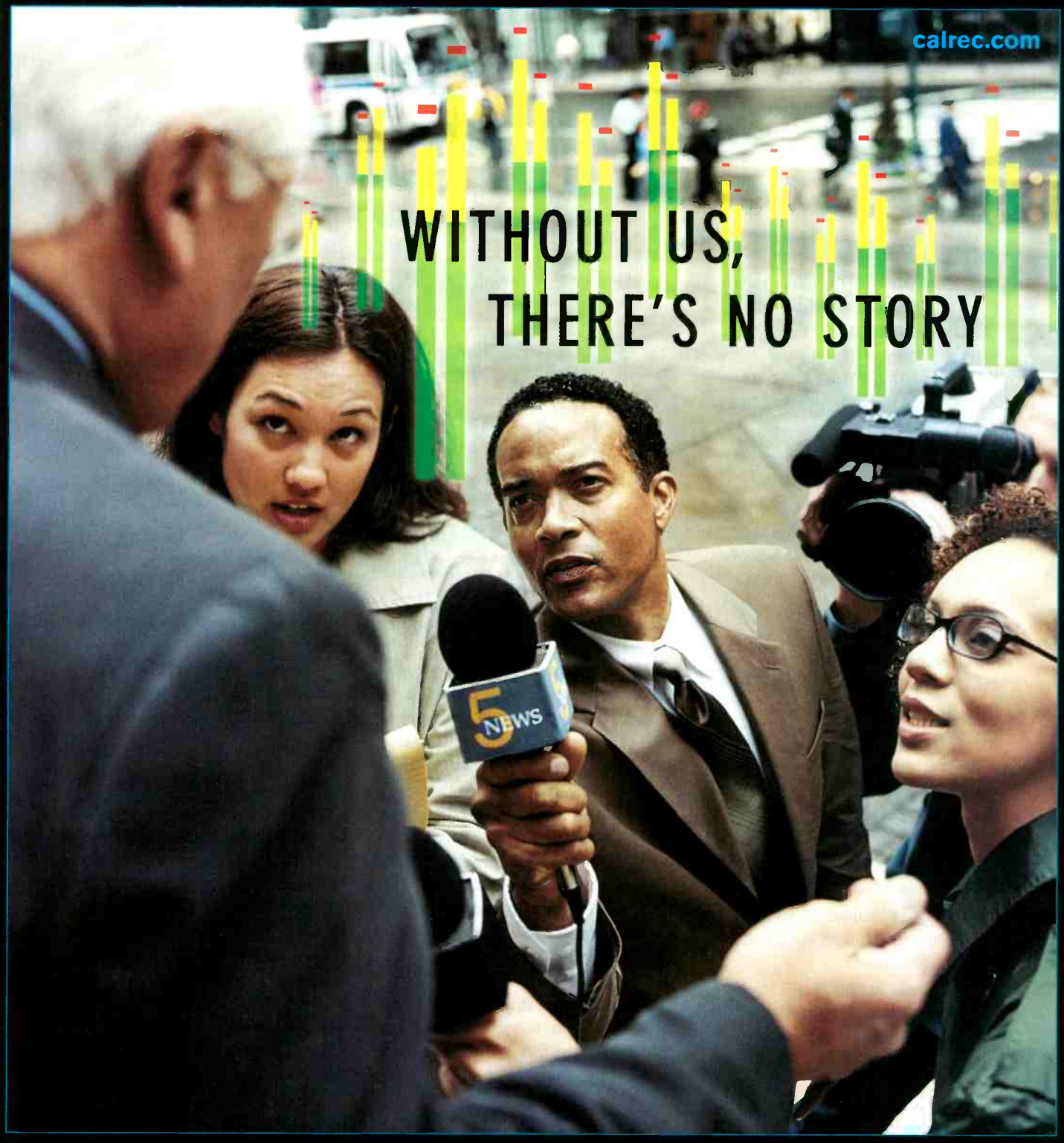
Digital LOUDNESS matching

Don't forget the set-top box.

BY JEFFREY C. RIEDMILLER

In previous articles, we examined the theory behind loudness estimation as well as the use of the level of dialogue as a metric to establish a subjective level match from any type of content source (analog or digital). Now we turn our attention to an important part of addressing the loudness puzzle — the digital set-top box decoder.





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Footnotes

[1] The dialogue normalization value in an AC-3 bit stream must be set by the program originator to indicate the dialogue level of the program relative to 0dBFS. The valid range for this value is from -1dBFS to -31dBFS. Also note that the dialnorm value is used by the decoder (within the set-top box) to normalize the programming to a consistent level.

[2] The FCC limits are of no significance to RF modulators in set-top boxes, VCRs and PVRs.

[3] That is, dialnorm value represents the long-term A-weighted level of spoken dialogue in the program.

[4] -23dBFS Leq(A) in each channel of a two-channel decoder.

[5] That is, below 100 percent modulation 25kHz peak deviation.

[6] Scientific-Atlanta Resident Application.

[7] Some systems may choose to remove the ability for the subscriber to access/change decoder operating modes via the DNCS. However, each set-top box should be defaulted to narrow mode.

[8] Use of wide mode is being deprecated and must not be used under any circumstance.

[9] With the exception of overload protection, dynamic range control metadata (if present within the audio bit stream) is not applied in this mode.

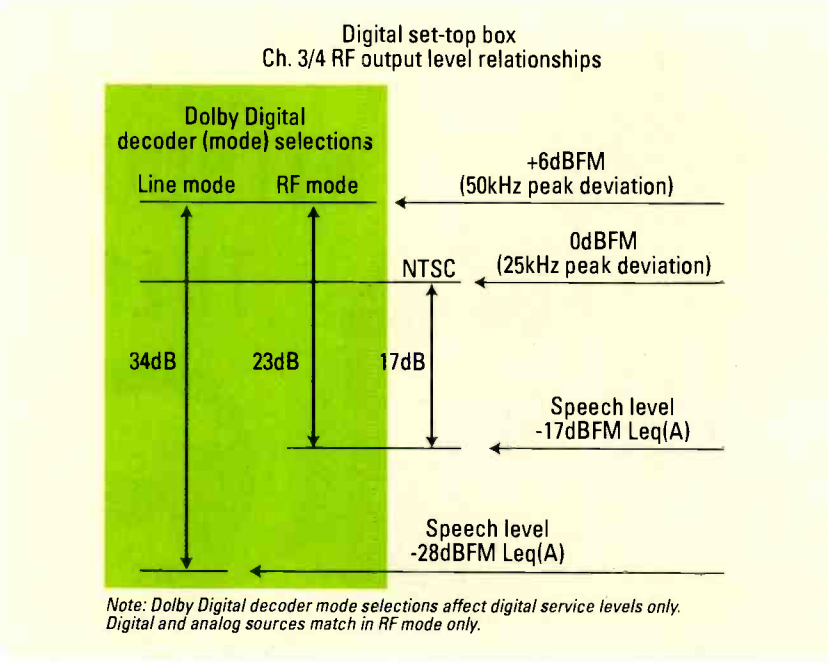


Figure 1. Analog adjusted so that the level of speech is about –17dB FM

The design of its internal gain structure and its default operating modes combine to make the STB decoder one of the most critical components of the North American DTV and digital cable system. Yet it is often overlooked by many system operators when troubleshooting viewer complaints about loudness. This article will provide a brief overview of how this portion of the system works and what it expects from both digital and analog programming sources — and users — to make it work correctly.

Today many viewers are presented with programming from both analog and digital sources via a single piece of hardware, the STB. As a result, one of the most important and challenging goals of everyone involved in delivering content — including the broadcaster, cable operator and STB manufacturer — is to provide viewers with a seamless listening experience as they switch between digital and analog channels.

At first glance, this level of operability may seem impossible to achieve considering the fact that we are trying to line up two types of signals (analog and digital) that can differ greatly in areas such as available headroom above dialogue peaks and dynamic range. However, with a thorough understanding of the Dolby Digital (AC-3) system and current NTSC practice, and some knowledge of STB internal gain structure, we can be better prepared to address the actual source of the problem in a given situation.

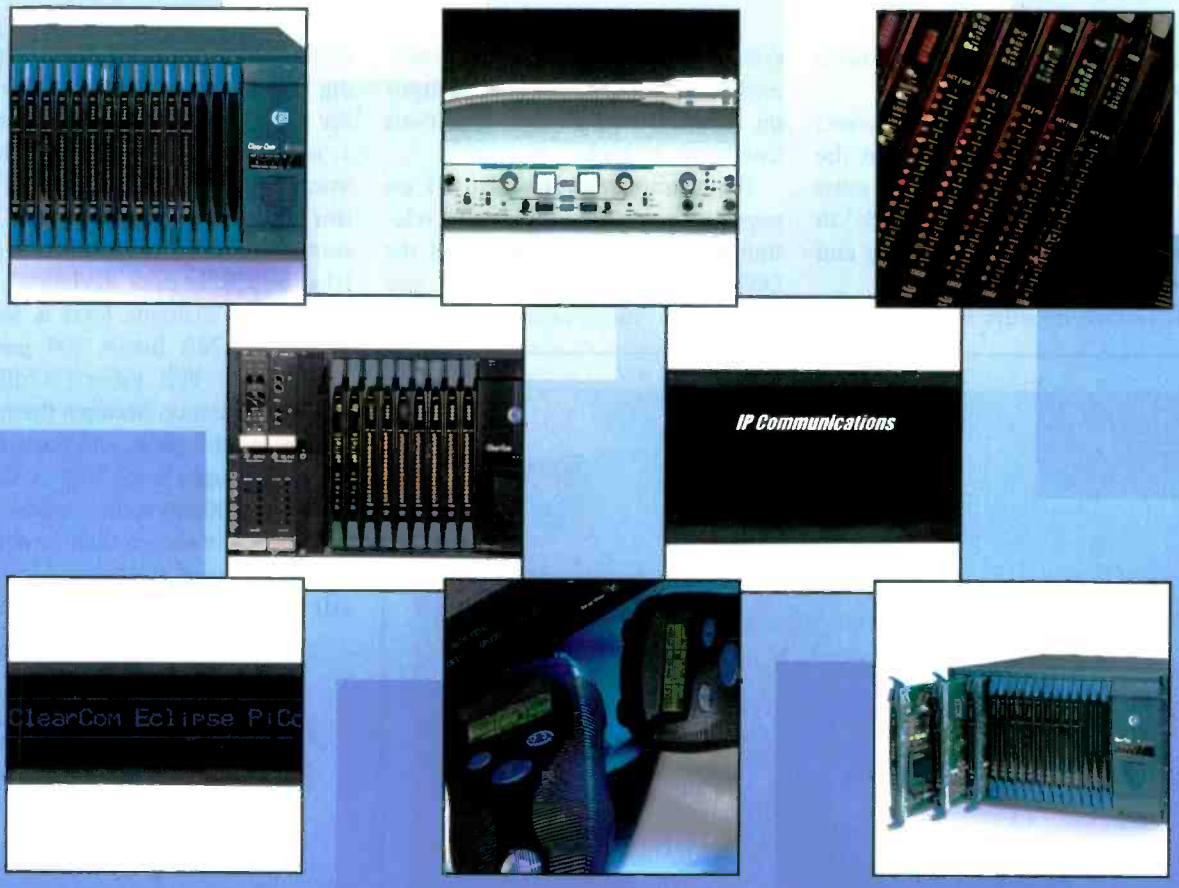
The STB decoder is one of the most critical components of the North American DTV and digital cable system.

Internal gain structure

First, we must not forget the little-known fact that the internal audio gain structure of digital STBs has been designed with several assumptions about the signals these boxes will receive and provide to the viewer.

The STB decoder assumptions required to provide dialogue level matching between analog and digital sources are as follows:

- Many digital STBs (designed for North America) assume that while tuned to an analog NTSC channel (either off-air or via cable), the average dialogue level is about 17dB Leq(A) below 100 percent modulation.
- The digital STB assumes that while tuned to a digital service (either off-air or via cable), the transmitted dialnorm



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value carried in the AC-3 bit stream is correct for that program.

• If the listener is using the channel 3/4 remodulated RF output on the digital STB, the AC-3 decoder must default to the RF operating mode[1] to provide a match between analog and digital channels.

Therefore, in order for digital programming to match analog programming (at the channel 3/4 RF output on the STB), all of the conditions listed must be met.

To illustrate this point, Figure 1 on page 56 shows the proper level relationships between the output of the Dolby Digital (AC-3) decoder and the NTSC tuner/demodulator for the modulated RF output of a typical digital STB used in North American for DTV and digital cable. In Figure 1, notice that the NTSC scale has a maximum value of 0dBFM and that this level is equivalent to 100 percent modulation as per FCC rules (that is, 25kHz peak deviation), and the Leq(A) dialogue level is shown to be at 17dB below 100 percent modulation. This value (-17dBFM) indicates the ratio between the maximum program peaks and the average Leq(A) dialogue level. Why -17dBFM Leq(A)? Measurements taken over the years have shown that the equivalent loudness of dialogue (A-weighted) for NTSC broadcasts is typically 17dB below 100 percent modulation. Therefore, a properly designed digital STB assumes this condition is always true (for any analog channel) and requires it in order to provide a level match to digital sources. *(Note: This article focuses only on analog vs. digital level matching for the RF remodulated output of digital set-top boxes. For further information on other outputs (i.e. baseband and digital), see the references on page 62.)*

The equivalent loudness of dialogue for NTSC broadcasts is 17dB below 100 percent modulation.

Set-top decoder modes

For digital sources, the Dolby Digital (AC-3) decoder can typically be operated in two modes: line and RF. In many cases, these modes can be controlled by the viewer. If we refer to the decoder mode selections in Figure 1, we see that the maximum permissible level of +6dBFM (equivalent to 200 percent modulation → 50kHz peak deviation) for Dolby Digital (AC-3) sources is available at the channel 3/4 RF remodulated output.

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Set-top box manufacturer	Guide application	Setup menu item	Set-top mode selection	Equivalent AC-3 decoder operating mode
Scientific-Atlanta	SARA[6]	Audio dynamic range:[7]	Narrow	RF mode
Scientific-Atlanta	SARA	Audio dynamic range:	Normal	Line mode
Scientific-Atlanta	SARA	Audio dynamic range:	Wide	Not applicable[8]
Motorola	TV Guide	Audio\audio output:	TV	RF mode
Motorola	TV Guide	Audio\audio output:	Stereo	Line mode
Motorola	TV Guide	Audio\audio output:	Advanced/heavy	RF mode
Motorola	TV Guide	Audio\audio output:	Advanced/light	Line mode
Motorola	TV Guid	Audio\audio outpu	Advanced/none	Line mode with no DRC

Table 1. Digital set-top audio decoder nomenclature

This level relationship is intentional since the Dolby Digital signal being decoded by the STB potentially has 6dB more headroom above dialogue peaks than NTSC analog audio (that is, while the decoder is operating in RF mode). Furthermore, because the BTSC system leads to a maximum peak deviation of 73kHz, most television tuners today can accept up to 8dB above 25kHz peak deviation in the absence of pilot and subcarriers without distortion.[2]

Figure 1 gives us the entire story. You can see that with the set-top decoder operating in RF mode, the decoded dialogue level for digital sources will match the dialogue level of analog sources if and only if the analog source has its dialogue level provisioned at about 17dBFM *and* the dialnorm value within the Dolby Digital bit stream is set properly.[3] Also note that if the viewer unknowingly switches the Dolby Digital (AC-3) decoder into line mode, the decoded level of dialogue will be reproduced at -28dBFM Leq(A), or 11dB lower than the analog source! (And it most likely will generate a complaint that will send you on a wild-goose chase to find a problem within your facility, when in reality the STB is in the wrong mode.)

RF mode is intended for products such as DTV receivers and digital cable STBs that generate a signal for transmission via the channel 3/4 remodulator which feed an RF (antenna) input of a television set. This decoder operating mode was specifically designed to match the average reproduced dialogue level and dynamic range of digital sources to those of existing analog sources such as terrestrial NTSC and analog cable TV broadcasts. In this mode, dialogue normalization is enabled and applied in the decoder at all times. However, the dialogue level in this mode is reproduced at a level of -20dBFS Leq(A)[4] only when the transmitted dialnorm value is valid for a particular program. Thus, the Dolby Digital decoder introduces a shift gain of +11dB, and therefore the maximum possible peak to dialogue level ratio is reduced by 11dB when compared to line mode.

Viewers can easily create a level mismatch between properly transmitted analog and digital programming.

This leads to an important question: How do you know which operating mode your STB audio decoder is in? First, differences do indeed exist between manufacturers of STBs and program guide application providers (used in cable) as to the nomenclature they use to indicate Line or RF mode operation to the viewer. Table 1 lists the Dolby equivalent modes for the most common digital cable STBs in use today.

A quick glance at Table 1 shows that viewers can easily create a level mismatch between properly transmitted analog and digital programming. There have been a handful of cases over the years where STBs were deployed into viewers' homes defaulted to the wrong operating mode due to a lack of understanding as to what these user-selectable parameters did

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or their impact on the reproduced audio. Many viewers seem to have based their choices purely on face value. ("Normal or wide mode must be better than narrow mode, right?") Thus, every customer service or support department should always inquire about decoder operating modes first when taking complaints.

Another point frequently raised by cable operators across North America: "Why do my digital channels sound so quiet compared to analog?" The appropriate response: "How do you know that your analog channels aren't too loud?" In fact, I have found (more times than not) the average dialogue levels on analog channels of cable television systems to be significantly higher than -17dBFM. In these cases, the STB (even when in RF mode) could not provide a match between analog and digital sources. Hence, in these situations, the deviation on the analog modulators must be adjusted so that the average dialogue level is truly -17dBFM Leq(A).

Recommendations

In the end, education and knowledge about the end-to-end system are key to providing great audio programming to viewers.

I will close this article with a few short recommendations:

- Provision any NTSC analog audio modulation equipment (off-air or cable) so that the A-weighted average dialogue level is about 17dB below 100 percent modulation.
- Digital STBs that include an RF remodulator must default to RF mode. (Don't worry; viewers who want full dynamic range will use the S/PDIF output of the STB to feed their 5.1 home theaters.)
- Properly provision the dialnorm value to match the long-term A-weighted dialogue level for programming.

Note: The points made in this article are all referenced in the OpenCableT Host Device Core Functional Requirements (for OpenCable digital STBs), as well as in a bulletin issued by the Electronic Industries Association (EIA) and the Consumer Electronics Association (CEA) titled "EIA/CEA-CEB-11 NTSC/ATSC Loudness Matching." The EIA/CEA document provides guidance to digital STB manufacturers on how to maintain uniform audio loudness between existing NTSC programming and digital television services while simultaneously preserving the dynamic range capability of the digital services. The bulletin also addresses the capabilities of consumer broadcast products to match loudness from the listener's perspective, internal gain structure and output specifications. BE

Properly provision the dialnorm value to match the long-term A-weighted dialogue level for programming.

References

- "EIA/CEA-CEB-11 NTSC/ATSC Loudness Matching," Engineering Bulletin
- "An Analysis of Audio for Digital Cable Television: Recommendations for the Digital Transition via Metadata," Jeffrey C. Riedmiller, NCTA Technical Papers, 2001

Jeffrey C. Riedmiller is senior broadcast product manager for Dolby Laboratories.

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SPECIAL REPORT:

Video compression

Take the journey from MPEG-1 to H.264 and see how the process really works.

BY CLIFF WOOTTON

Consider the progress we have made since the early origins of digital video when MPEG-1 was introduced. Video codecs for digital broadcast and distribution all descend from that common heritage. Technical decisions made 15 years ago were amazingly farseeing. The state of the art is represented by H.264 coding for HDTV services at bit rates that were inconceivable just a few years ago.

How it works

Video encoders output a serialized bit stream that modulates a carrier signal for broadcast or networking. Producing an economically coded bit stream with no unnecessary duplication is challenging. The receiver reconstructs a sequence of moving pictures from this stream.

Only the player is standardized. The encoders will use smarter techniques as they evolve over time. This is not a problem, provided they produce a compliant output. This demonstrates that bit rates will improve. Sound is processed independently and delivered with reference to the same timeline.

Frames

Video plays for hours at a time but is actually compressed in short sequences. The length depends on the video format and target platform. Fifteen frames for a

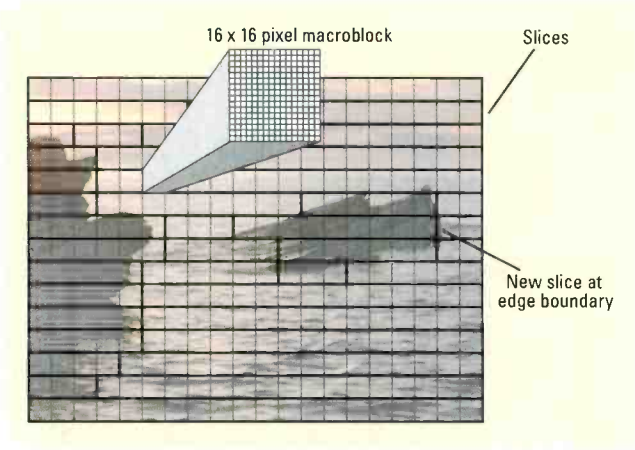


Figure 1. Macroblocks, slice edges and pixels

group of pictures (GOP) is typical. There are three kinds of frame in a GOP:

- Intra-frames (I-frames) at the start;
- Predicted frames (P-frames) at the end; and
- Bidirectionally coded frames (B-frames) in-between.

The I-frame is coded first, just like a still photograph. The image is divided into 16 x 16 pixel macroblocks. Macroblocks are grouped into horizontal slices that help with dropout reconstruction. Some bit rate saving results immediately from culling similar macroblocks and only buffering unique blocks. (See Figure 1.)

Then P-frame content is analyzed. Only new blocks not present in the I-frame are retained. The collection of macroblocks describes the frames at each end of the GOP. Now, the intervening B-frames can be coded more efficiently.

B-frame macroblocks are discarded if they duplicate any I- and P-frame blocks already collected. The buffer maintains these unique macroblocks that are referred to by different frames.

The last frame of the GOP must be delivered earlier than it is presented for display so the B-frames can be reconstructed. Frame reordering immediately causes some coding latency because of the GOP length. If latency is a problem (perhaps for video conferencing), use shorter GOPs or omit P-frames altogether.

Motion JPEG encodes I-frames only. It won't achieve compression ratios as high as MPEG, but it does produce editable content.

I-frames could encode as small as 40KB. A GOP with just 15 I-frames would occupy 600KB. A single P-frame might save 35KB. These byte savings don't add up to much on their own, but the rest of the GOP then encodes as 1KB B-frames. The whole GOP might encode in less than 60K. So, P- and B-frames yield a useful 10:1 compression if we can tolerate latency. (See Figure 2.)

Macroblocks

MPEG-1 provided simple match and discard techniques for macroblock reduction. Later codec designs find macroblocks that are similar but

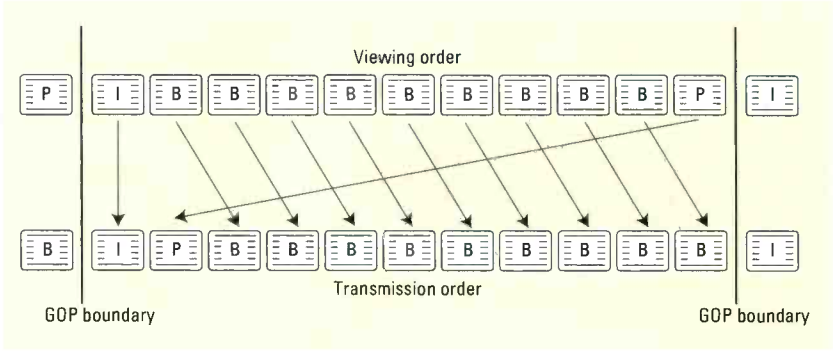


Figure 2. GOPs and frames

$$F(u,v) = 0.25 * C_u C_v \sum_{x=0}^{7} \sum_{y=0}^{7} f(x,y) \cos\left(\frac{(2x+1)u\pi}{16}\right) \cos\left(\frac{(2y+1)v\pi}{16}\right)$$

Where:

$$C_u = \frac{1}{\sqrt{2}} \text{ for } u = 0 \text{ otherwise } C_u = 1$$

$$C_v = \frac{1}{\sqrt{2}} \text{ for } v = 0 \text{ otherwise } C_v = 1$$

Figure 3. The discrete cosine transform formula

not identical and encode the residual differences. If the blocks are not identical, we could eliminate a few more at the expense of image reconstruction accuracy.

Some details in the macroblocks might have moved fractionally from one frame to another. MPEG-2 allows pixels to be shifted along a motion vector before working out the residuals. H.264 enhances this by allowing the distance to be less than a whole pixel. Motion vectors are computationally challenging but reduce the amount of data that needs to be encoded.

MPEG-2 and H.264 also widen the range of their search for duplication. MPEG-1 looks only within the same slice, MPEG-2 within the same GOP, and H.264 can look outside the GOP. Longer reach leads to better compression ratios.

Modern codecs provide many tools to eliminate macroblocks. H.264 implements a superset of all the tools supported by its competing codecs. Because it was worked on by a consortium of experts from several standards bodies and technically reviewed by hundreds of engineers, it should outperform the other codecs.

Transformation

Encoding macroblocks directly into the output bit stream would not yield enough compression. We need a general-purpose reduction that is easy to apply and simple to reverse for the player.

A single macroblock is represented as luma at full 16 x 16 resolution and two chroma difference blocks at 8 x 8 resolution. The eye is less sensitive to color information. Compressing from 10-bit RGB to 8-bit Y'CbCr and reducing the chroma to 8 x 8 pixels gains a further 2:1 compression. This is still not enough.

Using frequencies rather than pixels is more efficient. Applying a fast Fourier transform delivers coefficients that describe how much each frequency contributes to the spatial image.

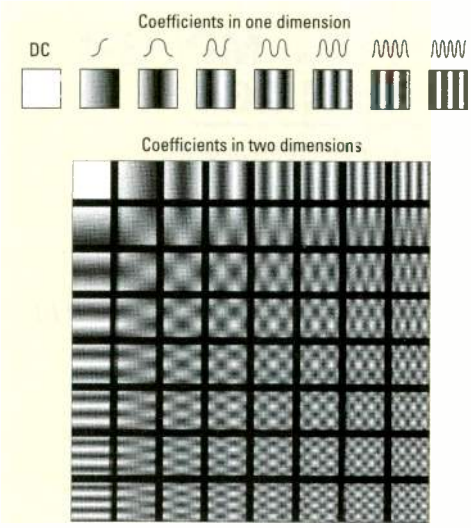


Figure 4. DCT coefficients

Discrete cosine transform computation is quite straightforward but compute intensive. The DCT formula is shown in Figure 3. The algorithm visits every pixel in the macroblock, accumulating the frequency coefficients and storing them in a grid. Luma is transformed as four 8 x 8 pixel blocks. (See Figure 4.)

The first value is a DC offset (average value). The rest are frequency perturbations that modify it. Frequency (and hence detail) increases to the right and towards the bottom. Fine detail is in the lower right of the grid with coefficients decreasing in

From MPEG-1 to H.264

The progression of the MPEG format:

- MPEG-1 delivers basic capabilities.
- MPEG-2 adds interlacing support for broadcast TV and DVD.
- MPEG-4 part 2 adds more sophisticated coding tools and alpha channels.
- MPEG-4 part 10, (aka AVC and H.264) adds more efficient DCT computation and better macroblock culling.

The important steps in video compression for each sequence are:

- Locate the I-frame.
- Define the slices.
- Store unique macroblocks.
- Locate and analyze the P-frame.
- Append its unique macroblocks.
- Analyze remaining B-frames saving new unique macroblocks.
- DCT the macroblocks into frequency plots.
- Entropy code to remove unnecessary fine detail.
- Assemble into a usable bit stream taking care of buffer overflows.

magnitude for higher frequencies.

Starting at the top left, walk in a zig-zag fashion down towards the lower right to order the coefficient values for transmission. (See Figure 5). The values decrease towards zero where the walk is truncated (entropy coding). Until this point, the encoder is lossless. Discarding earlier coefficients will cause visible artifacts. Even at high compression ratios, the picture can still look good.

Now, the original macroblock is represented by just a few coefficients ready to be coded into the bit stream. Buffer size feedback controls the entropy coding truncation to throttle the bit rate.

Compression ratios

What compression ratios are possible? Say the video content can cull 25 percent of the macroblocks in an I-frame. Each subsequent stage contributes towards the result:

- I-frame culling — 75 percent
- B- and P-frames — 10 percent
- Sub-sampling — 50 percent
- DCT/Entropy — 50 percent

That is about a 50:1 compression factor and in the right ballpark for a well-tuned compression system. Reducing picture size and frame rate for Internet streaming will improve the performance.

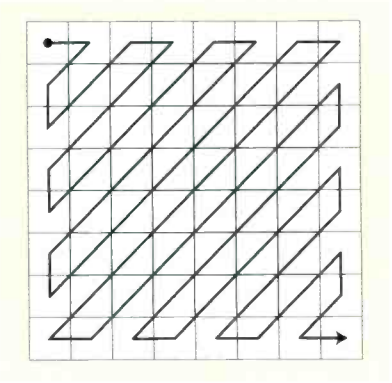


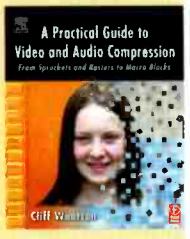
Figure 5. Coefficient ordering for transmission

The future

Certainly, encoders will get better. H.264 will achieve amazing compression ratios, especially for HD. It is already very attractive for SD and even more so for building the emerging Interactive TV 2.0 concepts, which are on the horizon and being developed around MPEG-4 BIFS and LASeR standards. The journey isn't finished yet. BE

Cliff Wootton was the technical systems architect for BBC News Interactive TV and is now writing and developing advanced interactive TV content systems.

You can read more on this topic in "A Practical Guide to Video and Audio Compression: From Sprockets and Rasters to Macro Blocks," by Cliff Wootton (Focal Press).



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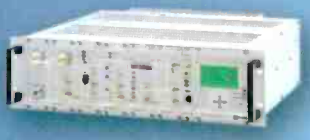

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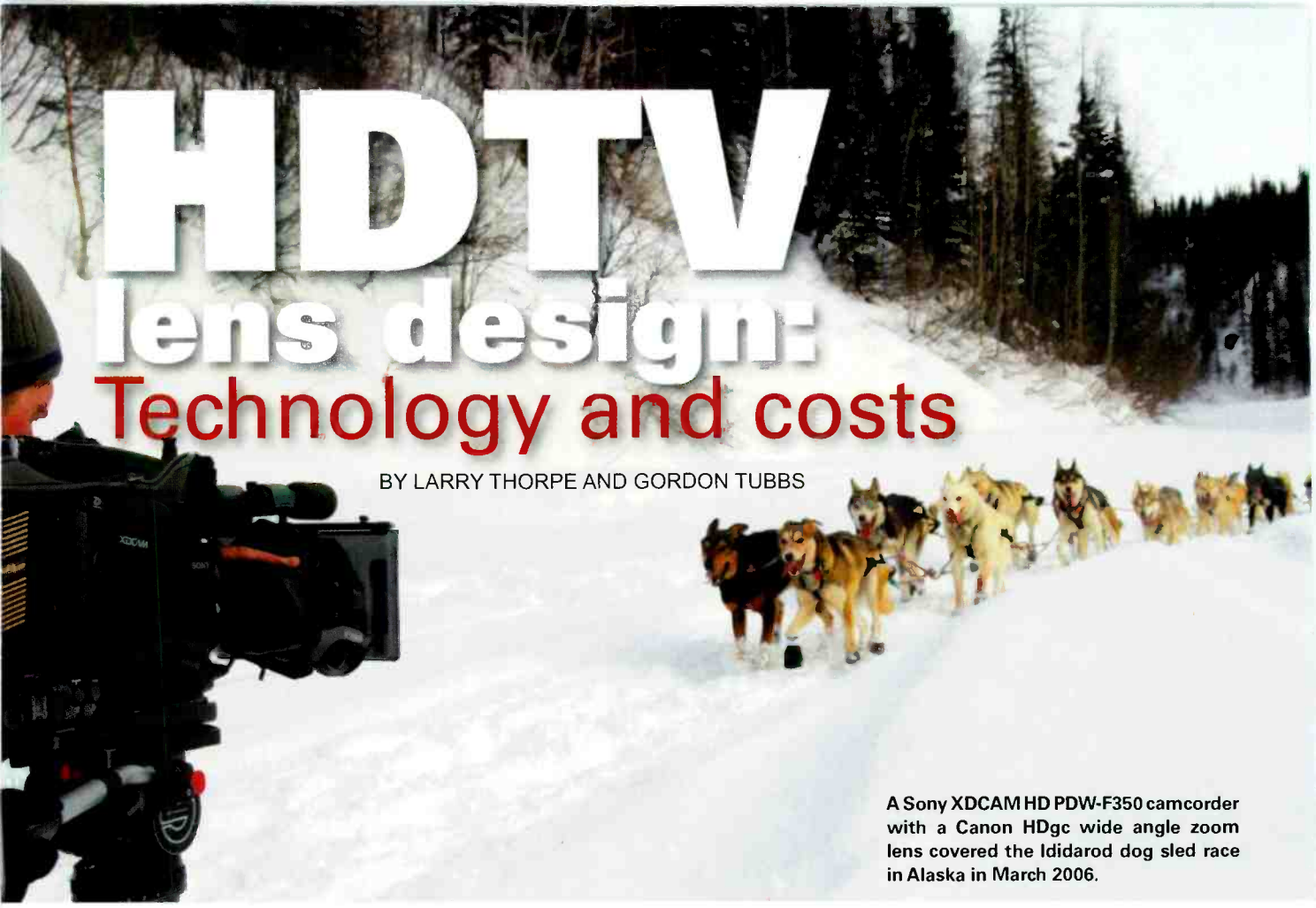
HDTV lens design: Technology and costs

BY LARRY THORPE AND GORDON TUBBS



A Sony XDCAM HD PDW-F350 camcorder with a Canon HDgc wide angle zoom lens covered the Ididarod dog sled race in Alaska in March 2006.

Astonishing advances are taking place in HDTV program-origination equipment. The internationally standardized 2/3in format HD camera continues to raise the bar in image performance, moving from 10-bit digital to 12-bit and now to 14-bit, with up to 30-bit nonlinear calculations. All the while, these cameras continue to pack increasingly powerful HD video processing and extend creative flexibility. HD CCD and CMOS imagers are constantly being refined. Associated HD digital recording has elevated tape capabilities to near-1Gb/s real-time performance and to uncompressed baseband recording on tapeless media.

At another extreme, HD camcorders have splintered into new, cost-effective 2/3in systems and even lower-cost 1/2in- and 1/3in-based systems. These have simultaneously branched into using a variety of tapeless media that are revolutionizing HD production workflow.

Meanwhile, the HD lens continues a steady advance, with each new generation exhibiting incremental performance improvements. Over the past decade, prices of such lenses have dropped, but very slowly. Today it is possible to acquire an HD camcorder that is lower in price than the lens that accompanies it. This has sparked widespread industry discussion with respect to the perceived high costs of such lenses.

Contributing costs of professional lenses

All professional lens categories share three major subsystems that, in combination, make up the

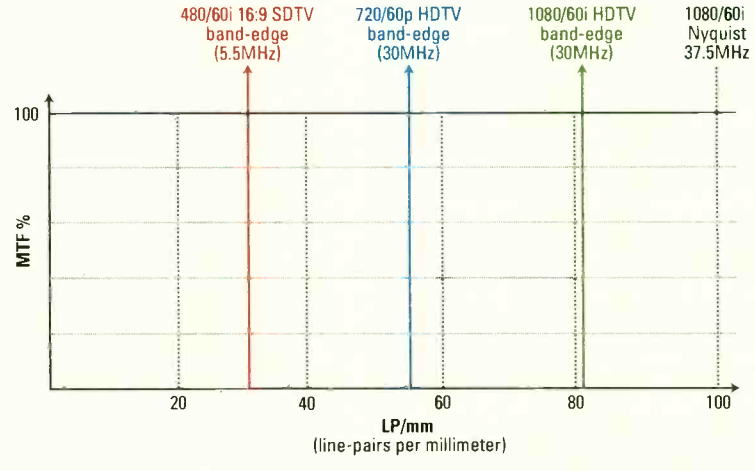


Figure 1. The concept of optical bandwidth, relating optical line-pairs per millimeter with electronic bandwidths for different digital television systems

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contemporary zoom lens:

- The *optical system* is made up of the many optical elements that work in tandem to provide the requisite lens operational requirements and high imaging performance.
- The *optomechanical system* is the mechanical system that supports the precision mounting of all the lens elements and implements the physical movement of those elements when zooming and focusing — in addition to the iris aperture control.
- The *electronic system* is the precision digital servos systems for operational control of zoom, iris and focus.

Each of these subsystems adds cost in a professional lens. This is because each of them involves high technologies, materials and progressive refinements (dictated by global end users). But their addition results in enhanced stability and reliability and makes lenses increasingly impervious to environmental conditions. With optical and optomechanical systems also comes the cost of the manufacturing processes.

The HD lens continues a steady paced advance, with each new generation exhibiting incremental performance improvements.

The optical system

The overall optical performance of a lens is dependent upon:

- *The optical design criteria.* This is associated with every element comprising the lens system and made increasingly sophisticated with computer-aided design tools.
- *The optical materials used.* Different materials are used for different lens elements; some of these are particularly costly.
- *The multilayer coatings used.* This is a highly refined process involving the deposition of various exotic materials.
- *The manufacturing tolerances of each element.* This involves the cutting and shaping processes, followed by the long grinding and polishing processes to achieve the specific surface tolerances prescribed by the particular lens design criteria.

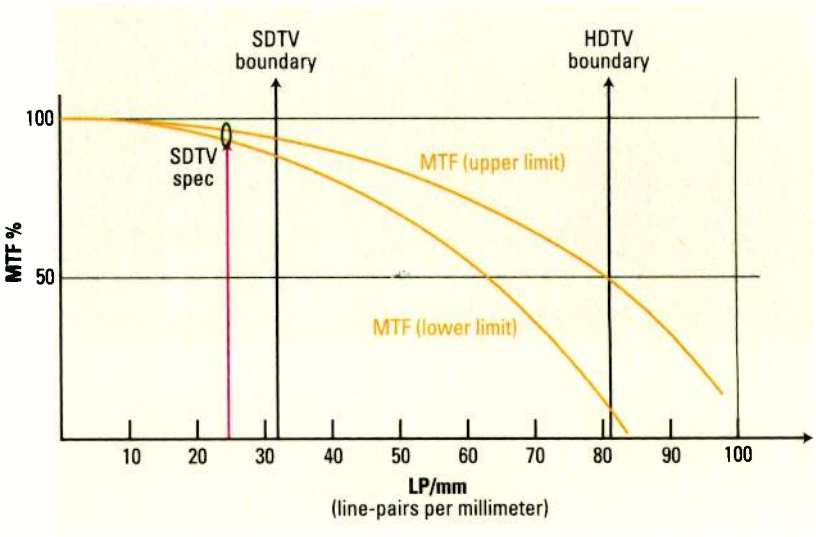


Figure 2. The tightly specified SDTV lens MTF across the passband of interest (5.75MHz or 32LP/mm) and the relaxation of the MTF spec beyond. (Note: This curve is generic and does not refer to a specific SDTV lens.)

Differentiating between an HDTV and SDTV lens

The most discernible performance difference between the HD and SD lens is that of resolution. That, in turn, is determined by the quite distinct modulation transfer function (MTF) characteristics of the two lenses.

The optical passband of an HDTV lens for 1080-line HDTV (in terms of its Nyquist frequency) is 100LP/mm (line pairs per millimeter). (See Figure 1 on page 72.) The recommended 30MHz SMPTE filter guideline for that system would define an 82LP/mm optical boundary. The equivalent for 5.75MHz SDTV is 32LP/mm. That is almost a 3:1 difference.

Designing a lens system involves a careful choice of glass materials, element thicknesses, precision of design curvatures and precision of element alignment that ensures system performance specifications that meet the intended application. There is a fine balance between the implementation of the design and the overall associated costs.

SDTV lens resolution requirements

In the case of an SDTV lens, the

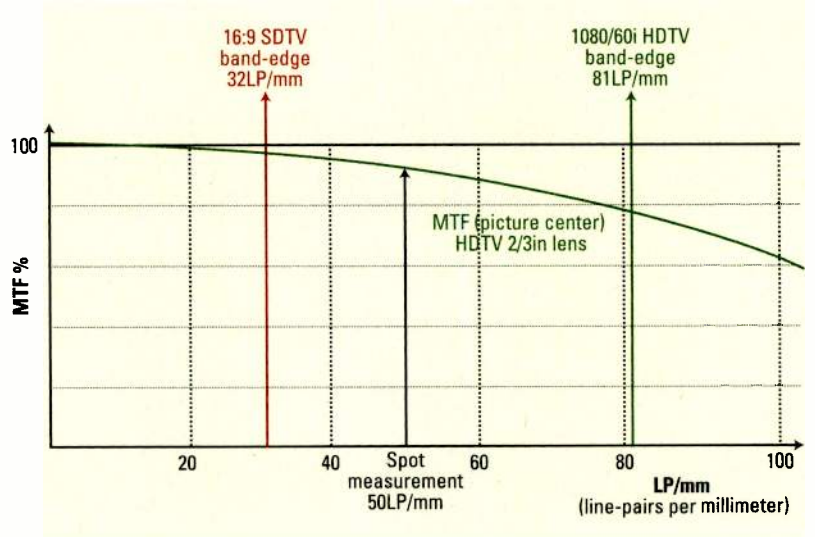
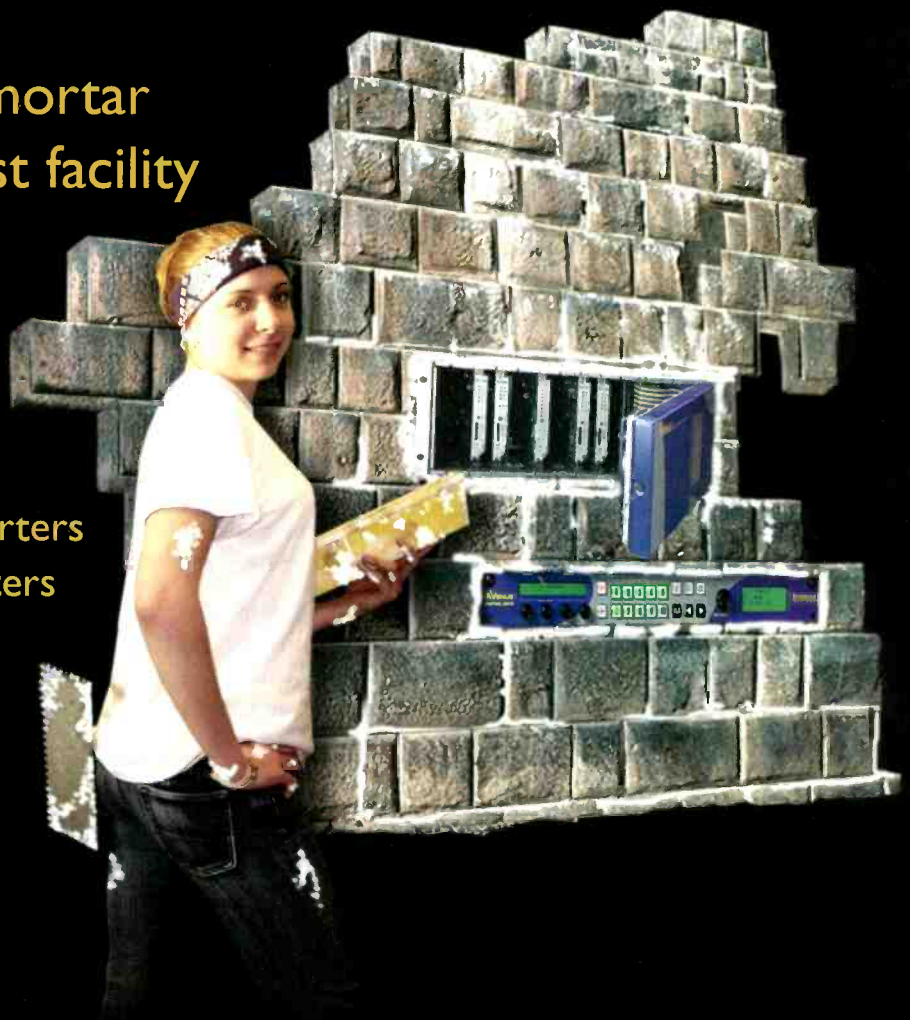


Figure 3. A typical MTF curve for a contemporary HD lens

The bricks and mortar of your broadcast facility



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goal is to achieve an MTF specification that is high and tightly controlled across the required spatial frequency passband of 0LP/mm to 32LP/mm. The science of modern lens system design is to meet all specifications over the optical passband of interest — and to stop there. Any refinements that further enhance the performance beyond those specifications can be accompanied by a rapid rise in manufacturing costs. Close familiarity with manufacturing processes is essential for lens designers to optimize the performance-cost tradeoffs.

An SDTV lens is typically specified and measured at 25LP/mm, a convenient "spot" measurement in the upper portion of the SDTV optical passband. The complex manufacturing processes are all meticulously tailored to ensure that the MTF level at 25LP/mm will fall within a tightly specified window. (See Figure 2 on page 74.) Beyond that point, the lens tolerance is considerably relaxed.

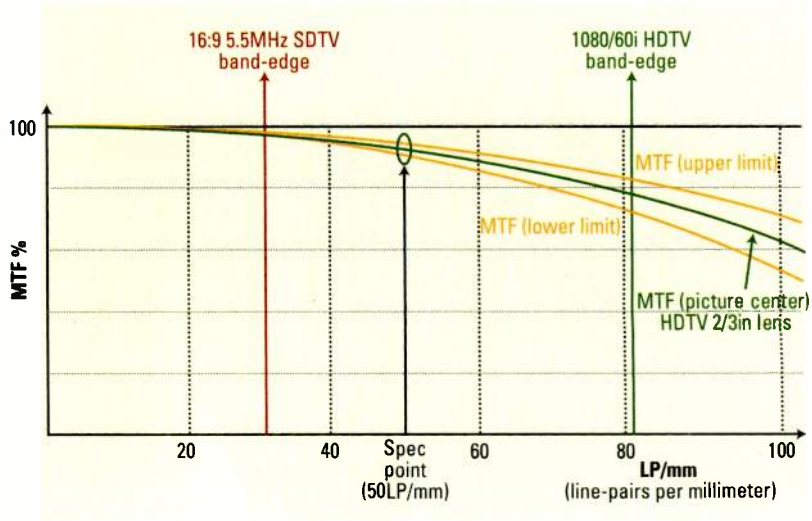

Figure 4. The tolerance in HDTV lens MTF characteristics when tightly specified at 50LP/mm. (Note: These curves are generic and do not refer to a specific HD lens.)

HDTV lens resolution requirements

The HDTV lens seeks the same tight specification control as its SDTV counterpart — but at a considerably higher spatial frequency. To ensure that it meets the more stringent resolution demands of HDTV, the lens seeks a high MTF across the much wider 0LP/mm to 82LP/mm passband and also a tighter control of that MTF across the entire 16:9 image plane. (This is particularly important as HDTV viewing entails considerably larger screens than NTSC television.) The design also implements a tighter control of MTF as lens elements are moved during zooming and focusing. (See Figure 3 on page 74.)

Optical surfaces deviate from the mathematically precise models of the computer-aided design due to practical limitations in optical element grinding and polishing. The behavior of the lens element at the much higher spatial frequencies entailed by HD needs a much greater degree of control, involving much tighter tolerances in manufacturing.

The most discernible performance difference between the HD and SD lens is that of resolution.

The cosmetic quality of each lens element also demands close quality control — and optical designers specify scratches and pits down to tens of microns. Centration is another specification that seeks to precisely align the optical axis of the multi-element system with the centers of curvature of all of the optical surfaces involved.

Realities of high-end HDTV lens design

Canon identifies its high-end HD lenses with the HDxs logo (and HD-EC for the cine lens variants.) For these lenses, the manufacturing process is governed by a well-defined MTF specification at 50LP/mm — a frequency that lies inside the HD passband but significantly beyond the SD passband. This seeks a high MTF at that spatial frequency with a tight tolerance on that number. (See Figure 4.)

Achieving a narrow specification window at the inband spatial frequency of 50LP/mm helps ensure preservation of a high MTF at the HD band-edge of 82LP/mm. Glass materials, lens element multilayer coatings and tighter manufacturing tolerances contribute to this high performance. Optics is physical, and there are no shortcuts.

The quest for lower-cost HDTV lenses

The recent arrival of much lower-cost HD cameras and camcorders in the marketplace has created a need for HD lenses that are lower in cost than the "best that can be made." These new cameras have been specifically developed to facilitate cost-effective HD origination for broadcast newsgathering and other program genres governed by tight budget strictures.

Canon recently introduced a new HD lens platform, HDgc. It provides HD performance carefully aligned to the performance of these lower-cost HD cameras and camcorders now emerging from numerous professional manufacturers.

Unlike the high-end HD lenses, which exclusively conform to the internationally standardized 2/3in image format, some lens strata support the 2/3in, 1/2in and 1/3in image formats reflective of the broad range of these new camcorder designs.

End users have clearly stated that they expect such lower-cost lenses to retain the same robustness, reliability and operational precision of the high-end HD lenses. Accordingly, of the three subsystems that constitute the overall lens system, the

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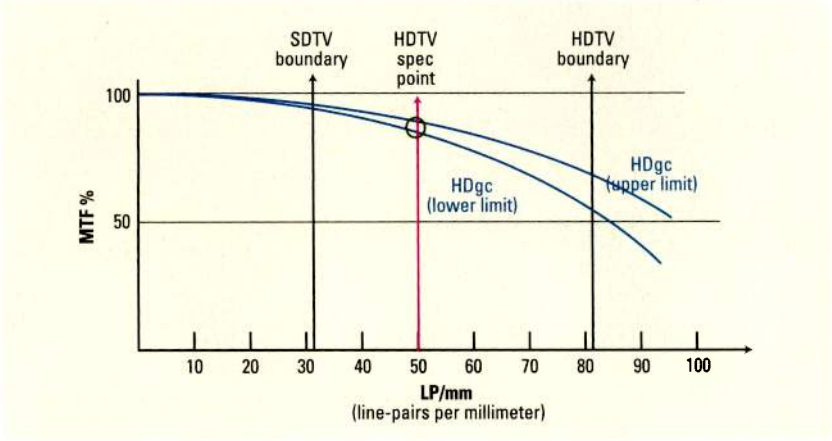


Figure 5. A lower-cost HD lens and the compromise that might be necessary in the MTF characteristic. (Note: These curves are generic and do not refer to a specific lens.)

optomechanical and the electronic subsystems cannot be altered. Thus, the burden of cost reduction falls squarely on the optical subsystem.

To meet this challenge, optical designers must return to the same set of variables — glass materials, design curvatures, coatings and manufacturing tolerances. There is no silver bullet here — only solid optical engineering principles and pragmatic compromises. Each manufacturer will harness some proprietary combination of the variables (in materials and manufacturing) that will realize the sought-for optimum HD performance and cost goals. Figure 5 shows the approximate form of the MTF characteristics that typify the lower-cost HD lens families.

Clearly the HDgc lens has a lower MTF than high-performance counterparts. Bear in mind, however, that these lenses are intended to operate with lower-cost HD cameras and camcorders, with their own pragmatic design compromises. The driving design imperative for both these camcorders and associated lenses are costs that meet the highly competitive needs of HD newsgathering and other low-budget programs.

The camcorders have mobilized a wide array of design strategies to meet these costs, including smaller image formats, subsampled imager lattices and aggressive bit-rate reduction strategies in their associated recording systems. This is all in the interest of dramatically lowering costs while producing HD performance that is "good enough" for a wide range of applications that do not seek top-of-the-line image quality.

Summary

Figure 6 summarizes the concept behind the design criteria of three types of professional broadcast lenses — an SDTV lens and two levels of HDTV lenses. Specific MTF characteristics are different between categories of lenses (studio, field, cine and EFP/ENG), so these curves are illustrative only. But they do represent the essential differences underlying these three lens types.

Lens design does not benefit from the dramatic cost-reducing dynamics of digital electronics. Lens design is intractably physical. Specifying lens performance entails management of multiple variables followed by lens element manufacturing and precision assembly and alignment.

Within that complex mix lie the variables that can be creatively engineered to realize specific performance levels and their associated costs. Fortunately, optics is a highly sophisticated science that not only leverages advanced new materials but also the latest supercomputer simulation technologies to extend the boundaries of lens performance to unprecedented degrees.

These advances impact high-end HD lens technology and make possible new, more affordable lenses for cost-effective HD cameras. For image acquisition in the new age of HDTV, this is good news for everyone. BE

Larry Thorpe is the national marketing executive and Gordon Tubbs is the assistant director of the Canon Broadcast & Communications Division.

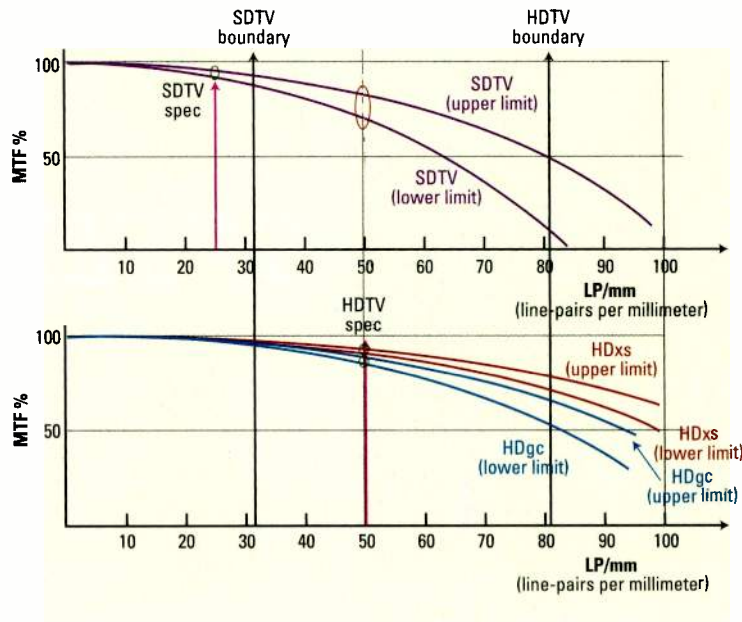
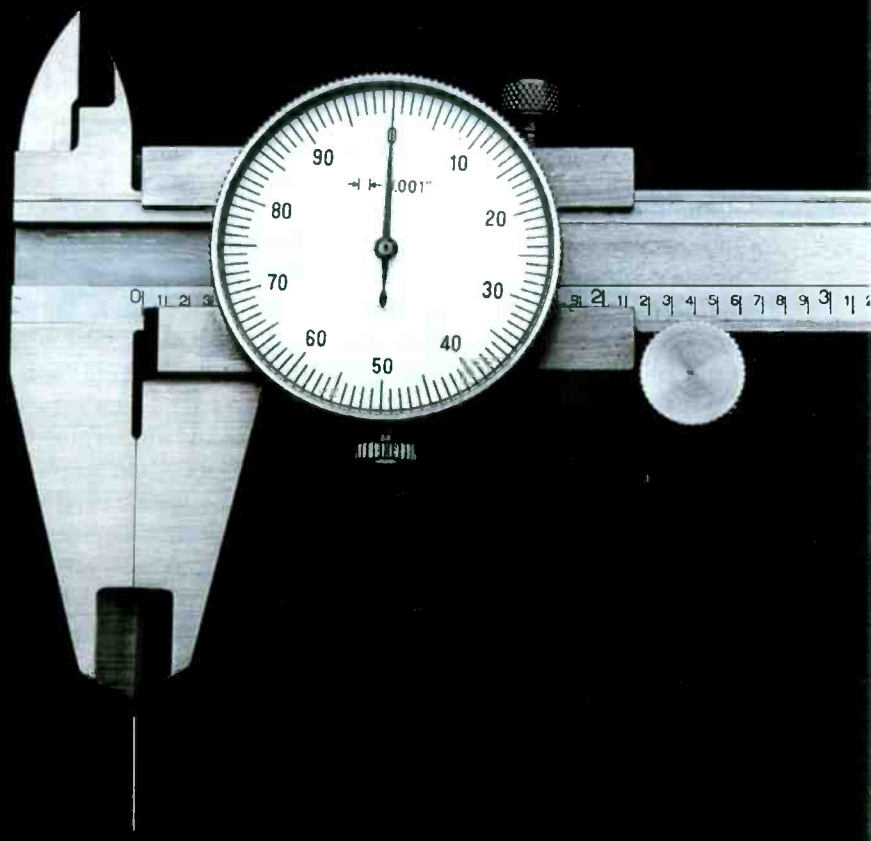


Figure 6. The essential differences between an SDTV lens and two different performance levels in HD lenses



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Omneon's MediaGrid

The active storage system adapts to changing times and changing needs.

BY GEOFF STEDMAN

As television broadcast and production facilities seek new ways to minimize their costs and new opportunities for increasing revenues through new services or repurposing existing content, they require a storage solution that offers exceptional day-to-day performance while also handling the different workloads and applications found in a single facility.

The real challenge for broadcasters is in bringing online a system capable of enabling increased workflow integration using high-performance, high-availability storage platforms. Such platforms must be capable of scaling easily to suit the needs of the facility; meeting the facility's requirements in terms of capacity, performance and data availability; and providing the necessary bandwidth, storage capacity and computing power to ensure optimal and uninterrupted access to media.

Rethinking the traditional storage scheme

Omneon designed the architecture of the MediaGrid active storage system to meet the changing needs of today's broadcast and production facilities, particularly with regard to large-file storage and simultaneous access to media. By scaling bandwidth, capacity and processing power, the system ensures end-user accessibility and constant availability of media files. It provides storage capacities from just a few terabytes to multiple petabytes, all within a single file system, and can scale data-access bandwidth to many hundreds of gigabits per second of aggregate throughput.

The system's architecture protects media while simultaneously providing maximum access to it. As data is transferred to the system, it is divided, replicated and distributed across the entire array of disks. This arrangement provides built-in data integrity by maintaining replicas of files stored in different locations of the storage pool. It also optimizes file availability by taking advantage of any file replica for data access. Additionally, users can dynamically increase the number of copies for high-demand content.

The system's architecture protects media while simultaneously providing maximum access to it.

The system achieves this flexibility through "object-based storage," which uses "slices" as the smallest unit of storage. Each file is broken into slices, each a minimum of 8MB. A slice is a smart object whose behavior adds to the intelligence of the overall system with information including lifetime CRC, active consistency monitoring and metadata redundancy.

The use of lifetime CRCs allows for constant checks to ensure that any random data corruption or loss is identified and automatically corrected — in most cases, before that file has even been accessed. Because slices carry information indicating to which file and where in that file

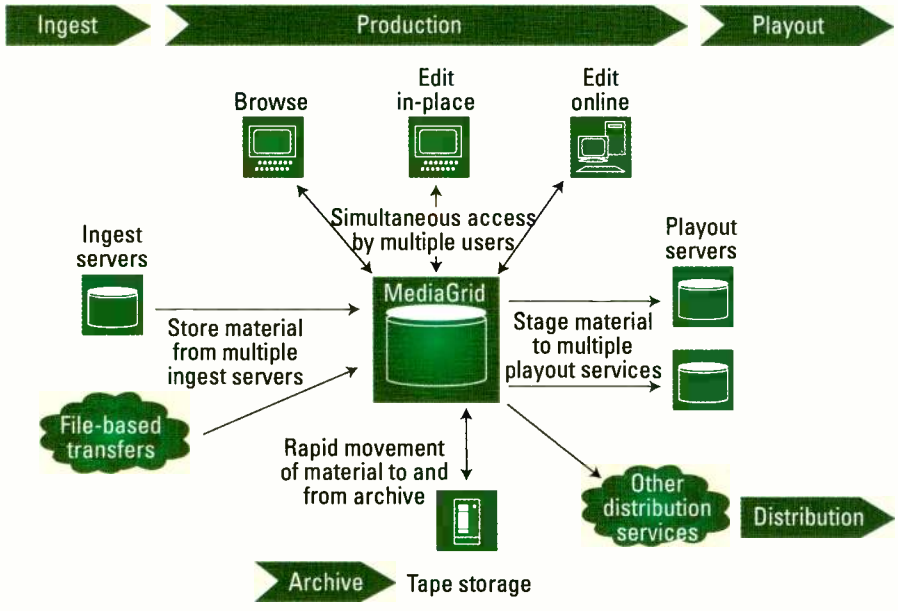
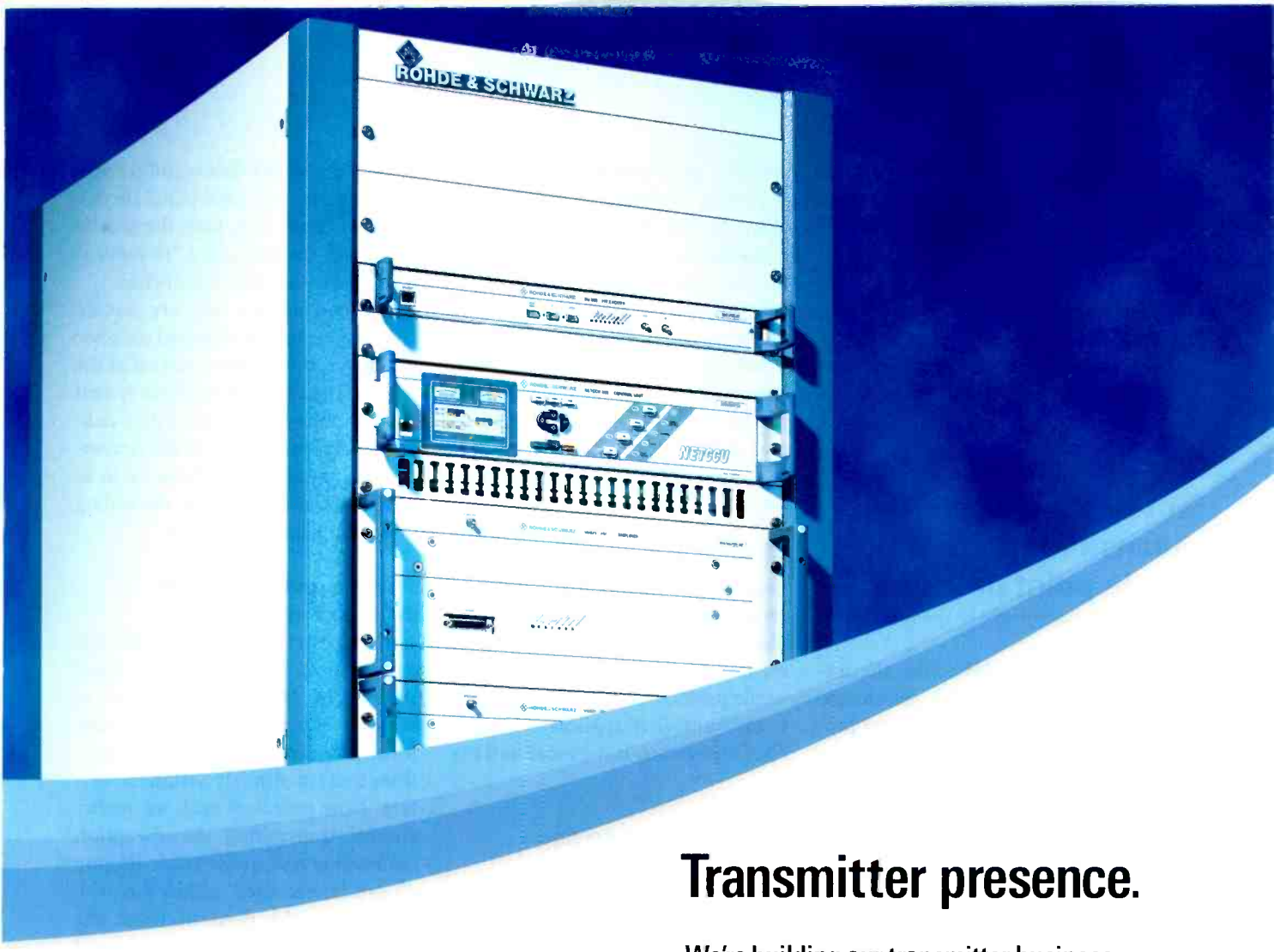


Figure 1. MediaGrid is designed to sit at the heart of a broadcast facility, enabling a coordinated, centralized workflow while meeting capacity, performance and data availability requirements for the entire operation.



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they belong, the system can perform "bottom-up" validation of file system consistency not possible in traditional storage systems.

Media storage access and control

ContentDirectors and ContentServers are the two major operational components of MediaGrid, the former providing overall file system and data management and the latter providing access to data and raw storage.

The distributed design of the storage system means that there is no single point of failure.

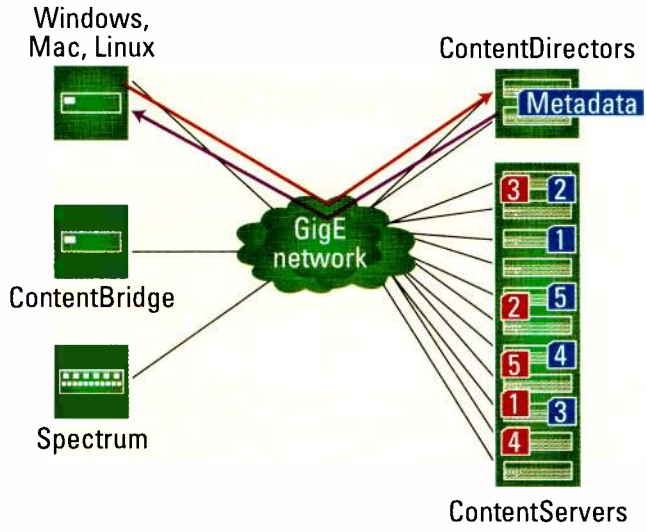


Figure 2. ContentDirectors provide clients with information needed to access files. Once this is accomplished, interactions are directly between the client and the ContentServers.

In general, clients interact with the ContentDirector to request control-type services (e.g. file open), and the it responds by referring the client to one, or more, ContentServers for data access (e.g. file read). Once a client has a list of servers to contact, interactions occur directly between the client and the servers.

The servers make up the bulk of the system, housing storage for the system, monitoring that storage, providing available CPU computing power to grid-based applications, and maintaining constant communication with the file system controller to keep them updated as to drive status, file slices stored, etc.

Slice allocation is based on server availability, system load, available capacity and server grouping. The actual disk space available is managed as volumes, or file systems. Volumes are made up of one or more groups, and a group is made up of one or more servers. Each slice of any particular file is stored on a different server, and a replica of each slice is placed on another server. Depending on specific needs for file availability or file protection, the user can specify the number of replicas of any file. Slice replication is dynamic and immediate, and the process allows multiple clients to access any slice of any file from any available content server, thereby reducing resource contention across the system and enhancing its performance.

An "idle time" management process handles functions ranging from data verification to processing of deleted slices. Verification of data in every slice occurs during idle time to verify that the slice data is still accessible (readable) and valid (CRC check). If either check fails, then the slice is marked as invalid, and a "re-replication" of the slice data is launched.

ContentDirectors run very specific applications to maintain and monitor the flow of content onto and off of the servers. Typically, a MediaGrid system will have two or three file system controllers and some number of ContentServers, ranging from about 12 to as many as several hundred, depending on storage capacity required.

Asset movement and processing

The greater integration of broadcasters' workflow processes is most evident in MediaGrid's ability to serve as a parallel computing platform for media processing applications that run directly within the system. Now processes such as quality control, transcoding, closed caption embedding and audio track tagging all can be executed within the grid, eliminating the need to move the data to separate digital islands and then back into storage.

Because the storage system is based on an all-Ethernet interconnect, no translation is required when moving data between storage and clients, thus avoiding the attendant bottlenecks and failure modes. Omneon's SystemManager is used to configure, monitor and manage the system, with the SystemManager being responsible for discovery, configuration, monitoring, alarms and reporting.

Data protection

Data is protected in a number of ways. The distributed design of the storage system means that there is no single point of failure — either for any hardware component or for the data itself. Data stored using advanced data replication techniques is always available to clients, even in the event of a disk failure, because the system automatically manages all aspects of protecting and recovering from data loss. The system is also designed to

allow for expansion of storage, clients and bandwidth without shutting down or interrupting operations.

Data rebuild in the event of a hard-drive failure is extremely rapid, without any noticeable overall system performance degradation. By the time a failed drive has been replaced, the data that had been on the failed unit will, in all likelihood, already have been re-replicated somewhere else. Re-replication occurs across the system, using every node for data rebuild operations. Therefore, recovery speed is literally an order of magnitude faster than typical RAID-based systems. As client requests have priority over replication traffic, peaks in client traffic are handled seamlessly, without interrupting client operations.

Client interfaces to the storage system are provided from a variety of operating systems. Each client interface is capable of recognizing a loss of connection to the server architecture and automatically connecting to another ContentServer that has a replica of the requested data. Of course, behind the scenes, the storage system will also have identified the error and started a re-replication of the data if required. When a ContentDirector is lost, typically the impact is minimal. When the replacement ContentDirector boots, it connects to the cluster, identifies itself and requests an update for the MediaGrid file system. The update comes in the form of a synchronization operation that makes the new ContentDirector current.

Recovery speed is literally an order of magnitude faster than typical RAID-based systems.

The system accommodates the broadest range of media processes and data management tasks, all while minimizing complexity for system administrators. Regardless of the size of the system, its distributed intelligence and processing capability ensure that it can deliver the highest-quality media-access performance. Any broadcaster seeking to streamline workflows and integrate multiple applications can rely on this innovative new solution to deliver scalable capacity and bandwidth for fast and reliable media storage and management. BE

Geoff Stedman is vice president of marketing for Omneon.

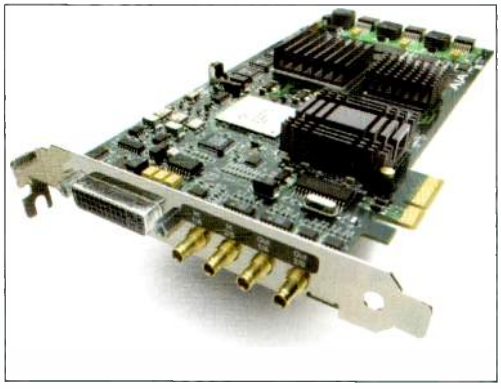
AJA's KONA 3

The capture card creates a data-centric 2K workflow.

BY JON THORN

The KONA 3 from AJA Video Systems is an I/O Mac-compatible capture card for facilities considering to enter the "film as digital" landscape. The card is capable of working with SD, HD, dual-link HD and 2K files. It can receive and send 2K data via high-speed data link (HSDL), making it compatible with 2K telecines and DDRs that output 2K data via HSDL.

The easiest way for video professionals to understand HSDL is to think of it like dual-link HD for the transmission of 2K data. Where dual-link HD moves HD across two SDI cables as video, HSDL moves 2K over the two SDI cables as data.



The AJA KONA 3 captures and plays back uncompressed 8- and 10-bit digital video and 24-bit digital audio.

When used with AJA's VTR Xchange software, users can ingest 2K data and create simultaneous DPX and QuickTime files. By creating a QuickTime file and a series of DPX files, the number of applications that can use the 2K data increases dramatically. This is because some applications only accept QuickTime files, while others will only accept DPX files. This flexibility is a benefit to post-production facilities with a variety of software and hardware applications in their workflows.

I/O capability and beyond

The advantages of the KONA 3 are more than just a 2K HSDL I/O capability. The card can also send HD-based data on a crop of the 2K media.

Users can simultaneously create an SD downconversion of this HD video. To review the data, the dual-link HD-SDI outputs are fed to 2K projectors as 2048 x 1080, to HD monitors as 1920 x 1080 or to SD monitors. These functions make the card useful as a display converter for users working in 2K to see their work on different types of monitors.

Another benefit is that existing 2K data files from film scanners or files generated via software applications in the Cineon and DPX file formats can be wrapped into QuickTime Reference Movies via the AJA's DPXToQT translator application. This provides display and output flexibility without requiring the writing of large amounts of new data to the storage system.

The QuickTime movies point back to the source's original DPX files, rarely occupying much space. Compare this with the hundreds of gigabytes used to define a series of 2K DPX files, which require 12.2MB per frame. This means the cumbersome sequence of potentially thousands of frames can be nondestructively consolidated into single files for easier management and tracking.

If the media needs to be transferred to a facility that does not accept QuickTime movie files, it can be converted back into sequential DPX files. Again, this conversion can be accomplished via the company's translator application. However, because there may now be changes in the media, such as effects, the process writes new data to the storage system.

Working with 2K vs. 4K

There is a growing need for cost-effective tools that work with 2K images in an evolving data-centric workflow. Although some people argue that 4K resolution is a better choice for cinematic jobs, working with 4K is exponentially more of a burden than working with 2K.

Some 4K and larger resolutions are currently used on feature films, but even then, only for select shots. Someday, 4K will supplant 2K as standard practice, much like HD is replacing SD.

Capable 2K devices, such as the KONA 3, help facilities and filmmakers create an efficient data-centric workflow.

However, that day is distant. For now, many motion picture companies have settled on the high quality provided by 2K images. That 2K source can derive the high-quality film, digital cinema, HD and SD deliverables without compromise, while not imposing a cumbersome technological and financial leap to 4K.

Capable 2K devices, such as the KONA 3, help facilities and filmmakers create an efficient data-centric workflow. The result is a universal mastering environment. BE

Jon Thorn is product manager of Mac desktop products for AJA Video Systems.

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Sensaphone's IMS-4000

The infrastructure monitoring system at Turner Studios protects production equipment.

BY BOB DOUGLASS

Turner Broadcasting Systems' Atlanta campus is a sprawling complex of large office buildings spread across several acres. Within those buildings, staff and equipment work to support the organization's mission of producing news and entertainment for a variety of media outlets, including Cartoon Network, CNN, TBS, TNT and Turner Classic Movies. Not surprisingly, the space and the technology are expensive to run and maintain, and even more expensive to replace.

The complex houses Turner Studios Engineering's pre- and post-production facilities. A division of Turner Broadcasting, Turner Studios produces numerous programs every year, including live broadcasts of NBA games, Atlanta Braves baseball games and "Dinner and a Movie." In fact, Turner Studios provides facilities and resources for all of the Turner Entertainment Networks worldwide.

Turner Studios' facilities include fully equipped studios, editing suites and graphics production centers. The studios are supported by terminal gear rooms for storing switches, network gear, video servers and so on. And it is absolutely critical that the temperature in each gear room remains cool.

Shown here is the gear room at Turner Broadcasting Systems in Atlanta, which is monitored by the Sensaphone IMS-4000.

The studios are supported by terminal gear rooms for storing switches, network gear, video servers and so on. It is absolutely critical that the temperature in each gear room remains cool.

In the mid-1990s, the studio experienced several incidents when the add-on cooling system failed. Staff members scrambled to address the problem before any equipment was damaged from prolonged exposure to the high temperatures.

Walt Youmans, broadcast engineer with Turner Broadcasting, researched possible early detection systems. He learned that a remote environmental monitoring system with auto-dialing capabilities would be an uncomplicated, but significant, step toward safeguarding the equipment.

Initially, Youmans installed a Sensaphone 1104, which offered four monitoring inputs and four alarm notifications. Later, expansion at Turner Studios meant Youmans needed a more robust solution; he chose Sensaphone's IMS-4000 infrastructure monitoring system.

Monitoring

The IMS-4000 monitors for power failure, smoke and fire, temperature and humidity changes, water on the floor, motion and more. An interface allows users to connect to and monitor any dry contact device or any 4mA to 20mA device.

When potentially dangerous conditions are detected, the system alerts engineers who can take the necessary steps to prevent lost network functionality. Those alerts are issued via e-mail, pager or phone.

The system also comes with an internal data logging function that accumulates time-based snapshots and event-driven data. The data history can be viewed using the built-in Web

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The Sensaphone IMS-4000 family includes Host, Node and PowerGate units. Each Host and Node unit can support eight environmental sensors.

interface or through the Windows-based PC software delivered with the product.

The system works with a dial-up line and comes with built-in voice, data and modem with a standard RJ-11 phone connection, in addition to the 10/100 Ethernet interface. It is also supplied with an internal UPS battery backup robust enough to continue its monitoring functions for several hours after the power is lost.

The investment at Turner Studios proved to be reliable. In one incident, the system sounded an alarm at 2 a.m. It automatically contacted the technical staff and dispatched the appropriate engineer to respond. The system had detected a significant increase in temperature in a room that housed complex and expensive computer graphics equipment vital to the network's day-to-day business.

Had that situation gone undetected, Youmans said, it would have likely resulted in several hundred thousands of dollars in repair and replacement costs. The implementation of the IMS-4000 system has been so successful that Turner Studios is considering expanding its use to other areas of the complex. BE

The system had detected a significant increase in temperature in a room that housed ... equipment vital to the ... business.

Bob Douglass is the vice president of sales and marketing for Sensaphone.

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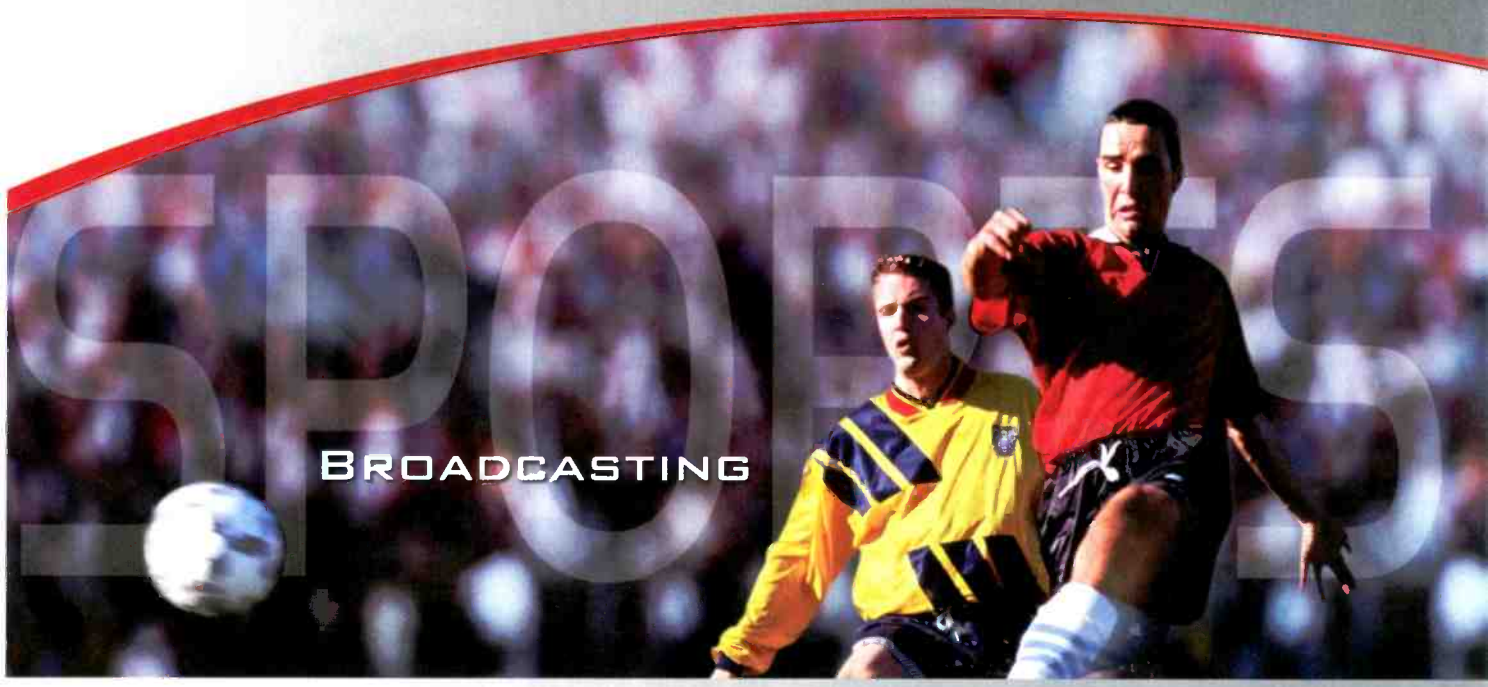

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Pentadyne's VSS_{DC}

The flywheel power system keeps WBRZ-TV on-air during power disturbances.

BY CLYDE PIERCE

Broadcast engineers in Louisiana know firsthand the demands of keeping sensitive digital production and transmitting systems up and running. Weather-related issues are a constant threat, as Hurricane Katrina demonstrated in August 2005.

Integrated into a UPS system, Pentadyne's new VSS_{DC} battery-free flywheel system provides protection against more than 98 percent of power disturbances.

Baton Rouge-based WBRZ-TV was experiencing problems with its backup power set-up. The double-conversion 50kVA battery-based UPS system had been replaced just two years before and already suffered from battery cell failures in a number of strings. Subjected to the impact of numerous voltage sags and temperature extremes in a technical room with no air conditioning, the batteries of the existing UPS degraded quickly, requiring regular replacement of failed cells.

The backup power system was critical because it supported the station's 24-hour newsroom equipment and corporate data center. It became necessary to take action and find a better solution.

The solution

In the station's search for a reliable and proven solution to upgrade its backup-power set-up, it was determined that a new 50kVA UPS paired with a Pentadyne VSS_{DC} (Voltage Support Solution) DC flywheel power system was the answer. The system is fully compatible with UPS systems from leading manufacturers. A flywheel power system operates as a mechanical battery. It is an electro-mechanical device that stores kinetic energy in a rotating mass with the capability to convert it back into electrical energy when backup power is needed to support critical loads.

The flywheel provides ride-through time to bridge over to backup generators for continued power during long-term grid-power outages. It serves as a quiet, low-maintenance, space-saving alternative to service-intensive batteries for UPS systems. Compared with traditional battery-based UPS systems, the flywheel dramatically reduces UPS costs while improving UPS system reliability.

Longer battery life

Because the two-year-old battery pack had recently undergone service, most of it could still be used; it was then retained as part of the backup power set-up. In parallel with batteries, the flywheel power system provides battery protection by taking care of short disturbances and preserving battery capacity for longer disturbances. Only the power disturbances lasting longer than the flywheel's ride-through time use energy from the UPS's battery bank.

The flywheel reduces UPS costs while improving UPS system reliability.

The system serves as an effective means of isolating chemical battery strings from more than 98 percent of power disturbances. Calling on batteries less often — while minimizing the number of battery charge/discharge cycles — has a direct effect because battery usage decreases battery life. This configuration consequently extends the battery's life expectation while improving UPS system reliability.

Easy installation

Once the design was finalized, the

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station's director of engineering and operations set the start-up time of the new backup power installation. With all the equipment in place, the installers performed an initial start-up procedure on each piece of equipment. They connected the original battery pack to the DC bus, and adjusted the flywheel settings so that the system discharged completely before the batteries would be called upon.

The flywheel is rated for 160kW for 12.5 seconds. However, with only 50kVA on the UPS output, the discharge duration lasts about one minute — well in excess of the 10 to 12 seconds needed to start and synchronize the generator.

Dependability

WBRZ-TV had been struggling with its aging battery-based system for years, unaware that there was a better alternative available. The station initially retained the battery pack and used the system in parallel with the flywheel.

During Hurricane Katrina, Pentadyne Power's VSS_{DC} flywheel power system played a key role in keeping WBRZ-TV on-air, providing uninterrupted, vitally important, around-the-clock TV news coverage.

Now that station engineers have built up their confidence in the system, the battery strings are simply removed as they fail. Soon the station will be relying solely on the flywheel system to ride through to the generator during grid disturbances or when a transfer to the generator is manually initiated as storms approach. BE

Clyde Pierce is the director of engineering and operations for WBRZ-TV.

With only 50kVA on the UPS output, the discharge duration lasts about one minute — well in excess of the 10 to 12 seconds needed to start and synchronize the generator.

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Canon's XL H1

The 1/3in camcorder offers max resolution.

BY BARRY BRAVERMAN

Canon's XL H1 camcorder has been shipping for more than nine months, and has stood the test of time. Compared to competing HD/HDV models, it offers excellent robustness and accessible controls.

In the heart of every 1/3in HD or HDV camcorder there inevitably lies more than a few compromises. These compromises are understandable given these cameras' relatively low price points that preclude the inclusion of superior HD optics with the basic camera.

The bracket at the rear of the XL H1 supports an external battery or FireStore. The camera, when fitted with the standard 20X lens, is front heavy, so the additional weight at back improves camera balance, especially when shooting handheld.

Other inherent compromises deleteriously impact key user functions. The mediocre viewfinders and LCD screens found in most sub-$10,000 HD camcorders are at the top of my pet peeve list.

Another serious compromise is the lack of robustness in camera hardware — the flimsy switches and controls that cause serious professional shooters extreme angina. I worked for years with *National Geographic*, facing charging rhinos and erupting volcanoes, so hardware integrity is a major issue for me.

The camcorder's external controls are rugged and accessible, significantly contributing to the overall superior usability of the camera.

Control

In my recent cinematography and lighting class conducted at Video Symphony in Burbank, CA, students easily accessed key operational functions, such as frame rate and scan mode, without consulting a manual or cheat sheet. As a veteran cameraman, I can say that accessibility is a key feature, and that drilling down through umpteen setup menus to access routine functions is not a professional shooter's favorite pastime.

In my recent cinematography and lighting class ... students easily accessed key operational functions, such as frame rate and scan mode, without consulting a manual or cheat sheet.

Native resolution

The XL H1 offers shooters the maximum native resolution available in a 1/3in 3-CCD camcorder. At a chip resolution of 1440 x 1080, it performs well in simple resolution tests. Table 1 on page 96 shows manufacturers' native CCD resolution specs for their most popular camera models.

The camera's internal menus in conjunction with Canon's extensive Console software control color settings. The configuration of internal and external controls is well thought out.

Of course, native resolution of a camera's CCD only tells part of the story. Reduced pixel size in a 1/3in (5mm) imager can also dramatically reduce light sensitivity, just as fine grain film provides increased resolution albeit at the price of lower ASA and film speed.

In my evaluations, the XL H1 exhibited about two stops less sensitivity in low light than the Panasonic HVX-200. The P2 camera's lower chip resolution of 960 x 540 (and thus larger pixel size) is a major factor for the camera's better low-light performance.

Another impact of the high-resolution chipset in the XL H1 is reduced highlight latitude. This is most apparent in the camera's reproduction

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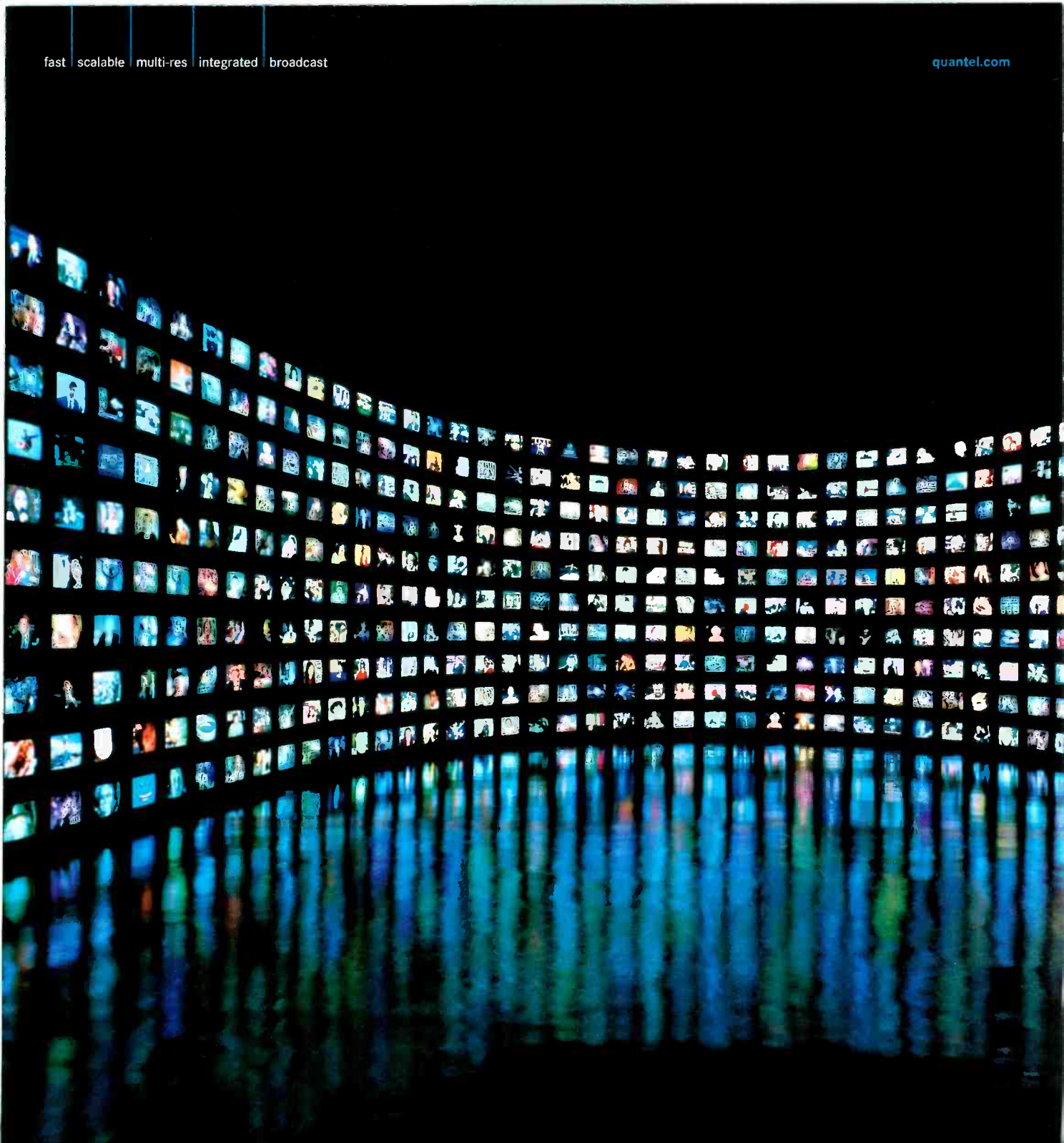

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Manufacturer/camera type	Native CCD resolution specs
Canon XL H1	1440 x 1080i
JVC GY-HD100U	1280 x 720p
Sony HVR-Z1U	960 x 1080i
Panasonic HVX-200	960 x 540p

Table 1. The XL H1 offers substantially higher native resolution than competing small-format HD camcorders. But like everything else in this crazy digital world, there's more to this particular issue than meets the eye.

of specular highlights, which tend to produce fringing around the edges of objects. One explanation for the appearance of this artifact is the camera's inability to properly handle 1440 resolution within the constraints of the HDV format. Outputting via HD-SDI to DVCPRO HD or HDCAM circumvents the HDV constraints, producing cleaner, more professional images, indistinguishable in many ways from broadcast cameras costing ten times the price.

Detail settings

As delivered, the XL H1 appears distinctly like an ENG camcorder — both in look and tone. While this may be acceptable for news and some corporate applications, the more discriminating shooter will almost certainly want to tweak the camera's extensive setup menus.

Abundant controls allow users to precisely adjust color. The controls offer the most extensive array I've seen in a small-format HD/HDV camcorder.

The detail setting in the camera presents a bit of a conundrum, however. Many shooters have lamented the inability to entirely disable the detail circuit (as is possible in JVC models). This means that some edging is always visible, even at the lowest (-9) setting.

In my evaluations, I liked the camera's -3 detail setting used in conjunction with a Schneider ¼ Digicon. The filter introduces a slight diffusion without flare or loss of resolution. Small-format HD and HDV cameras demand smart on-camera filtration to adequately address these cameras' many inherent compromises. The HDV codec appears to perform much better with fewer obvious artifacts when proper diffusion filtration and polarization is applied in front of the lens. I suggest that shooting naked is not the best course of action with HDV cameras, including the XL H1, given the perils in satisfactorily capturing high detail scenes or when evaluating images out of HD-SDI.

Uncompressed HD

While HD-SDI output and genlock allow (in theory) for optimal integration into multicamera and post-compositing environments, the camcorder's HD-SDI output presents its own set of issues. The basic problem stems from the lack of embedded audio. The camera's built-in A/D converter introduces a latency in the video stream, placing it out of sync with the audio. This discrepancy does not appear in the analog component output; therefore, recording to an external VCR or hard disk drive may actually be more reliable by not using the camera's HD-SDI feature. (Note: Canon has rectified this issue in the recently announced XH G1, which outputs HD-SDI with embedded audio and LTC time code (SMPTE 299M). SD-SDI signals, which are output, are also supported in the newest model.)

Latency issues in the broadcast control room have been an occupational hazard for some time. Because of the wide range of LCD, plasma and CRT displays in use, producers and post-production supervisors have grown accustomed to latency issues and resultant synchronization snafus.

The time delay introduced by the various A/D processes brings about heart palpitations at the highest levels of the industry. With the advent of the XL H1, the specter of latency issues raises its ugly head during image acquisition.

Because of the wide range of LCD, plasma and CRT displays in use, producers and post-production supervisors have grown accustomed to latency issues and resultant synchronization snafus.

The camcorder produces clean images overall, as evidenced in relatively flat scenes, such as this one.

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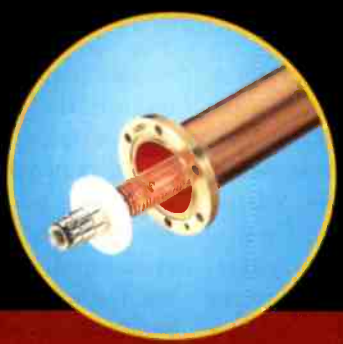

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Luckily, one recent solution — the Miranda HD-Bridge DEC — digitizes the camera's component output, time code and audio into a proper HD-SDI stream. Future camera revisions will no doubt incorporate a correct multiplexed bit stream, but for the moment, users will have to rely on a third-party solution.

Reduced camera detail sharpness should be a top priority for XL H1 shooters hoping to extract the most natural looking images. However, some edge enhancement is visible even at the lowest detail setting. So, shooters are advised to use appropriate on-camera diffusion to suppress the "video look" and facilitate HDV compression.

A closer look

With a suggested list price of less than $9000, the XL H1 produces a high-quality image at a good value. But there's more to this statement than is apparent at first glance. Compromises in low-light performance and ongoing qualms regarding the HDV format and workflow have raised concerns among some users.

Regarding HDV and its relative merits, Canon has tweaked the performance of the HDV codec, reducing the artifacts that are sometimes apparent in high-motion scenes. I don't know how Canon accomplished this — and Canon isn't giving up the secret.

The interlaced 3-CCD chipset produces a progressive scan at 24fps and 30fps but the resultant HDV tapes are incompatible with Sony or JVC HDV equipment. Thus, workflow continues to be a challenge. Many shooters simply opt to bump their source tapes out of the camera to an intraframe-based format, such as HDCAM or DVCPRO HD. The latter format makes particular sense because files can be transferred and edited at full resolution on the desktop or laptop via FireWire. The camera's built-in HD-SDI is best limited to onset monitoring.

The camcorder's 20X interchangeable lens also contains some compromises. The motor-driven controls seem vague, especially the zoom ring, and the lens exhibits chromatic aberration at wider apertures where users tend to do most of their work.

The 20X also exhibits considerable breathing, but this is typical of interchangeable objectives in this price class. This particular compromise only underlines the route followed by other manufacturers who permanently mount lenses for their cameras. In this way, lens deficiencies, such as pronounced breathing, can be electronically compensated for and mapped out.

The genlock feature in the camcorder eliminates the painful ordeal of synchronizing multiple cameras via "jam-sync," smart slates or other more makeshift methods. The camera's HD-SDI output is a welcome feature but the lack of embedded audio presents significant latency challenges.

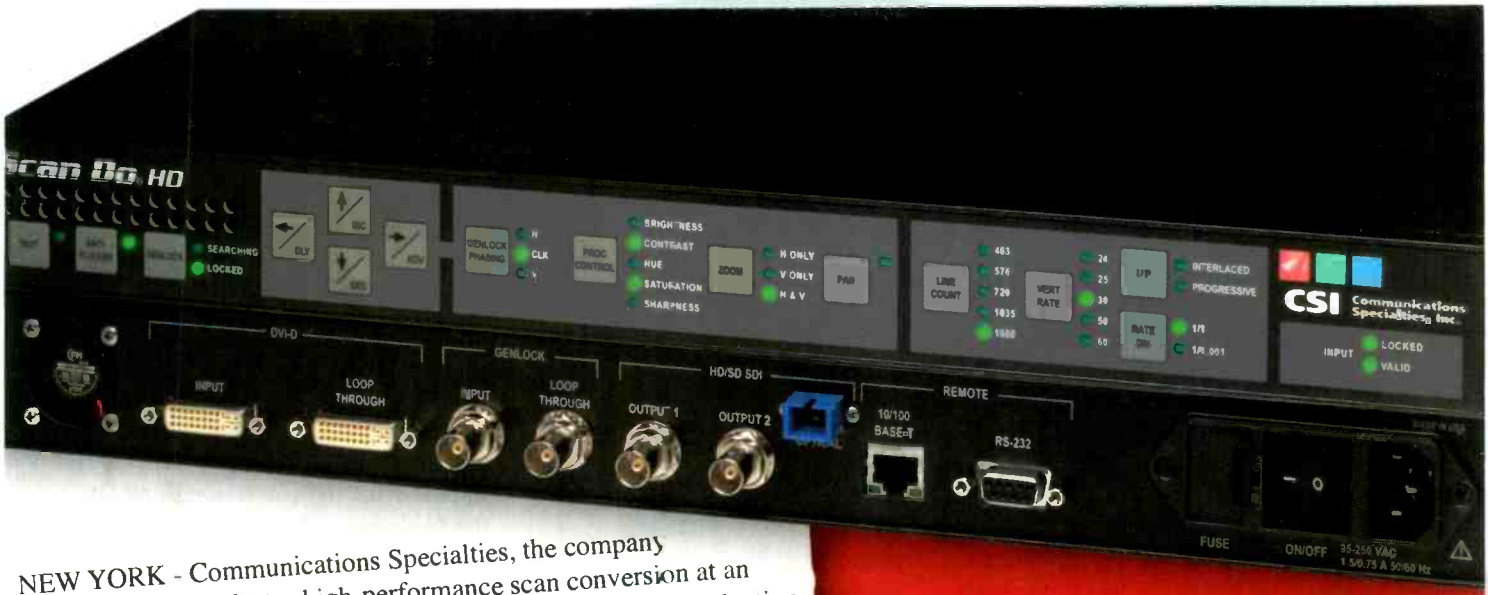
The SD viewfinder, while robustly constructed, exhibits some smear and motion blur. Seeing what one is doing is a fundamental requirement for professional shooters, especially in HD, so using a Panasonic BTLH900A or other high-end monitor is imperative for proper monitoring.

Compromise is a fact of life for the small-format HD shooter. Shooters must understand the depth and nature of a camera's compromises to do their best work.

Conclusion

Compromise is a fact of life for the small-format HD shooter. Shooters must understand the depth and nature of a camera's compromises to do their best work. BE

Barry Braverman is a veteran cinematographer with more than 20 years experience in feature films, documentaries and music videos. He is currently serving as a digital media expert and consultant to major studios. His latest book, "Video Shooter," is available from CMP Books at www.cmpbooks.com.



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Newsroom editing

Today's systems feature improved workflow.

BY JOHN LUFF

In the context of a magazine focused on technology, it is important to remember that the purpose of editing is to order images and sound in a way that tells a story. When the technology becomes the focus, it is in the way of the craft. The highest order of intent for a news editing system designer — along with all technological innovation — is to make the innovation either invisible or so compelling that its visibility does not interfere with the reason that technology exists.

Early news editing systems

Some early electronic news editing systems were hardly successful in this critical respect. Nonlinear news editing systems were thinly disguised entertainment editing systems. A tie to the workflow of a newsroom was missing.

Many early systems also tried to impose the workflow of craft editing, which missed important distinctions. Principal among these was the emphasis on preview and trim capability over speed and efficiency. News editing is certainly similar to craft editing, but craft editing is seldom done in the context of short timelines. It provides less emphasis on artistic intent and on developing complex story lines.

As a result, early nonlinear news editing systems used the same "ingest then edit" paradigm that craft editing had developed in the same hardware. I remember asking one vendor if it was possible to lay shots directly to the timeline while ingesting. I received a terse reply that I did not understand how news is edited. Needless to say, I think I have been vindicated as systems have evolved.

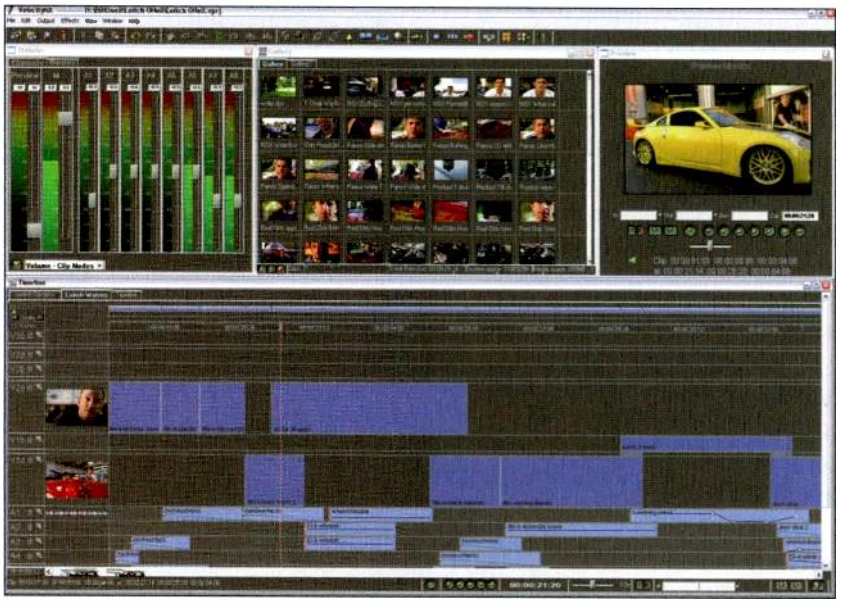
Current news editing systems

Today, the most important aspects of the highly sophisticated news editing systems are quite different from craft editing. First, the systems are tightly connected to newsroom computer systems and their content development tools.

Second, the emphasis on technology has disappeared. Instead, the emphasis is again on content and the most efficient way to execute the editorial process. For instance, a key concept in the early development of nonlinear editing systems was that they were offline content decision-making tools, which most often were followed up with online editing of the final piece. That suited the workflow of craft editing well, mimicking the film process where cuts are conformed on the original negative.

Today, that same paradigm has reemerged in the news environment with the introduction of products that allow producers and journalists to rough cut their item and send the script, cut list and notes to a craft editor for final conforming and finishing. Now this can all be done in one seamless networked environment, without the sneakernet of writing down time code numbers for the cuts to the story and then carrying them to an editing room for completion.

The workflow improvement of the most modern tools is more than evolutionary, and it replicates the most comfortable ways for related professionals to work.



Harris Leitch's VelocityNX enables editing of native HD and SD content (both 720p and 1080i) directly from NEXIO shared storage. The editing and effects toolset is ideal for news operations that require more compositing capability.

Today, the most important aspects of the highly sophisticated news editing systems are quite different from craft editing.

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www.florical.com
www.acuitastv.com

```
"Basic filenaming (using a date-centric example)
yymmdd_[media type]_[subject or story name]_[show name]hhmm

Examples of media type:

For raw elements:
SF (satellite feed)
TDV (tape DVCPRO), TB (tape Beta), etc.
ST (studio)
LF (live feed)

For cut elements:
V (VO)
S (SOT)
P (package)
T (tease)

Story names: Abbreviate to conserve character
spaces, but remain meaningful

Show names: Initialize names, e.g. NL for NewsLine,
NN for News at Nine, EN for Eyewitness News, etc."
```

Figure 1. Grass Valley's filenaming framework

The technology

What can technology do to continue to improve the workflow and match the tools to the intended purpose? A useful way to explore this is to look carefully at the technology and what it can and cannot do today.

Moving related pieces of the news story around the station as it is finished is all done electronically. But some parts still require careful thought in implementation. For instance, the naming conventions for files is a critical element that ties the items together in ways we can interpret quickly and efficiently.

One manufacturer, Grass Valley, has suggested

a framework to its customers. (See Figure 1.) Dates are prefaced by year, so the list is sorted with the oldest or newest entries at the top. By using this coding scheme, the implementing technologist creates a system that is easily understood.

It might be equally possible to use a serial number to identify the file completely, with all of the related metadata in a lookup table and displayed in application interfaces. However, when confronted with the filename alone, there is no point of reference, rendering the naming useful only in the software domain.

Similarly, early time code editing systems forced users to constantly look at strings of numbers to complete their job. Later, nonlinear systems allowed users to work with pictures only, while the computer kept track of the numbers it needed.

Today, systems allow highly flexible interfaces, even using speech recognition technology to synthesize a script from a "sound on" file. The systems then let the professional, often a producer or journalist, rearrange the script and allow the edits to automatically track the edited script.

New pieces of workflow are possible, some of which were not practical when media was not networked. The legal department, or perhaps executive producer, can review sensitive items while the editing is in process and make informed judgments about whether material is appropriate to air.

Editing standards

Most editing systems use some elements of standard communication, MOS for instance. Some systems use file wrappers that are standardized by more than one manufacturer.

As systems get more complex, the systems that adopt common applications interfaces that other manufacturers can comply with will be successful. Unfortunately, the other class of successful products is likely to be those that adopt fully featured approaches that use their own best engineering ingenuity but remain closed to protect both their market share and the ability of the customers to get a large and bulletproof feature set.

Personally, I would opt for the former even though it might be more problematical to implement and support. I strongly believe that the majority of manufacturers will see their best interests served with open standards. BE

John Luff is senior vice president of business development for AZCAR.

? Send questions and comments to: john_luff@prismb2b.com

Image Server MAXX — 360 Systems

The high-performance, three-channel broadcast video server with graphic store and key and fill supports MPEG-2 video up to 50Mb; inputs MPEG-2 and DV over GigE from Apple FCP and Avid, as well as TARGA files from graphics programs; includes frame sync, SDI video ports, AES/EBU, digital, analog and embedded audio.

818-991-0360; www.360systems.com

HES20 — Axon Digital Design

The aligner and frame synchronizer automatically detects Dolby E, and a possible offset of the guard band is measured; any offset of up to +/-0.5 frame will be corrected automatically by delaying the Dolby E between 0.5 and 1.5 frame; the video part of the SDI stream is delayed by one frame as default.

+44 118 973 8920; www.axon.tv

7767VIP8-HSN — Evertz

Signal video monitor and display; simultaneously accepts, auto-detects, analyzes and displays eight synchronous or asynchronous HD, SD and analog video signals; an additional ninth input is a computer graphic input for display of a dynamic background image; displays up to WUXGA (1920 x 1200) resolution; fits into the company's 7700FR-C frame.

905-335-3700; www.evertz.com

H-Class Content Delivery Platform — Harris

The platform includes H-Class Airtime Sales, H-Class Scheduling, H-Class Digital Asset Management, H-Class Media Ingest, H-Class Playout Automation and H-Class Intelligent Transport; offers platform-based advantages, including content management and sharing, intra-application messaging, increased security, and scheduling functionality; management of content assets, associated metadata and content relationships enables the delivery of rich media across multiple distribution channels.

800-622-0022; www.broadcast.harris.com

Infinity — Grass Valley

The multiformat camera platform supports 1080i50/60, 720p50/60, 525i/60 and 625i/50; records at DV25, JPEG2000 and MPEG-2 SD and HD; records and plays from integrated REV PRO drive and professional-grade CompactFlash media; supports HD-SDI, CVBS, TC and AES audio; IT-based interfaces include three USB, a FireWire and an HDMI display connectors and GigE.

503-526-8150; www.grassvalley.com

XT[2] — EVS

Server for live production, post, content management and playout; can be combined to build a complete multichannel and real-time media sharing production network with nearline central storage.

973-575-7811; www.evs.tv

PTX-PRO — Microwave Radio Communications (MRC)

The portable ENG transmitter supports integral MPEG-2 SD/HD encoding, plus analog or COFDM and high-speed single carrier digital modulation in bands between 1.9GHz and 2.6GHz; features user-friendly front-panel controls, built-in AC/DC power supplies and nine programmable presets, which make setup easy.

978-671-5700; www.mrcbroadcast.com

PIsys — Irdeto

The IPTV control system is a modular, large operator conditional-access system for any kind of content; developed as a transport platform independent solution; can be used as a convergent solution to secure DVB, IP and mobile content.

425-497-2800; www.irdeto.com

HDN-X10 Editcam HD — Ikegami

The HD camera features a tapeless recording system and 2/3in 2.1 megapixel CMOS sensors for superior picture quality and wide dynamic range; uses the Avid DNxHD mastering codec to deliver HD-resolution full-raster (1920 x 1080) images that can be edited in real time; features a data rate of 145Mb/s to capture images in the 1980/60i, 1080/24p and 720/60p HD formats on Ikegami's FieldPak2 recording media.

201-368-9171; www.ikegami.com

Newsbox HD — Quantel

A convenient, affordable and self-contained news system; has the capability to ingest, view rushes, choose shots, edit stories, review finished pieces and play them to air; available in HD, SD and HD-upgradeable configurations.

703-448-3199; www.quantel.com

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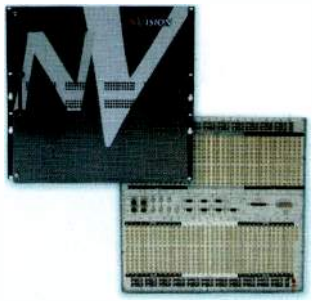
NV8288 — NVISION



The digital video router features Gennum's 3Gb/s HD/SDI chipset; is specifically designed for use in video production trucks and other applications where space is limited; built for HD; supports all standard SD data rates; is ASI-compliant; can be configured for systems ranging in size from 12 x 12 up to 288 x 576; all modules, including power supplies and cooling fans, are front-serviceable and hot-swappable.

530-265-1000; www.nvision.tv

FSH3-TV — Rohde & Schwarz

Portable analyzer offers all the functions and features of a spectrum analyzer, combined with the functions and features of an analog and digital TV test receiver; comes equipped with a preamplifier, tracking generator and TV module that permits the analysis of analog and digital TV signals and their demodulation; the demodulated video signal, which is made available at an output that can be used either as an analog TV or as a digital output, can be routed to an external monitor or an MPEG-2 decoder.

410-910-7800
www.rohde-schwarz.com/usa

Cine 30 HD — Sachtler

Fluid head features a sideload clamping mechanism for the camera plate; offers several benefits, including newly designed control elements such as the brake lever and pan bar.

+49 89 32158 244
www.sachtler.com

UE 9000 — Scopus Video Networks

The universal encoder series allows broadcasters and network operators to easily migrate from MPEG-2 to MPEG-4; features a dense encoding architecture and allows dual-channel encoding in a 1RU chassis; provides superior image quality and can be integrated in open- or closed-loop statistical multiplexing architectures; UE 9310 provides one MPEG-2 channel and by adding an H.264 software upgrade, the encoder can simultaneously transmit either or both formats over ASI and IP networks.

609-987-8090; www.scopus.net

XDCAM HD PDJ-C1080 — Sony

An automated robotic cart system; accommodates up to four PDW-1500 units and up to 80 discs to store 1.8TB of AV material; ideal for ingesting, archiving and on-air playout applications; is equipped with a standard VCC control protocol, allowing easy integration into existing systems; the PDJ-CS10 Cart Interface Software is available to interface with MXF-compliant systems.

800-686-7669
www.sony.com/professional

EN8030 and EN8090 — TANDBERG

The EN8030 is an MPEG-4 AVC SD ultracompression encoder; the EN8090 is an MPEG-4 AVC HD/SD ultracompression encoder; the encoders enable HDTV services to be delivered at data rates below 6Mb/s, with similar improvements to SD services; enable operators to deliver HD and SD multichannel and single-channel services across cable, satellite, telco and terrestrial networks.

678-812-6300; www.tandbergtv.com

KONA 3 — AJA

SD/HD capture card now features 2K resolution video support; now provides customers editing and finishing on an Apple Power Mac G5 with the capability to bring in and play back material at 2K; provides support for hardware-based 1080i-to-720p or 720p-to-1080i crossconversion.

530-274-2048; www.aja.com

On-Air — Blackmagic Design

Real-time HD mixing console with the power of Multibridge Extreme; results in a complete live TV production studio; supports two cameras; provides HD-SDI quality, direct recording to disk, graphics keying, genlock outputs and full camera monitoring; is a free software update for all Multibridge Extreme users.

702-257-2371
www.blackmagic-design.com

HX200 — Chyron

HD/SD character generator features broadcast-quality, real-time animation and seamless interoperability with external systems; ideal as an entry-level HD/SD solution for studio and mobile live broadcast and production operations; allows the creation of 2-D and 3-D graphics that can be taken to air immediately; content can be created on- or offline.

631-845-2133; www.chyron.com

legalEyesMDi — Eyeheight

Multidefinition legalizer accepts 1080i and 720p, as well as 625i PAL and 525i NTSC SD; enables program producers and editors to ensure that the level of their video signals remains within the strict tolerances required for HD and SD transmission to air and DVD mastering; levels can be monitored continuously and manually or automatically corrected.

866-469-2729
www.eyeheight.co.uk

NetComplete — JDSU

A digital and IP video service monitoring application; provides continuous, simultaneous monitoring of more than 250 video streams, as well as test access coverage at QoS-relevant points in the network; addresses every deployment phase, including initial design, network element deployment.

408-546-5000; www.jdsu.com

Xstation — Miranda

Creates, schedules and airs complete DTV subchannels incorporating national, regional and local content; SD/HD video and graphics; includes hardware, software, data-parsers and asset management; RAID storage; compatible with Xmedia Suite.

973-683-0800; www.miranda.com

Masterpiece — Pro-Bel

Offers HD and SD switching, advanced audio processing and flexible keying and DVE options; upgrades include the addition of an HD DVE and the option to install Dolby E decoders and logo storage; now benefits from four keyers and has the ability to handle audio mixing.

925-735-9269; www.pro-bel.com

Voice-Plus — Autoscript

Prompter module for the WinPlus; eliminates the need for users to manually control the speed of the text on a teleprompter; requires no training; the system simply follows the spoken work of the talent.

203-338-8356; www.autoscript.tv

DTV-4200 — MultiDyne

A four-channel SDI and audio fiber-optic transport; provides high-quality performance with built-in SDI frame synchronizers; the system supports four SDI, 16 audio or eight AES/SPDIF channels.

800-488-8378; www.multidyne.com

Enterprise — Broadcast Traffic Systems (BTS)

Traffic management system with a new user interface uses a standard browser, making it easy to use and reducing training time; additional developments include a fully configurable workflow that allows users to tailor the system to meet its own operational processes; advanced user-maintained multilingual dictionaries allow the system to cater for all language sets, including Arabic and Chinese.

805-856-9103; www.bts.tv

Super High-Density Coax (SHDC) — ADC

Coax cable designed for AES audio, 5.1 and 7.1 applications where space is critical; the 1.5RU panel features 4 x 48 coax ports (96 circuits) with switchable termination, allowing selection/deselection of a 75Ω termination function on each circuit pair.

800-366-3891; www.adc.com

Helios — Snell & Wilcox

Software-based conversion platform combines Snell & Wilcox's Ph.C motion estimation and FormatFusion technologies; encompasses a complete automated solution that can convert — under user control — video, audio and metadata to any required format in a single "anytime" pass; can be used in both the stream- and file-based domains.

212-481-2416; www.snellwilcox.com

D9054 — Scientific-Atlanta

HD encoder delivers high-quality compression using its combination of single-slice encoding and massive processing power; its full-picture architecture provides HDTV at 8Mb/s; a H.264 tool-set combines with sophisticated look-ahead algorithms, extensive motion and spatial prediction searches and advanced mode decision algorithms to optimize encoding efficiency.

770-236-5000
www.scientificatlanta.com

NTP625 — NTP Technology

A multinorm audio routing matrix; can be installed either as a master control room matrix system or associated to user surfaces and/or control panels for use in studios.

+45 4453 1188; www.ntp.dk

Neptune — Pebble Beach Systems

New improvements to the automation system include increased capacity for large systems, providing virtually unlimited expansion, SNMP alarm alerts, improved media transcoder functions, comprehensive timers, extended search and replace functions, and new drivers to support a range of additional devices.

+44 1932 333 790; www.pebble.tv

SBT3-7500 ACT-L3 — Streambox

The encoder solution is built on Streambox's ACT-L3 codec and advanced proprietary video compression technology; is integrated in one compact portable device that features a lower power requirement to flexibility of mobility without sacrificing broadcast-quality video; matches MPEG-2 video quality at a 75 percent lower data rate and is up to 50 percent more efficient than MPEG-4.

206-956-0544; www.streambox.com

1053 — Fischer Connectors

HDTV connector features an integrated Corning UniCam fiber-optic contact, which eliminates the need for epoxy and polishing during termination; is practical and economical to assemble and repair in the studio and in the field; is fully SMPTE signal- and cable-compliant; employs two single-mode fiber contacts, two high-voltage contacts and two signal contacts.

678-393-5400
www.fischerconnectors.com

Cifer — Digital Vision

A universal standards converter; a joint development with Pro-Bel; converts between all the primary HD standards (regardless of frequency), any SD standard, and from SD to HD or vice versa with no loss of picture quality.

818-769-8111; www.digitalvision.se

Vista 5 — Studer

The 32-fader digital audio console consists of 20 channel strips, optimized for input channel operation, and 12 additional versatile strips for operating output and input channels; by using the standard Vistonics screen, up to 52 outputs are under immediate control; a total of up to 240 channels can be accessed from the desk and laid out in any order with the Vistonics system, giving instant control over all related channel functions.

866-406-2349; www.studer.ch

MC-400 — Utah Scientific

Channel branding system can be used as a standalone or part of a multichannel master control system under the control of an MC-2020 master control network; can be installed in an output slot of a UTAH-400 router frame, giving the processor full access to every signal within the router; system automatically changes between SD and HD operation by sensing the reference input signal.

801-575-8801
www.utahscientific.com

SoftVoICE — Clear-Com

A virtual intercom panel; allows PC users to communicate with the matrix intercom system over IP; the matrix can mix connections with digital wired, digital wireless and IP PCs to provide all user requirements, near and remote.

510-496-6600; www.clearcom.com

HD-e series — Thales Angenieux

Cost-effective lens series consists of three zoom lenses: the 19 x 7.3 AIF HD-e, with a zoom ratio of 19X and focal length ranging from 7.3mm to 139mm; the 10 x 5.3 AIF HD-e, with a zoom ratio of 10X and focal length ranging from 5.3mm to 53mm; and the 26 x 7.8 AIF HD-e, with a zoom ratio of 26X and focal length ranging from 7.8mm to 203mm.

973-812-3858; www.angenieux.com

LC-42 and LC-47 — Barco

LCD displays feature full high-definition resolution (1920 x 1080) and large display sizes (42in and 47in diagonal); compatible with a wide variety of signal sources; capable of showing analog and digital video, as well as data content, in sequence or picture in picture; feature a fanless design for low noise, frame lock and low-power consumption; accept 1080p signals.

678-512-6100; www.barco.com

Flexiscope Microflex — Hamlet

A multiformat, multistandard handheld waveform, vector, audio and picture monitor; uses a built-in 3.5in diagonal high-quality high brightness TFT display; shows the picture in 4:3 or 16:9 formats; also shows conventional waveform, vector and audio displays together with data analysis; easy to plug-in input option modules allow operation in all current formats and enables future standards to be accommodated.

949-597-1053; www.hamlet.us.com

Multibridge Pro — Blackmagic Design

A bidirectional capture and playback converter that instantly switches between HD and SD; features 4:2:2 and 4:4:4 video quality; includes the new high-speed PCI Express connection; can be used as a high-quality converter or editing system.

702-257-2371; www.blackmagic-design.com

Agility Web — Anystream

Web-based publisher features load-balanced batch encoding capabilities, supporting numerous format versions and content volume; supports mobile formats and network distribution profiles, including Nextreaming and AMR narrowband audio for new-generation handsets and turnkey distribution profiles that deliver media to mobile service providers.

202-661-4665; www.anystream.com

Digital Plus — Dolby

HD audio technology is build on Dolby Digital; designed for the delivery formats of the future, but remains fully compatible with all current A/V receivers; features multichannel sound with discrete channel output; channel and program extensions can carry multichannel audio programs of up to 7.1 channels and support multiple programs in a single encoded bit stream; supports data rates as high as 6Mb/s.

800-243-2001; www.dolby.com

BrightEye series — Ensemble Designs

Nine added units in the palm-sized equipment line offer new HD converter and sync pule generator choices; includes an HD or SD analog-to-digital converter with either an electrical or optical output and eight-channel audio multiplexing; BrightEye 55 is a genlockable sync pulse generator and test signal generator in a small form factor; is useful for mobile applications or for facilities with space limitations; dual-format HD and SD optical and electrical converters provide solutions for long cable runs; supports single- and multimode fiber.

530-478-1830
www.ensembledesigns.com

Turbo iDDR — Grass Valley

Leverages the digital storage, networking and media-management capabilities of the company's Profile video servers; fits into any existing environment; users can load content as audio or video, or as files from removable media.

503-526-8200; www.grassvalley.com

5-MC — Euphonix

Designed for audio post applications, the console interfaces directly to digital audio workstations, such as Steinberg's Nuendo and Merging Pyramix, using the EuCon high-speed control protocol; control surface can be fitted with eight to 48 channel strips; has eight knobs per strip, a moving fader and TFT screen, and an MC Intelligent Application Controller for master console functions; includes integral control of the DAW.

650-855-0400; www.euphonix.com

XP series — Link Research

The wireless camera range consists of six major systems; all of the systems are fully agile in the 1.95GHz to 2.7GHz or 3.4GHz to 3.58GHz band; a new 7GHz transmitter counters the increasing problems of frequency congestion and works in the 6.4GHz to 7.1GHz band.

+44 1923 474 060; www.linkres.co.uk

X-Link — MEDIORNET

Fiber-optic signal transport is designed for broadcast, OB, events and multimedia applications; integrates video, audio, data and control signals into a single, low-latency and secure network, without the need for compression; uses intelligent nodes linked by fiber-optic cable; is scalable from a single switch to a large, meshed wide area network spanning hundreds of kilometers; is modular and future-proof.

954-704-1552; www.mediornet.com

Cheetah DRS — PESA

A multiformat audio router that scales from 64 x 64 in 1RU up to 2048 x 2048 in 36RU; inputs or outputs can be added as needed by adding another 1RU frame; can be used as standalone 1RU system or expanded with either a single Cat 5 or fiber expansion cable; each frame supports redundant power, redundant control and quick access front-loadable, hot-swappable matrix cards.

631-912-3101; www.pesa.com

XDCAM HD PDW-D1 — Sony

An XDCAM disc drive unit; specifically designed for use in nonlinear editing systems; the drive unit supports the i.LINK interface supporting DV I/O and File Access Mode protocols, allowing connection with a variety of nonlinear editing systems; features a highly compact and lightweight design.

800-686-7669
www.sony.com/professional

HE4000 — Tiernan Radyne

Dual-program video encoder can simultaneously encode one HD and one SD video stream, as well as up to four stereo audio pairs; supports 1Mb/s to 160Mb/s encoding on 4:2:0/4:2:2 signals; features a two-pass encoding process and built-in video upconverter and downconverters.

602-437-9620
www.radynecomstream.com

SCamp — Telecast Fiber Systems

An inline SMPTE cable amplifier/repeater for 311M copper/fiber cable; receives and retransmits optical signals on each fiber at -7dBm; is powered by the camera's base station; features 15dB of new optical budget and integral optical power metering.

508-754-4858
www.telecast-fiber.com

TFT-MegaPixel Marshall Electronics

HD monitor provides high-pixel density for 10.4in to 3.5in displays in one-, two-, three- and four-screen configurations; newly developed proprietary technology delivers a completely digital image process onto each screen; features improvements in brightness, contrast ratio and viewing angles; configurations are available with HD-SDI, SDI, DVI, component HD/SD and composite video inputs.

310-333-0606; www.lcdracks.tv

OptiLinx OLX-3000 — Opticomm

A versatile, multipurpose, non-blocking transparent switch; provides high-speed switching between ports with minimal effect on overall network latency; is capable of switching digital signals up to 4.25Gb/s with any of its 144 ports, all in a compact 4RU chassis.

858-450-0143; www.opticomm.com

Synergy MD — Ross Video

Multidefinition production switchers; new formats include SD at 525 and 625 lines and HD at 720P, 1080i and 1080psf with 50Hz, 59.94Hz and 24fps rates; the WARP engine adds curvilinear effects to the Squeeze & Tease 3-D DVE; Squeeze & Tease 3-D adds just-like-a-wipe (JLAW) transitions, making it simple to perform a background or any combination of background and key transitions.

613-652-4886; www.rossvideo.com

OnAir — SintecMedia

Manages airtime sales and traffic operations, as well as content acquisition, broadcast rights, long-term and detailed schedule planning, and promotion planning; new management tools allow broadcasters to manage the streaming of video and data in parallel to regular events; other enhancements include revenue and inventory management, internal process controls and multicampaign promo optimization.

917-606-5310; www.sintecmedia.com

XBL — Artec Technologies

Broadcast logger unifies compliance recording, archiving, monitoring, streaming and media service into one unit; multiple numbers of TV channels can be recorded together with metadata such as EPG, as-run logs, closed captions and Teletext; is operated and administered via network-based Web clients; clips can be produced in WM9, MPEG-2, Real or 3G format.

+49 5441 5995-0; www.artec.de

ES-206U — ESE

A video time and date inserter that references an internal standalone clock; the clock is line-frequency referenced; an internal DIP switch allows selection of a crystal time base reference; six digits of time and six digits of date are superimposed onto a video signal looped through the unit.

310-322-2136; www.ese-web.com

Matador — FBBT

Software monitors, manages and helps control workflow by collecting, organizing, consolidating and leveraging network data from broadcast production, playout and transmission systems; can reduce salary and training costs of engineers and support staff by 25 percent; reduces disruptions and outages.

+44 2890 317990; www.fbbt.co.uk

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Univision Network the leading Spanish Television Network in the US, is seeking qualified applicants for the position of Production Technical Supervisor. The successful candidate will be in charge of our standard definition expando mobile unit based in Miami, Florida. Responsibilities include the operation, maintenance, and equipment upgrades of the unit.

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Please send resumes via e-mail to **ecaro@univision.net** or fax to 305-471-4286. No phone calls will be accepted.

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BROADCAST ENGINEER/TECHNICIAN

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SR. ELECTRONIC DESIGN ENGINEER, BROADCAST EQUIPMENT

Marshall Electronics in El Segundo, CA has an immediate opening for Sr. Electronic Design Engineer with at least 5 or more years of experience with digital video / audio design. Deep understanding of hardware / firmware, extensive knowledge of high definition signals and processing, HDSDI, DVI, HDMI, AES-EBU, Video Scaling, De-interlacing, Color Space Conversion, Audio Embedding / De-Embedding. Previous work experience with design of LCD driving boards is a plus Candidate must have the ability to assume a hands-on Engineering Management role. Good verbal and written communication skills are a must. This person should be enthusiastic about what they do and the product they design. BSEE/MSEE desired. Submit resume to tami@marshallelectronics.net

CHIEF ENGINEER

KMEX-TV Channel 34, LA's leading Spanish language television station, seeks a highly motivated professional to oversee the broadcast engineering operations, including the design, installation and maintenance, both hardware and software, of all broadcast equipment and RF systems. Individual will also establish and maintain technical quality standards, forecast, prepare and maintain departmental operational and capital budgets. Must be a strong team player with excellent interpersonal skills. Familiarity with an all digital facility and experience with high power UHF transmitters and antenna systems are essential. Bilingual English/Spanish is desired. Requires a BSEE or equivalent technical training/work experience, FCC General Class License and Senior SBE Certification. 10 years of TV Broadcast Engineering experience to include supervisory roles in a union environment. Please send resumes to 5999 Center Drive, Los Angeles, CA 90045 or via fax (310) 348-3414 attention: Human Resources. EOE.

MAINTENANCE TECHNICIAN (GROUP III) WETA, ARLINGTON, VA

WETA-TV, public television serving the greater Washington DC area, seeks a dedicated Maintenance Technician (Group III). Primary responsibility is to perform routine preventive and corrective technical maintenance of all equipment (including at remote locations) associated with 24/7/365 television operations and to assists in design, construction, integration and installation of new equipment and systems. College degree in electronics and minimum five years experience in television/radio engineering systems maintenance. SBE Certification (television) desired. Must have knowledge of and experience in working with digital television equipment, including HDTV & Satellite & ATSC terrestrial transmission systems. Please visit www.weta.org for the full job description or to apply on-line. WETA is an EOE employer.

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Bloomberg TV has a challenging opportunity within the Broadcast Engineering Group. You will be responsible for coordinating and performing maintenance of equipment as needed to support live broadcast operations. We will look to this Engineer to be pro-active, and troubleshoot production and on-air issues. You will also be responsible for updating transmitter/shift logs, conducting tests and diagnostics evaluations, and executing checklists to discover equipment and/or system anomalies. In addition, you will have the opportunity to coordinate and install new components and systems, as well as create and update engineering documents and diagrams.

REQUIREMENTS:

Qualified candidates will have strong knowledge of technical TV and radio broadcasting equipment (including cameras, robotics, VTRs, routing equipment and production switchers). Knowledge of broadcast automation systems and thorough understanding of PC hardware and software operations. Ideal candidate should possess strong troubleshooting skills and have the ability to work independently and quickly in high-pressure situations.

Must be flexible - may include evenings, nights and weekends.

Apply online at http://careers.bloomberg.com, choose "Job Search" then "News" Select "Broadcast Operations - Broadcast Engineer"

Help Wanted

ENGINEER

Provide scheduled and emergency maintenance of equipment and facilities to maintain the high quality and technical integrity of News 12 Traffic & Weather. Responsible for receiving and transmitting video and audio and operating other equipment as part of the regular station operation as well as maintaining equipment, tool and parts inventory and service records. Must participate in the planning and implementation of technical projects as well as assist in the wiring of facility and training of co-workers.

Experience with DOS, MS Windows 2K, XP, NT, Irix, Linux and Mac OS. Extensive knowledge of IT Networking, A+, Network +, or MSCE certification preferred. Familiarity with Automation, DDR,'s, Routers. and various tape formats. Ability to read and follow schematics and facility system wiring diagrams. Experience with equipment integration and installation. Familiar with test and measurement equipment. Experience with troubleshooting electronic circuits down to the component level. Some lifting of heavy equipment required.

Minimum of an A.A.S. in Electronic or Electrical Engineering Technology or equivalent experience preferred. Minimum four years exp with television broadcasting audio-video equipment preferred. Must be able to work flexible hours in a high-pressure environment with strict deadlines. To submit your resume, please go to the URL below. Cablevision is an equal opportunity employer.

http://jobs.brassring.com/1033/ASP/TG/cim_home.asp?partnerid=25032&siteid=5181&Areg=409BR&Qsite=5180&Codes=EXT,IBCC

TV TECHNICAL SPECIALIST

Raycom Media has an immediate opening for a TV Technical Specialist. Candidate must possess a minimum of ten years broadcast television experience with an emphasis on RF maintenance as well as TV technical project management. Position requires varied levels of travel in support of Raycom 33 station group. Relocation to Montgomery, AL is preferable. Send your resume to: bthurber@raycommedia.com. EOE-M/F/D/V

BROADCAST VIDEO ENGINEER

NEP Studios has immediate need for experienced Broadcast Video Engineer for on-site client services and technical support in NYC studio. Degree with technica training in Engineering, 2+ years experince broadcast engineering, Avid ACSR certification, knowledge of studio facilities & equipment, communication and supervisory skills required. Resume, salary history to: HR; **hr@nepinc.com** Fax: 412-820-6045; NEP Broadcasting, 2 Beta Dr. Pittsburgh, PA 15238. **www.nepinc.com**

Help Wanted

BROADCAST ENGINEER

KLCS-TV/DT (Los Angeles, CA) seeks an experienced self-starting Broadcast Engineer. The ideal candidate will have a minimum of five years experience in a broadcast cable, or post production facility with responsibility for the maintenance of technical equipment used in color video production, recording, and transmission, and the maintenance of FCC-required logs and reports. This position requires outstanding people skills, the ability to work flexible shifts, and willingness to participate in cutting edge broadcast technology. Visit **www.lausdjobs.org** for the detailed job announcement and to apply online. Los Angeles Unified School District EOE

MOBILE UNIT ENGINEERS / DRIVERS

TRIO VIDEO, the Midwest's leading mobile television production company, is seeking qualified applicants for:

Mobile Unit Engineers to operate and maintain its standard and high definition mobile unit fleet from its base of operations in Chicago. Responsibilities include coordinating, troubleshooting and maintaining on-site mobile unit operations and equipment. All experience levels considered with: engineering degree, technical training, multiple years of hands-on broadcast experience or any combination.

Drivers for long-haul and local tractor/trailer transport from its base of operations in Chicago. Current CDL Class A license required with minimum of 3 years tractor/trailer experience.

Qualified candidates should send their resume to: Trio Video, 2132 West Hubbard, Chicago, IL 60612; resumes@triovideo.com; fax 312-421-0361.

BROADCAST MAINTENANCE TECHNICIAN

Position requires a self starter possessing strong computer skills with Microsoft Windows and MAC OS and Networking. This position also requires experience with video servers such as AVID ISIS, UNITY, Seachange or HP. Experience with SDI and AES/EBU digital standards, AVID Media Composer, Beta SP/SX, News ENG, Vinten Robotics, Sony Studio Cameras, Telex ADAM RTA & IFB systems and general studio maintenance and studio operations. Comark transmitter operation a plus. Knowledge of troubleshooting to the component level and basic understanding of FCC rules a must.

Send resumes to Angelo Macci, Maintenance Manager, WTNH-TV, 8 Elm Street, New Haven, CT 06510. No phone calls please. EOE

Legal Notices / Bids

Northeastern Pennsylvania Educational Television Association (WVIA-DT) will be accepting sealed bids for a HD production project. The project includes the purchase of three studio cameras, production switcher, intercom system, audio console and video /audio monitoring. The bid specifications can be downloaded at www.wvia.org/about/bidspecks For additional information you can contact Joe Glynn, at joeglynn@wvia.org

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The end of an era

"Top of the Pops" goes off the air after 42 years.

BY PAUL MCGOLDRICK

I entered the world of broadcasting in September 1963 when I was hired as a technical trainee at the BBC. The Beeb paid me a salary and, at the same time, trained me in the magical arts of broadcast engineering and sent me to college to learn all the electronics theory.

So there were no vacations during college breaks for me. I was shipped off to different locations in both radio and television, in studios, recording areas, telecine, outside (remote) broadcasts and transmission. It was a hell of a lot of fun for an 18-year-old.

I was fortunate to be rotated through Manchester at a time when the nearly new "Top of the Pops" program was on the air. Every Thursday evening, the studios at Dickenson Road (a converted church) turned into a zoo.

The week's top 20 songs were all mimed by the stars involved or were filmed video performances. Miming was de rigueur at that time because there was no way that a television studio could reproduce all the recording effects that were starting to be applied in the post production of vinyl.

Through the doors of "Top of the Pops" passed the big stars of the day, including the Rolling Stones, Petula Clark and the Who. After the second show aired, the head of BBC-1 took a call from the Beatles manager, Brian Epstein, who asked the program to play the Fab Four's new single. The response was that if they showed up in person, they could play. They did, and it was tremendous publicity.

Throughout my time at the show, I witnessed events such as a raid from the Greater Manchester Police when the Jackson Five were found with drugs — and let off with a caution. Stars would fight in the canteen over nothing, nervous for their first appearance on the show.

Their concern was probably because the show was live at the time. Thirty minutes of on-air adrenalin pumped through the entire technical and production team.

The first producer of "Top of the Pops" was Johnnie Stewart. He was hands-on and absolutely brilliant at his work; the show was his format. He did most of the directing but left the most important job of calling all the shots during transmission to the production secretary. Rarely did anything go wrong and, when it did, the viewer never got to see it. Stewart created an icon and deserves the credit for it.

Knowing the camera angles that were going to be used, I was on camera regularly, much to the pleasure of my 90-year-old grandmother watching in London. "There's Paul!" Ah, technology.

When I was working a part-time job on the show, such as telecine, I would go down to the studio floor and dance with ladies. Knowing the camera angles that were going to be used, I was on camera regularly, much to the pleasure of my 90-year-old grandmother watching in London. "There's Paul!" Ah, technology.

The era of "Top of the Pops" has gone. The show was unable to fight all the digital pop channels with their music videos and huge budgets. The last program, a wrap-up of the 42 years of the show, was broadcast at the end of July. It was meant to be broadcast live — for the first time in more than 30 years — but the original host, Sir Jimmy Saville, had a conflict with an important event in Scotland.

Many people who wrote about the show's demise focused on its slow decay, with the ultimate insult being its move from the mainstream BBC-1 to BBC-2. But nobody talked about why the show had been so successful.

The floor manager, Cecil Korer, was also a major player in the success of the show in the early days. And Harry Goodwin took wonderful still photos of the stars for many years on the studio floor.

So, "Top of the Pops" has gone, but it lasted 17 years longer than Dick Clark's "American Bandstand." The program was a chronicle of an era, thanks to the largely unsung heroes behind the scenes. We will not soon see its like again. BE

Paul McGoldrick is an industry consultant on the West Coast.

? Send questions and comments to: paul_mcgoldrick@prismb2b.com

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