DECEMBER 2007

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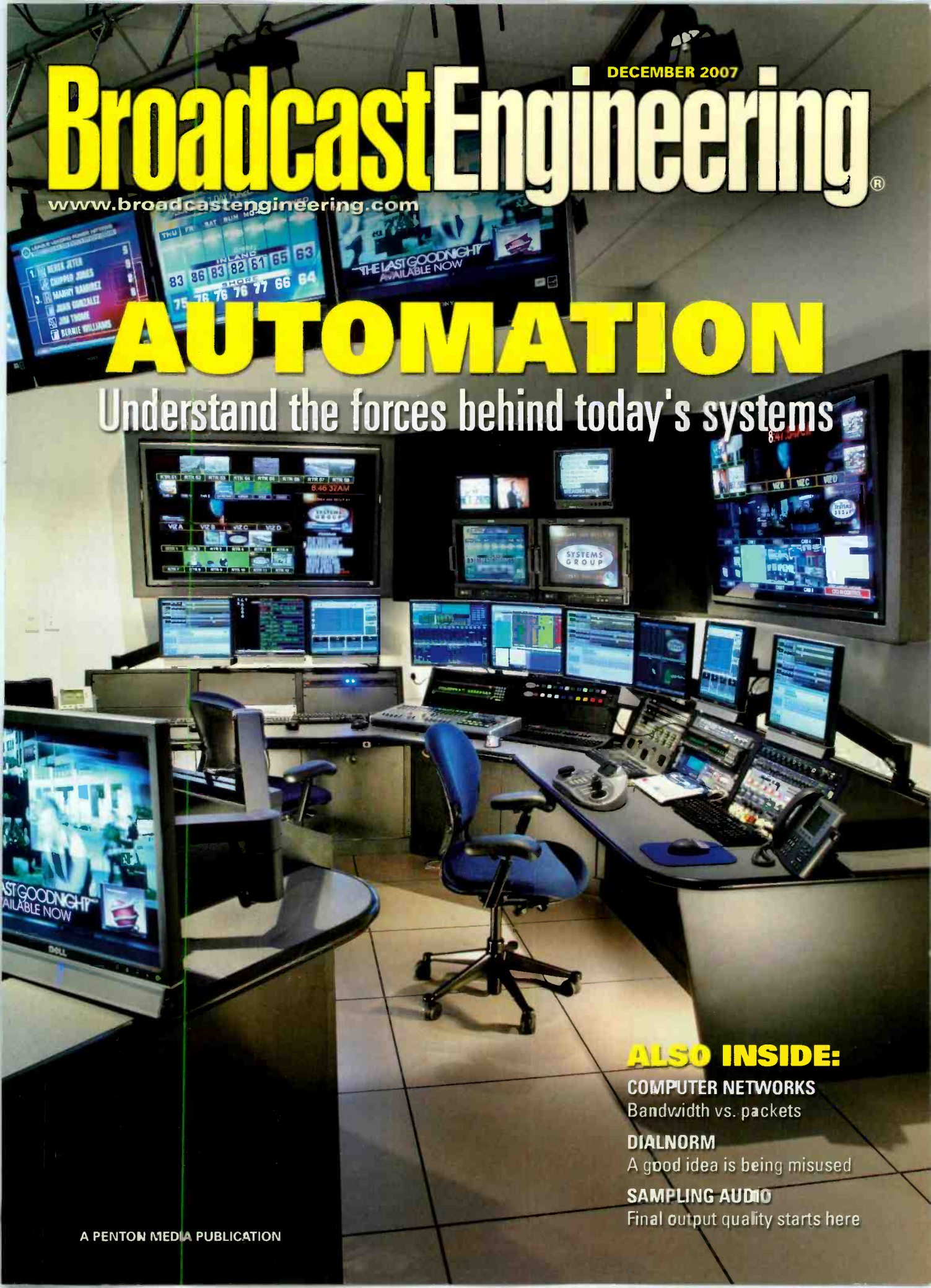

AUTOMATION

Understand the forces behind today's systems

ALSO INSIDE:

COMPUTER NETWORKS
Bandwidth vs. packets

DIALNORM
A good idea is being misused

SAMPLING AUDIO
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A PENTON MEDIA PUBLICATION

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TABLE OF CONTENTS

VOLUME 49 | NUMBER 12 | DECEMBER 2007

Broadcast Engineering®

FEATURES

BEYOND THE HEADLINES

DOWNLOAD

FCC UPDATE

DIGITAL HANDBOOK

TRANSITION TO DIGITAL

COMPUTERS & NETWORKS

PRODUCTION CLIPS

continued on page 6

ON THE COVER:
WFSB-TV in Hartford, CT, relies on Harris ADC 100 automation. Photo courtesy The Systems Group. Photo by Andy Washnik.

THIS MONTH'S FREEZEFRAME QUESTION

At this year's NAB convention, the association's engineering department released the tenth edition of the "NAB Engineering Handbook." How many sections does the handbook contain, and how much does the record-setting book weigh?

Readers submitting correct entries will be entered into a drawing for *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "Freezeframe-December" in the subject field, and send it to: editor@broadcastengineering.com. Correct answers received by Feb. 1, 2008, are eligible for the drawing.

Some things you **can't** control.
Some things you **can**.

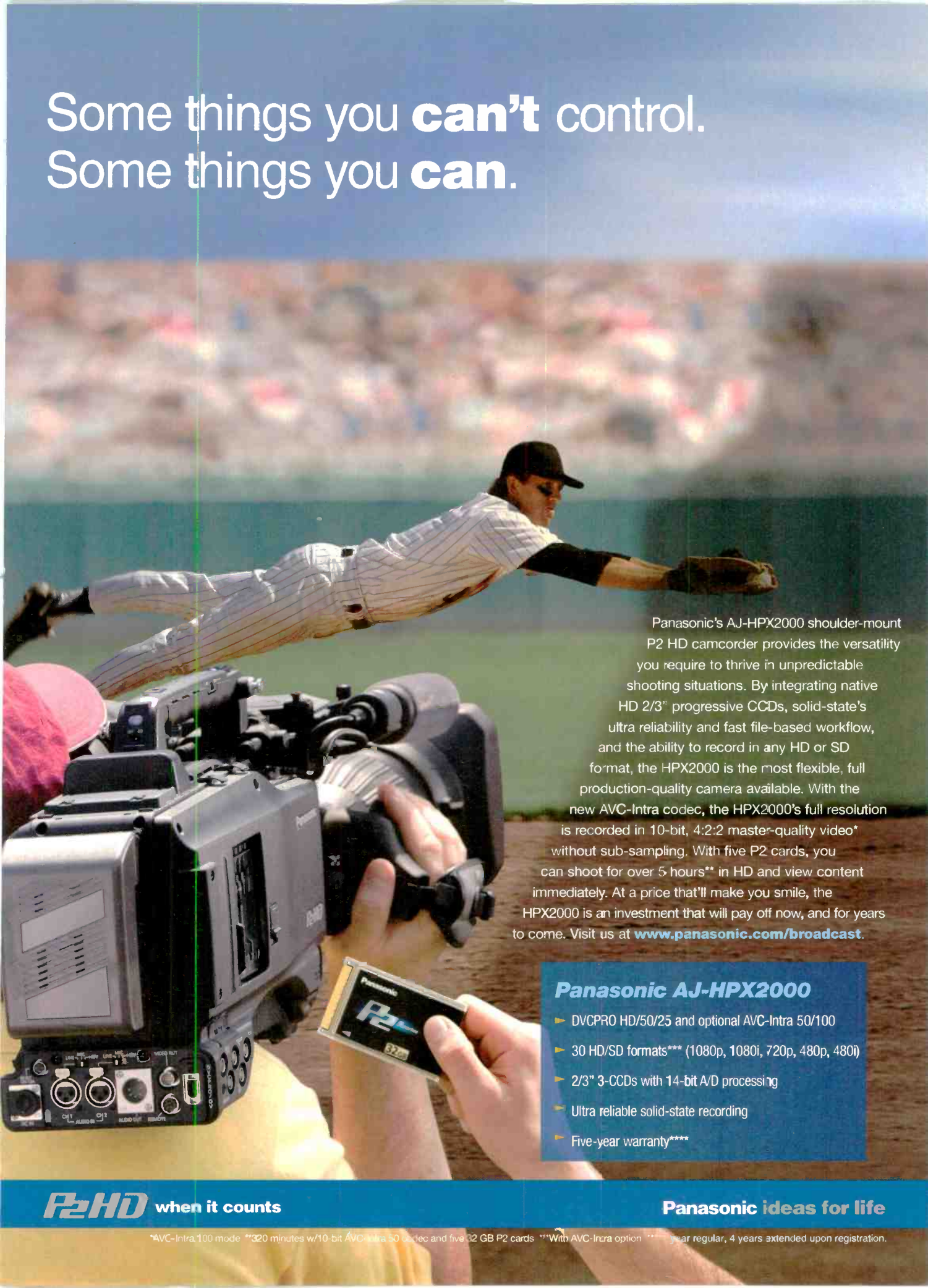

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TABLE OF CONTENTS (CONTINUED)

VOLUME 49 | NUMBER 12 | DECEMBER 2007

SYSTEMS INTEGRATION

SHOWCASE

TRANSMISSION & DISTRIBUTION

NEW PRODUCTS & REVIEWS

APPLIED TECHNOLOGY

TECHNOLOGY IN TRANSITION

NEW PRODUCTS

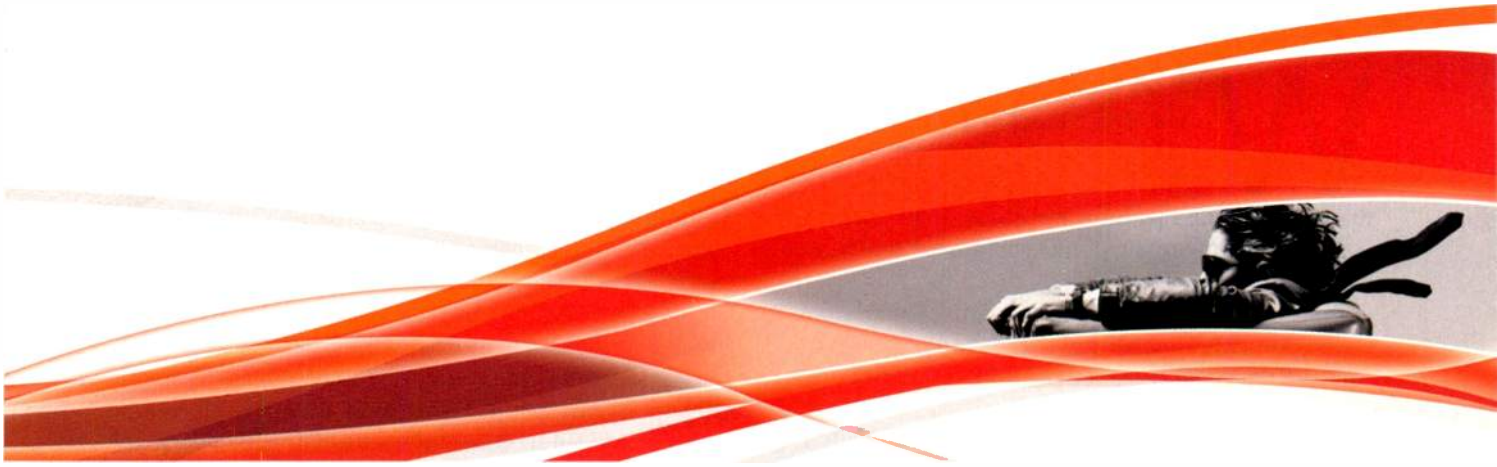
DEPARTMENTS

OCTOBER'S FREEZEFRAME ANSWER

Ten years ago, these marketing phrases appeared in *Broadcast Engineering* magazine. Match the phrases to their respective companies.

DTV ready	Sony, insert page 51
Digiclean	Snell & Wilcox, page 79
The answer is always	Dolby, page 47
It's Un-Reel	360 Systems, page 35
Next level solution	Harris, page 33
The DTV solution for every resolution	NDS, page 31
We're bringing tomorrow together	Philips, page 3
Next generation television and video	Panasonic, page 5

READERS WHO ANSWERED CORRECTLY:
There were no correct submissions.



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David vs. Google

With all the media noise recently generated over Google's predicted Gphone, you'd think all other technology was blasé. The press gave the impression that the Gphone's features would be so all-encompassing that the only other things you'd need to live would be food and water.

The reality is that the Gphone is not a phone at all. It's a software development kit called Android. What does Android do, you ask? First a little background.

In July 2005, Google bought a small, young start-up company called Android. This company was chock-full of mobile-device code-writing talent. This began the media's prediction of a soon-to-come Gphone.

Sixteen months later, Google announced Android, describing it as an open software platform consisting of an operating system, middleware, user-friendly interface and applications. The key here is the word *applications*, which is geek-speak for functions and features.

What threw most observers is that Google decided not to compete against Apple's iPhone with a Gphone. Rather, the Internet giant hopes to change the rules by forming a consortium of 34 companies under an umbrella called The Open Handset Alliance. These companies have agreed to use Android as the platform for products they will develop. Using a common platform across many handsets would revolutionize the cell phone industry. The benefits would be incredible for both manufacturers and users.

In addition, Google has committed $10 million to reward developers coming up with new ideas developed on Android.

Where does television fit in this mix?

Just prior to this year's NAB convention, the ATSC announced it was launching a development process to create a terrestrial broadcaster DTV-to-mobile broadcast standard called ATSC-M/H. The goal is to enable TV stations to broadcast video to mobile receivers.

The last we've heard from ATSC was that it had received 10 responses to its RFP. Two of those are A-VSB (Advanced VSB) promoted by Samsung and Rohde & Schwarz, and MPH (Mobile-Pedestrian-Handheld) proposed by Harris and LG.

Some might argue that I'm comparing apples to oranges. After all, reception technology in a handheld isn't an application. Or is it?

Users don't care a hoot about whether their cell phone or mobile device uses ATSC or Google's Android to get video. They won't care if it's streamed or broadcast. They just want their MTV and other programs.

So, while Google hands out $10 million to build better handhelds, ATSC works with donated time and unpaid expertise.

Broadcasters need a place at the video-to-mobile table. One way stations and engineers can help protect their future is to participate in the Open Mobile Video Coalition. This is an alliance of U.S. commercial and public broadcasters committed to the development of mobile digital television. The coalition claims its members operate more than 420 stations. However, that means two-thirds of U.S. broadcasters are not participating.

Until someone can hand out $10 million to support an ATSC-compatible solution, it's up to individual stations to make mobile digital television a priority. Give these guys your support. Visit the Open Mobile Video Coalition at *www.openmobilevideo.com*. BE

Brad Dick

EDITORIAL DIRECTOR

Send comments to: editor@broadcastengineering.com

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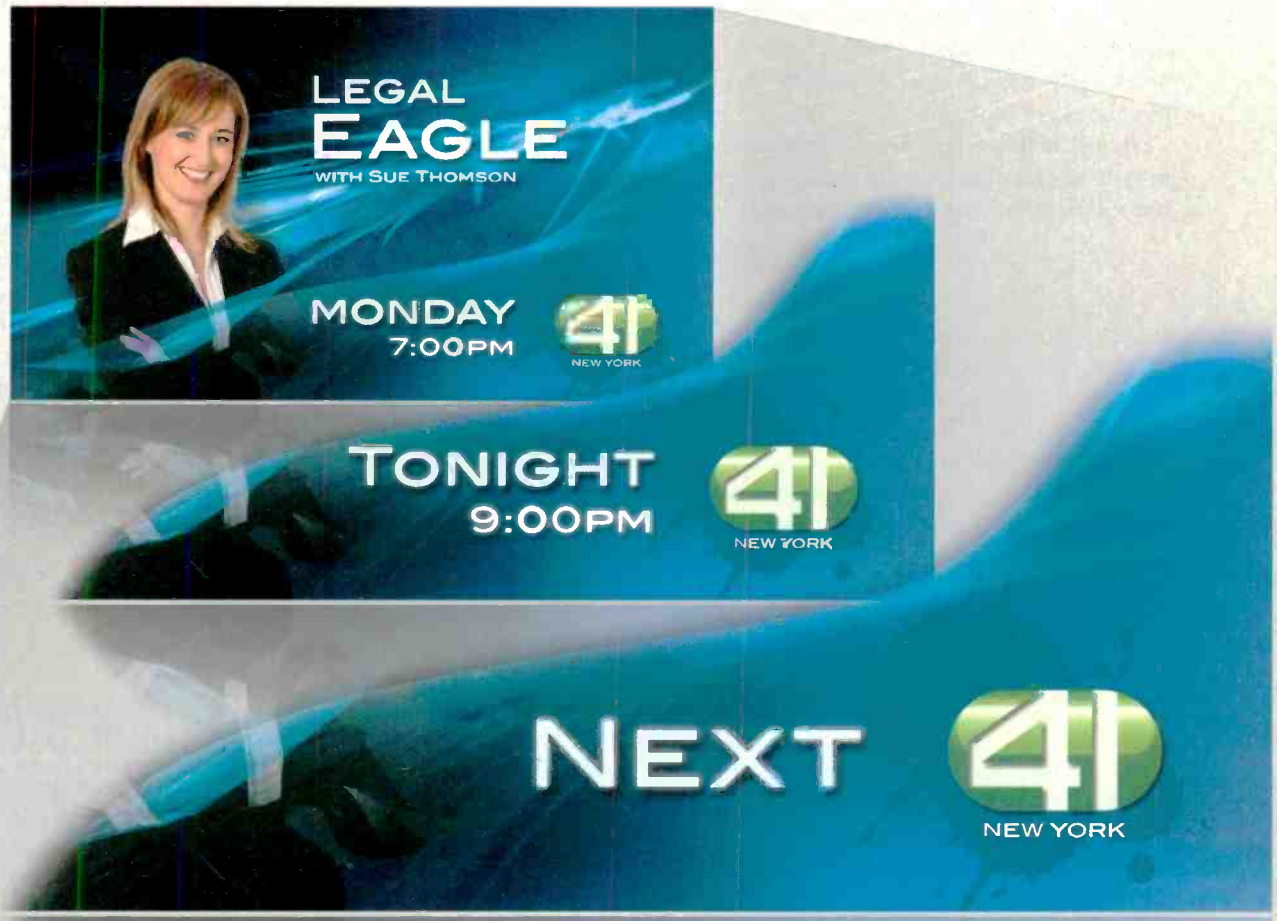

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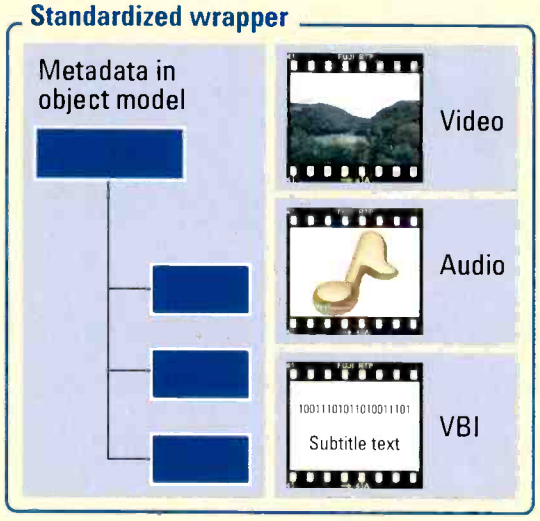

The EBU/SMPTE Task Force recognized that there was a need for a standardized wrapper that could hold video, audio, vertical blanking interval (VBI) and other data essence, along with metadata in an object model.

Metadata interchange

Dear Brad Gilmer:

I thought the July 2007 Computers & Networks column titled "Metadata interchange" was a great article. Clearly standardized metadata is becoming increasingly necessary. Sure, today we may have standards, but I think we have too many of them.

I hope the Task Force's work on a standardized wrapper goes well and that its recommendations are universally adopted. Standards aren't really standards if everybody's got a different one.

Mike
New Mexico

Brad Gilmer responds:

The industry has talked about the importance of metadata for many years. I think everyone realized that it is vital, but users are just beginning to harness the power this can bring to their facilities. Why did it take so long? Well, first tape-based technology needed to be converted to files. Then video and audio needed to be interchangeable. It turns out that this was no simple feat! Finally, metadata was at a point where it could aid workflows, but before it could do that, it needed to get past proprietary solutions. All of this took some time, but I think you will see major advances in this area in the coming years.

DTV education needed

Dear editor:

I am president of WatchTV, a Class A and LPTV operator in Oregon. I am also a past president and current board member of the Community Broadcasters Association (CBA), *www.dtvnow.org*. By writing you this letter, I hope to shed some light on an issue that the CBA has with the upcoming DTV transition.

First, let me give you a little background information. TV translator, Class A and LPTV stations are exempt from the Feb. 17, 2009, DTV deadline. There are more than 7300 such stations in the United States, which is more than four times the number of full-power stations. That means only one-fourth of transmitters will cease analog broadcasting in 2009.

The CBA is concerned that publicity about the DTV transition is misleading if it suggests that no over-the-air analog TV service will be available after the 2009 deadline.

Moreover, Class A and LPTV station viewers should not be misled into believing that they must buy digital receivers to continue to view these stations. These consumers will be further misinformed if they are encouraged to subscribe to cable and satellite television services that do not carry Class A and LPTV stations.

Here's what should be done in order to avoid misleading viewers:

- Publicity about the digital transition should be fully informative.
- Class A and LPTV stations need additional opportunities to apply for digital companion channels.
- Mutually exclusive digital companion applicants should be permitted to settle by selecting new channels that are not mutually exclusive rather than being forced into auctions.
- Congress should be encouraged to pass legislation affording must-carry rights to all television broadcasters, not just full-power TV broadcasters.

The CBA has met with FCC commissioner Jonathan S. Adelstein and Rudy Brioché, the commissioner's legal assistant for media issues, with its concerns. We hope that the FCC and other organizations who are helping to advance the DTV transition will remember that some analog service will remain available after the transition. We also hope that consumers will be educated rather than misled.

Greg Herman
President
WatchTV

Test Your Knowledge!

See the Freezeframe question of the month on page 6.

Send answers to editor@broadcastengineering.com

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Capturing the future

Divergent options may influence decisions on field acquisition gear for local TV news.

BY CRAIG BIRKMAIER

The news industry is in turmoil. The Internet is changing the fundamentals of how Americans (as well as people globally) get their daily news fixes. Virtually all of the traditional news sources are losing audiences as more people turn to the Internet to augment the sources they have traditionally relied on for local, national and international news.

Newspapers are taking big hits in subscriber levels; however, they are embracing the Internet and the economic advantage of creating and distributing bits as opposed to physically distributing bits of dead trees with ink blotches. While the newspaper industry has already experienced massive consolidation, most markets have only one economically viable daily newspaper today. Those that remain are acutely aware of the challenges to stay relevant in a world where most of what gets printed is a rehash of the stories that radio, TV and the Internet have already covered over the last 24 hours.

The situation in the newspaper industry has grown so acute that the chairman of the FCC is promoting the idea of newspaper and TV cross-ownership in the top 20 U.S. TV markets. (For more, see "Web links" on page 14.) In an op-ed piece published in the "New York Times," FCC chairman Kevin Martin noted falling newspaper circulation and dwindling advertising dollars as indications of the poor health of the industry. (See "Web links.")

Martin wrote: "At the heart of all of these facts and figures is the undeniable reality that the media marketplace has changed considerably over the last three decades. In 1975, cable television served fewer than 15 percent of television households. Satellite TV did not exist. Today, by contrast, fewer than 15 percent of homes do not subscribe to cable or satellite television. And the Internet as we know it today did not even exist in 1975. Now, nearly one-third of all Americans regularly receive news through the Internet."

The long-standing advantages of the electronic news media — sound and pictures — are available to any news organization.

What Martin did not mention is that the long-standing advantages of the electronic news media — sound and pictures — are available to any news organization when a viewer turns to an Internet news portal for the latest stories. In many cases, audio and video coverage of a story is available on demand, not just from the evening news.

Such is the reality in a world filled with inexpensive SD, and now HD, camcorders and citizen news reporters equipped with phones that capture high-resolution stills and video.

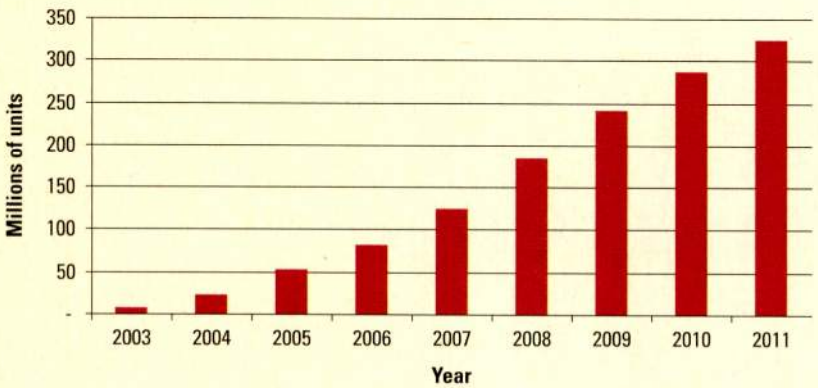
Which path to follow?

It's not like things are all rosy in TV land either. In its report on "The State of the News Media in 2007" (see Web links), the Project for Excellence in Journalism says: "Local TV news, long America's most popular information medium, is hardly proving immune to the revolution changing journalism. In 2006, audiences appeared to be dropping for newscasts across all time periods during the day — even mornings, which had been growing."

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

Worldwide smart phone shipment forecast

By 2011, global shipments are expected to reach 324 million



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- Automated broadcast media file QC and loudness correction
- Pay-per-view (PPV) file analysis and loudness correction

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Local TV news organizations, already challenged by declining ratings and competition from the Internet, are in many cases facing budget cuts. This comes at a time when the investment in new technology for newsgathering may be critical to their future prosperity.

To further complicate the situation, stations are confronting the imminent transition to DTV, including the ability to deliver widescreen images in standard and high definition. Upgrading a station's news organization to HD is the most visible way a station can demonstrate it is embracing DTV. This may become a competitive necessity as other stations in a market upgrade to HD.

As broadcasters approach this crossroad, the choice is not which path to follow, but how to follow multiple paths:

- Should the station upgrade to HD for studio segments of its newscasts?
- Should the station upgrade to HD ENG for field acquisition?
- Should the station divert or add resources to take the stories that are created for on-air use to the Internet?

Web links

- "Martin proposes changes to cross-ownership rules," *Broadcast Engineering's* "Beyond the Headlines" newsletter *http://broadcastengineering.com/RF/martin-changes-cross-ownership-rules-1115*
- "The Daily Show," by Kevin J. Martin, "The New York Times," *www.nytimes.com/2007/11/13/opinion/13martin.html*
- "The State of the News Media in 2007," The Project for Excellence in Journalism *www.stateofthenewsmedia.org/2007*
- "Being Digital" by Nicholas Negroponte *http://archives.obs-us.com/obs/english/books/nn/bdcont.htm*

As the newspaper industry is learning, sticking with what has worked for decades is not an option. The industry already has a considerable lead over local TV news organizations with respect to the development of functionally useful news portals.

Should a station invest in HD to keep up with other stations in its market? Should a station focus on the development of an Internet news portal? Can it do both?

If the answer is both, which from this vantage appears to be the only viable option, how does this impact investments in newsgathering gear and the back-end infrastructure needed to deliver the news through multiple distribution media?

Being digital

The DTV transition involves much more than transmitting bits that deliver higher quality pictures and sound. Nicholas Negroponte, in his book, "Being Digital," talked about the many benefits that flow from turning all forms of information into bits. (See "Web links.")

At its core, the DTV transition is about the digitization of virtually all of the workflows (and the underlying technology) that stations need to support existing operations. But even more important, being digital means that the bits that the station produces can easily be repurposed for new applications — for example, to provide content for an Internet news portal.

To draw this column to a logical and productive close, let's focus on a single issue: How should you be acquiring images from the field?

Many stations are taking the HD news plunge. The first step typically involves upgrading the news set and the studio cameras to support HD. SD sources are upconverted, and a station may place information in the pillarbox areas around 4:3 sources.

The second step typically involves HD newsgathering equipment, where there are many emerging options for field acquisition gear. JVC, Panasonic, Sony and Thomson Grass Valley are delivering acquisition products for the HD ENG market.

There is another option, however, that stations should explore that may help bridge the expensive decision to purchase HD ENG gear. Your station may already have camcorders that can capture news footage in the 16:9 widescreen aspect ratio, and there is wide range of affordable camcorders that can acquire widescreen SD images. These widescreen assets can be upconverted for integration into an HD newscast with very good quality.

If you are planning to take the big plunge to HD ENG, think progressive.

Shooting in widescreen formats should be the first step. Even if a station has not upgraded the studio infrastructure, it will help the field crews become accustomed to the issues of shooting in a widescreen format and improve the archival value of stories. And these widescreen assets can be repurposed immediately for an Internet news portal.

If you are planning to take the big plunge to HD ENG, think progressive. Interlace complicates the transition to being digital. It is a legacy compression technology that is disappearing along with CRT-based television displays. Frame-based images can easily be converted to any resolution for display — up for the highest quality 1080p displays or down for Internet and mobile TV applications. 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@penton.com

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The Aviator images are courtesy of Miramax, Warner Bros. and theBasement.

FCC issues VNR fines

The commission charged Comcast $20,000 for airing video news releases without naming the source.

BY HARRY C. MARTIN

In response to complaints filed by public interest groups in November 2006, the FCC has fined Comcast $20,000 for carrying portions of video news releases (VNRs) without attributing them to a source. The material was carried in cablecasts of four episodes of a consumer interest program appearing on a regional Comcast channel.

Section 76.1615(a) of the commission's rules, which applies to cable-originated programming, is similar to the sponsorship identification rule applicable to broadcasters. Both rules require sponsorship identification where program materials are provided at no or nominal cost because the free footage is deemed to have significant value. Here is a summary of the VNRs at issue:

- One segment about nonprescription sleep aids featured footage produced by Nelson's Rescue Sleep, a natural sleep aid product. It was the only product mentioned during the segment, which contained the statement, "If you are one of the estimated 70 million Americans who have trouble sleeping, Rescue Sleep may be what you're looking for."
- A segment about health and fitness used material produced by General Mills about Wheaties cereal and the "Wheaties Fit to Win Challenge." Again, this was the only commercial product shown or mentioned during the segment.
- Another segment discussed the importance of life insurance and that September is "National Insurance Month." The segment showed footage from two interviews with a representative of Allstate Insurance. One portion contained the Allstate logo. Both interviews were produced by Allstate.
- A segment that discussed laptop computer security employed video footage produced by Trend Micro, the maker of a software product called Remote File Lock. The video illustrated the dangers posed by lax security and the prevalence of identity theft from laptop users. The specific footage explained the utility of that product as a defense against identity theft.
- One segment featured extensive images and mentions of Bisquick pancake mix. The segment was produced by General Mills, and Bisquick was the only commercial product shown during the segment. The story was about the history of Bisquick and ran on its 75th anniversary.

This and other recent decisions dealing with VNRs raise First Amendment issues because they intrude into the newsroom and affect editorial independence.

Comcast argues its case

Comcast contended that Section 76.1615(a) of the rules is invalid because Section 317 of the Communications Act, which authorizes the FCC to regulate sponsorship identifications, applies only to broadcasters and not to cablecasting. Comcast further argued that it did not violate the rule because it received no compensation in exchange for use of the VNRs. The FCC affirmed its jurisdiction over cablecasting and found that Comcast received valuable consideration when it was provided with the free material.

VNRs' affect on newsrooms

This and other recent decisions dealing with VNRs raise First Amendment issues because they intrude into the newsroom and affect editorial independence. This is of particular concern where VNRs are edited by a station's news staff or where only small clips from such materials are used in newscasts or other programming. For this reason, the Radio and Television News Directors Association (RTNDA) has actively opposed the FCC's initiatives in this area. The FCC crackdown on VNRs has not yet reached the courts. BE

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

? Send questions and comments to: harry.martin@penton.com

Dateline

- February 1 is the deadline for TV stations in Kansas, Nebraska and Oklahoma to file their biennial ownership reports.
- In the following states, February 1 is the deadline for TV, Class A and LPTV stations that originate programming to place their annual EEO reports in their public files and place them on their Web sites: Arkansas, Kansas, Louisiana, Mississippi, Nebraska, New Jersey, New York and Oklahoma.

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Digital audio

Give maximum fidelity to the original production.

BY ALDO CUGNINI

Last month, we looked at some of the audio processors used in today's digital broadcast plants. This month, we'll dig a bit deeper into multichannel audio encoding for DTV transmission.

Surround is all around – isn't it?

Artificial or matrixed surround, such as Dolby Surround or ProLogic, is an analog process that creates a multichannel experience by matrixing surround information onto a stereo pair, then decoding this at the receiver to produce additional surround channels. Matrix refers to the mathematical operation whereby three input signals — left, right and surround — are transformed into two channels — left total (Lt) and right total (Rt) — for transmission. Separation between the main and surround channels varies and can be as low as 3dB.

True 5.1 multichannel sound is encoded by means of five channels plus low-frequency effects (LFE). With Dolby AC-3 (Dolby Digital) and MPEG-2 audio compression, 5.1 is encoded onto six discrete information channels, all with perfect separation between them. Often, a broadcaster will not send any of the LFE information, resulting in what is commonly called 3/2 encoding, which is three front channels plus two rear surround channels.

Due to the large amount of legacy stereo content available, many broadcasts are still sent in 2/0 mode, or regular stereo. This is also true for a large amount of new content because of the extra workflow (read: expense) involved in creating a five-channel mix. However, much stereo content has already been generated with Dolby Surround encoding, and this will benefit from appropriate decoding. Thus, broadcasters will often take existing Dolby Surround-encoded material and transmit it in 2/0 mode. ATSC A/52 includes a 2-bit field in the bit stream info (BSI) header that can indicate whether the transmission is matrix surround encoded. Many (perhaps all) AC-3 decoders include Pro Logic decoding when 2/0 content is received, so such a transmission will be reproduced in Dolby Surround if the transmission mode is set and the receiver is equipped to do so.

For maximum fidelity, the broadcaster should always switch the transmission to 2/0 if only two channels are sourced.

Some broadcasters will just lock the AC-3 encoder into 3/2 mode and send the stereo material in L/R. With no audio on the other channels, the encoder will allocate very few bits to them, so this is no big waste of bandwidth. However, a bigger problem exists, as can be seen in Figure 1 on page 20. If surround-encoded 2/0 Lt and Rt content is put into the L/R of a 3/2 delivery, this will only come out of L/R of the five-channel decoder, the Pro Logic decode function will not activate, and it will just come out in stereo with a hollow center (also known as the hole in the middle). Thus, the broadcaster should always switch the transmission to 2/0 if only two channels are sourced.

Some broadcasters also will generate a pseudo-surround by synthesizing surround from a stereo signal and transmitting it in 3/2 mode. This is an equally bad practice, as the downmix to a stereo playback will ruin the original stereo mix.

The ATSC standard includes a method for carrying AC-3 within a

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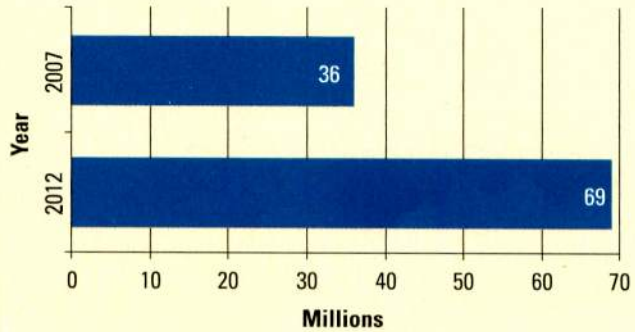

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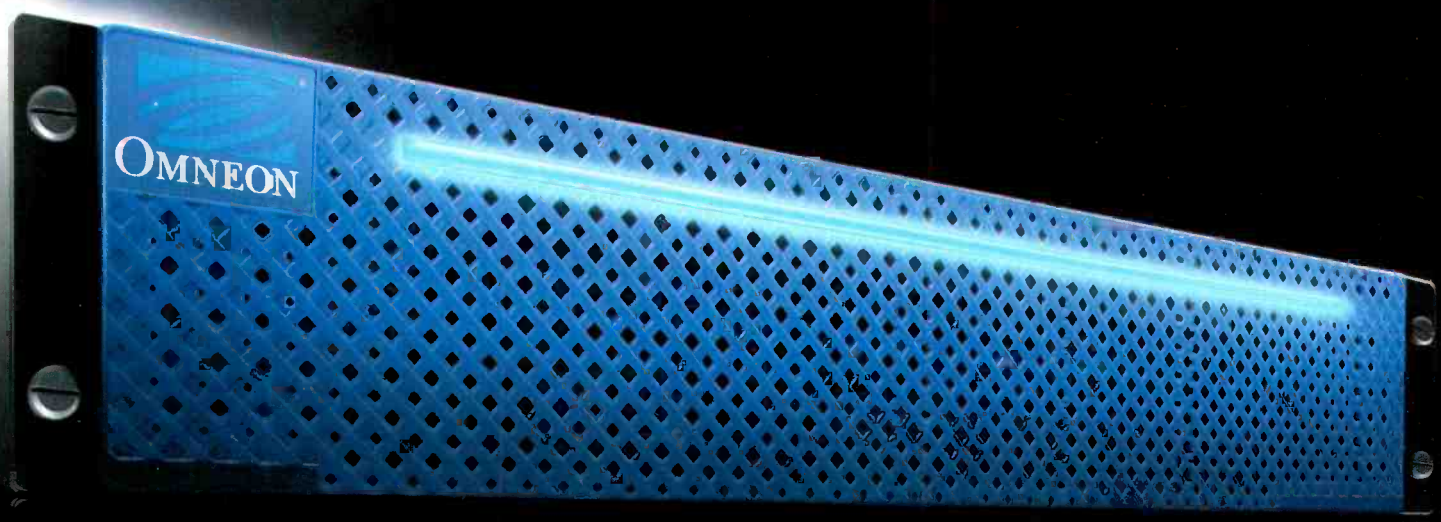

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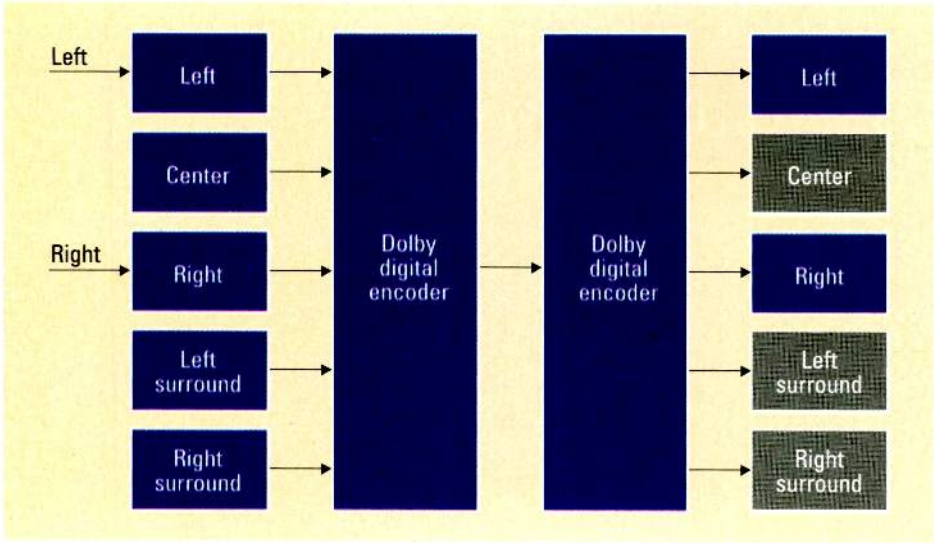


Figure 1. Sending Lt/Rt over a 3/2 transmission will result in a poor surround experience.

serial digital audio stream. By conforming to the IEC-958 logical format, AC-3 can be carried on AES3 interfaces as well as S/P-DIF and embedded with video into SDI. Dolby recommends that networks distribute their 5.1-channel programming using Dolby E, a technology designed for optimal transmission of multichannel audio through stereo infrastructures. Like AC-3, Dolby E can be carried over discrete or embedded interfaces. At the local stations, the Dolby E stream can be routed or switched as necessary before being decoded and then encoded into Dolby Digital 5.1 for DTV broadcast to consumers.

Metadata can be used to carry channel configuration information, allowing proper switching of audio coding modes. However, there is no guarantee that this metadata (or the embedded audio) will be carried pristinely through all SDI devices. This is a particularly vexing problem with ad hoc systems that must be set up and taken down due to dynamic requirements. For this reason, there must be a standard protocol set up for all devices to be used in the video and audio chain. Also, installation of each piece of equipment must be followed by a rigorous confidence check, to ensure that all audio content and metadata are carried properly.

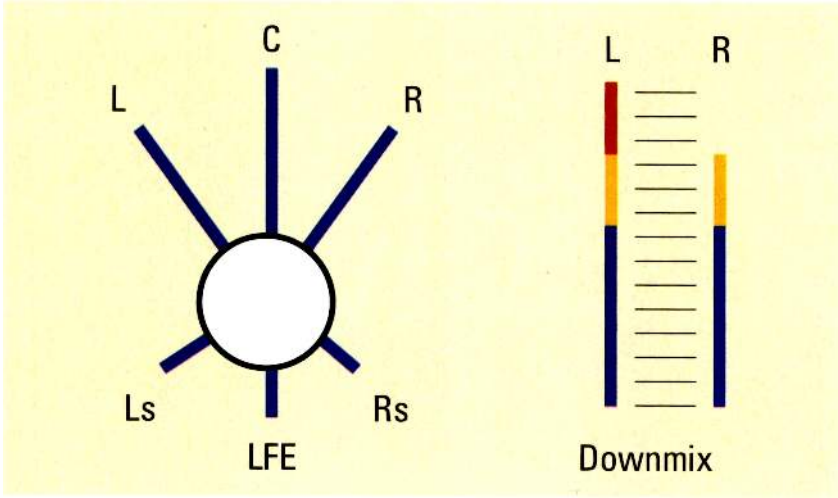


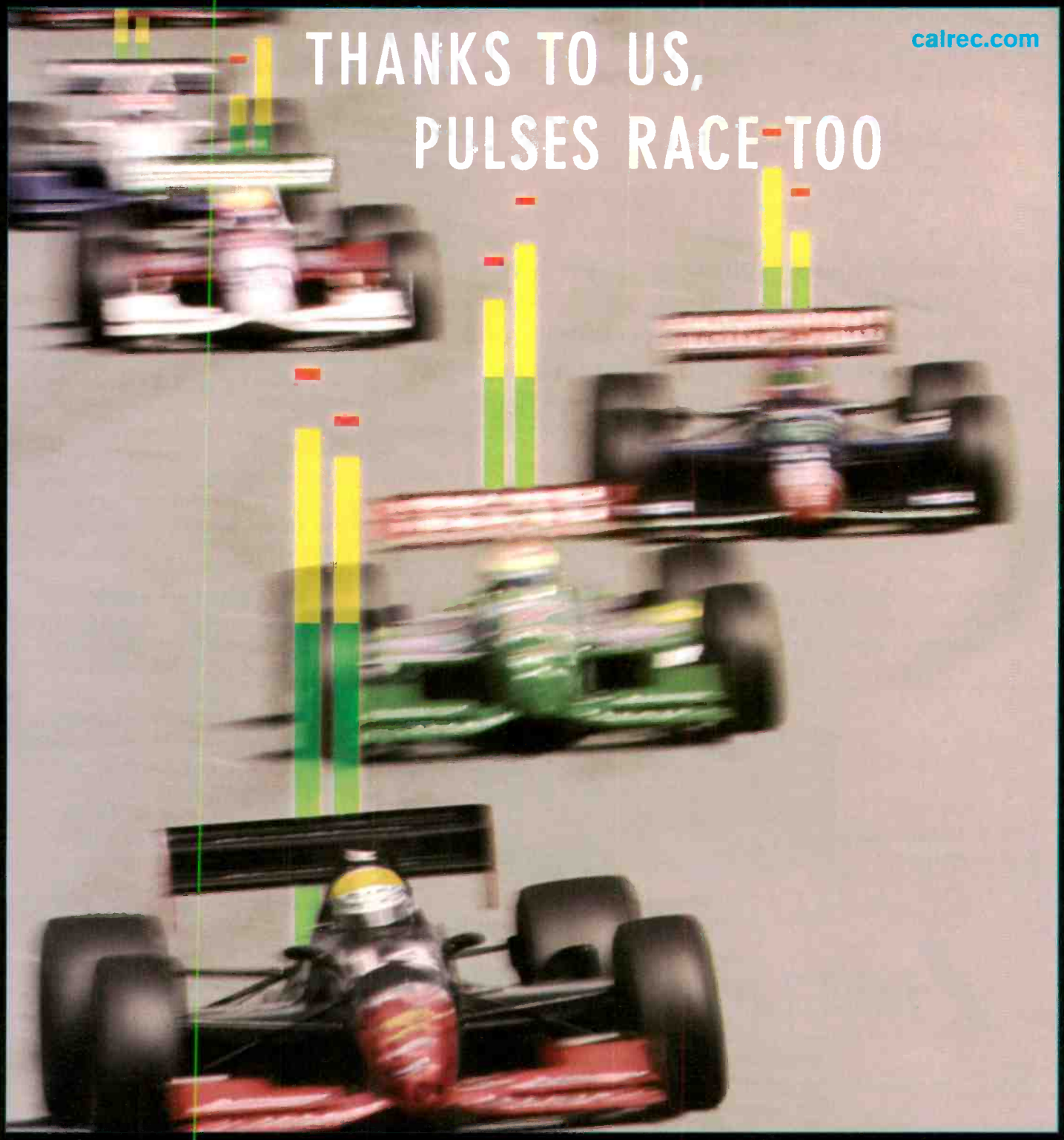
Figure 2. A typical display can show various characteristics of a multichannel audio signal, but not necessarily give an indication of what the signal is supposed to look like.

Maintain proper audio levels

The subject of dialog level and how to set the Dolby Digital dialnorm parameter has been covered in this magazine extensively, and shall not be repeated here. However, one situation has come to mind that should never be tolerated. Never process your audio with a standard NTSC broadcast limiter! Such a device was designed to account for the high-frequency pre-emphasis of analog NTSC audio transmission and therefore applies limiting based on a rising pre-emphasis curve. This is not a good idea! If there is a piece of legacy analog equipment that you just can't part with — for whatever reason — make sure that it does not process audio based on any kind of pre-emphasis or equalization curve. Study the operation manual (or better yet, the schematics, if possible) to convince yourself of this.

If there is a piece of legacy analog equipment that you can't part with, make sure that it does not process audio based on any kind of pre-emphasis or equalization curve.

Similarly, the dynamic range of your audio should be judiciously maintained. NBC Universal (NBCU) and other broadcasters are now implementing procedures to help station engineers establish and maintain proper station loudness levels, and NBCU has urged the industry to



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adopt similar procedures. Subjectively producing proper levels is a labor-intensive process, so it's important to at least use an appropriate loudness-sensitive processor to maintain the proper dialnorm and dynamic range levels. (For more, see "Dialnorm: A good idea gone bad" on page 66.)

Subjectively producing proper levels is a labor-intensive process, so it's important to at least use an appropriate loudness-sensitive processor to maintain the proper dialnorm and dynamic range levels.

Monitoring is not simple

While various tools exist to monitor multichannel audio, and these should be used to verify that all channels are present and accounted for, surround production inherently produces a dynamic situation that cannot be deemed correct by a simple viewing of a display. (See Figure 2 on page 20.)

For example, since dialog will not always be present, it is not unusual for the center channel to be zero for periods of time. Similarly, while a production will almost always have audio on the left and right channels, the surround levels will often change widely, and may also be absent for considerable lengths of time.

These tools can monitor various aspects of the audio, such as levels, interchannel phase and loss of audio. They can also be placed at various key points throughout a broadcast plant, allowing for a centralized monitoring of the signals. Currently, however, the best these tools can do is to monitor and display the various parameters of these signals. There is no way to sound an alarm when the condition is different from the way it was originally produced. For example, how do you know if a channel that has been quiet for five minutes isn't supposed to be that way?

The right tools are available

Thankfully, there are products available today that can solve many of the problems mentioned here, combining dynamics processing for loudness control with surround sound upmixing, handling metadata, processing Lt-Rt downmixes and ensuring that two-channel audio being sent to consumers is not wrongly signaled as 5.1-channel. Work remains to be done in the area of automated monitoring and should include a combination of metadata and signal processing. The best way to operate a multichannel sound facility is to give maximum fidelity to the original production, whether it was monophonic, stereophonic or true multichannel. The best promise of digital television is to enhance the prior art, not to use gimmicks to pretend that something is what it is not. BE

Aldo Cugnini is a consultant in the digital television industry.

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Compression issues

On packetized networks, bandwidth is at a premium.

BY BRAD GILMER

Compression is a core enabling technology for the digital television revolution. Without it, digital television simply would not be possible. It allows viewers to experience outstanding quality without huge increases in cost. Seemingly, compression is relatively straightforward. Broadcasters should use as much compression as their viewers can stand. Of course, the issue of compression is especially critical in IP-based networks, where bandwidth is usually at a premium.

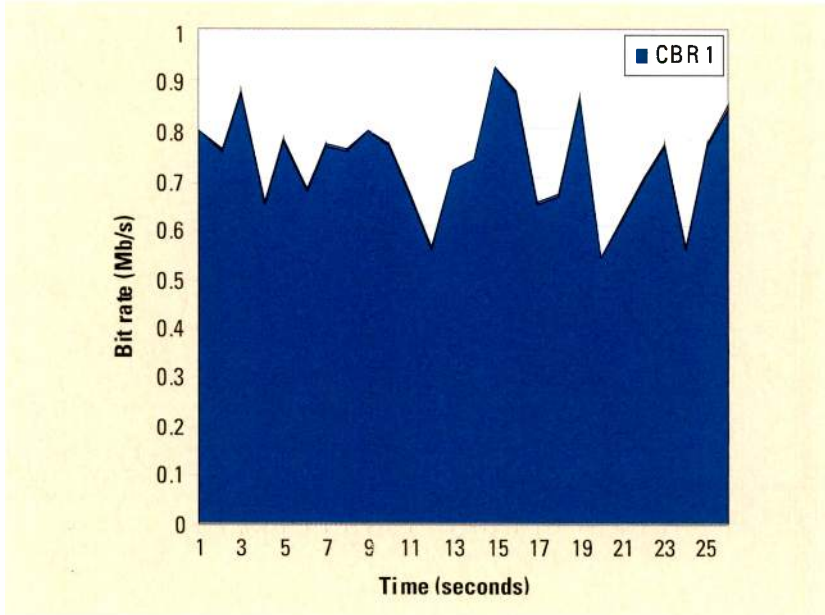

Figure 1. In the case of a CBR feed set for 1Mb/s, the output from the encoder will always be 1Mb/s. The blue represents the amount of bandwidth required by the encoder. The white area above the graph represents wasted bandwidth, because it is the area between the required bandwidth (blue) and what is actually sent.

Constant bit rate

Once the compression is complete, there are two ways to clock the data out of the encoder: constant bit rate (CBR) and variable bit rate (VBR).

As Figure 1 shows, in a CBR system, the output of the compression device is constant. After you set the compression parameters, the bit rate from the encoder never changes.

CBR has great advantages. For example, you always know how much bandwidth is required to transmit the stream, whether that is over an STL or during transmission to the home. Encoder design is relatively simple, so costs can be reduced.

Although CBR is simple and predictable, it is also inefficient. The complexity of an image varies with the image content. In other words, it is much more difficult to compress a panning shot of a basketball game than it is to compress a talking head during a newscast. With CBR, it's important to allocate enough bits to know that when you air a basketball game, the viewers have an acceptable quality level delivered into their homes. Set the CBR level accordingly. But when you are transmitting a simple image, such as a newscaster sitting behind a desk, you could get the same quality level using much less bandwidth. Since the bandwidth is nailed down at a worst-case CBR rate, that extra bandwidth is wasted.

This is not a major problem when you are transmitting single signals across an STL, or sending a single television transmission over the air to someone's home. It becomes a big problem when you are transmitting signals over a computer network with limited bandwidth. IPTV distribution networks, satellite transmission systems and the Internet are all examples of network systems where bandwidth is at a premium. In these systems, it would be great if the engineer could establish a picture quality level and then have the compression system only allocate the bits needed to reach that level. In this way, more bits are used when the scene is complex with a lot of information, and fewer bits are used when the scene is simple with less information. This is the basis of VBR systems.

Although CBR is simple and predictable, it is also inefficient. The complexity of an image varies with the image content.

Variable bit rate

VBR systems allow the engineer to set a high limit and a floor. From that point on, the bit rate varies between these two values. These parameters establish the best quality achievable for complex scenes because the

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encoder is capped and cannot use more bits to encode the complex scene than is allowed by the high limit. They also determine the minimum bit rate the encoder will produce, with the simplest content presented to the encoder input. As you can imagine, this system is much more efficient in its use of bandwidth. Now that there is extra bandwidth in the system, how can we make use of it?

This may not be as simple as it seems. While there is extra bandwidth available, you never know when it will be available, because it's hard to predict the level of complexity of video appearing at the input to the encoder. That said, if the system is properly configured, using statistics, we can predict with some certainty that over a given period of time, a particular range of extra bandwidth will be available.

Assuming there's a transport medium that will carry a number of channels, the VBR system will allow us to multiplex several channels on to a single transport, using much less bandwidth than if a CBR was used for each channel. (See Figure 2.) As long as the peaks and valleys in the different channels are randomly distributed (in other words you are not carrying the same content on all channels at the same time), an intelligent multiplexer can intermix the bit streams from several channels in such a way as to maximize the quality on all the channels while at the same time reducing the total bandwidth consumed.

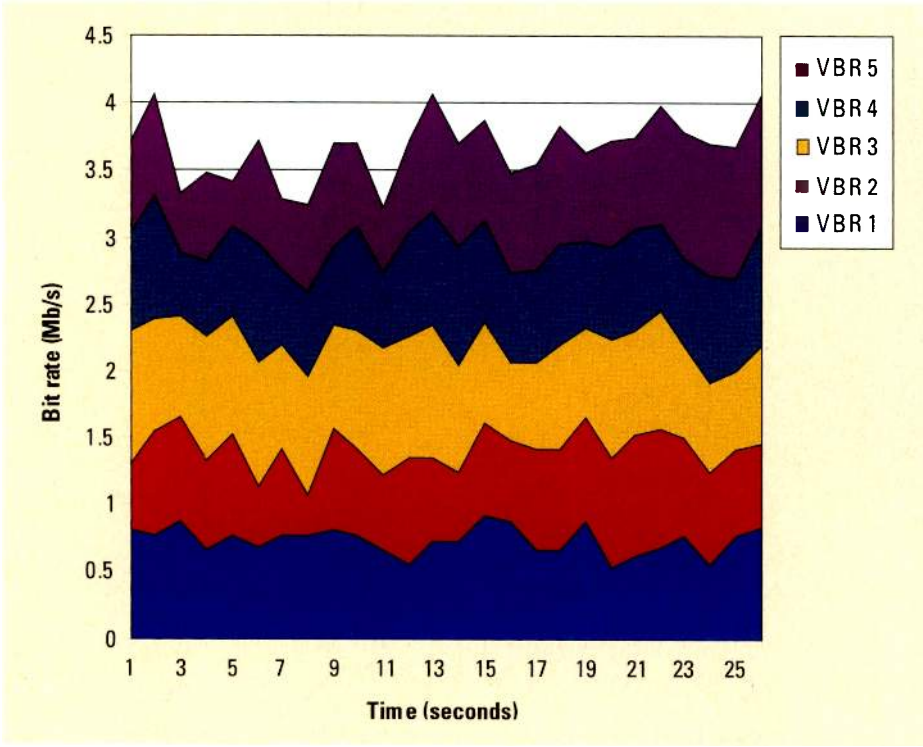

Figure 2. In a multiplexed VBR system, only the bandwidth required for encoding the video is transmitted. In this figure, the encoder is using VBR to compress five feeds to 1Mb/s maximum and is then multiplexing them together. The highest bandwidth peak is about 4Mb/s to send all five 1Mb/s streams. In the VBR case, the white area above the graph is not transmitted. In other words, the output starts at about 3.75Mb/s and then increases to just over 4Mb/s. Next, it immediately drops below 3.4Mb/s. Only the data that is required is sent over the network.

Comparing CBR and VBR

Looking at the figures again, in a CBR system, encoder output bandwidth stays constant. However, the amount of bandwidth required to compress the image while maintaining a set quality level at any given point in time varies such that there is extra, unused bandwidth available in the channel. Of course, if multiple CBR streams are sent across a packetized network, this unused bandwidth is multiplied by the number of CBR streams.

In a VBR system, the bandwidth of each channel fluctuates. When several VBR streams are multiplexed into a single transport channel, the output of the multiplexer tends to remain relatively constant. The transport pipe is filled completely. VBR systems are more complex than CBR systems. Not only does the system need to perform the compression process, but it also needs to multiplex the various streams together. Finally, it needs to control the compression process to ensure that bits available for each channel meet the maximum and minimum settings specified during configuration.

CBR MPEG-2 transmission over IP has been defined in a new SMPTE standard (SMPTE 2022). The Video Services Forum is now working on an addition to this standard which will cover VBR transmission. The group intends to submit this for standardization next year.

Low bit rate transmission over IP

Another interesting aspect of transmission of video over packetized networks is the issue of low bit rate transmission. There may be times when the output of an encoder may drop to almost zero for an extended period of time. This may seem alien to broadcasters who are almost always dealing with compression at data rates of more than 1Mb/s. What sort of use case is there for a compressed feed where the bit rate goes to zero?

The application is picture-in-picture (PIP). PIP streams produce a small image of an alternate channel that the viewer is interested in watching on the TV screen. For example, the viewer can watch a movie chan-

nel while simultaneously keeping an eye on a football game on another channel. The PIP channel may run at a nominal rate of some hundreds of kilobits per second. Because the PIP channel display is small, and because every bit used for PIP takes away bandwidth from the main channel, it makes sense for design engineers to minimize the amount of bandwidth used by PIP.

Logically, PIP channels are VBR. In cases where the PIP channel is sending images that are easy to compress, the output from this channel may fall to zero for long periods of time (literally seconds). This poses a challenge for decoder manufacturers who must always produce output from the decoder. In these cases, you cannot blank the screen.

An intelligent multiplexer can intermix the bit streams from several channels to maximize the quality while reducing the total bandwidth consumed.

Of course, you could just repeat the last frame of video over and over. That takes care of the problem at the display end, but how do you keep the decoder synchronized and keep the memory buffer in a reasonable range when there is no input for an extended period of time?

The most reasonable alternative is to have the encoder send out packets at some nominal low bit rate, even if that means it has to pad the output of the encoder with nulls. This means that you will consume some marginal amount of bandwidth on the IP link, even if there is no need to send any data, but at least this provides an easy way for the decoder to maintain synchronization.

Compression has been a key enabling technology for IPTV, but it has not been without its challenges. The good news is that organizations such as SMPTE and the Video Services Forum are starting to address the issues. **BE**

Brad Gilmer is executive director of the Video Services Forum and the Advanced Media Workflow Association. He is also president of Gilmer & Associates.

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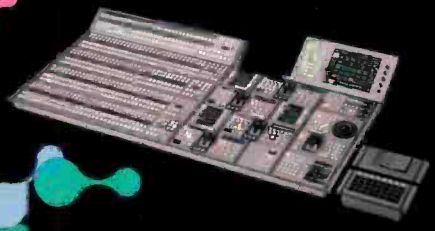

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recreate the movement and changes in a given scene.

During deinterlacing, motion compensation moves different parts of the picture to the correct point in time, recreating the missing lines from the interlaced scan so that each field is presented in full resolution. The same technique can be used to perform accurate frame-rate standards conversion, as both processes must be able to recreate the position of images at any point in time. When converting video from 50Hz to 60Hz, motion compensation can be used to replace 50 frames of video with 60 frames of video.

A common misconception is that 10 frames are either added or subtracted to achieve the correct frame rate. Actually, every frame in the converted output is synthesized from scratch. Because each frame-rate standard samples different points in time within the same one-second interval, phase-correlation technology measures the measure motion between two inputs that straddle the desired output field and then scales the motion vectors accordingly. As a result, an entirely new set of frames is generated accurately.

Processing challenges

In a motion-compensated standards converter, the interfield interpolation axis is not aligned at the time axis in the presence of motion. (See Figure 1.) In practice, the interpolation axis is skewed by using the motion vectors to shift parts of the source fields. The displacement is measured in pixels, and the value is divided into the integer part (the nearest whole number of pixels) and the fractional part (the subpixel shift). Pixels from input fields are stored in RAM, which the interpolator addresses to obtain input for filtering.

The integer part of the impulse response shift is added to the RAM address so that the pixels from the input field appear to have been shifted. The vertical shift changes the row address, and the horizontal shift changes the column address. Address mapping moves the image with pixel accuracy. This is followed by using the subpixel shift to control the phase of the interpolator. Combining address mapping and interpolation in this way allows image areas to be shifted by large distances with exceptional accuracy.

What makes the quality of motion estimation so critical is the behavior of outputs when the converter makes a mistake in creating an intermediate field. Say a camera pan causes a person to move from left to right; the motion compensation system must locate that person in a point in time never actually captured by the camera. If the technology moves the head and body differently, the human eye and brain will know at some level that something's not right. Thus a minute error in motion estimation, even for one output picture, is enough to create a significant disturbance for the viewer.

Fast and complex motion can be a challenge for conversion; however, speed can help mask the effects of poorly performed motion compensation. (See Figure 2 on page 34.)

Still picture management is also important. While it seems like an easier task, some technologies turn stills into a picture with moving bits. Even seemingly benign images can go to pieces, such as a still shot of a building exterior, with the windows in motion.

Moving roller credits are a particular challenge. It takes sophisticated motion estimation to account for the movement of small objects within a picture. Phase-correlated motion compensation can enable high-quality deinterlacing as well as precise, clean frame-rate conversion even for complex graphics, fast-motion sports, film and variable speed camera outputs.

Exceptional motion compensation is not just higher accuracy in creating pictures, but also how it makes mistakes. A mathematical byproduct of phase correlation is a reliability indicator that can tell the system when it is working effectively and when it must tread more carefully. This information provides a graceful fallback mechanism for concealing any errors the system inevitably will make.

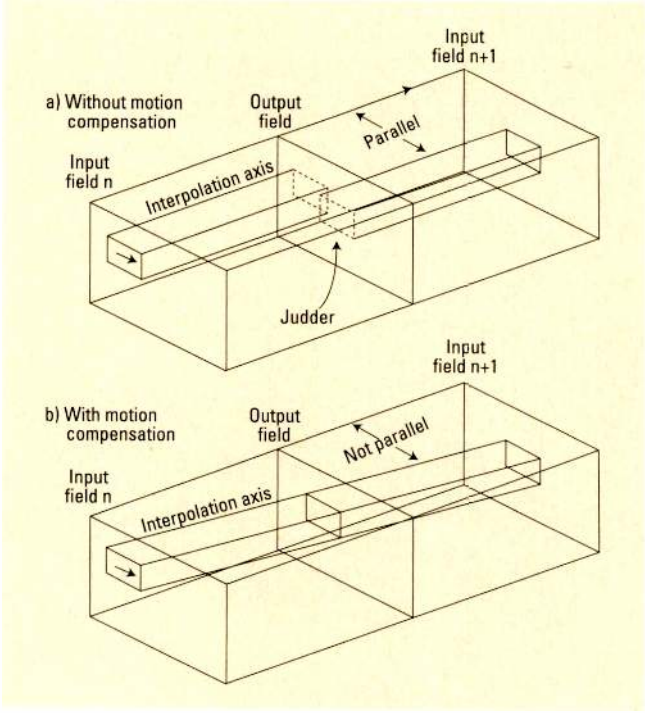

Figure 1. Movement of the interpolation axis with motion compensation

Added image and audio

When motion-compensation standards conversion became available, phase correlation was so effective that often the only residual artifact for the viewer or clue for the downstream broadcaster was that cuts were no longer clean. Since then, different technologies have been developed to ensure clean video transitions between scenes and programs. Some solutions allow operators to choose the field dominance of the converter output. Prior to this, converters scrambled field dominance whether or not it was

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The problem with fluctuating field dominance is that it becomes difficult to edit programs. It is also an issue with international program exchange. Post-conversion master editing is tricky when the field dominance isn't consistent.

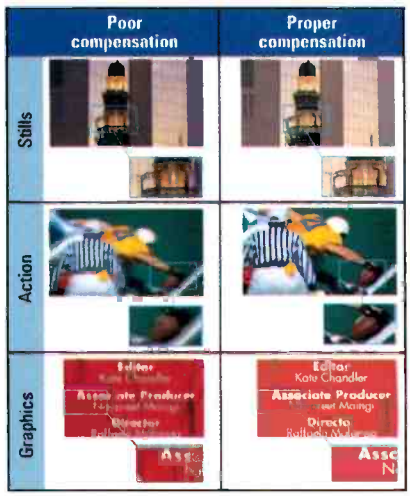


Figure 2. Processing by content type

Because most content is compressed somewhere within the delivery chain — whether on DVD or over a broadcast media — fluctuating field dominance is also a problem here. The issue makes it difficult for a downstream compression system to insert a single clean I-frame. The efficiency of both workflows — and the quality of the end product — can be compromised when standards conversion doesn't provide clean transitions.

Consider pixel accuracy

If content is shot using an interlaced camera and the content contains interlaced content on a field-by-field basis, the only transparent way to convert between formats is to use motion estimation to measure the movement between fields and compensate for the effects of the movement between them.

The first step is to use motion estimation to nullify the effects of any movement and to make sure that pixels within the input frame are aligned in time. Within this deinterlacing process, it is the motion estimator's job to deliver motion information that can be used to near-perfectly compensate for movement.

Another issue accompanying modern standards conversion is aspect ratio. The transition to a 16:9 aspect ratio is still relatively new to most U.S. broadcasters. This means production companies and broadcasters must deal with at least two aspect ratios. Fortunately, every standards converter made today includes built-in aspect ratio conversion with various preset and user-definable modes.

The audio side

Dealing effectively with audio also has become the standards converter's responsibility. Standards converters should accommodate 16 channels of audio, or eight AES pairs, and be able to resample audio and perform sample rate conversion from the input rate to the output rate. The Dolby audio standard is used extensively throughout the broadcast industry for multichannel surround. This means handling up to 16 channels filled with Dolby E, discrete 5.1 audio, an additional stereo mix and perhaps a second language or soundtrack information.

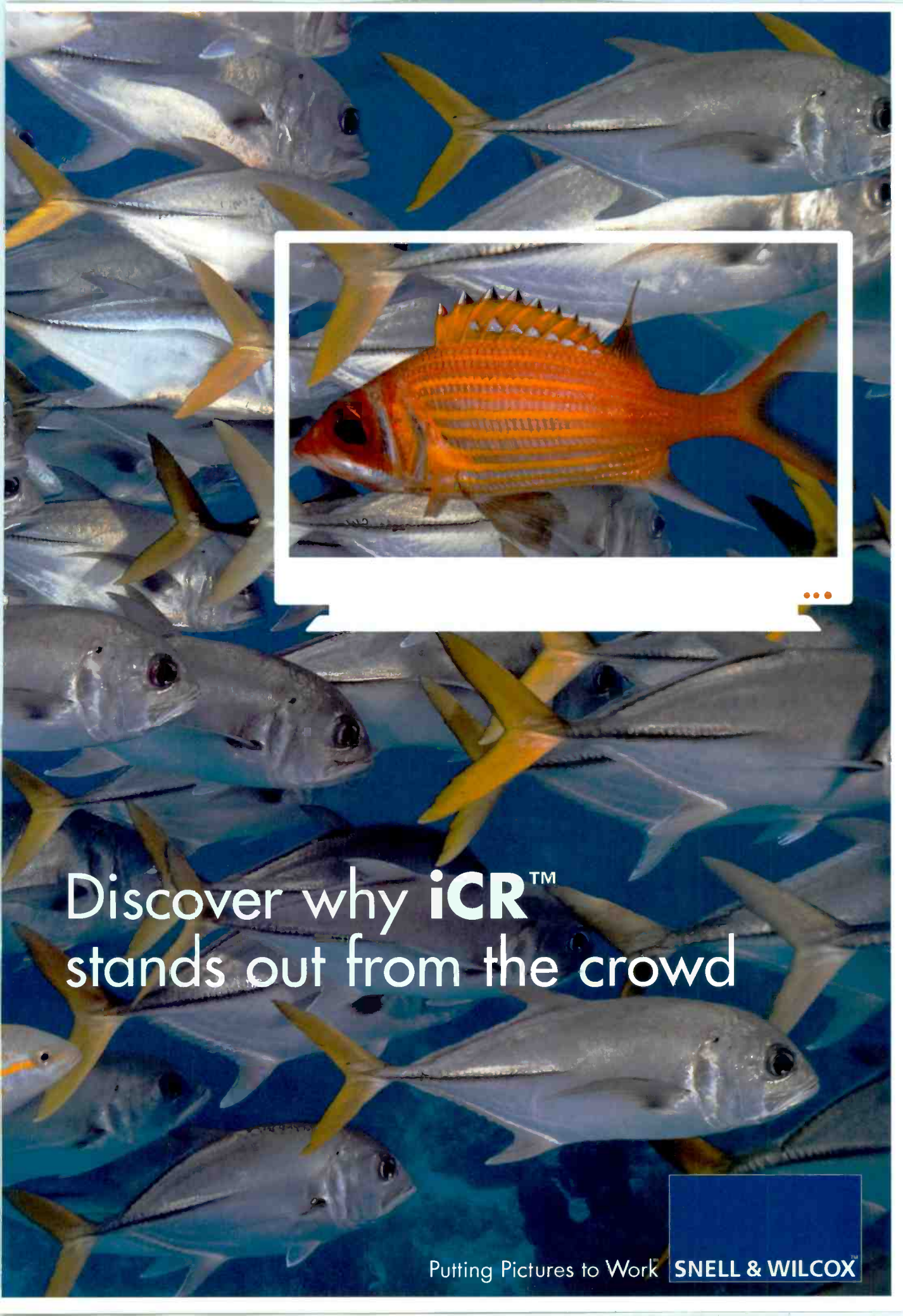
Dolby E brings its own requirements to conversion because it is locked to the incoming frame rate of video and must be decoded, recoded and relocked to ensure that the audio can be re-edited downstream without corrupting the Dolby E signal.

Product development

Investing in standards conversion technology is an important decision in the life of a broadcast, post or duplication facility. Advanced solutions today include comprehensive film tools for 23p, 24p, 25p, 30p and sF formats, along with 3Gb/s capabilities to handle 1080p. Standards conversion platforms are capable of operating within both the hardware or software domain.

Standards conversion issues do not disappear in the file-based workflow. Content must remain at the correct frame rate through the entire workflow right to the end of the consumption chain. BE

David Tasker is head of technical sales for Snell & Wilcox.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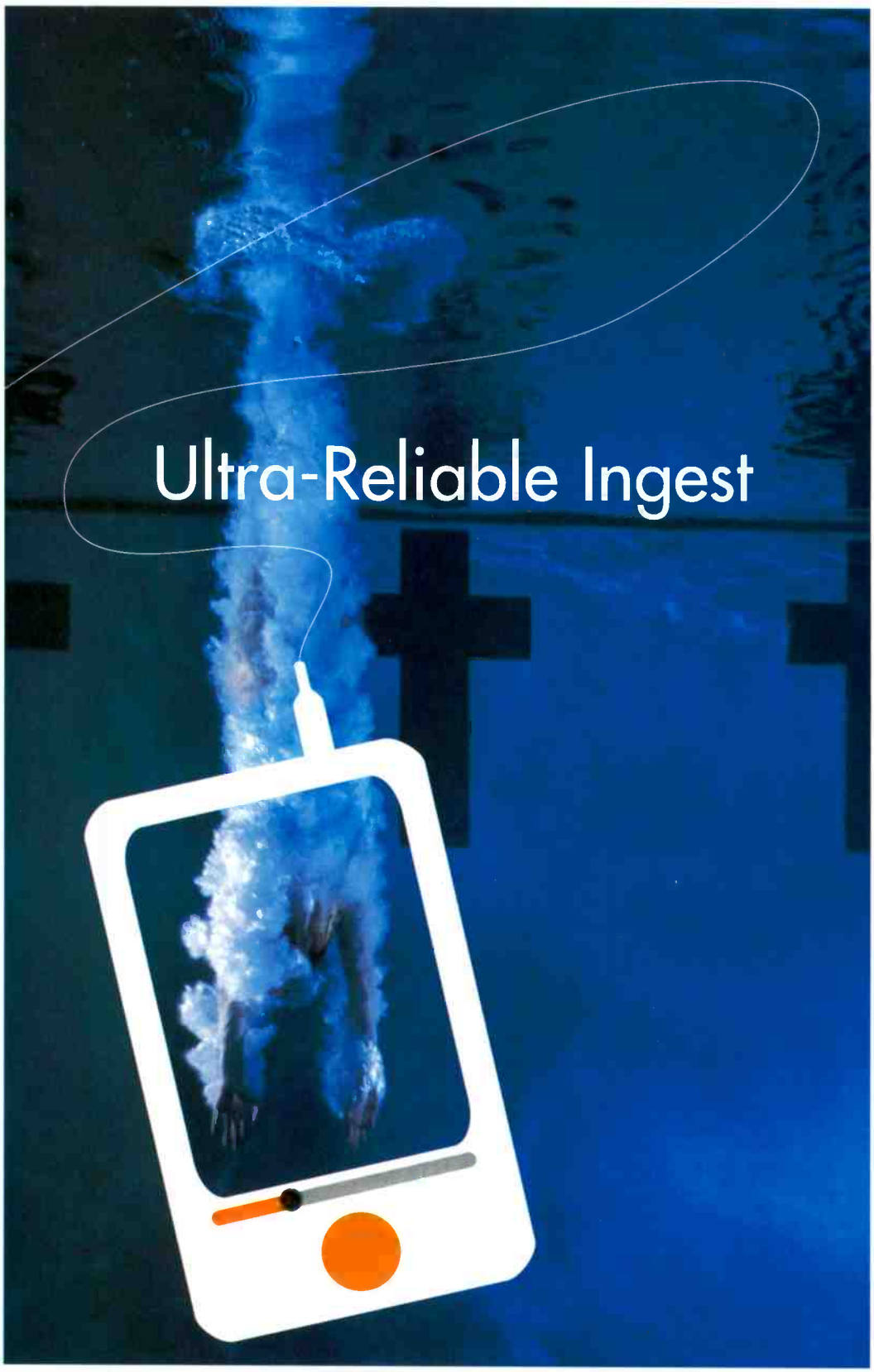

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TVW's new Hayner Media Center accommodates three production control rooms. The edit suites are identically configured with Thomson Grass Valley Kayak switchers and a 48-input Evertz MVP multiviewer for creating a monitor wall on a single large display.

TVW moves into Hayner Media Center

The upgraded facility results in a more efficient production and enhanced on-air look.

BY MARK SIEGEL

More than two years ago, TVW — Washington state's public affairs network — asked Advanced Broadcast Solutions (ABS) to manage the design, installation and systems integration of its new state-of-the-art digital production and distribution facility, known as the Jeannette C. Hayner Media Center, in Olympia, WA.

TVW's plan was to vacate its leased office space by January 2007 and transition to the new facility across the street without any interruption of its live daily broadcast operations.

TVW, which provides unbiased coverage of Washington's Senate, House, Supreme Court and executive branch proceedings, sends its 24/7 signal via fiber to Comcast Cablevision, which distributes it to 1.5 million subscriber households. Independent research indicates that nearly 1 million people tune into the TVW cable channel on a regular basis.

Challenges in the beginning

Moving the existing gear from the old facility over to the new location

was not an option because TVW had to continue broadcasting during the transition. Therefore, ABS decided to start fresh and build from the ground up with an all-digital infrastructure and new serial digital equipment.

The network's budget was $6.5 million, of which $3 million was earmarked for construction costs. That left $3.5 million to cover the technical core budget. TVW was adamant about not going over budget.

Without the luxury of time, the crew had to compress the planned 18-week, on-site build down to just 11 weeks.

In this two-year period, the greatest challenge was keeping the project on budget despite significant changes to the cost and capabilities of the technology the team planned to use. ABS successfully maintained the budget. In fact, there was only one change-order to the entire project, and that was to add closed captioning at the request of the network.

Another challenge was the lengthy delays in construction that impeded the crew's ability to run cables, and install and test equipment. Construction delays outside of TVW's control caused the network to move just as its lease expired and begin broadcasting from the new facility on Jan. 7, 2007.

Without the luxury of time, the crew had to compress the planned 18-week, on-site build down to just 11 weeks. ABS worked closely with TVW to determine the proper location and footprint for the entire plant, including the technical core and production control areas. The company advised the architect about its specific technical needs with respect to the electrical and HVAC loading and design, as well as wire routing, sound abatement, lighting and specialized treatment for ceilings, walls and floors.

To make the most of the time, technicians and subcontractors worked overtime to do all of the prewiring, prebundling and preterminating of cables in ABS' 5000sq-ft warehouse. Crews stuffed all of the equipment into the racks with plans to move them right into place at TVW's new production facility as soon as they could gain access to the new location.

Equipment in the technical center

The Hayner Media Center has three times the space of the old facility. Of the 15,000sq ft of space available at the new location, a 520sq-ft area is devoted to the technical center, which is where the racks were permanently installed. The technical core of the facility also houses key video equipment systems, such as a Thomson Grass Valley Concerto house router, as well as equipment supporting streaming media, telephony and the IT infrastructure.

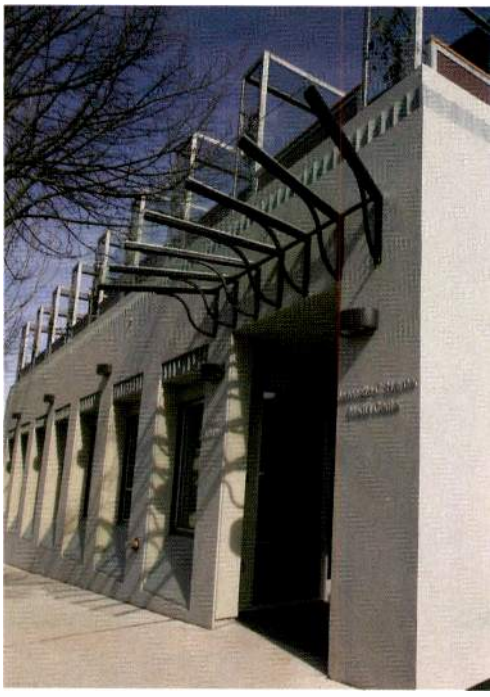
All video conversion, fiber connectivity and other digital glue tasks are handled by Evertz products. The facility employed the company's MVP multi-image display and monitoring system to create video walls on a single large-screen display.

In total, there are 20 racks of equipment at the facility, all of which were installed in the technical center. They were arranged in two rows of 10 racks and installed on a cement floor. The cables and wires were installed in an overhead cable tray. For the initial installation, the crew used 19 32in standard rack units, and one 36in rack at the end of a row to house the server because the depth of the server required a wider rack unit.

Evertz processing gear was used to precondition and optimize the fully SDI signal. The equipment includes distribution, A/D distribution, frame synchronization, noise reduction, proc amp and fiber connectivity from Capitol Hill to TVW. The facility also used the company's Vistalink for signal monitoring for quality control.

In any facility, high-quality power and HVAC is crucial to having good signal quality within a facility. To ensure the proper signal environment for the network, ABS installed three-phase power, isolated ground, UPS and a generator.

When the crews began the installation at the new location, there was no HVAC or power in place yet. The crews had to work around the construction trades to pull their cable and wire from room to room. This was not an ideal situation. In this case, high levels of dust and dirt at the site created a nightmare for the systems integrator because delicate equipment is susceptible to damage under those conditions. Prior to bringing the equipment in, ABS couldn't pump air through the filtration systems, which would have helped to clean the environment sufficiently to protect the gear. Once the crews were on-site, they used Visquine plastic sheeting and air filtration systems as they worked.



The move to TVW's new 15,000sq-ft facility enables the network to produce three simultaneous events.

Three control rooms

The next challenge was debugging all of the installed systems — a painstaking process that took one month.

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on-demand from its Web site at *www.tvw.org*. The Web site also makes all of the events available as streaming audio, and many of the events can be viewed as live streaming media or on-demand as well as via podcasts. The site attracts more than 500,000 visitors annually.

Flexibility for the future

When TVW began broadcasting from the Hayner Media Center, there were several workarounds in place to smooth over technical issues ABS could not address in time. The integrator continued to refine the installation for one month following the premiere broadcast. The facility performed flawlessly, and the initial audience feedback indicated that viewers noticed the network's more polished, graphics-rich on-air presentation.

The goal of the project was to design a technical operation that was free from error-plagued or cumbersome tasks, and one in which all technical employees could understand the data and workflow.

Today, TVW has a properly scaled facility with inherent room for growth and the flexibility to accommodate any technological advancements it might want to incorporate in the future. BE

Mark Siegel is president of Advanced Broadcast Solutions (ABS) in Kent, WA.

Technology at work

AJA Kona I/O video capture cards
Allen-Heath series 3800 audio mixer
Apple Final Cut Pro NLE systems
Avid Titan automation
Evertz
- 3000 MVP multi-image display processor
- 7745FS frame synchronizer
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Harris Inscriber graphics
Mackie 140 ZVLZ audio mixer
Omneon Spectrum video server
Panasonic 655 box-style cameras
Pictron digital asset management system
Rhozet Carbon Coder file transcoder
Sundance Digital
- Archive Manager
- Titan automation

Thomson Grass Valley
- Concerto router with Jupiter control
- Kayak switchers
- Maestro master control switcher

Vinten robotics LCP-8000 camera control system

Design team

Advanced Broadcast Solutions
Mark Siegel, executive in charge
Timothy C. Colwell, system and CAD designer
Kenneth M. Scott, system and project commissioner
David Williams, project manager
Allan D. Freedman, lead installer
Matt Minnihan, wiring technician

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Low-power transmitters

Stations need high-quality, low-power DTV systems.

BY DON MARKLEY

Up to this point, most of the reporting on DTV transmitters and antenna systems has focused on equipment for the large, full-power DTV systems. That includes transmission lines, multiplexers, filters and the other big pieces of equipment needed for ERP values up to 1MW. Now that the FCC tables of allocations are almost complete, it's time to look at the smaller hardware.

The need for lower power

While there are more than 1700 full-service TV stations in the United States, more than 7000 Class A, LPTV and TV translator stations provide service to both urban and rural communities. The ERP levels on those stations vary from less than 10W for some VHF stations to more than 100kW, depending on class, location and protection requirements. In any case, virtually all of those stations are analog. In addition, several licensees and groups are trying to lift the current freeze on new stations. Many manufacturers are trying to move into that large market. They figure if the number of $1 million deals is shrinking, it's time to start doing a bunch of $50,000 deals.

Add to the LPTV and translator business a growing interest in SFNs, and the need for lower power transmitters becomes even more obvious. The SFN approach holds promise, especially in areas where the terrain is highly irregular. Better service can be offered through a network with lower powered transmitters and shorter towers as opposed to using a giant tower with maximum power that ends up creating holes in the coverage. Each of those networks can have as many as 10 or 12 transmitters in the system.

Therefore, it's obvious why transmitter manufacturers are introducing new features in equipment smaller than the 1kW range.

Transmitters

Larcan recently announced the MXi series, which provides output power of 10W to 350W. Fully solid state, the units are particularly aimed at the translator market, with optional receivers to make a full system for off-the-air reception and conversion to the correct output channel. The systems are all fully frequency flexible and field changeable. The MXD series goes up to 1kW.

Better service can be offered through lower powered transmitters.

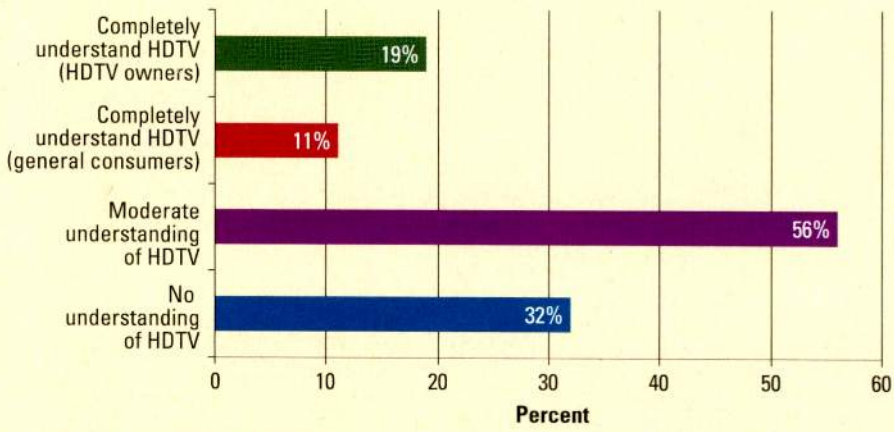
Harris' Ranger line goes from 100W to 1kW, and its ATLAS line goes up to 13.5kW. Again, these are both fully solid state. One thing to notice about these systems is that the exciters are comparable with those used for larger DTV transmitters. This is important because the quality of the output signal for any transmitter is fairly fixed by the exciter. Obviously, this is greatly improved by correction based on the output signal quality from the transmitter. However, if the exciter doesn't have high quality, you can't fix it later. It's not like the old days when you could take a cable TV modulator, hang an amplifier on it and shove it out the door. The digital signal is a lot more demanding. Stations should look at the exciter first. If it isn't first rate, the station never will be.

BEXT's Lex100 has a power output of 1W to 1kW, with its next largest model ranging from 250W to 10kW. Many of the larger low-power transmitters grow by adding modules to the basic system. The better equipment allows hot switching or replacement of modules to permit maintenance work without shutting the

FRAME GRAB *A look at the consumer side of DTV*

Consumers have little understanding of HD

Thirty-two percent of consumers have no understanding of HDTV



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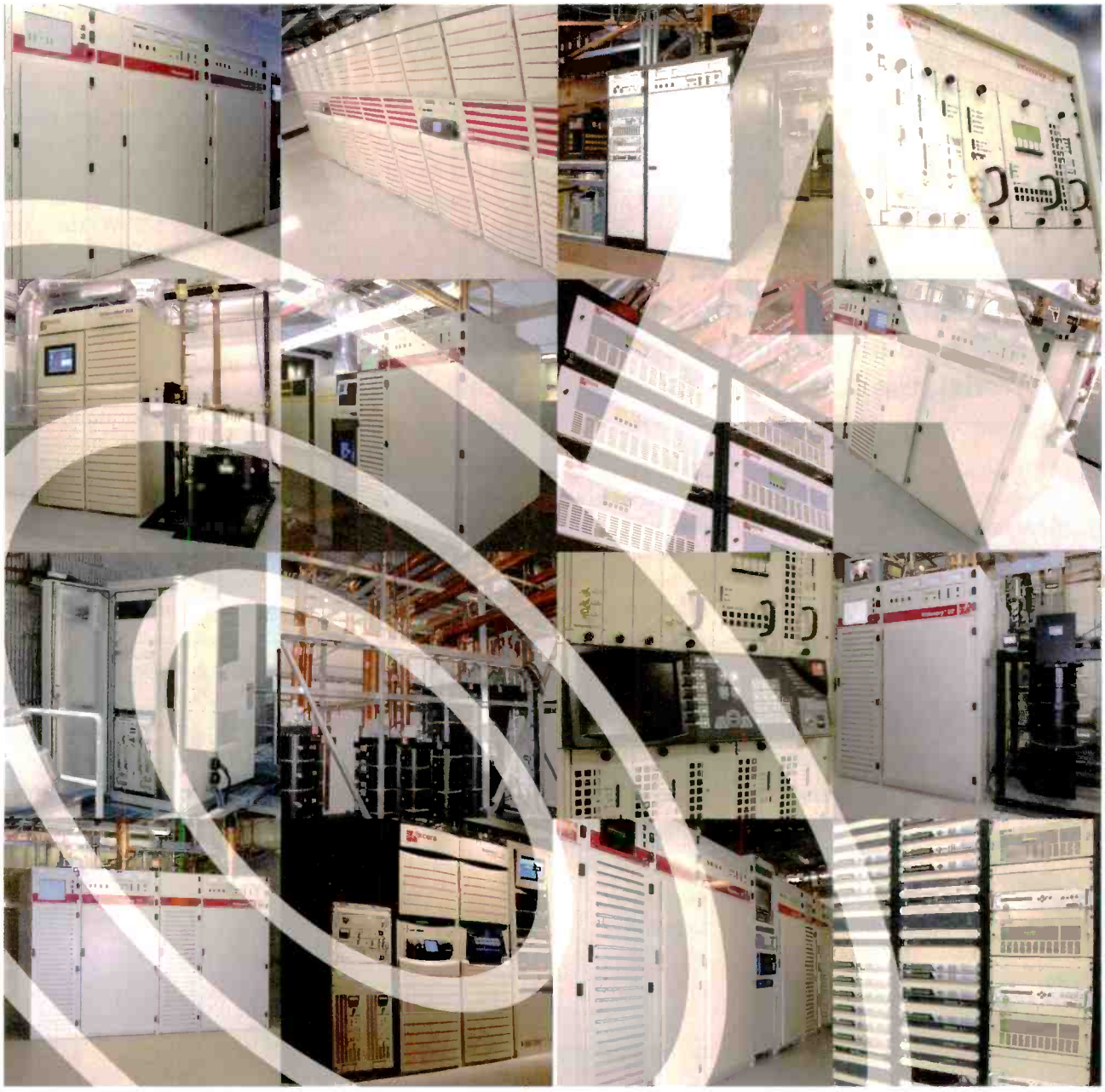

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entire system down.

Axcera offers the solid-state Innovator at power levels up to 350W and the Innovator LX at levels up to 3kW. There isn't a rational argument for using a tube-type device at the low power levels. Such tubes are becoming harder to find and to replace with domestically manufactured parts. An enormous amount of experience exists with solid-state modules at these lower power levels, so station technicians should not encounter any unanticipated problems.

Rohde & Schwarz's NH/NV7000 transmitter features liquid-cooled LDMOS devices. These are available up to 5kW. The company also makes the NH/NV7001, which uses fully air-cooled devices and is available from 75W to 300W.

Both Teko Telecom and Screen Service develop low-power transmitters and translators, although they call them transposers. Screen Service has a series of seven models, starting with a 5W exciter, which becomes the centerpiece for solid-state transmitters up to 8kW.

Lucid provides American Technical Services with low-power transmitters that can be configured as translators. These units are available in models up to 2kW for DTV.

DMT has transmitters at low and medium power designed for either LPTV or translator service. The power outputs range up to 3kW.

Thomson Grass Valley's Elite 100 transmitter goes to 1200W. The Elite 1000 is liquid-cooled with a power output of up to 4kW.

As the allocations for the full-service TV stations become finalized, there will be a continuing need for LPTV and translator stations to change channels.

Antennas

As the allocations for the full-service TV stations become finalized, there will be a continuing need for LPTV and translator stations to change channels. One of the nasty things about most TV transmitting antennas is that, other than wideband panel antennas, they don't like being moved to different channels.

Scala's SL-8 omnioid is one rugged

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and inexpensive option. However, it is not available as a directional model. For the lower power stations, primarily translators, Scala has a range of antennas that are available in various powers and gains. Another antenna for LPTV is derived from the Bogner series of antennas, now available through RFS America.

Low- and medium-power TV antennas are available through Dielectric, ERI (which acquired the old Andrew line) and Jampro. Those systems are variations of the medium-power antennas used by standard broadcast stations. The three companies also manufacture diplexers and multiplexers for combining several LPTV stations into a single antenna. That type of operation can minimize the need for new tower space and new antennas. The multiple station operations most often use panel-type antennas. These systems feature power handling and bandwidth capabilities, but the panels often pose a problem for LPTV stations. The protection requirements for LPTV and translator stations are totally contour-based and are usually different for the various frequencies at a given site.

MCI's manifold-style diplexer can be used in both low- and high-power applications.

MCI's panel antennas offer design flexibility. As an example, one of the company's antennas has different beam tilt in varying directions to meet some unusual protection requirements. It also manufactures a manifold-type multiplexer for both low- and high-power applications. That type of multiplexer can be set up to allow stations to be plugged in as they come online rather than requiring everyone to buy in at the same time.

Conclusion

Now that the business is slowing down on the really big hardware, it is obvious that manufacturers are cranking out lower powered systems. The quality of the equipment is just as good as that for the big systems, which is a far cry from the way it was 30 years ago. BE

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

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Dave
Operations and Engineering Manager, independent station, top-50 market

A hands-on workaholic, he's building his way to HD out of a mix of analog and SDI. How will he get there in little steps, without wasting any money along the way?

Bill
Chief Engineer, independently owned station, small market

Doubles as an engineer for the AM/FM radio stations. How will he move to digital on a micro budget. Hint: he plans to exploit his suppliers.

JW
VP of Engineering, major TV network

He led his network's move to HD. Now it's time for his 20 network-owned stations to convert to digital, but they can't agree on one set of suppliers. Who will see it JW's way? Who gets axed?

WFSB-TV in Hartford, CT, relies on Harris ADC 100 automation. Photo courtesy The Systems Group. Photo by Andy Washnik.

THE STATE OF BROADCAST AUTOMATION

BY SID GUEL

Automation is surprisingly alive and well considering how many companies exist. Latest estimates show 50 broadcast automation companies worldwide. (See Figure 1.)

Veteran broadcast automation companies have been successful in keeping their system technology current to stay competitive and desirable. Also, several companies have expanded their portfolio of products and now sell into other areas of the broadcast facility.

A 2007 study done by the European organization International Association of Broadcasting Manufacturers (IABM) shows the automation segment of the broadcast market is valued at $430.9 million (see Figure 2 on page 56), which is about 4 percent of the total broadcast industry. The library management segment is valued at $106.5 million, which is about 1 percent of the total broadcast industry. The storage segment is valued at $1.57 trillion, or about 14 percent of the industry.

Worldwide, the broadcast industry is reportedly worth $11 billion. It continues to grow at a solid pace of 11 percent annually, especially in the Americas and Europe. Asia is growing as well, but its gross numbers are much lower. The library management

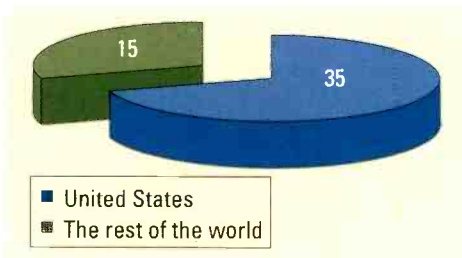

Figure 1. Out of an estimated 50 broadcast automation companies worldwide, 35 are in the United States, and 15 are from the rest of the world.

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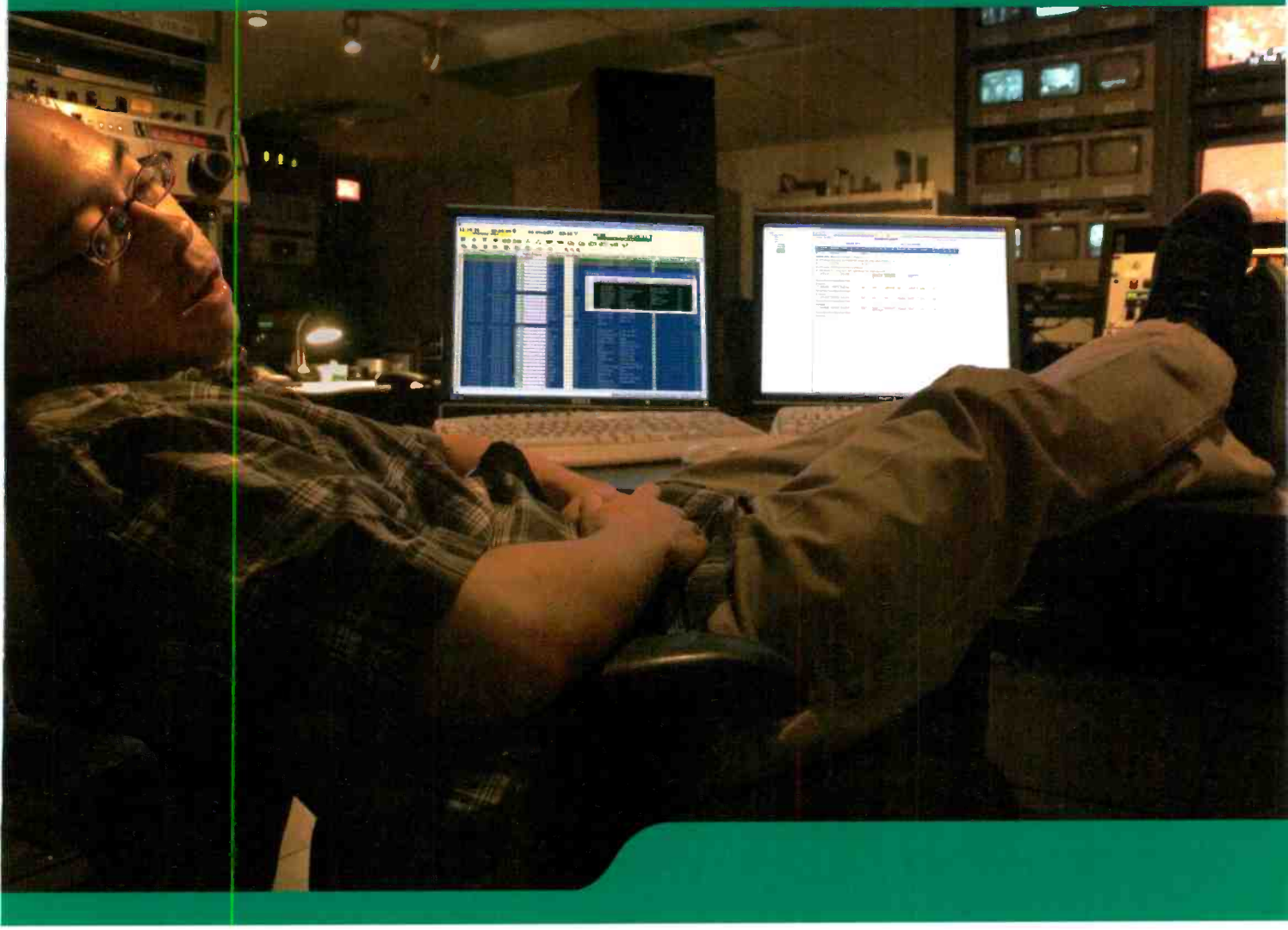

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Automation companies span a wide area of the broadcast market. Some companies overlap, providing solutions across various market segments.

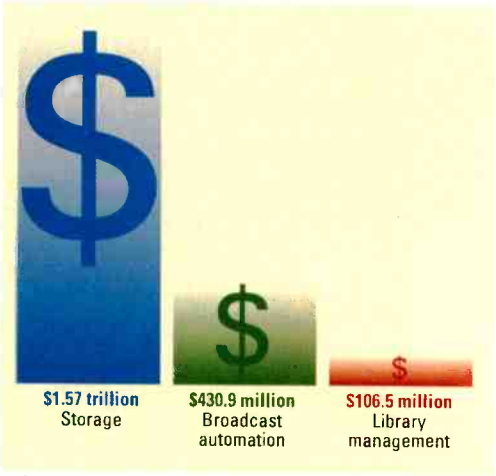

Figure 2. The automation segment of the broadcast market is valued at $430.9 million, which is about 4 percent of the total industry. The library management segment is valued at $106.5 million, or 1 percent of the total broadcast industry, and the storage segment is valued at $1.57 trillion, or about 14 percent of the industry.

Types of automation

Technology foundations for broadcast automation companies vary. The standard trend, however, is clear. Certain technologies are more popular than others, primarily broadcast automation types. The three main types of automation are:

- Standard device control
- Video server and broadcast automation combo
- Hybrid device control and video server combo.

The trend is moving toward a hybrid system in which a video server and broadcast automation combo controls more third-party devices in software plug-in form, rather than controlling external hardware boxes.

Research shows that Microsoft Windows is the operating system used most by broadcast automation companies. Figure 3 on page 58 shows the types of operating systems used by broadcast automation companies. The trend is moving toward Linux-based systems because companies are finding it to be a cost-effective alternative to Windows-based systems.

Pairing video servers with automation systems

Today, most major automation players now offer video server and broadcast automation combo systems. They are basically broadcast automation software running on video servers with advanced interfaces and device control for third-party equipment. These systems are usually made up of off-the-shelf broadcast-quality video cards and off-the-shelf disk drives for storage. High-end systems use industry video cards, transcoders and RAID sets. It's a trend that's here to stay.

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What's the biggest factor? Cost. The smallest TV station markets are required to switch to DTV within the next two years. Broadcast automation companies can expect good sales in the entry-level of broadcast automation.

Some industry experts question the reliability of these systems. There are many risks with having so much master control on one system.

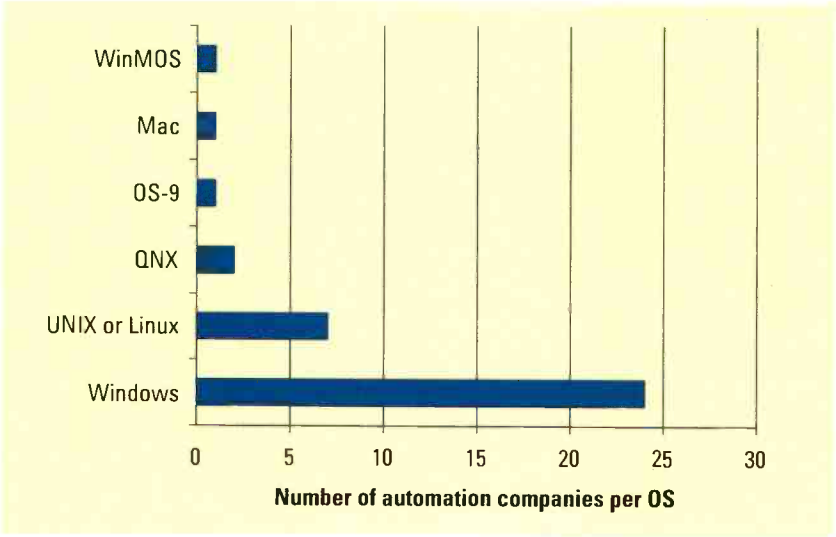

Figure 3. Types of OS used by broadcast automation companies

Industry watchers advise there should be more built-in redundancy within a single system and that external redundancy should be standard in all systems. Like any product, the broadcasters ultimately decide the level of redundancy they can afford and are comfortable with.

Branding automation

Branding automation companies are coming out with their own versions of master control automation. These systems integrate a graphics playout server, animations, live video, video clips, audio, real-time external data feeds and master control automation functionality. Normally, these systems are controlled by master control automation systems as a third-party device. Today, they are being used as standalone automation systems for controlling DTV channels.

The BXF standard

The new SMPTE (S22-10) standard is quickly being accepted by the broadcast automation community for the proper transfer of schedules and as-run logs between traffic and broadcast automation. For years, broadcast automation and traffic companies had to create a conversion application or traffic features to convert schedules and as-run logs to and from whatever traffic system they were working with. This created additional and unwanted costs to the broadcaster.

Not all broadcast automation companies are BXF-compliant, but many vowed at NAB2007 that they would be compatible this year. Some advertising agencies have also become involved in the new standard. The jury is still out on whether or not they all accept the new standard. By involving the advertising agencies, interstitials can have unique identification codes that stay with the metadata from creation to playout to reconciliation and finally affidavit and billing.

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Asset management

Asset management systems have become the center of every media enterprise. To be successful, a solid asset management system should come complete with built-in transcoding features. Transcoding needs to be as transparent and cost-effective as possible. The system should also include a built-in source to a destination-intelligent management system to automatically transcode various video formats with ease.

There's money to be made by redistributing rich media assets, whether it be via new DTV channels, the Internet, IPTV or cell phone video. For the broadcast automation industry, the key is to cater to each department individually. From there, other departments can be added to the asset management system, and then wrapped together into one central enterprise-wide system. Resources, networks and storage do not need to be revamped. The infrastructure already exists. You're simply adding more capabilities to an existing system.

Fewer RU boxes, more software

A few automation companies are selling systems with broadcast hardware equipment capabilities. In previous years, manufacturers of broadcast hardware embedded their software code on chips. Now the tables have turned. Automation companies are including hardware functionality in their software systems.

Some automation companies have mixed their systems with a variety of graphics hardware system capabilities. One broadcast automation company claims it has DTV video muxing within its system. Imagine a video server automation system with built-in DTV mux capabilities.

Virtual master control

Hybrid and combo broadcast automation companies spur a new business model. New global broadband service providers manage the broadcasting aspects of distribution and delivery of all forms of digital content. These companies enable content creators and distributors to extend their digital media presence through physical and virtual production, broadcast and infrastructure facilities.

Hybrid and combo broadcast automation companies provide virtual master control systems without the usual requirement of hardware found in today's uplink facilities. These new service providers are targeting media and entertainment organizations worldwide.

Expanding systems

Some automation companies are expanding their software to

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But if that weren't enough, panels now have color-lit LEDs, making controls easy to see in darkened rooms. With its bold new contemporary design and ultimate functionality, the V-Series puts total control at your fingertips. Clear-Com is raising performance.

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integrate both the business side and automation side of a broadcast facility. Broadcast automation companies are now providing programming, sales, traffic, master control, asset management and billing applications. Most traffic/automation companies in the United States have separate software systems and databases. A closed loop, traffic interfaces or BXF is used for bidirectional communication between these applications.

Some automation companies are expanding their products to integrate the engineering side or the news and production side of the broadcast facility. This trend will continue as companies expand their product offerings. Automation companies look to expand because doing so supports and strengthens their business. Broadcasters like it because they get integrated products with centralized databases and automated streamlined workflows.

IPTV sales opportunities

Industry players think there are growth opportunities in the IPTV world as telcos roll out their DTV broadcasting services over telephone lines. IPTV may already have solutions for VOD services and pass-through channels, but many are developing their own network channels. Some of the issues IPTV is trying to solve are problems that have already been solved in the broadcast world. Even if IPTV is being driven by the IT/computer world, broadcast automation companies have opportunities in IPTV.

Third-party vendors

New third-party vendors are developing software plug-ins and add-ons for new business model automation systems. New plug-ins are being developed for services such as content verification, error tracking, fail-over tracking, compliance recording and also legacy third-party hardware products, such as routers, switchers and branding. Since these are software plug-ins, no additional hardware is required, keeping the cost low.

This change is a paradigm shift in how third-party vendors interact with broadcast automation systems. In the past, third-party vendors sold hardware systems that the automation company would control via Serial RS422 or RS232. Now, a third-party device is just a software plug-in. Many of the hybrid and combo broadcast automation companies sell their own third-party device plug-ins, but there is still plenty of room for third-party vendors to develop and sell plug-in options. Other areas could include branding features, switchers, routers and audio servers.

Automated workflow management

There are various types of automation systems within a broadcast facility. Traffic, master control, productions and news are good examples of areas that use automation systems. Each of these products have advanced to a point that a clear set of business rules can be implemented and configured to create a logical workflow for the successful completion of a goal.

Automated workflow management is either the successful completion of a goal across various departments or within an automation system. It includes three important levels:

- Day-to-day staff operations
- Operations monitoring, control and performance reporting
- Global reporting and statistics for upper management.

Adhering to and being compatible with SMPTE and industry standards will help tear down the walls between the various automation system silos. Standards implementation is key. Continuance of control level software development will also help bridge the gap between various automation systems. With IT infrastructures the norm in broadcast facilities, automation companies will be more open to interfacing with other broadcast facility automation systems at a horizontal or vertical level, depending on the workflow requirements.

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Automation tomorrow

In the future, there will be an automated asset management system in which the ingesting and archiving of digital media will be fully automated. Master control will no longer be staffed. It will be monitored by traffic, engineering and production, depending on the situation. Spots and programming will come in from media delivery services in digital form and autopopulate the playout video servers or ingest video server. Metadata with spot and program lengths, segments lengths, titles and identification numbers will be automatically imported into the traffic system.

Hybrid automation systems will be the virtual master control of the future. Instead of various hardware components, there will be software plug-ins. Third-party vendors will already have the software for their hardware systems. It just a matter of redesigning it without the hardware. Instead of a router or switcher, they'll provide a software plug-in for the automation system.

Soon we will not be able to make a move unless the computer system says it's OK. Someday built-in intelligence added to monitoring and messaging systems will decide the best form of action for every request. In the broadcast industry, there is already built-in intelligence in traffic systems for plotting the highest paid commercials in the log schedule. Broadcasters use these systems to maximize the profit potential of any given time slot. The difference will be who or what is in control. Instead of applications controlling processes, these applications will soon control people.

Controlling the enterprise

Metadata is the key to everything broadcast. It's required at every level and in every aspect of the broadcast facility. The metadata has to be present, available, accurate and transportable from system to system, department to department, and vendor to vendor. That's our future.

Traffic departments will be in control of the master control room because year after year, the goal is to reduce manpower and to automate processes more. Someday the traffic department will be in full control of everything master control. Since traffic controls the metadata, who better to control the final product? Granted, there will be times when a live person will be needed in master control. This will probably be a dual role with either an engineer or a production person.

The bottom line

It's never easy to predict the future, but there are clear technology trends. Hardware is miniaturizing, and eventually, it will go away completely. Expect more company mergers and acquisitions. Companies with low-cost solutions will do well in the next few years as the final small market level of TV stations switch to DTV.

Smart broadcast automation companies are staying ahead of the curve and developing the next generation of automation products for new business models, such as virtual master control, IPTV, mobile phone, the Internet and DTV business. Expect to hear more about SOA methodology and monitoring and control systems.

Companies are riding the last of the automation business and should soon move toward alternative business models. Expanding your product line into new areas and working in new business model sectors is critical for increasing market share and staying in business after the big switch is over. BE

Sid Guel is a broadcast automation consultant.

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Dialnorm:

A good idea gone bad?

BY BRUCE JACOBS

How is the most important audio parameter for ATSC transmission so often maligned and misused? A little byte of audio metadata in the DTV AC-3 stream — dialnorm — was made into a standard with good intentions but from the beginning, it has been in a state of disrepair.

The analog curse

Analog TV audio levels are maximized by the marketplace and capped to avoid exceeding FCC modulation limits. This results in a limited dynamic range — a squashed sound. There's no opportunity for a dramatic moment. Movies sound lame. Symphonies sound anemic.

With the upper limit determined by a peak-reading meter, the loudness for consumers is inconsistent. Complex waveforms are made softer than simpler ones in order to avoid an FCC fine, to the disadvantage of the listener.

To make matters worse, high frequencies are compressed even more, causing the audio to sound dull. This is necessary to avoid overmodulation from the pre-emphasis that was included in the FCC transmitter rules back when audio didn't have much high-frequency content. There was a time when the resulting reduction in noise from a matching receiver de-emphasis seemed like a good idea.

Right off the bat, digital audio is better than FM audio, because there is no need for pre-emphasis. This eliminates dull-sounding audio!

But how do we manage levels in the digital age? A bad solution would have been to let the marketplace decide — as was done with the compact disc and MP3 files. The upper limit would be simple; the highest digital number is the highest peak value, where anything higher is clipped. The lower limit is 96dB down, leaving plenty of dynamic range available for the producer to keep average levels low and avoid clipping. But this approach results in a lose-lose loudness war just like with analog broadcasting and increasingly with digital audio files. Everybody tries to be the loudest. Everyone loses dynamic range. For digital television, there must be a better way.

The good idea

In developing the AC-3 compression system for movies, Dolby's engineers rightfully wanted to give the home listener the same benefit enjoyed in the

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theater — a consistent dialog level and a wide dynamic range.

The consistent dialog level is achieved by the use of a long-term averaging meter that is A-weighted to favor the frequencies in which our ears are most sensitive at low levels. Movie audio levels are adjusted so the average weighted dialog level remains consistent, pleasing both the listeners (who can better hear the dialog) and the theater owners (who get fewer complaints about trailers being too loud).

Understandably, a movie is often mixed so that the level of explosions and music crescendos exceed the average dialog level by a significant amount. This helps make a movie exciting!

Dolby could have picked a fixed average dialog level for AC-3. The specified dialog level could have been chosen a safe number of decibels below 0dBFS, leaving room for dramatic peaks. This level could have been adopted by the FCC, along with the AC-3, within the ATSC standard.

Broadcasters could have adjusted their dialog levels using the appropriate metering to the level specified. New meters meeting the standard would become available. Hopefully, legacy content would have audio levels close to the chosen value. If not, processors could keep levels within bounds.

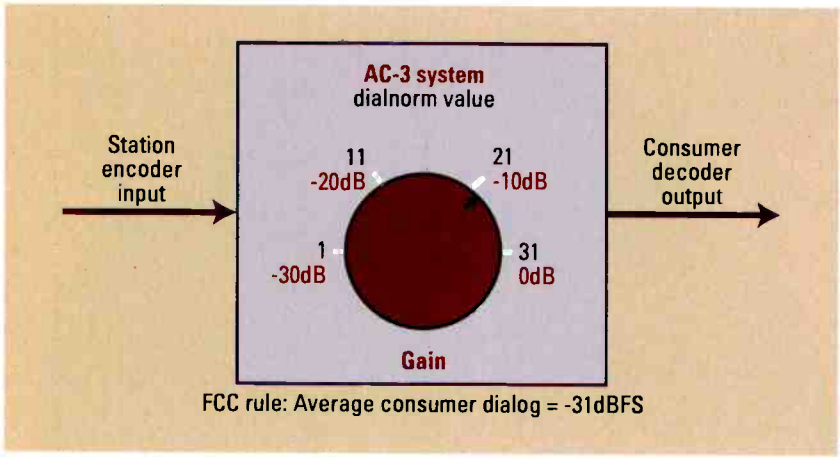

Figure 1. Dialnorm parameters

The idea of giving the consumer consistent dialog level and a wider dynamic range would have been achieved. Life for the broadcaster would have been simple. Life for the consumer would have been improved. But this is not what Dolby did.

The trouble begins

Nobody likes limits. Who chooses the limit? Should Dolby have designed AC-3 to suit the film industry or the broadcast industry?

Rather than specify a fixed amount of dynamic range, Dolby made it adjustable from 1dB to 31dB. This was accomplished by including a special data parameter that remotely controls the output gain of all final AC-3 decoders. (See Figure 1.) Every consumer decoder must apply this adjustment under terms of the Dolby license. This is the parameter dialnorm.

If the mix engineer wants the largest possible dynamic range, the dialog is mixed to a level of -31dBFS, and the dialnorm is logically set to -31. This results in unity gain at the decoder. If the mix engineer wants less dynamic range, a higher dialog level is chosen along with a dialnorm value of the same numeric value, resulting in a decoder gain reduction of the appropriate amount. This approach keeps dialog

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levels consistent from movie to movie, from show to show and from channel to channel. If dialnorm is set properly, the average dialog level from the decoder will be -31dBFS when measured with the averaging A-weighted meter.

There is no one right dialnorm value. It depends. Just because Dolby ships encoders set to -27 doesn't mean this is the correct value for your station. The correct value is the average dialog level on the input of your AC-3 encoder. This is where the good idea starts to go bad.

Metadata madness

Nobody likes complexity or confusion. Here's what happened after the ATSC adopted AC-3:

- Encoders came with an obscure knob that could be set between -1 and -31, where increasing the value makes the audio in every home illogically softer!
- The shipped encoders had the knob set to -27 without saying why, leading many broadcasters to think this is the correct value. This left other broadcasters with the impression that they need to set dialnorm individually for every show in their library — a literally impossible task.
- Broadcasters were told they needed to build systems to carry the metadata through their SD plant and storage system when no equipment existed to make it practical to do so.
- This technology was introduced in an environment with no enforced standards for the analog portion of consumer equipment. A proper dialnorm setting can result in digital dialog levels that are below analog dialog levels.

All this complexity and confusion has caused listeners in many markets to report DTV audio levels much less consistent than the analog counterpart channels. Stations serving some of the major networks routinely transmit dialnorm values far from the actual dialog level, resulting in their programming appearing significantly louder than other networks. Stations offering multicast channels sometimes deliver widely varying audio levels even on their own channels. "With DTV, consumers have better pictures but more annoying audio. Varying audio level is the number one complaint. The public deserves better," according to Jim Kutzner, chief engineer at PBS. It is a sorry state of affairs. Wasn't digital was supposed to make things better?

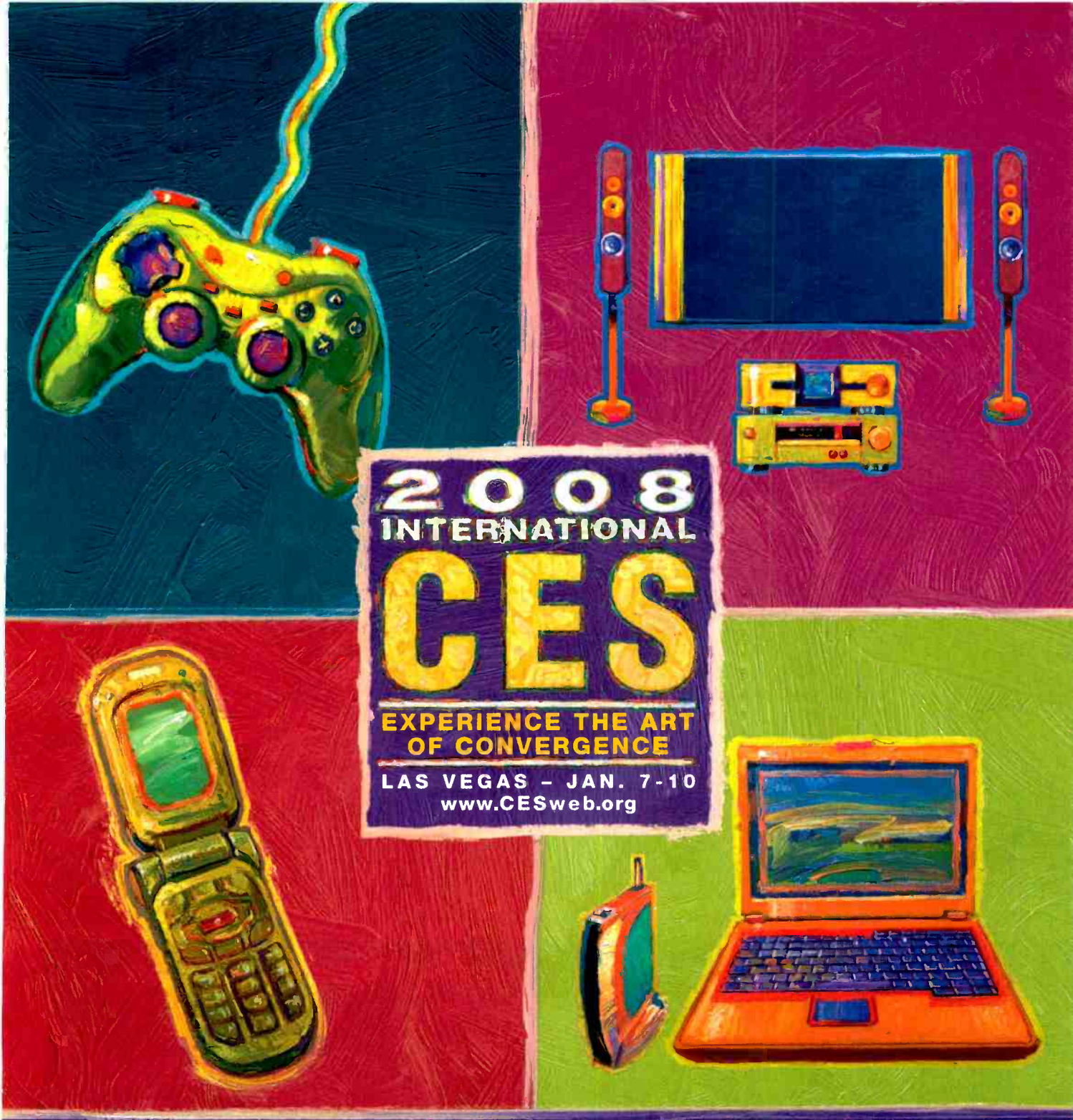
If the broadcast industry is going to achieve a consistent dialog level and wide dynamic range, it has work to do.

Fix dialnorm

"Dialnorm doesn't have to be complicated," says Jim Starzynski, principal audio architect with NBC Universal and chair of the ATSC S6-3 audio working group on DTV loudness.

Currently, the NBC Universal DTV network performs ongoing tests of legacy and commercial content mixed using traditional meters. The LEQ(A) average dialog level ranges from -20dBFS to -24dBFS. By simply setting station AC-3 encoder dialnorm remotely from the network to the average value of 22, reasonably consistent dialog levels in the home are achieved, matching other dialnormed sources. This averaging method is effective when specific content-matched metadata is not available and can work for local station content as well. It is not necessary to remix all the old shows. In the case of local commercials with extremely varied levels, a simple, properly adjusted audio compressor and limiter can be successful in reaching a targeted dialog level. PBS has adopted a similar approach, using a value of -24.

The 2007 edition of the PBS Technical Operating Specifications requires all new content to be delivered with an Leq(A) dialog level of -24dBFS. "This specification is key to our effort to



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improve audio for the public," Kutzner said. (The specifications can be found at *www.pbs.org/producers/redbook*.) NBC Universal uses a similar value of -23dBFS. Currently, there is no need for a complex metadata system for every production, only a new approach to metering the final mix and layback.

Knowledge of this fixed dialnorm approach allows stations to consider simple steps to fix the dialnorm problem. (For more, read "Four simple steps to successful dialnorm.") As awareness and technology progresses, an agile metadata system that tags matched dialnorm to content can be a goal, fulfilling the original intent of the DTV audio designers.

What about cable?

As the cable industry continues to reduce the number of analog channels and increase the digital ones, properly set dialnorm becomes even more important. In the old analog days, many cable systems ran all audio channels through their own compression equipment to reduce consumer complaints, making actions of a station irrelevant.

As cable converts to digital and passes supplier-provided dialnorm to analog and digital services, it is vital that the value in our broadcast stream is correct. Cable providers prefer to pass the signals without processing them.

The future

The ATSC is leading an industry-wide effort to improve the situation. The organization's subgroup is considering a recommended practice to help the industry properly implement dialnorm. According to Starzynski, the subgroup is evaluating adoption of the new ITU LKFS loudness measuring standard, which is similar to the current ATSC Leq(A) specification but better suited to the measurement of music and other content without dialog.

By adopting ATSC A-53, the FCC applied the force of law to the proper value of dialnorm: "The value of the dialnorm parameter in the AC-3 elementary bit stream shall indicate the level of average spoken dialogue within the encoded audio program." If the industry doesn't obey the law, count on consumer complaints and congressional hearings.

As consumers increasingly rely on AC-3 audio delivery through digital broadcasting, cable and DBS, it is imperative that the production, network, station and cable industries work together to make dialnorm effective. BE

Bruce Jacobs is chief technologist with Twin Cities Public Television and a long-standing member of the PBS Enterprise Technology Advisory Committee.

Four simple steps to successful dialnorm

1. Measure the long-term average A-weighted dialog level for different types of content and ensure that the dialnorm parameter is set to the measured value.
2. If the correct meter is not available, set the dialnorm value 14dB lower than the typical peak value and compare with other stations. If your channel seems too loud, move the dialnorm value toward the value of -1. If your channel seems too soft, move the dialnorm value toward the value of -31.
3. If the average dialog level going into the encoder varies by more than 4dB from show to show, install a gentle audio automatic gain control.
4. Encourage your peers to follow these same rules.

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MEETING THE HD CHALLENGE

- HD bursts onto the television stage
- Stations respond with HD innovations
- Viewers are in transition

A letter from the publishers

Thirteen months and counting. That's how long before U.S. broadcasters enter a new era of HD and DTV-only broadcasting. Are you ready?

Researchers claim that up to 20.4 percent of homes in key U.S. cities are equipped with HD television sets. The Consumer Electronics Association claims that as many as 16 million homes currently receive HD programming. No one expects the rapid uptake of HD television sets, transmission capability and HD content to decrease. After February 2009, the adoption rate of HD technology and programming by viewers may increase.

So, what does the quickening pace of HD adoption mean to content producers and broadcasters? It means if you aren't producing and broadcasting HD content, you're already slipping behind the HD curve.

To help our readers meet the challenge of implementing HD, *Broadcast Engineering*, *Broadcasting & Cable* and *Multichannel News* have joined forces to create the "High Definition Summit." The Summit is an on-site, face-to-face conclave of high-level industry experts. In two days of meetings, managers, engineers and program producers share questions — and best of all, solutions — to common issues. Augmenting the Hollywood event is this printed supplement, which highlights some of the key issues facing program producers and broadcasters.

Fortunately, making the move to HD need not be daunting. Our readers can rely on the experience of these three industry-leading magazines and the experts they have assembled to smooth the path to HD.

Take heart in that the answers you need to become an HD leader in your market may be just ahead.

Jonathan Chalon
Group Publisher,
Broadcast Engineering and *Radio*

Larry Dunn
Publisher,
Broadcasting & Cable
and *Multichannel News*

Articles

HD continues its march into the living rooms of Americans, but there appears to be a conflict over how many households are actually set up with an HD display and tuner.

HD metrics

How many U.S. households have an HD set? That depends on whom you ask.

BY PHIL KURZ

By any measure, HDTV is making its mark on the television landscape in the United States. Viewers, programming hours and sets sold are all up, and consumer desires this holiday season point to strong prospects for the future.

In fact, a new poll from the Consumer Electronics Association (CEA) found that when consumers were asked if they could have any gift this holiday season, what would they choose, "big screen television" — generally understood to be a synonym for a 40in or larger flat-screen HDTV — came in third, behind a new computer, and peace and happiness.

While there's general consensus among researchers that HDTV has gained strong momentum and will continue to proliferate and eventually dominate television viewing, Nielsen Media Research raised a few eyebrows in late October when it reported that only 13.7 percent of U.S. television households have an HD set and tuner and that 11.3 percent are actually receiving HD programming.

That's 15 million households with the gear needed to watch HD, a figure significantly lower than what's quoted by other industry authorities:

- The CEA data from June 2007 shows 32 percent of U.S. households own an HDTV.
- Leichtman Research released figures last month showing about 25 percent of U.S. households have at least one television set that can receive HD programming.
- Strategy Analytics in October projected 40 percent of U.S. households would own a flat-panel TV by year's end, although it must be noted that not all flat-panel TVs are HD.

The difference between Nielsen's numbers and those generally accepted in the industry is significant — a disparity of between 10 percent and 18 percent. This raises the question: Who's got it right?

That's more than an academic question. The difference between 13.7 percent and 32 percent is the difference between a market of early adopters and innovators and a market filled with mainstream adopters. With hundreds of mil-

Top 5 Holiday '07 Wish List Items Among Adults	
No. 1	Computers
No. 2	Peace and happiness
No. 3	Big-screen TV
No. 4	Clothes
No. 5	Money
Top 5 Consumer Electronics Gifts Consumer Hope To Receive	
No. 1	MP3 player
No. 2	Notebook/laptop computer
No. 3	Video game system
No. 4	Digital camera
No. 5	Any type of TV

Source: Consumer Electronics Association 14th Annual CE Purchase Patterns study

lion of dollars on the line in capital investment and marketing funds, that's an important distinction.

Leichtman Research Group in Durham, NH, specializes in research and consulting on the broadband, entertainment and media industries. Led by Bruce Leichtman, the market research firm said in November that about one in four U.S. households owns an HDTV. Why are Nielsen's numbers so much lower?

"Plain and simple. They used the wrong denominator," Leichtman says. "Their number is just wrong. Their denominator was households that had HD sets with a built-in tuner."

According to Leichtman, the number of people Nielsen found who are actually viewing HD television is similar to his organization's number.

"But their actual number of HD homes, just based on sales, based on anything, is impossibly low," he adds.

However, Leichtman's characterization of what Nielsen used for its "wrong denominator" may not be entirely accurate. In announcing its findings, Nielsen did in fact define what it terms HD-capable households as being "equipped with an HD television and HD tuner capable of receiving signals in HD." The research organization never said its universe of HD-capable homes included only sets with built-in HD tuners.

The CEA updates its estimate of HD households in the United States twice per year. The last estimate in June pegged the percentage of HD households at 32 percent, up from 26 percent in January. According to Tim Herbert, CEA senior director of market research, the association's research methodology is based on two prime components, telephone and on-line surveys and detailed sales data of manufacturer shipments into the retail channel.

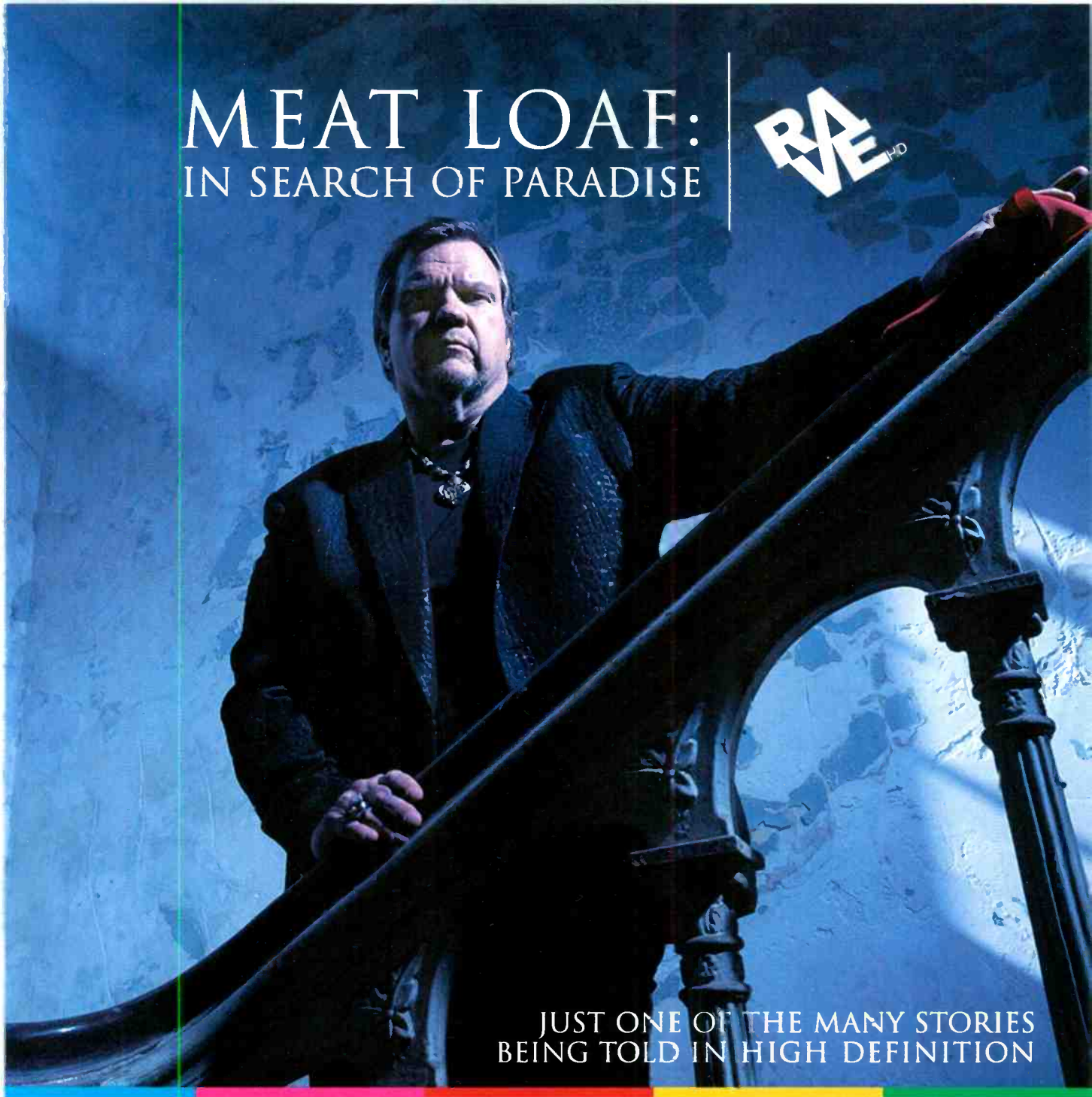
"Nielsen's number appears to be quite a bit lower than everyone else," Herbert says, referring to the general consensus about the number of HD households among independent researchers. "One thing we speculated, if you look at the number of households actually receiving HD — and that would be 44 percent — 44 percent of the 32 percent (CEA's HD household penetration) comes out much closer to the 13.7 percent figure Nielsen has (for HD-capable homes)."

The CEA's last estimate in June pegged the percentage of HD households at 32 percent, up from 26 percent in January.

Nielsen methodology

Nielsen's Oct. 30 release of numbers for HD-capable and HD-receivable households offers statistics for national HD household penetration as well as the number of HD households in 13 individual markets. Nationally, the numbers show that from a total universe of almost 113 million TV households in the United States, 15.5 million are capable of receiving HDTV — in other words, those households have an HD set and an HD tuner. Further, it revealed that 11.3 percent, or 12.7 million households, have the HD equipment and are actually receiving one HD channel or network.

Nielsen's numbers are based on total U.S. and local People Meter homes. According to Anne Elliot, Nielsen media VP of communications, measuring HD households based on the organization's 35,000 People Meter homes is significant. To become a People Meter home, households must agree to allow a representative from Nielsen to enter their home to connect the meter to a set or set-top box. Therefore, the organization has firsthand knowledge gleaned from observation by its trained personnel about what's



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actually being used in the home to receive and watch television.

"We held out coming out with a universe estimate until we could do it based on our field reps actually seeing the television," Elliot says. "As you can imagine, if you call somebody and ask, 'Do you have high-definition television?' everybody who watches TV and sees 'Now in high def,' a certain percent of those people, I would guarantee, will then assume they have high definition. That does not mean they have the equipment to see high definition."

Additionally, if a People Metered household buys a new television set and begins using it rather than the metered set, Nielsen can detect a change in the household's viewing and respond.

"We'll pick up a dramatic change in viewing in such instances," Elliot says. "That might trigger us to call them and say, 'We've noticed there is no viewing in your living room anymore. Did you get a new set?' Then we come back out and install it. We check each day to ensure that the data we get is good, which indicates that the equipment is in working order."

Perhaps the more relevant number is what Nielsen terms HD-receivable homes.

HD-receivable homes

So, who's right? Nielsen on the low end, or the Consumer Electronics Association, Leichtman Research Group and others on the high end? It seems impossible to know for sure. Both camps make strong cases for their view of HD market size.

Perhaps the more relevant number for stations, groups, networks, consumer electronics manufacturers, the ad community and everyone else whose future is touched by how many HD households exist is what Nielsen terms HD-receivable homes.

When it comes to how many homes are actually watching HD programming, the numbers are much closer. Nielsen pegs the figure at 12.7 million households nationally. Leichtman Research estimates about 53 percent of HD-capable households, or about 15 million, actually receive HD programming. Similarly, the CEA puts the number at about 16 million households.

Working from this common agreement about how many households actually watch HD in the United States appears to give the industry a baseline from which to measure its progress. Perhaps that's where the industry should focus its attention. ■

Phil Kurz authors several Broadcast Engineering e-newsletters, including "HD Technology Update."

HD Television Household Estimates
November 2007

	TV HHs	HD-Capable	%	HD-Receivable	%
Total U.S.	112,880,000	15,500,000	13.7	12,730,000	11.3
New York	7,391,940	1,334,840	18.1	1,293,790	17.5
Philadelphia	2,939,950	457,900	15.6	438,110	14.9
Detroit	1,925,460	238,830	12.4	212,370	11.0
Boston (Manchester)	2,393,960	399,440	16.7	388,350	16.2
Washington, DC (Hagrstwn)	2,308,290	447,160	19.4	387,680	16.8
Atlanta	2,310,490	345,680	15.0	287,710	12.5
Tampa-St. Pete (Sarasota)	1,783,910	296,300	16.6	277,970	15.6
Chicago	3,469,110	585,960	16.9	485,580	14.0
Houston	2,050,550	344,260	16.8	270,820	13.2
Dallas-Ft. Worth	2,435,600	425,420	17.5	364,850	15.0
Los Angeles	5,647,440	1,152,380	20.4	965,200	17.1
San Francisco-Oak-San Jose	2,419,440	397,860	16.4	320,740	13.3
Seattle-Tacoma	1,782,040	255,960	14.4	216,530	12.2

Source: Nielsen Media Research, October 2007.

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Upon further review

HD television is giving NFL officials a clearer view of challenged calls.

This season, the NFL has turned to HD technology to give officials a clearer view of challenged calls from their sideline reviewing stations and replay booths.

With its 16:9 aspect ratio and more detailed pictures, HD television is helping the league's officials do their jobs better, says Dean Blandino, NFL director of instant replay.

"Our old system was great, but innovation is one of the things the NFL stresses, and we wanted to stay on the cutting edge," he says. "HD is the technology that is out there, and we wanted to be at the forefront."

In all but four stadiums — Dallas, Indianapolis, Kansas City and New York — with ongoing renovation or construction, referees peer into shrouded sideline replay stations with 26in high-def LCD monitors to review questioned calls with the benefit of a clearer, broader view.

"HD's a clearer picture, so you can see when the toe drags on the grass," Blandino says. "In a lot of these field turf stadiums, you see those rubber pellets kick up when the receiver drags his toe. On pass complete or incomplete, when the ball is coming in low and the receiver gets his hands underneath, you can really get a good shot of that in HD."

The wider aspect ratio of HDTV also is important to the league for replay judgment calls, says Ken Aagaard, CBS Sports senior VP, operations & production services.

"The NFL went to a high-def replay system because they realized they were missing information that the high-def viewer at home had, because in previous years they were looking at a 4:3 signal," Aagaard explains. "Of course, what happens is fumbles could occur outside that 4:3 in that 16:9 set, or a foul or penalty that could be seen by an HD viewer and not an SD viewer."

The National Football League this season kicked off use of high-definition displays inside its replay booths and on the sidelines to give replay officials a clearer, wider view of challenged calls.

The NFL relies on broadcasters like CBS to provide the video its referees use to review plays. Replay officials seated in a stadium booth equipped with two HD monitors watch every play. A touch-screen interface allows the official to access any video available from the broadcast production truck.

"They can run it back, run it slow motion and run it frame by frame," Blandino says. "They are basically picking the angles the referee will look at when he reviews the play."

One area hasn't quite worked out as some sports writers predicted at the beginning of the season. Some built the case that sharper HD resolution and a 16:9 aspect ratio would actually make deciding whether or not a call stands faster. However, at best, HD has shaved a couple of seconds from the time needed to reach a decision this season compared to last, Blandino says.

"We keep track of the amount of time to review plays, which is 60 seconds, and we also keep track of the overall delay — how long we are delaying the game from the time the challenge is initiated to the time we make the announcement that the challenge is over," he says. "Last year, we averaged about 50 seconds to make a decision, and maybe we're at 47 to 48 seconds so far this season. There is no need for them to get out real quick if they're not sure. So we encourage them to use the full minute if that's what they need."

Overall, the league is happy with HD.

"It just gives the referees more tools to do their jobs," Blandino says. "They've already been doing a great job, and it's just allowed them to keep it up." ■

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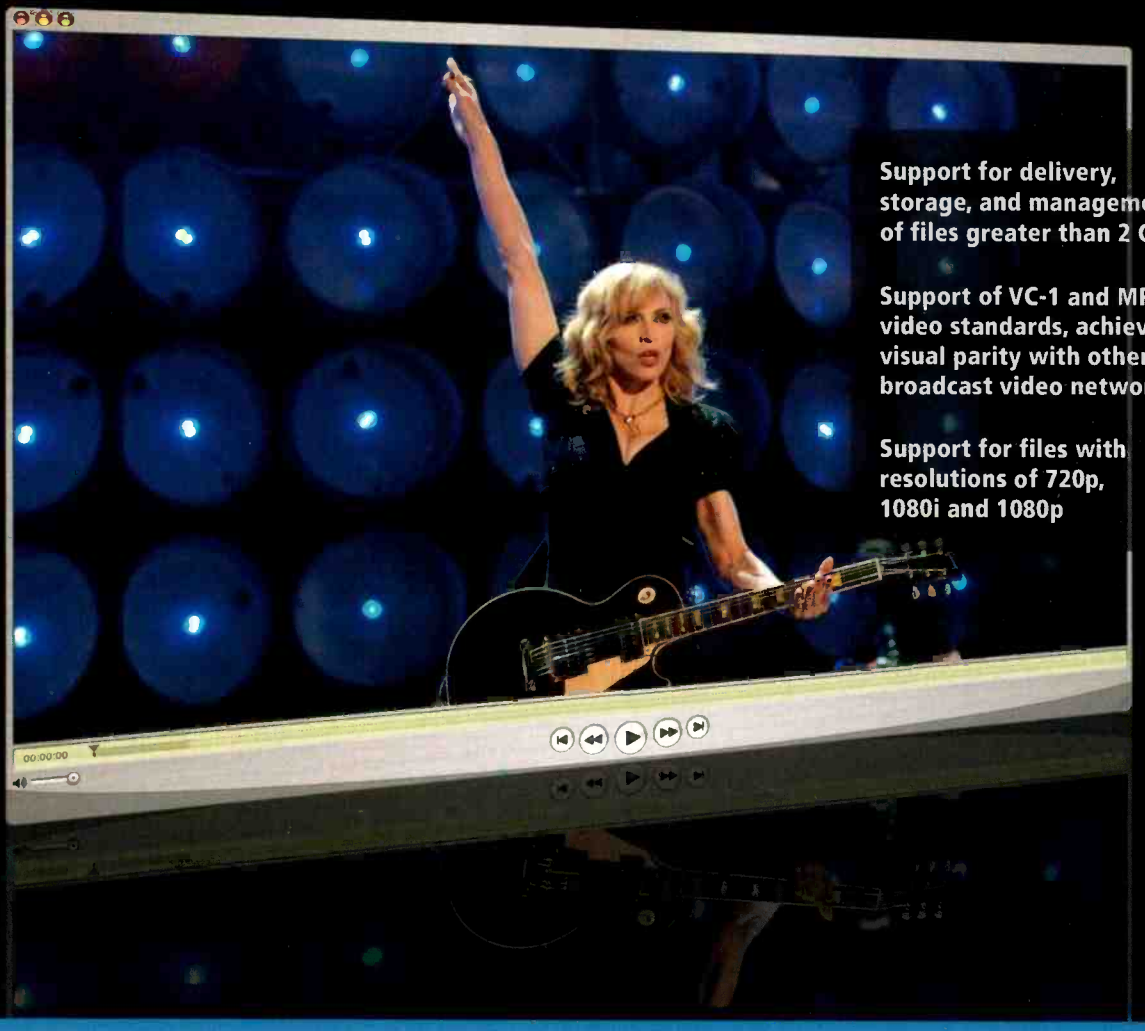

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Forging ahead in HD

DIRECTV is closing in on its goal of 100 channels of HD by the end of the year.

Three years ago, DIRECTV began planning for its ambitious direct-to-home satellite delivery of HD television, says Derek Chang, the company's executive VP content development and strategy.

According to Chang, who is presenting a keynote speech during the *Broadcast Engineering, Broadcasting & Cable* and *Multichannel News* HD Technology Summit Dec. 4-5 in Universal City, CA, the lead time needed to build and launch a new satellite like DIRECTV-10, the Boeing 702 DBS HD satellite put into orbit July 7, gave DIRECTV valuable time to build support among networks and resolve how customers access HD.

"When we came out in January and said we are going to have 100 channels of HD by the end of the year, all of the cable guys and a lot of our competitors laughed at us and said there aren't a hundred channels to put on," Chang says. "It's gone from there to the point where we are closing in on 100. There are programmers who still aren't on and are now coming to us saying, 'I don't want to be left out.'"

Recalling initial talks with programmers that began in the summer of 2006, Chang says a mismatch of sorts existed between DIRECTV's sense of urgency to offer HD programming and some programmers' timetables to roll out HD.

"Some of the initial conversations were pretty difficult because a lot of these programmers knew HD was coming but didn't have a game plan for it," he says. "Over a six- to nine-month period, we had gotten them to realize that if they didn't have a plan for HD and weren't reserving a space on our platform, they were actually going to miss out."

Getting people up to speed on HD is a matter of education, says Derek Chang, DIRECTV executive VP content development and strategy.

What's resulted, in Chang's view, is an unequaled stable of HD sports, movies and entertainment that will establish DIRECTV as the top source for HD programs.

"We have multiple feeds from basically every programmer out there. No one else can say that right now," he says. "Whether it's Disney, Turner, Viacom, NBC, FOX, Discovery, The Movie Channel, HBO, Showtime or Starz, we've got it all. We also have loaded up on our ability to get all of our sports products in HD, including all of the out-of-market games, which take up a lot of bandwidth. When you try to do 10 baseball games a night, not everyone can do that. But we are already carrying it because we are carrying the RSNs (regional sports networks). So that's where we believe we have certain advantages over some of our competitors."

Adding 100 new HD channels without thoroughly thinking through how customers will find them could create a big problem, so DIRECTV was determined to make the experience simple.

"From a user standpoint, getting people up to speed on HD is a matter of education. What we came up with was the concept that channel line-ups and guides could be difficult," Chang says. "Instead of having customers memorize new numbers for new channels, we actually created our technology so you tune to the same channel you've always tuned to, and if you have HD service, it just comes in as HD. For example, ESPN is on Channel 206. If you purchase an HD set and have an HD box, when you tune to 206, you will get ESPN in HD without having to memorize new channel numbers."

That approach is consistent with how DIRECTV views HD in general, he says.

"The theory for us is HD is just an enhancement. It's a visible enhancement; it's just a much better quality picture," Chang says. "At the end of the day, most people are going to want to watch what they traditionally watched. So, we took the route of really trying to urge and encourage programmers to start putting their existing services in HD. It's really the same service that they've invested a lot of money in. It's just you get to watch it on an enhanced basis. Our strategy is that HD fits with DIRECTV. DIRECTV has always been a premium brand, a premium experience, and HD really reflects that." ■

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The technical operations center inside KYW-TV's new 100,000sq-ft greenfield facility monitors the pulse of CBS-3 and CW-57 in Philadelphia.

HD makeover

HD television demands that stations remake themselves, a task easier said than done.

BY PHIL KURZ

The conversion to HD touches all aspects of broadcast operations. For a lucky few, starting from scratch at a green field site is a possibility. Advantages abound, but the biggest may be setting up a new broadcast operation without impeding the necessary work of the ongoing SD plant.

For most, however, launching HD operations will require layering HD onto an ongoing enterprise — a task few will find pleasant, but all will find necessary as broadcasting enters an era where HD will be commonplace.

This is the story of how some broadcasters — large and small, independent and group-owned — have managed their own HD makeovers.

KYW-TV

KYW-TV, the CBS O&O in Philadelphia, went on air from its new 100,000sq-ft HD broadcast center April 2. Located on the sixth floor of a former SmithKline manufacturing plant, the station has been recognized by General Building Contractors Association and is nominated for a Pennsylvania Society of Professional Engineers Excellence Award.

Starting fresh gave the station a big leg up in many ways, but it wasn't without its own set of issues.

"The first challenge was making sure the television station worked as a television station," says Rich Paleski, KYW-TV director of engineering and operations.

Specifically, that meant making smart decisions about the physical layout of the plant. The new station is located on a single floor and covers about two acres, which affects both engineering and people, he says.

"We spent a lot of pre-planning time — almost like a jigsaw puzzle — working all of the departments into this one footprint to be as efficient as possible in terms of the operation of the station," Paleski says.

On a human level, that translated into keeping closely knit departments like sales and traffic adjacent to one another. On an engineering level, it meant being mindful of minimizing the length of cable runs.

"We located the central rack room in the center of the facility closest to master control and the news control

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rooms to keeps cable runs as short as possible," Paleski recalls.

Leaving its 35-year-old facility and starting over with a green field also gave KYW an opportunity to leave the past behind.

"I want you to understand that we are completely a high-definition plant," Paleski says. "Even our SD signal is converted to HD. We distribute everything as HD-SDI."

In master control, the station relies on two separate HD master control switchers, each running its own automation system.

"At the end of the line, the one for standard definition is center cut and then downconverted for SD," he says.

The station also operates WPSG-TV, CW Philly 57, with its own master control. Taking this approach lets KYW continue to meet its SD obligations but disengage itself from legacy technology as it proceeds into an HD future.

"It didn't make any sense to design two separate television stations when everybody knew that SD was going away," he says. "When we looked at it, it was really more economical to build an HD-only plant. In the future, we won't have to worry about throwing much of anything away."

KCRA-TV in Sacramento, CA, is one of three HD makeovers Hearst-Argyle Television has made to existing station facilities.

KMBC-TV and KCRA-TV

KMBC-TV, the Hearst-Argyle Television-owned ABC affiliate in Kansas City, MO, is one of four stations in the group currently originating HD on a local level. Residing in a new building on the eastern edge of town, the station had a classic green field site for HD. But HD was not the impetus behind the new building.

"The original intent was never to be an HD facility there," says Joe Balkan, Hearst-Argyle western regional director of engineering. "From the standpoint of that market and need for HD at this point in the game, it probably wouldn't have happened if it weren't for Jerry (Agresti, KMBC director of engineering) being so diligent and wise about what he bought."

In Kansas City, MO, having a green field on which to build an HD facility was crucial in Hearst-Argyle's decision to put KMBC-TV on-air in high-def.

Unanticipated construction delays pushed off the installation of critical infrastructure, Balkan says, which gave HD equipment prices additional time to fall.

"When we got to the point of, 'Do we or don't we go HD?' it was a slam dunk from a corporate perspective," he says. "Everything was in place, and the incremental cost was not great nor was the installation because it was a green field."

Says Agresti, "The biggest concerns were to future-proof the technology as much as possible and to stay within budget."

KMBC's green field experience offers an interesting contrast with the HD retrofit of KCRA-TV, the Hearst-Argyle station in Sacramento.

"The challenges in Sacramento were really that you have to keep producing the 45 hours-plus of news that they create every week between the two stations (KCRA and KQCA My 58)," Balkan says. "They really had to not interfere with the product on-air while dealing with studio changes and control room changes simultaneous to the upgrade. That's a pretty big undertaking."

Stefan Hadl, KCRA director of engineering, implemented an incremental approach to HD.

"Stefan wanted to bring the technology into the plant without doing a cutover on the air that would be too much to digest in one session," Balkan says.

Thus, the station installed its HD control room long before it put its newscast on air in HD. Taking advantage of a free studio that could be used temporarily to house the SD news set, crews conducted demolition and construction of a new HD news set.

"Basically, they began doing the show in high-def and downconverting to an old studio that didn't warrant doing it in high-def while they were building the new studio," Balkan says. "The fact that the on-air product was not compromised during the whole process was key."

FOX Business Network

The mid-October launch of FOX Business Network in 720p HD was a bit green field and a bit accommodation of existing infrastructure.

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From an HD point-of-view, the new national business channel was built from the ground up without any legacy encumbrance. However, from a newsgathering point of view, FOX Business Network naturally maintains a close tie with the FOX News Channel and its 11-year-old infrastructure.

"Our tech center ended up being a green field space for a lot of the HD infrastructure," says Greg Ahlquist, FOX senior network director/project manager of digital newsroom integration.

Having a fresh start for the new HD operation was critical to hitting the six-month deadline the organization was given to launch the business channel.

WLEX-TV, the Cordillera Communications station in Lexington, KY, not only layered HD onto an existing SD plant, but also converted to a file-based workflow and new newsroom system at the same time.

"Having the green field space was a luxury, especially in that short time frame," Ahlquist explains. "We didn't have a lot of time to make decisions that would have been dependent on (simultaneously operating a) breaking news (organization). So we were able to configure our HD infrastructure and test it without interrupting our newsgathering organization. Without the demands of a 24-hour news operation, you don't have the need to support that. You are allowed to get in there. Because it is such a new technology and is changing so quickly because new products are always coming out, you are able to wire them and test them, and you know what you are going to get."

However, the luxury of the green field only went so far, he said. At some point, it was necessary to tie in the existing FOX News Channel news gathering resources with the new business network, and where that happened, so did a surprise or two.

"Embedded audio was definitely an issue," he recalls. "The embedded audio issue in an HD environment really becomes an issue between the two environments since Fox News Channel was built 11 years ago, and there are analog mixers and analog audio and embedded throughout that plant."

Ahlquist's FOX Business Network experience has given him a bit of insight. First, control costs, he says.

"There are so many bleeding edge technological options that are out there that understanding it and having a plan as to what you are trying to achieve is probably the biggest challenge out there," he explains

His second suggestion is closely tied to the first.

"Know how you process the signal throughout the plant," he advises. "Each particular vendor has many options; you must know the dependencies of each one of those."

KVOA-TV and WLEX-TV

Andy Suk, VP of engineering and operations for Cordillera Communications, doesn't mince words when describing an HD station upgrade

"When you get into the backbone of the station — the routing switching network, the production switcher and all the parts and pieces that are part of that puzzle — you are talking about ripping out the spine of the station and reinserting a new one," Suk says. "Or, you can try a stepped approach to do the same thing."

He should know. KVOA-TV in Tucson, AZ, and WLEX-TV in Lexington, KY, Cordillera Communications' largest television stations, both upgraded their existing broadcast facilities for HD origination this spring.

The approach used in Tucson was to rely on an HD-capable routing switcher installed the year before that could be populated with HD cards to build an HD matrix. In Lexington, the approach was to add a separate HD matrix tied to the existing SDI router via some custom software. While that made the move a bit smoother than a total spinal transplant, a host of other challenges had to be met, he says.

"Monitoring becomes more of an issue than we would like to admit," he says. "Everybody has HDMI inputs. You can pick up plasma displays to go into offices, conference rooms, whatever, and they all have HDMI inputs. Unfortunately, we're routing HD-SDI signals around the plant. It's $700 a whack to do those conversions."

The "oh-by-gollies," a term Suk coined for such expenses, aren't confined to conversions.

"I think one of the biggest things from an engineering standpoint is to say, 'Oh, I need a switcher; I need a router; I need monitoring and graphics,' and miss all the other things that keep you pulling that adding machine lever back as you go," Suk says.

Other less obvious HD expenses include Doppler radar, a new news set and the cost of hiring contractors to do the construction renovation. Aside from expenses, the other complication, particularly when it comes to HD upgrades, is keeping SD operations on track during the process.

"If it were a green field conversion just starting from the ground up, that would be a piece of cake," Suk says, "but keeping the rest of it up and alive, a lot of that has to do with the SD process, the conversion to SD and figuring that out before the HD conversion."

According to Suk, often there are other conversions tied to the HD upgrade going on simultaneously that can put a strain on SD operations. For example, WLEX converted its news production from a tape-based to nonlinear workflow and its newsroom computer system to ENPS all at the same time.

Why put so much strain on staff to adapt to so much new technology at once? Simple: the addition of HD servers for playout of all stories.

"If you are going to put in the playout server, that effectively is your nonlinear editing system," Suk says.

WINK-TV

WINK-TV, the Fort Myers Broadcasting-owned CBS affiliate in Fort Myers, FL, sprinted into HD local origination Oct. 20 after deciding to upgrade to HD following NAB2007 in April.

If ever there were an HD extreme makeover, WINK would be it. It could be the poster child for the pain caused by layering an HD broadcast operation onto an existing broadcast infrastructure.

"One of the first things we needed to do was our control room, the only one we have currently," says Keith Stuhlmann, WINK director of engineering. "It's pretty much been the same for the last 15 years. We really needed to redo the room to get it into the modern age and ready for HD."

The first step in that process was ripping out the ceiling above the control room, all the while continuing to produce seven and half hours of news a day from the room. "Getting the ceiling down and the new suspended ceiling up was going to make it a whole lot easier for wiring," Stuhlmann says.

While the station's entire operations center is on a computer floor, there were many advantages of being able to "fly wires" overhead, including the ability to get from Point A to Point B.

"Hanging the suspended ceiling made that much easier," he says.

To protect the graphics systems, production switcher and other control gear from the debris and dust, Stuhlmann turned to drop clothes and vacuum cleaners.

Ripping out the existing producer's stations, monitor wall and switcher/graphics cabinet required cutting existing cabinetry apart a little at a time when the station wasn't airing news. To keep the saw dust to a minimum, it was not unusual for two people to be vacuuming while a third person operated a circular saw.

"Vacuum cleaners are your best friend," he notes.

As the cabinets were being cut into pieces for disassembly, station engineers began hanging the plasma monitors that would become its new monitor wall on the wall behind its existing monitor racks. News production personnel identified the absolute minimum monitors they needed to maintain the newscast. That reduced the number of racks needed from six to three, Stuhlmann explained.

Unneeded racks were removed and the newly populated racks were pulled tight against the switcher desk, creating a 3ft gap to hang the plasmas. Eventually, all of the old equipment cabinets were replaced with new custom cabinetry, the control room was rewired, and old broadcast equipment was replaced with new HD gear. The last piece to go was the disconnect Ampex AVC-335 switcher, which was replaced a Snell & Wilcox Kahuna production switcher.

Without question, WINK is using state-of-the-art equipment, including a Miranda Technologies Kaleido-X multiviewer, Ikegami HDK-790EX III studio cameras, a Bitcentral Precis news production system, Thomson Grass Valley Edius software and a host of other equipment, but it's the station's story of the control room renovation that best illustrates how extreme the challenge of upgrading to HD can be in some cases.

"The first thing, when someone hands you a project like this, is you have to carefully plan out what your moves are going to be and in what order," Stuhlmann says. ■

Today all is calm behind the Kahuna production switcher at WINK-TV, but a few months ago, this control room saw major demolition and rebuilding during a six-week period to upgrade to HD while maintaining control of its SD news from the room.

Phil Kurz authors several Broadcast Engineering e-newsletters, including "HD Technology Update."

HD sports coverage

Producing 'NFL on CBS' coverage in HD is no easy task, says CBS Sports VP.

While the increasing number of HD networks, programs, locally originated newscasts and sets sold are testaments to the growing pervasiveness of HD television in the United States, much needs to be accomplished before the next era in TV can truly be considered complete.

There may be no better example than HD coverage of sports, if you consider the point of view of Ken Aagaard, CBS Sports senior VP, operations & production services.

"What happens to people like us at CBS Sports — because we are in a position where we do multiple, simultaneous HD feeds as we do on "NFL on CBS" and because capital isn't something that just falls out of trees — is we find ourselves in a partial-SD world and partial-HD world," he says.

The reality of a bifurcated broadcast world translates into obstacles.

"The main point is the HD revolution has happened, but we're not home yet. We have a long way to go. There are still a lot of issues," says Aagaard, who is presenting a keynote speech during the *Broadcast Engineering, Broadcasting & Cable* and *Multichannel News* HD Technology Summit Dec. 4-5 in Universal City, CA.

For example, on any given Sunday during the NFL season, CBS Sports produces five to six games in HD, depending upon whether or not the network is presenting a doubleheader, out of a total of as many as eight game telecasts. With that mix, what to do with audio becomes a major obstacle.

"Right now, our NFL studio, which is our wraparound studio, still has only stereo audio," Aagaard explains. "But every time we switch to that studio for updates, half-times, post-games and pre-games, we take a game that is in 5.1 surround sound, and if you are listening in 5.1, it collapses down to stereo. The problem that causes is not necessarily a happy story for the guy listening in 5.1."

Ken Aagaard, CBS Sports senior VP, operations & production services, says 5.1 surround sound, mixed aspect ratios and the ad community present the network with challenges in producing NFL coverage.

Currently, not a lot of HD viewers have surround sound at home, but the number is growing, which adds urgency to overcoming the 5.1-stereo issue, he says.

Obstacles arising from the mix of SD and HD games aren't confined to audio, however. Switching from market to market to update viewers on games across the country creates challenges related to aspect ratio.

"As we switch from game to game, one minute you are on an SD 4:3 game. Then the next minute, you are on an HD game," Aagaard explains. "It becomes technically and operationally difficult for the stations and the viewers, too — especially the HD viewer."

While the SD viewer remains unaware of the aspect ratio changes, the HD viewer sees it all.

"Now that the penetration of HD is so much larger among the viewing audience, this is a bigger deal," he says.

The trouble of mixed aspect ratios also touches sponsors. Many agencies and advertisers deliver HD 16:9 aspect ratio commercials, but fail to ensure they are 4:3 safe, Aagaard says.

"Many of the stations in our system just take HD, and they derive the SD 4:3 out of the HD feed," he says. "What that means is those commercials get clipped, and that presents its own problems."

Fixing the problem is a matter of educating sponsors, but they better learn soon, Aagaard says.

"Come next year, all broadcasters are going to tell them: 'Time's up. Deliver us an HD, 16:9 4:3-safe commercial,'" he warns.

These HD growing pains aren't the whole story, however. Bright spots abound, and HD sports production sheds light on the progress. Only a few years ago, tools and technology considered commonplace in SD sports production simply didn't exist in HD. But that has changed.

"From a production point of view, the manufacturers have caught up," he says. "You can't even go buy SD gear anymore. It doesn't even exist. I really cannot think of one thing I cannot do in high def that I couldn't do as long as I'm willing to pay for it." ■

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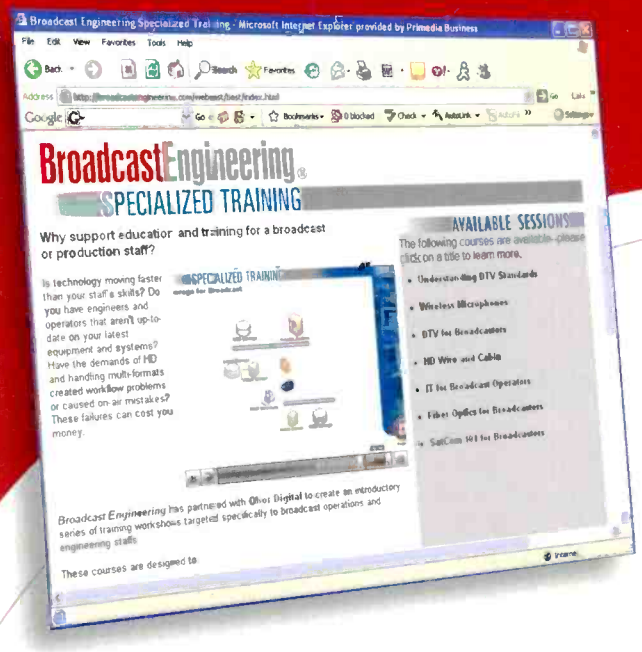

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OPTICAL STORAGE
for HD video acquisition

BY WAYNE DESMOND

The evolution of recording media continues to keep pace with the increasing storage capacities and transfer rates needed for HD video acquisition. One of the two major nontape recording platforms used in today's broadcast facilities is optical storage. Here is a tutorial on how the technology works.

One of the two major nontape recording platforms used in today's broadcast facilities is optical storage.

Dual-layer blue laser

Increasing the capacity of current recordable and rewritable blue-laser discs, employing a 405nm wavelength to write/read to a 120mm disc, can be accomplished in a few ways. Physically speaking, the track pitch can be made narrower to increase the overall length of the track (pregroove) that spirals out from the center of the disc. Another choice is whether to adopt land-groove recording or groove-only recording. A third option is to decrease the recorded mark size, enabling more marks along the linear track.

As for the format, a compression algorithm with a higher compression ratio can be employed. The practical solution is to add record layers to the media, effectively doubling the capacity with the addition of each successive layer. Additional layers on opposite sides of the disc, though, require two pick-ups to access both sides or the use of a flipper to turn over the disc

to write/read to the opposite side.

Obviously, the use of two record layers on the same side makes more sense. However, that would require the outer-most record layer to have transparency so the inner-most record layer can be written to and read from by the laser. It must also have record layer properties necessary to store amorphous (low reflectivity) marks and crystalline (high reflectivity) marks.

Hence, two new developments were necessary to facilitate dual-layer recording. The first is a semitransparent record layer, and the second is a grooved transparent spacer layer, or the layer that separates L0 layer and L1 layer.

Semitransparent recording layer

Typical rewriteable single-layer discs reflect about 16 percent of the 100 percent incident blue-violet laser light back to the drives pickup. The record layer absorbs 84 percent and uses it to write the signal. Dual-layer relies on only 5 percent reflectivity from both L1 and L0 layers to achieve a reliable read process.

In Figure 1, the optical block, which consists of the laser diode and optical lens, physically moves as one to focus on L0 or L1 layer. The laser first writes to L0 layer radially, from the inside of the disc to the outer circumference, then to L1 layer, from the outside in. This is the movement of the optical block when continuously recording data.

L1 layer absorbs 45 percent of the light, reflects 5 percent of it and transmits the remaining 50 percent to write to L0 layer. Thus, L1 layer is said to have 50 percent transmittance. Because L0 layer reflects back only 10 percent of the light, and L1 layer has 50 percent transmittance, 5 percent

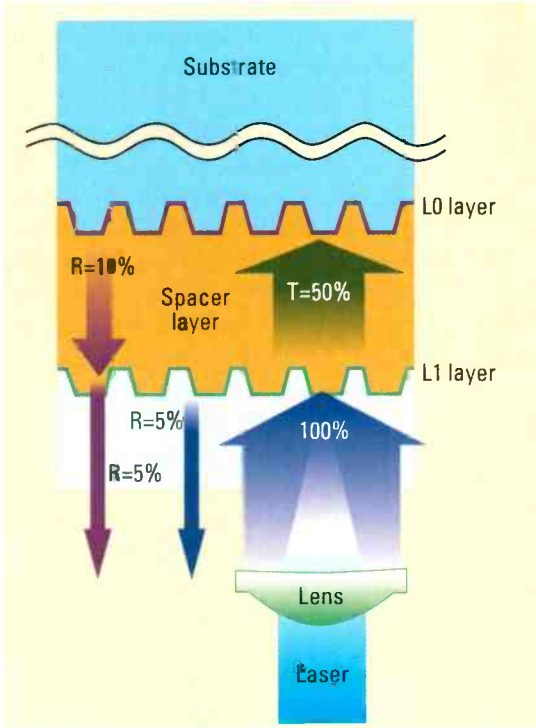

Figure 1. Dual-layer disc cross-section, showing transmittance (T) and reflectivity (R)

of the original incident light is ultimately received by the pickup from L0 layer.

Grooved transparent spacer layer

With single-layer optical disc manufacturing, a pregroove is stamped into the substrate, incorporating a wobble method to allow the laser to track properly on the groove. When two record layers are present, as is the case with a dual-layer disc, a groove must also exist in the second layer (L1 layer) to facilitate proper tracking on this layer as well. To accomplish this, after L0 record layer is applied to the grooved substrate, a 25μm-thick transparent spacer layer is spin-coated on top of it.

A soft stamper, embossed with the same groove pattern as was originally stamped in the substrate prior to applying L0 layer, is pressed down on the transparent spacer layer to create the pregroove for L1 layer. (See 2A in Figure 2.) The spacer layer is then cured using an ultraviolet lamp. (See 2B in Figure 2.) Once cured, the soft stamper is peeled away. (See 2C in Figure 2.)

It is important to note that not only does the spacer layer need to be transparent to enable the laser to write and read L0 layer during normal use, but the stamper must also be transparent in order for UV light to pass

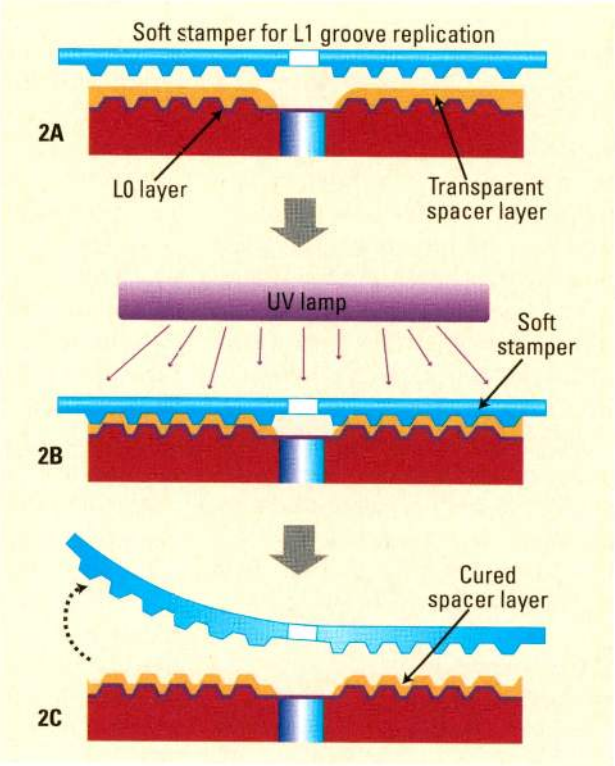

Figure 2. Grooved transparent spacer layer process

through it during the manufacturing process. L1 record layer is then applied to the grooved spacer layer. Both L0 and L1 layers now have the same groove structure with opposite spiral. These additional steps in the manufacturing process and the development of a transparent spacer layer and soft stamper are used in the manufacturing of dual-layer discs, including the Sony Professional Disc. (See Table 1.)

Conclusion

Advancements in manufacturing techniques and layer composition that support both transparency and reflectivity were necessary to bring dual-layer optical disc technology to fruition. The result is a storage/recording media with a capacity more than 70X that of the standard compact disc, yet relies on the same size disc.

Considering the data-intensive nature of HD recording, it is no surprise that this medium, capable of recording such a high bit-density-per-square centimeter in a low-cost, easy-to-handle, reliable and rewritable form, continues to be accepted as an alternative to tape for both HD video acquisition and archive applications. BE

Wayne Desmond is the national training manager of Sony's Media and Application Solutions Division.

Sony Professional Disc model	PFD-23A	PFD-50DLA
Recording capacity	23.3GB	50GB (25GB/layer)
Recording time	HQ (35Mb/s): approx. 60min SP (25Mb/s): approx. 90min LP (18Mb/s): approx. 120min	HQ (35Mb/s): approx. 145min SP (25Mb/s): approx. 190min LP (18Mb/s): approx. 250min
Maximum transfer rate (read)	126Mb/s (3.5x)*	126Mb/s (3.5x)
Maximum transfer rate (write)	86Mb/s (2.4x)*	86Mb/s (2.4x)

**Transfer rate will vary depending on hardware.*

Table 1. Single- (23.3GB) and dual-layer (50GB) disc record times

The MediaCache 1000

Concurrent's storage solution increases performance.

BY JOHN FENLEY

Digital content for interactive TV systems, such as VOD, nDVR or delayed-broadcast video, has traditionally been stored on and streamed from standard magnetic media hard drives. While the cost per gigabyte for hard drives is low, the use of this storage medium for digital video streaming applications has introduced several performance and reliability limitations.

Hard drive limitations

Digital video files are quite large, and effective management and distribution of these files can adversely impact disk lifetimes. Medium and large VOD systems deploy hundreds of hard drives that have exhibited mean time between failures (MTBF) rates as low as several hundred thousand hours in VOD applications. Due to the relatively low I/O performance characteristics of hard drives in video applications, content may be duplicated multiple times to satisfy streaming requirements. This increases the number of hard drives necessary in a system, reducing overall reliability.

Other issues inherent to hard drives include relatively short service life, high power consumption and increased strain on limited available rack space.

A solid solution

Concurrent's MediaCache 1000 is a solid-state storage solution designed to mitigate performance challenges associated with spinning disk drives. The system uses commercial off-the-shelf (COTS) flash memory solid-state drives (SSDs) in a standard storage chassis to achieve densities in excess of 1000 hours of SD MPEG-2 content. The performance is rated at 3000 simultaneous SD MPEG-2 streams, up to a 6X improvement over similar solutions in active title caching using regular hard drives. This increased performance allows for a 75-percent reduction in the storage needed to meet streaming requirements of active content.

Using solid-state storage has a direct affect on overall system reliability. Flash-based SSDs are specified to have about 3X the reliability of regular hard drives. This increased reliability, combined with the reduction in storage requirements, provides a 12X improvement in effective reliability for the storage system. SSDs also consume about 40-percent less power than regular hard drives. This savings, again combined with fewer drives overall, can provide an 80-percent reduction in storage power.

Wear-out is eliminated

The inherent wear-out mechanism in flash memory typically limits the number of write and erase cycles to a specified minimum of 100,000. Through multiple technical strategies, this wear-out limit has been eliminated in the MediaCache 1000. Although wear-leveling across the entire drive assures that all memory pages receive the same number of write and erase cycles over time, as in regular hard drives, pages of memory will eventually wear out. To combat this, a substantial quantity of extra flash memory is built into the drive.

Sophisticated data management and error detection and correction algorithms ensure that data is never lost. In a video streaming application, the anticipated service life of the drives due to flash memory wear-out is more than 200 years, much higher than that of regular hard drives.

Concurrent's MediaCache 1000 storage system uses COTS flash memory solid-state drives to achieve densities in excess of 1000 hours of SD MPEG-2 content.

Typical streaming video systems have a library of content that is considerably larger than the active content being streamed at any given time. The MediaCache 1000 is designed to be located with the video servers for storage or caching of this active content, where the performance is most advantageous. This allows the placement of video servers and associated active content storage in unmanned locations, such as at the edge, where performance counts and the added reliability reduces maintenance and provides peace-of-mind to the operator. The full library of content only needs to be stored once at a central, manned location using more cost-effective regular hard drives where maintenance isn't as big an issue. BE

John Fenley is a systems engineer for Concurrent.

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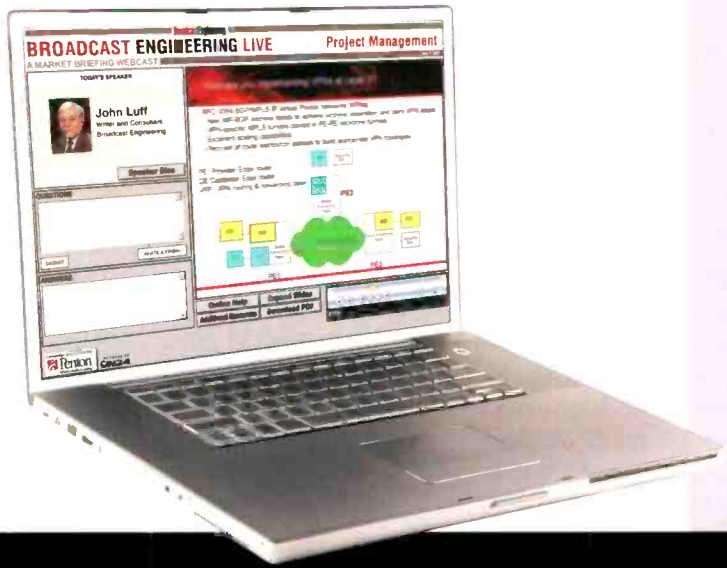

COMING IN JANUARY

Getting ready for February 2009: Analog goes dark

Presented by John Luff and Jeremy Ruck

January 8, 2008 – 2:00 pm EST

If you are like most stations, there may be a few tasks not yet completed in preparation for the February 2009 analog shutoff. But, have you considered everything? Could you be overlooking something? Let these experts help your station through the transition.

COMING IN FEBRUARY

Automation for engineers: Part I: Types and applications

Presented by Sid Guel

February 19, 2008 – 2:00 pm EST

Automation is part of most TV operations. This consulting engineer explains about the different platforms used to support automation technology. From software-based to hardware-focused, automation systems may appear similar, but they can go about their tasks differently. This first of a two-part course helps engineers and operational managers better understand what today's automation systems can do and features that should be considered to develop an efficient and cost-effective workflow.

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HD for news

A decade ago, critics questioned its place in news, but today, HD seems to be the way of the future.

BY JOHN LUFF

Many people in the broadcast industry speculated that HD news wouldn't be successful. Pundits predicted that HD might reach the news studio, but bandwidth constraints would keep it from ever reaching the field. Others questioned the motivation for HD news. They predicted that since HD without surround sound would not sell, news would likely never convert. Some people thought the cost for HDTV acquisition equipment would never be cheap enough for news departments. Indeed, 10 years ago, an HD camcorder at prices compatible with news acquisition was a long ways off. Editing was expensive, and with limited hard disk storage, the thought of nonlinear news editing in HD was mostly a pipe dream.

That was then, and reality and the passage of nearly a decade since HD approached real-world implementation has put clarity to many of the concerns. The early adopters of HD technology for news blazed a trail.

Early implementations sometimes simply followed studio shots using a cuts-only switcher slaved to the main 4:3 SD production switcher. As a result, production values were predictably low, giving the naysayers a case against HD news. But today, the cost of hardware has dropped so dramatically that HD news is fast becoming a necessity in markets where competition has always driven investment in news hardware. Without that competition, how many Doppler radar systems or news helicopters would there be?

Latency issues

Today the market is grappling with the differences that HD brings rather than fighting implementation costs and the lack of suitable hardware.

Thomson Grass Valley's Ignite control-room solution allows broadcasters to migrate from SD to HD.

Make no mistake about it, HD brings challenges that are materially different from those SD has conquered or never had in the first place. For example, look at the latency (delay) in ENG links. Analog links have essentially no latency at all. A digital microwave link will likely have much less than one frame of latency. For many years, HD encoders created significant latency, especially when bandwidth was restricted. Today, however, there are systems in several frequency bands that use COFDM modulation and low latency codecs, which feature latency as low as one frame (encode only), and typically a similar latency in decode. While not instantaneous, a system latency of two frames is acceptable in almost any application.

The market is grappling with the differences HD brings rather than fighting implementation costs and the lack of hardware.

There is a second place where latency in HD, indeed in all DTV, is an issue. If a field reporter is doing a live link with audio received from the off-air channel — a circumstance made more likely after the February 2009 transition — the received audio could be as much as several seconds late. Obviously, that doesn't work for live two-way interviews! With analog, it is not unusual to use cueing channels transmitted with the main signal. With HD local news, cell phones or other means have to suffice for IFB return circuits, unless a low latency return microwave link is employed.

The cost of HD

The economic equation that delayed the development of local HD news has radically changed due to the development of HDV and other technologies. These new technologies make HD news hardly more expensive than SD was a couple of years ago. Issues like expensive storage networks are no longer dragging down the switch to HD. Last year, for the first time, the cost of disk memory dropped below that of videotape for equivalent bandwidth. Cameras can record HD content at around 20Mb, so it is much easier to justify the storage bandwidth HD requires.

At the same time, the cost of HD-capable nonlinear edit systems has dropped considerably. It is now

possible for consumers to shoot and edit HD content with features broadcasters would have killed to have less than a decade ago. Terabyte laptops are not far off, and memory recording cameras can now capture about 80 minutes without moving parts. New codecs shared between consumer and professional products, such as AVCHD, further decrease the cost of HD storage.

Set design challenges

HD does present some challenges that are not likely to disappear any time soon. One is the need to spend more money dressing a news set for HD production.

Both the resolution of the cameras and the wide aspect ratio beg for new thinking on set design and lighting. High contrast lighting may challenge the physical appearance of some journalists with cameras that have twice the spatial resolution of SD. Compact fluorescent lighting can help by the nature of the extended sources used, creating a more pleasing and natural image.

Sets must be carefully thought through. For example, depth of field is not the same with HD cameras as with SD. To get the same effect on the background in a set, the camera shooting distance may need to be adjusted.

Handling 5.1 audio

It is safe to say that many broadcasters have not switched to stereo production, and 5.1 surround seems like an impossibility. Frankly, it probably is inappropriate for news content. But the question becomes how to handle the audio in the entire broadcast chain so the home receiver is not switching modes, with almost certain issues for home listeners. Many have chosen to use synthesized surround sound as the house standard. There are now devices available that can pass 5.1 when it is present and create a good synthetic image when it is not. Doing so allows the home receiver to remain locked to a surround signal, preventing receiver unlock.

Removing the final barrier

Lastly, the cost of HD infrastructure is rapidly reaching parity with SD, removing the last barrier to HD implementation. Today, equivalent systems are 10 percent to 20 percent more expensive in HD than SD, with only true HD-quality lenses likely to remain higher in cost for the foreseeable future. A few years ago, critical elements in the production chain, such as production switchers, were much more expensive. Now models with good feature sets are available at below the cost of some SD-only products. It seems likely that in the next few years, manufacturers will cease to make SD hardware, not unlike the cutoff of analog broadcasting looming less than 450 days from now. BE

John Luff is a broadcast technology consultant.

? Send questions and comments to: john.luff@penton.com

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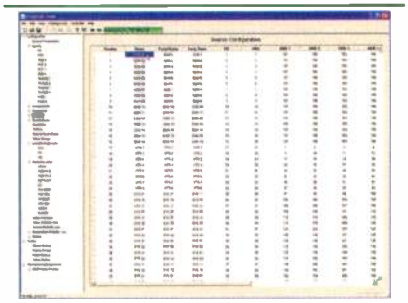

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Requires: Two years of Crestron or AMX video teleconferencing system programming experience, or solid understanding and use of other high-level programming languages, like C, C++, or Java; two years of audiovisual design and engineering; good verbal and written communication skills; and eligibility for DoD Security Clearance.

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Black Friday

Next year's presidential election will cause a spike in broadcast equipment sales.

BY ANTHONY R. GARGANO

As we prepare to ring in the New Year, "visions of sugar plums" are still dancing in many heads. Ah, yes. Welcome to 2008, a presidential election year!

For equipment manufacturers, each presidential election year represents a cornucopia of business opportunity — a marketer's dream and a salesman's delight. The equipment sales bonanza that occurs in the broadcast industry every four years is the virtual equivalent to Black Friday for retailers. I am sure many broadcast equipment manufacturers are thinking, "Wouldn't it be great if this too were an annual event rather than a quadrennial occurrence?" The four-year spike in sales revenue for manufacturers is as predictable as the sunrise.

This is the time when chief engineers sprinkle wish list dust on their long list of equipment needs. Maintenance and expense item budgets bulge and capital equipment budgets fatten as approval committees are not quite so tough with their wring-out procedures for evaluation of capital equipment purchase justifications.

The timing for this particular presidential election is really opportune. With the DTV changeover date coming early in 2009, next year will be a good time for broadcasters to make those DTV equipment purchases that were overlooked or that they couldn't afford in prior year budgets.

Test and measurement equipment needs, for example, are a huge area that many stations may have shortchanged or missed altogether. Waveform analyzers and vectorscopes are still the staple at many stations, but they won't cut it in the DTV era. And if you are the one still responsible for them being the staple, you better be careful or you might not be able to hack it in the DTV era!

Then consider HD news. With many stations wanting to or planning to transition local news to HD, 2008 might be the year to do just that both from a competitive and an affordability perspective.

The basis for all this spending largesse is the huge revenue spike that broadcasters will realize as those swelling political campaign coffers begin to pour into TV advertising.

The basis for all this spending largesse is the huge revenue spike that broadcasters will realize as those swelling political campaign coffers begin to pour into TV advertising. With wide open races in 2008, there will be a record number of candidates from both the Democrat and Republican parties seeking victory in the primaries and then the presidential election. Add to that 11 gubernatorial races, one-third of the Senate engaged in an election contest and all 435 House seats in play. Also, don't forget the messages that a host of issues and special interest groups will want to communicate. Plus there are a myriad of local races.

In all, analysts are projecting politically related media spending to be $3 billion during the 2008 election year, with the vast majority of the media buying going to television. That's a figure, by the way, that represents a 77-percent increase over what was spent four years ago and a whopping 13X the $227 million that was spent 20 years ago.

And, it's not only an airtime opportunity. Don't forget, all those spots will have to be captured, edited and postproduced.

If your station has a production arm, light a fire under the sales staff. Need some new production equipment? What better justification is there than an election year? In the noise of all those airing commercials, production value can be sold as a real differentiator.

Remember, by the time the harvest moon shines next year, that political advocacy golden carriage filled with media dollars will have just about turned into a pumpkin. Whether you're on the equipment supply side or the equipment acquisition side, you should already have a plan that ensures you don't wind up with just the seeds. BE

Anthony R. Gargano is a consultant and former industry executive.

? Send questions and comments to: anthony.gargano@penton.com

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