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Panasonic ideas for life

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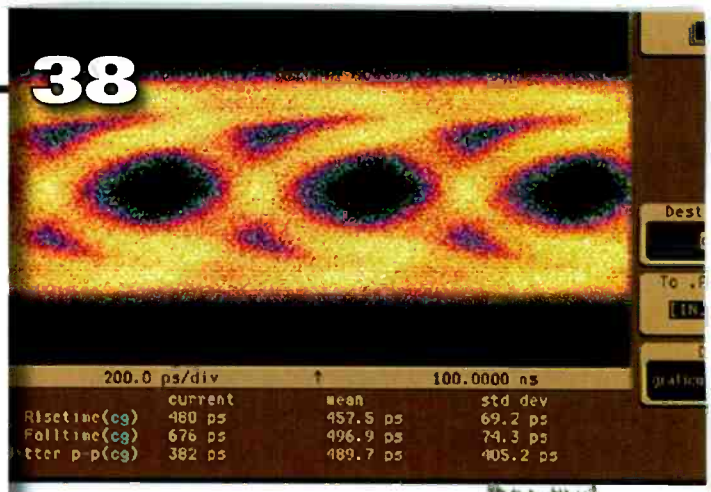
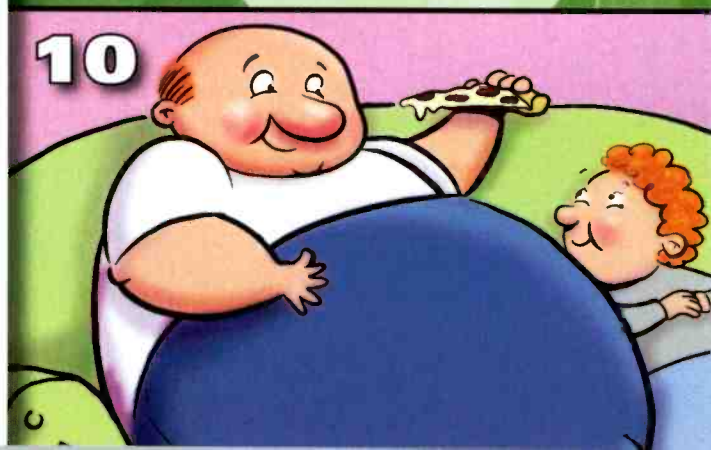




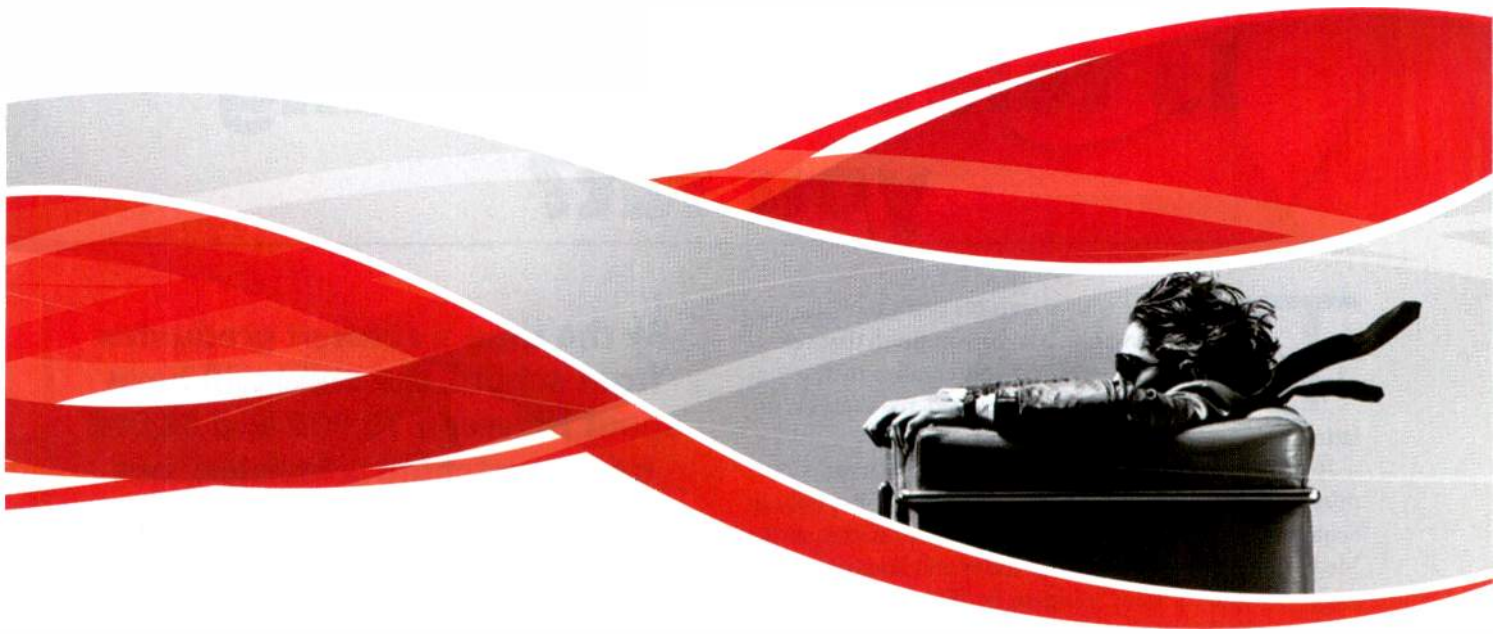
THIS MONTH'S FREEZEFRAME QUESTION

Complete the following definitions:

- The acronym BNC stands for _____.
- Cross luminance is sometimes called _____ _____.
- _____ is a picture defect typically caused by insufficient sampling or poor filtering of the digital video.
- The scanning format that captures in one top-to-bottom scan is called _____.
- The _____ frequency is defined as _____ the sampling frequency of a discrete signal processing system.

These questions are from Tektronix's "Digital Video Measurements."

Readers submitting winning entries will be entered into a drawing for *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "Freeze-frame-December" in the subject field, and send it to: editor@prismb2b.com. Correct answers received by Feb. 1, 2007, are eligible to win.



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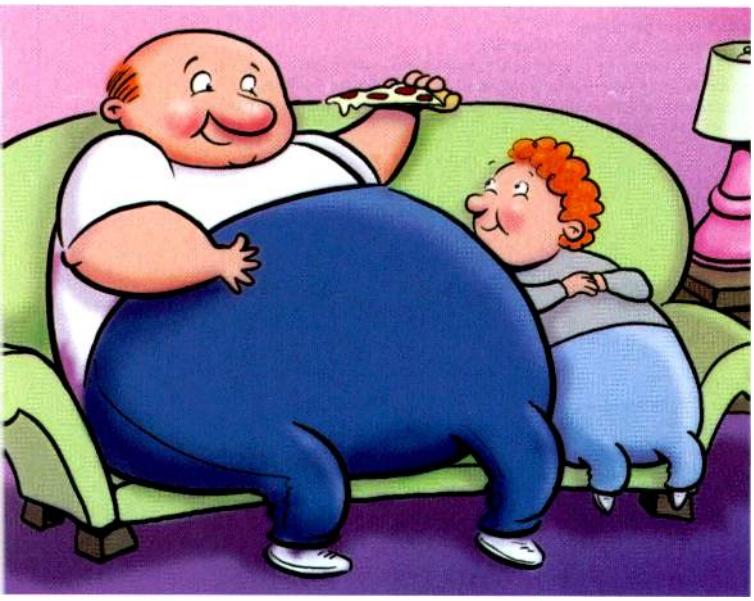
Is television making you fat?

The problem with television is it's too _____ [fill in the blank]. Maybe you think that television is too liberal, too conservative or too violent. But, have you ever considered that it is too fattening?

In September, FCC Chairman Kevin Martin, Commissioner Deborah Taylor Tate and Kansas Republican Senator Sam Brownback announced the formation of the Media and Childhood Obesity: Today and Tomorrow task force. Brownback said, "Judging by the sheer volume of media and advertising that children consume on a daily basis, and given alarming trends in childhood obesity, we're facing a public health problem that will only get worse unless we take action."

At first, one might think this was just political hot air to start another government-funded program. Unfortunately, there's some serious truth behind the issue.



Nearly one-third of American children between the ages of 5 and 14 are obese, compared with one in six 30 years ago. (People are considered obese if their BMI is greater than 30. They are considered overweight if their BMI is 25 to 30. BMI is calculated by dividing a person's weight by the square of their height (w/h^2), all expressed in meters and kilograms. Use this site to calculate your BMI: *www.nhlbisupport.com/bmi/bmicalc.htm*.)

Fifteen percent of today's children aged 6 to 9 are considered overweight, 4 percent more than in the previous study. Even worse, since 1960, obesity has grown by 54 percent in children ages 5 to 11 and by 40 percent in adolescents.

By the time a student graduates from school, the child will have spent between 15,000 and 18,000 hours watching television, but only 12,000 hours in school.

Unfortunately, we adults aren't setting a good example either because nearly one-third of American adults, close to 59 million, are obese. So what does television have to do with all this?

Researchers claim that children need to stop watching so much television and play more. A study at the Johns Hopkins University School of Medicine along with the CDC and NIH found that as children increased their consumption of television, their weight increased as well.

More than one-fourth of American children watch at least four hours of television a day. By the time a student graduates from school, the child will have spent between 15,000 and 18,000 hours watching television, but only 12,000 hours in school.

The study also shows that 42 percent of school children eat their dinner while watching television. Overweight children consumed 50 percent of their dinners in front of the television. Only 35 percent of normal-weight children ate while watching television. The research indicates that if you're watching television, you aren't paying attention to what, or how much, you're eating.

At last spring's NAB convention, Jim Davidson, executive director of the Advertising Coalition, said advertising wasn't the cause of children being overweight. If so, how does he explain the fact that the more television you watch the fatter you are?

While there is no reason to kill the messenger (television), we do need to get our kids — and ourselves — off the couch and exercise more. We'll all pay a price in higher health insurance and increased illnesses if we don't.

Brad Dick

EDITORIAL DIRECTOR
Send comments to: editor@prismb2b.com

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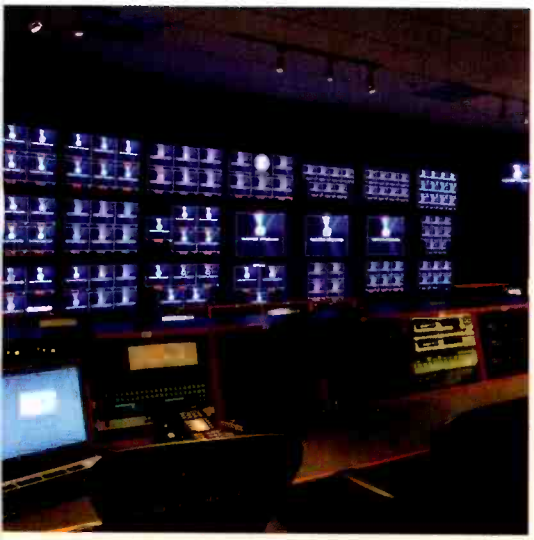


Turner Studios' PCR-22 studio production control room features NEC color LCD displays. Photo courtesy AZCAR.

Display differences

Dear editor:

I know that many broadcast control rooms and mobile units are converting from CRTs to LCDs, LEDs and plasmas. I am interested in learning more robust information on the topic. Specifically, I'm looking for any information on the size of the market; market growth; what features, functions and inputs are important to this market; and how LCD, LED and plasmas differ between control rooms and mobile units.

Elizabeth Wolff
NEC Display Solutions

John Luff responds:

The main issues in broadcast-quality monitoring environments are colorimetry and stability, motion portrayal, contrast, image cut off light leakage (black level), aspect ratio, HD/SD compatibility, input options, calibration strategy, and cost. CRT broadcast monitors (called grade 1) historically have had highly repeatable colorimetry and the ability to be finely calibrated.

Other monitoring methods, including front projection, and emissive and transmissive displays, must be measured in comparison to the capabilities of CRTs. The feature set of current CRT monitors for professional use is likely to be replicated in any solution accepted as a true replacement.

A few manufacturers have begun to attempt to satisfy this market with non-CRT hardware, but not without resistance and skepticism in the market because of the technical capabilities of alternative technologies. I suspect that little public research has been done on the market issues you raise.

Features and controls should not be the primary concern. Mobile units and even some video control rooms are not the issue, either. I strongly believe that in sensitive markets, performance is the main issue. This includes camera shading, telecine operations and quality control. The disappearance of CRTs will be a major issue confronting the industry during the next several years. Most control rooms, trucks and fixed facilities are more concerned with picture composition and approximation of the image received by home viewers. In this regard, it is particularly difficult to make a selection, because home viewers today have a spectrum of choices, all of which create a matrix of production and viewing conditions that makes a single technology choice difficult to justify. BE

A resolution

Dear editor:

The data sheet for my Sony BVM-A20F1U monitor says that with a 16:9 picture, the raster will display 700 TV lines. If I install one of these monitors with the HD module and give it a 1920 x 1080/59.94/2:1 interlaced signal, will I only be able to see 700 lines of resolution? What about the other 380 lines? If I then give the monitor a 1280 x 720/59.94/1:1 progressive scan signal, will I see more of the picture? Does the Kell factor affect this? What exactly am I seeing on the screen? Do any displays show all 1080 active lines of a 1920 x 1080i signal?

Name withheld by request

John Luff responds:

Your question is timely as the interest in 1080p displays is rising in consumer circles. Resolution in lines per picture height is measured on the basis of alternating lines of black and white.

The Kell factor is certainly important. With 1080 active lines, the Kell factor reduces the maximum resolution for interlaced pictures to about 70 percent, or about 756 lines. Progressive scan does not suffer because every line is present on every frame.

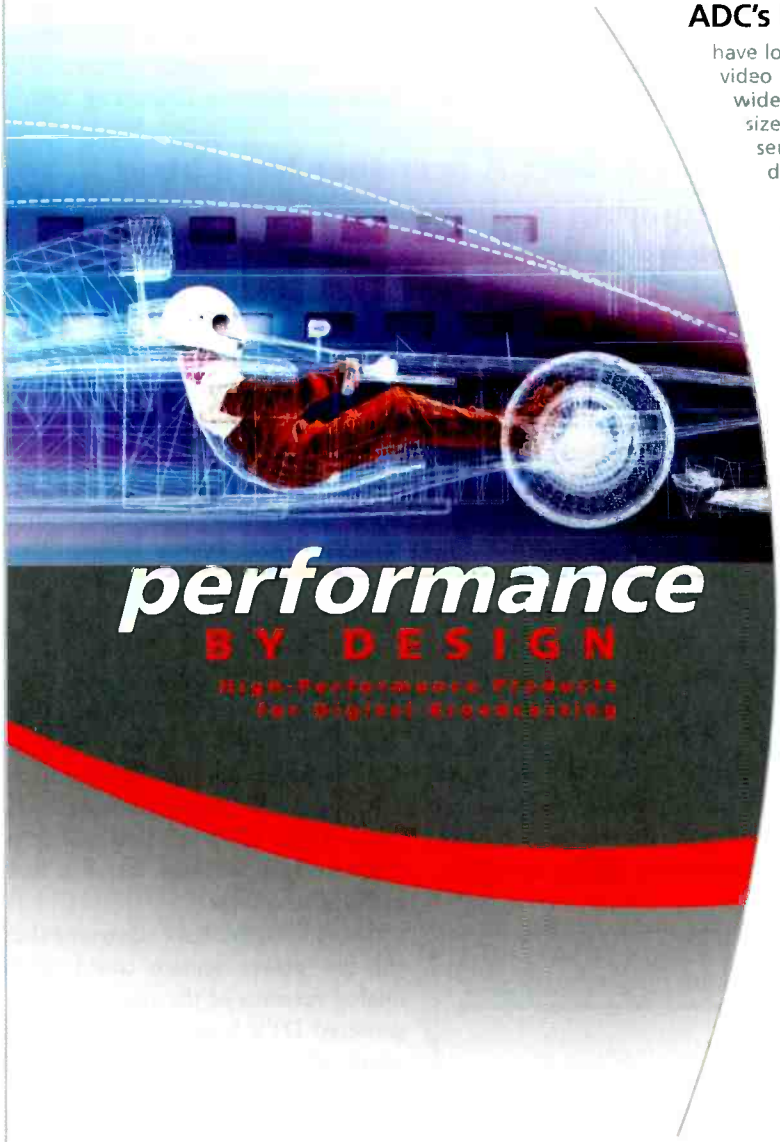
One could argue that 720p is about the same perceived vertical resolution as 1080i. Horizontally, there is a huge difference, in theory at least, with 720p having two-thirds of the resolution. In practice, most compression systems subsample all inputs to about 1440 pixels, making the two standards essentially identical at the home receiver. However, 720p has better temporal resolution, with 60fps compared to 30fps for 1080i.

Progressive scan images are easier to compress, leading to better pictures for the same data rate. 1080p displays have interpolated the missing picture data because consumer interlace pictures don't contain the full production aperture of 1080p through DTV systems. I suggest producing in 1080p and keeping it that way if you want to see all 1080 lines. BE

Test Your Knowledge!

See the Freezeframe question of the month on page 8 and enter to win a *Broadcast Engineering* T-shirt.

Send answers to editor@prismb2b.com



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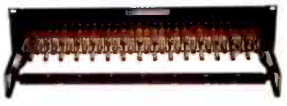

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Urban renewal

Digital LPTV could create a whole new ball game.

BY CRAIG BIRKMAIER

It was all supposed to be over soon. As America celebrated the arrival of 2007 in Times Square, potentially millions of televisions would go dark at the stroke of midnight when more than 1000 full-power NTSC transmitters were turned off forever. Instead, the nation's full-powered broadcasters will be celebrating yet another year of milking that old NTSC cash cow, flush with more than $1.5 billion in political advertising revenues from the midterm elections.

Last month in this column, I suggested that there might be a lot of old televisions sitting on the curb when the NTSC plug is finally pulled on Feb. 17, 2009. But this may not be the case.

While full-powered broadcasters are a decade into the DTV transition, the nation's Class A and LPTV broadcasters are just starting the process. And viewers in many markets, especially those in the more densely populated areas, may still receive NTSC broadcasts from these stations long after the full-powered NTSC transmitters go offline.

Earlier this year, the FCC announced DTV transition rules for Class A, LPTV and translator licensees, and opened an application window for new digital licenses. The new rules provide that existing permittees and licensees in these services be given the flexibility to choose one of two methods to convert existing analog stations to digital. Stations can either implement an on-channel digital conversion of their analog channel (a flash cut) or seek a (second) digital companion channel that may be operated simultaneously with their analog channel.

According to the FCC order, analog licensees are not guaranteed a digital companion channel and must identify a channel that can be operated consistently with the commission's interference protection rules. The order went on to say that at a date to be determined in the future, the commission will require that the permittee or licensee terminate analog operation, return one of the two channels to the commission and operate the station only in digital mode.

In recent months, the FCC began processing thousands of applications for digital Class A, LPTV and translator licenses. The agency is expected to begin issuing these licenses in 2007.

Many Class A licensees have been acquiring multiple licenses in major markets in hopes that these licenses will become more valuable through the use of digital broadcasting techniques.

After these licenses are issued, licensees will have three years to commence digital operations. Thus, low-power NTSC broadcasts will continue for an indefinite period, perhaps lasting well into the next decade.

Do nothing

The demise of full-powered NTSC broadcasts has been viewed as a short-term opportunity for some in the low-power segment of the industry. As the only analog game in town, Class A and LPTV stations will continue to serve the large, installed base of NTSC receivers.

Some licensees have suggested that the low-power service could carry analog versions of the signals of full-powered DTV broadcasters. But this point of view has not gained much industry support.

Many Class A licensees have been acquiring multiple licenses in major markets in hopes that these licenses will become more valuable through the use of digital broadcasting techniques. The most obvious benefit is the ability to deliver multicasts.

With multiple licenses, it would be possible to offer a multichannel service without subscription fees. Many

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

DVR penetration in the United States

DVR installations have been steadily increasing

Dates	Percent of total households with a DVR	Percent of total persons 18-49 with a DVR
May 1-7, 2006	5.5%	7.3%
July 10-16, 2006	7.2%	9.3%
Sept. 25 - Oct. 1, 2006	8.9%	11.5%

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LPTV operators have been developing carriage arrangements with content providers who cannot get clearance via cable or broadcast stations. The proponents of a rapid transition to digital broadcasting techniques are also interested in the ability to deliver new services using IP multicast techniques.

The Community Broadcasters Association (CBA), which represents Class A and LPTV broadcasters, has been highly proactive in lobbying for and promoting the transition to digital for its members. The organization's official Web site works under the banner of DTVNow.org.

The CBA has been lobbying the FCC to grant Class A and LPTV licensees greater flexibility in the technologies used with these new digital licenses. There is strong interest in the A-VSB proposals now being developed and tested by the ATSC. With A-VSB, it might be possible to serve portable and mobile receivers, and to create single-frequency networks to expand market coverage.

It is important to note that operation at lower power levels is not as large a disadvantage with DTV as it is with analog broadcasts. Many full-power broadcasters have been operating their DTV transmitters at reduced power levels with good results. And early ATSC receivers often suffered from overload in the analog front ends when in the presence of high power levels. At power levels around 15kW, a LPTV broadcaster may be able to cover 85 percent of the market area of a high-power broadcaster.

The prospect of building single-frequency networks offers Class A and LPTV stations the potential to be highly competitive in terms of the ability to receive over-the-air broadcasts. If portability and mobility were enabled, entirely new markets could be developed.

Also noteworthy is the FCC's authorization for DVB modulation techniques in spectrum that is being recovered from analog broadcasters. Companies such as Aloha Partners and QUALCOMM are developing mobile TV services by using OFDM modulation in the 700MHz spectrum that was acquired at auction.

The CBA is asking the FCC if it too can have the flexibility to choose an alternative to ATSC modulation. At the same time, the CBA is asking the NTIA to consider the possibility of an upgrade path for the digital-to-analog converter boxes for which the agency will be issuing $40 subsidy coupons.

There is strong interest in A-VSB. With A-VSB, it might be possible to serve portable and mobile receivers, and to create single-frequency networks to expand market coverage.

A-VSB developments

Members of the CBA have noted A-VSB's potential to add value to the digital LPTV franchise. The ATSC is in the process of testing and standardizing A-VSB. Several elements of the backward-compatible A-VSB proposals will make it possible to improve reception for fixed receivers using low complexity antennas and to enable walkabout portability and possibly mobile reception.

The A-VSB proponents — Rohde & Schwarz and Samsung, with support from the Sinclair Broadcast Group — recently tested these techniques in the Buffalo, NY, market. They were able to achieve solid reception at speeds up to 80mph.

Further testing is currently underway at the Communications Research Centre in Ottawa. It is anticipated that the ATSC will complete standardization of some elements of the A-VSB proposals in 2007.

As with the digital video broadcast system, improved robustness, portability and mobility come with a price. In a presentation by the A-VSB proponents at the Iowa DTV Symposium held in October, showed one example that trading 5Mb/s of the 19.2Mb/s 8-VSB payload added training signals for advanced equalizers to deliver a robust 1.5Mb/s bit stream.

There are many variables in the proposal. At this point, it is not clear what the actual tradeoffs will be or how A-VSB will compare with DVB-H.

What is clear is that the future may be filled with opportunities for a segment of the OTA broadcast industry that has struggled to compete with full-powered broadcasters. Given the high price that spectrum is bringing at auction, Class A and LPTV licenses may well be worth more than the paper they're printed on.

According to Greg Herman, president of WatchTV in Portland, OR, and vice-president of the CBA, this is an important time for Class A and LPTV licensees to stay the course. He says, "How do you stay in the game? Go digital!" BE

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

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

Web links

- Community Broadcasters Association
  http://communitybroadcasters.com/new.php
- "Mobile madness," *Broadcast Engineering*, July 2006
  http://broadcastengineering.com/news/broadcasting_mobile_madness/index.html
- A-VSB presentation at the Iowa DTV Symposium
  www.iptv.org/dtv/2006/media_pres.cfm?ses=5&id=7&Track=T

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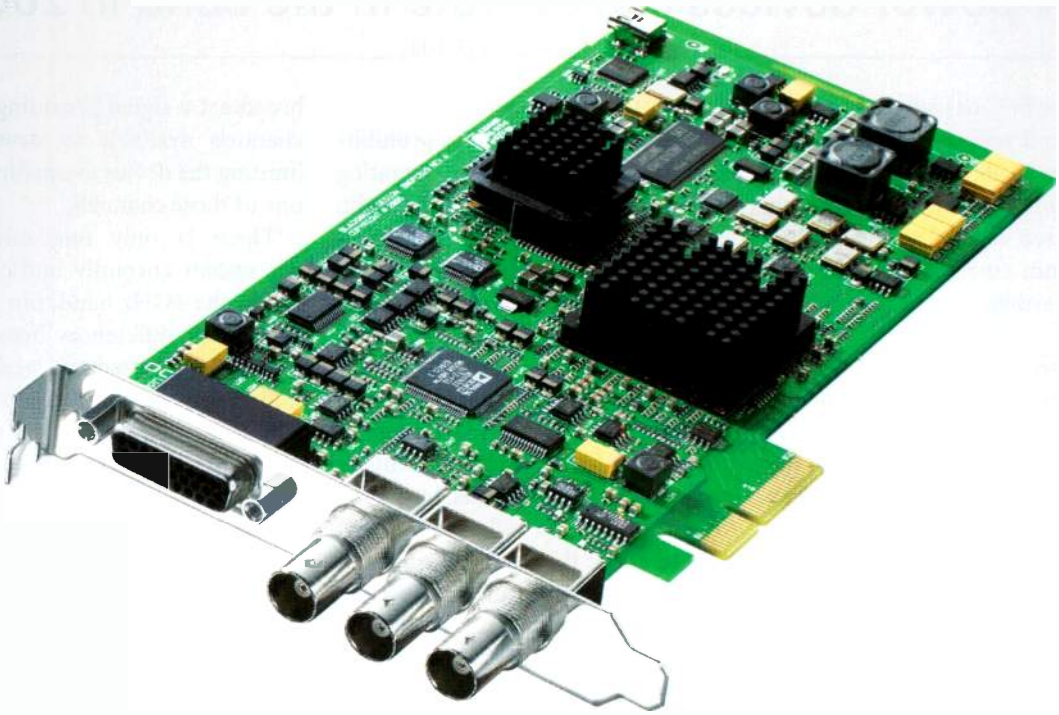

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White space use OK'd

Low-power devices can operate in the band in 2009.

BY HARRY C. MARTIN

The FCC has released a report and proposed rule making in its 2004 proceeding dealing with the authorization of unlicensed devices to operate in the spectrum currently set aside for TV broadcasting.

Low-power devices

In the report, The FCC authorized low-power devices to operate in the TV band, but only after the end of the DTV transition in 2009. The agency will not authorize the use of personal portable devices at this juncture. Only fixed, or stationary, low-power operations will be permitted. The use of personal portable devices would likely pose a greater risk of interference, so the FCC is seeking further comment on this issue.

The commission has also prohibited low-power devices from operating on Channel 37 (to protect the radio astronomy services) and Channels 52 to 69 (to protect the wireless and public safety services authorized to operate on these channels).

And the FCC has prohibited, until the end of the DTV transition in February 2009, the marketing of portable or fixed devices. It wants to protect TV stations finalizing their DTV transition as well as allow itself time to adopt the technical rules under which the new unlicensed service will operate. The marketing of these devices will ultimately be covered by the new rules.

The commission questions whether the use of the TV spectrum for these fixed low-power devices should be on a licensed or unlicensed basis. The FCC prefers the unlicensed use of the spectrum, given the wide range of the spectrum's availability (rural vs. urban) and the difficulty that would be involved in creating priority rights to the spectrum among licensees.

Use of unlicensed devices

Additionally, the commission is seeking comment on the appropriate method for determining whether a particular swath of spectrum is available for use and whether unlicensed devices would cause harmful use to TV stations in the vicinity.

The commission has proposed three possible solutions:

- enabling the devices to sense whether the spectrum is available;
- professionally installing the devices, equipping them with GPS, and guiding them by a database of existing TV stations; or
- establishing a control signal program in which existing FM, TV and CMRS providers would continuously broadcast a signal providing a list of channels available to devices, and limiting the device to operate only on one of those channels.

There is only one other sensing system currently authorized for use in the 5GHz band, but there are substantial differences between that already authorized use and the use under consideration. Therefore, the FCC is asking for testing to show that a sensing system could work in the TV band.

The commission is also seeking comment on the best method for making these systems work. The FCC wants comments on the appropriate threshold for sensing devices and on whether to protect TV channels that are adjacent to the spectrum to be used for the unlicensed devices. Also, the FCC is considering whether these unlicensed devices will be required to use transmit power controls that will limit the transmit power to the minimum necessary.

The FCC is also considering excluding the devices from operating on Channels 2 to 4. With respect to possible standards and limits for out-of-band emission levels, the FCC has asked whether it would be appropriate to use the same standards currently applied to other unlicensed devices.

The commission is also asking the public to substantiate its claims of interference or no interference with data and test results. While the FCC will be conducting tests to determine whether any of the methods for avoiding harmful interference will work, it is also seeking studies from the public. BE

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

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

Dateline

Jan. 10 is the deadline for placing children's TV programming reports (Form 398) in the public files of all full-power and Class A TV stations. Also, on Jan. 10, all commercial TV and Class A stations must place in their public files their certifications with respect to compliance with commercial limits during programming for children ages 12 and under.

Jan. 10 also is the date by which all TV and Class A stations must place their quarterly issues and program lists in their public files.

Feb. 1 is the deadline for renewal applications for TV, TV translator, LPTV and Class A stations in New Jersey and New York. TV stations in those states also must file biennial ownership reports by Feb. 1. TV stations, LPTV stations that originate programming and Class A stations must file EEO program reports by Feb. 1.

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

— Jason Taubman and Paul Bonar, Game Creek Video

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

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Digital conversion

Retaining high-quality video and audio requires a well-designed, integrated format converter.

BY ALDO CUGNINI

Aspects of format conversion have been known and appreciated for some time, due to the frequent need to convert between different video standards. Many of the same techniques that were developed for analog systems apply in the digital world. However, additional techniques are needed, some of which are not always appreciated. To understand the basis of digital conversion techniques, let's look at the analog situation first.

Analog conversion

When converting between two analog television systems, several elements must be changed, including frame rate, line rate, scan method and signal encoding. In effect, the first three elements are changed by an interrelated form of sample rate conversion, which was the subject of last month's Transition to Digital column. This element trio essentially defines the pixel rate of the system. Therefore, in order to convert between two different standards, it's necessary to do the appropriate sample rate conversion both spatially and temporally, meaning within a field or frame and between the fields or frames.

Mathematically, the appropriate interpolations or decimations need to be done in both the spatial and temporal directions. In practice, the situation is more complex because of the use of interlaced scan.

For simplicity, let's first consider a fictional case, with two systems at 30Hz and 60Hz frame rates and both using progressive scanning. Let's also assume that both systems have the same vertical line rate. Converting from the 30Hz system to the 60Hz requires interpolation between the 30Hz frames and the creation of new frames.

In principle, this would seem to be the same as a change in spatial resolution, which would involve spatial interpolation between adjacent spatial pixels, in order to create new pixels. However, the time dimension must account for objects in the picture that can move from one frame to the next. This creates a new requirement. Now, it's necessary to predict the motion of these objects to faithfully reproduce their motion in a new frame.

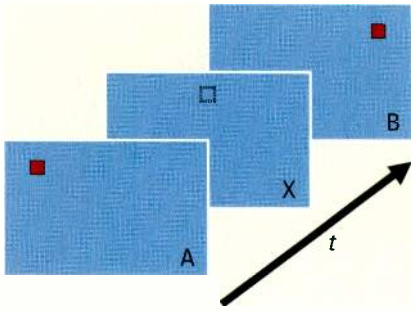

Figure 1. Frame X shows proper temporal interpolation of the movement of the object from Frame A to Frame B.

Intermediate images

By illustration, let's assume an object is moving horizontally, such that it appears at the locations shown in Figure 1 at the times A and B. (The translation is exaggerated here for clarity.)

Logically, an interpolator should produce an image as shown in the intermediate frame X. However, a straight pixel-by-pixel temporal interpolation by averaging the successive frames would actually produce the result shown in Figure 2 on page 22. Obviously, this is not the correct way to create the new frame.

In fact, using a more sophisticated filter to reconstruct the intermediate image, such as a (sin x)/x, creates an

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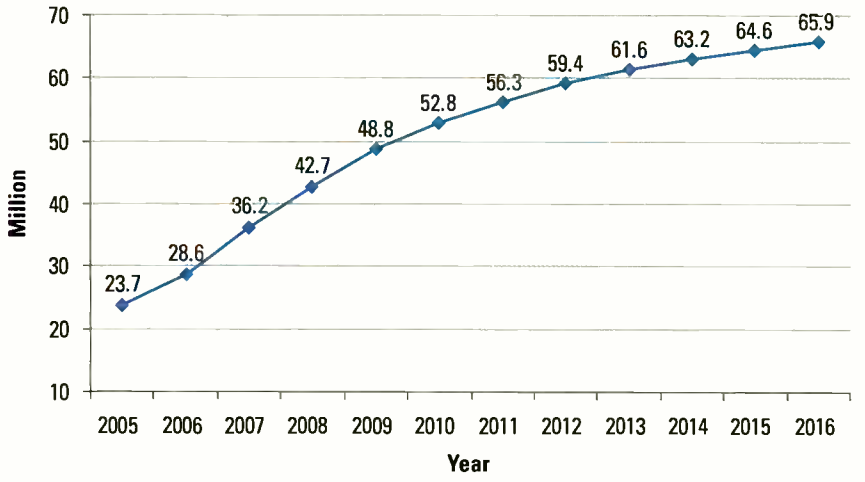

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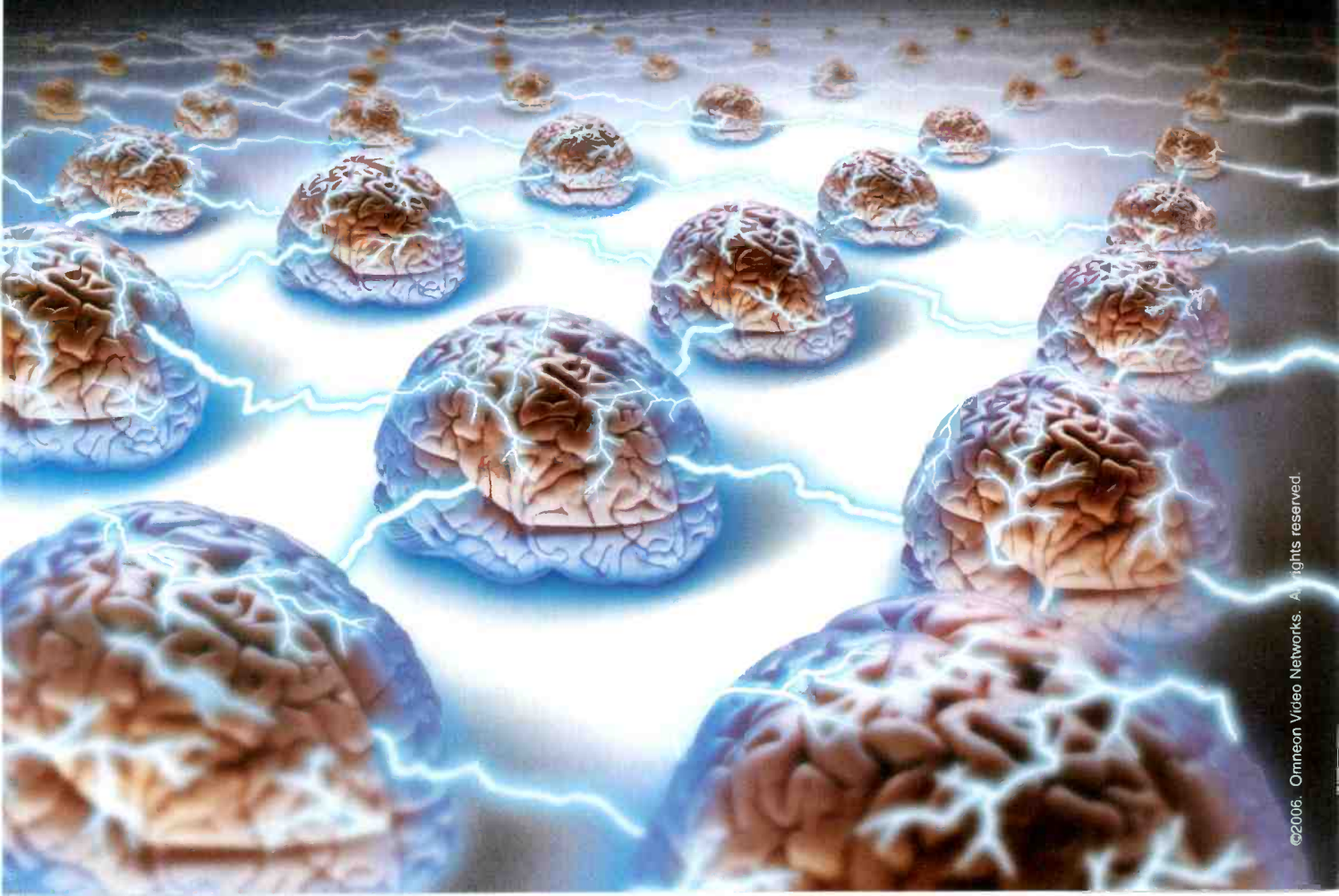


even worse situation. Such a filter requires many taps, or coefficients, in the frame-to-frame time direction. The result of such a filter is that the moving objects would become smeared over the same number of frames.

Motion estimation

An intelligent motion estimator is needed to determine the motion of objects within the picture and to create new pixels based on this motion. Before the advent of high-speed digital processing, this was impossible to do. And format conversion inevitably resulted in serious conversion artifacts when rendering sequences of moving objects.

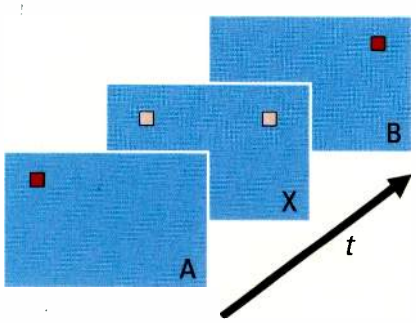


Figure 2. Frame X shows the result of poor temporal interpolation from Frame A to Frame B.

Extending the principle to conversions between field rates of 50Hz and 60Hz (or 59.94Hz), the difference is that it may be necessary to alter each frame to smoothly transition from groups of five frames to groups of six. Conversions in the reverse direction can also involve motion estimation, as the mere dropping of one out of every six frames would result in jerky video.

Interlaced scan

Adding interlaced scan to the situation further complicates matters. Interlace can be thought of as a vertical-temporal image sampling that alternates phase every field. (See Figure 3.) By further extension of the motion estimation technique, this sampling can be taken into account.

The difference is that objects having a vertical component to their translation should be processed using a different algorithm than objects with a purely horizontal motion. Deinterlacing, that is conversion from interlace to progressive, often entails maintaining the same image resolution. Fully generalized conversion, on the other hand, adds the element of spatial resolution to the process. Finally, the different analog standards require a conversion of the signal encoding techniques, such as luminance levels, chrominance encoding and blanking signals.

Digital conversion

In the digital world, the conversion between different scanning systems and resolutions is based on the same analog conversion techniques. However, the overall encoding is quite different when considering compression. A full digital standards converter thus adds the burden of conversion between different compression systems.

With MPEG-2 now a ubiquitous world standard, conversion between different compressed sources seemed to be straightforward, or even trivial. But the introduction of new standards, such as MPEG-4, keeps things interesting.

Image compression

The astute reader may have deduced that image compression may offer a shortcut to motion-compensated scan conversion, as MPEG encoding already performs motion estimation. However, this process in an encoder is aimed at lowering the energy in the frame-to-frame difference of images, and this is done on a block-by-block basis, without regard to visual objects in the image. (While certain parts of MPEG-4 actually do code visual objects within pictures, the more frequently used MPEG-4 Part 10, also called AVC or H.264, does not.)

Therefore, a motion-compensated scan converter cannot base its conversion exclusively on the MPEG motion vectors within the stream. But it can use these as a starting point to arrive more efficiently at the needed information.

DCT and quantization

In order to transcode between

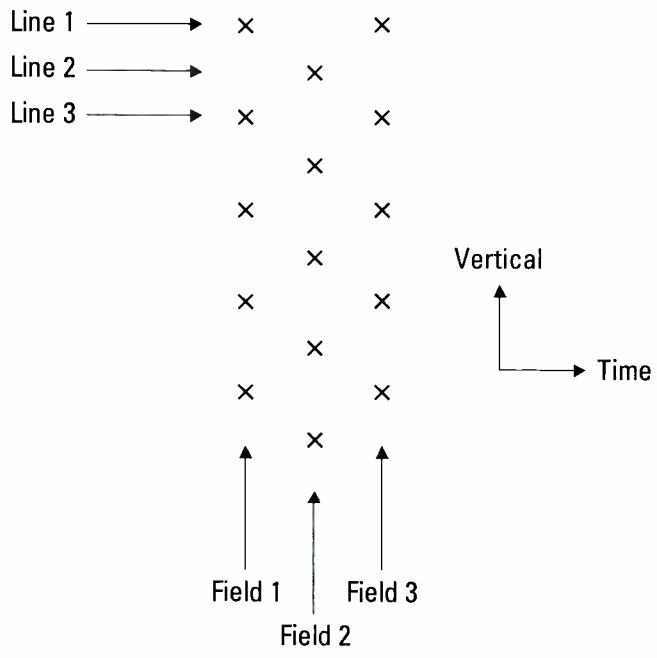
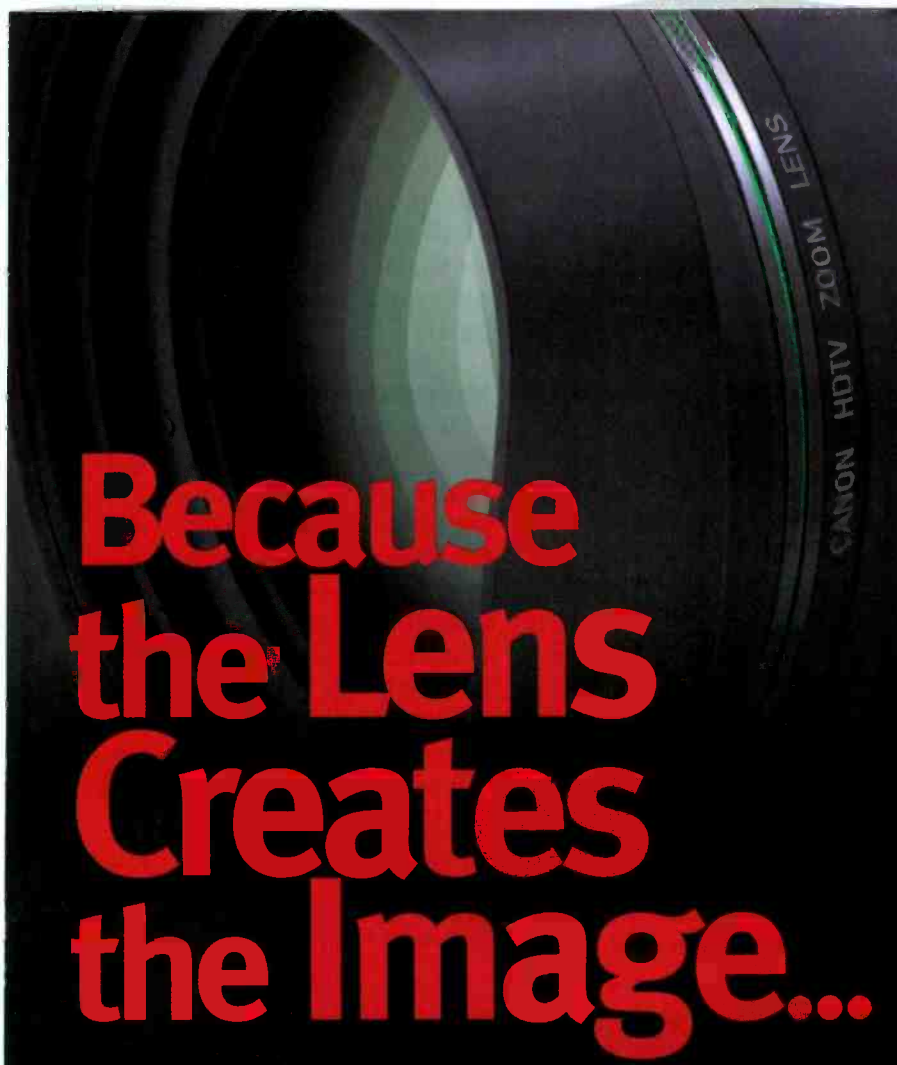


Figure 3. Interlaced scan in a vertical-temporal image sampling scheme.



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compressed signals, such as between MPEG-2 and MPEG-4, the brute force method is to completely decode the source and then re-encode the signal. However, this can often result in a substantial degradation of video quality, especially if the compression ratio is high.

A better conversion technique is to partially decode the source, and then re-encode from this point, while paying special attention to certain coding elements, namely, Discrete Cosine Transform (DCT) and quantization. (DCT is essentially a way of converting the spatial information in a block of pixels to an array of frequency information.) After this process is performed, the resulting coefficients can be quantized, or lowered in amplitude resolution.

This step actually performs the signal compression by reducing the number of bits required to represent each block of pixels. It also creates visual artifacts and limits the number of successive encode/decode cycles that are tolerable.

For this reason, successive recoding of pictures will result in fewer artifacts if the previous information on quantization is preserved as much as possible. In fact, even if this information is not used — if all the pixel blocks line up exactly where they were in the previous encoding — a subsequent encoder will often process the images in the same manner as the previous. This will cause fewer artifacts than a completely independent recoding.

Combining these effects, a well-designed integrated format converter should always yield better resultant video than the brute force method. Some of these same considerations apply to audio. For example, when converting between different perceptual coding systems, such as Dolby and MPEG, a better result should occur when the hardware takes into account the previously applied encoding and only partially decodes the signal.

Multiple generations

Always expect artifacts to become more apparent when multiple generations of encoding and decoding are applied. A recent widely broadcast sports even unfortunately demonstrated the results of a poor concatenation of standards converters. Choosing appropriate equipment, based on knowledge of how these conversions work, can go a long way to maintaining the highest quality video and audio. BE

Aldo Cugnini is a consultant in the digital television industry.

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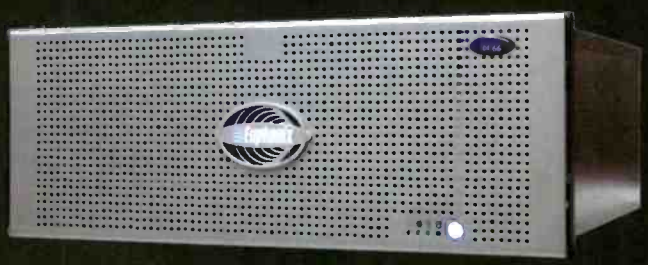

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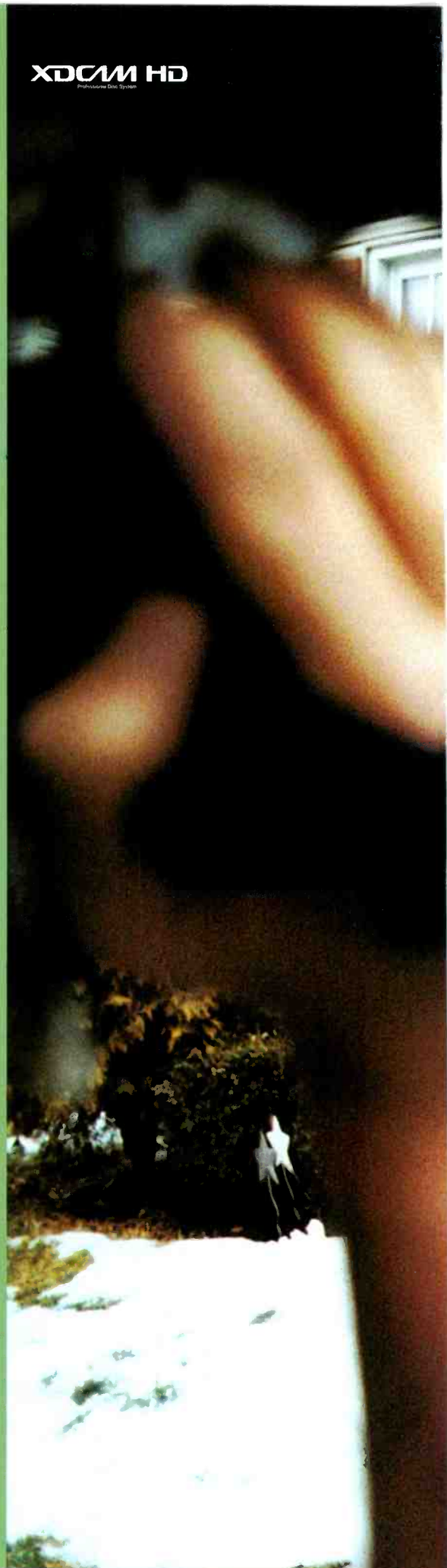

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Modern archives

The repository moves to the front of the workflow.

BY BRAD GILMER

I can remember walking through the MGM film archives shortly after Turner acquired the library. The archive is in a warehouse not far from the La Brea Tar Pits in Los Angeles. It consists of row upon row of shelves with just about every film and tape format you can imagine (except nitrate, which had been removed for safety reasons). The different videotape formats read like an artifact listing from a museum: 2in quad, 1in Type B and Type C, 3/4in, U-matic, various 1/2in formats, and so on.

As movie studios, broadcasters and post houses move from tape to digital facilities, the nature of their archives is changing. Modern archives house legacy film and videotape formats, but they are also repositories for new file-based content, much of which has never been copied onto tape. What is the meaning of an archive in a network-based facility? What is the role of an archive?

The traditional archive is an end-of-pipe process, meaning that it is a repository for finished content. The function of an archive has changed as new technologies have brought new possibilities.

In some facilities, the archive is the hub of a larger workflow. In others, it serves as the input source for subsequent processing. Both of these configurations depart dramatically from the traditional view of the archive as a repository.

Shared storage

Positioning the archive as the central point in the workflow transforms it to shared storage, where users can gain access to content concurrently. (See Figure 1.) While one person is editing content, another may be dubbing some of the same content to DVD. Some of these shared storage systems have long-term storage associated with them. In this configuration, these devices become an important archive for the organization.

Shared storage systems can turn into archives. We are rapidly approaching the point where disk storage is so inexpensive that it is not worth the time and effort to delete completed projects. As this shift takes place, the shared storage system naturally becomes an archive. Managing this stored content effectively is another issue.

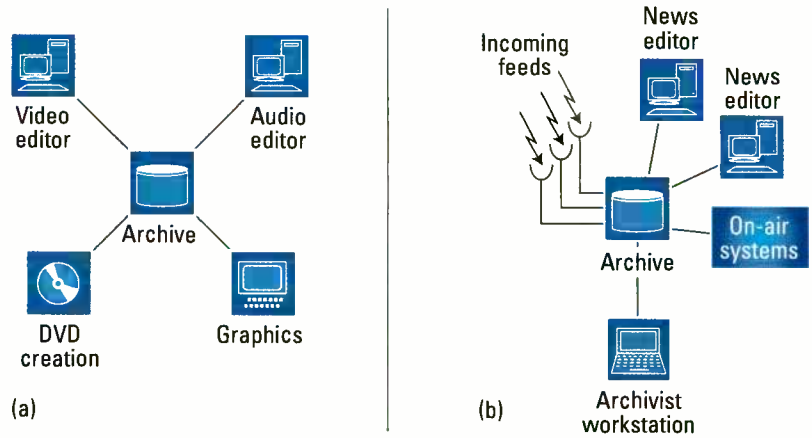

Figure 1. Archives are no longer end-of-pipe systems. Instead, they act as (a) shared storage for workgroups and as (b) triage systems in newsrooms.

Triage systems

Placing the archive at the start of the workflow allows incoming news feeds, for example, to go directly into the archive. Once the content hits the archive, one editor may begin working on a rough cut for a breaking news story. In parallel, another editor may be working on a longer version of the story for the evening news. Perhaps a little later, a third editor may access the same content for use in a magazine show that will air over the weekend. Again, content is available to several users at the same time, allowing innovative changes in workflow. An archivist looks through the content, determining what content should be retained and what should be discarded. In this way, the archive functions as a triage system. (See Figure 1.) It enables ubiquitous access to content while simultaneously allowing the organization to determine what to keep for the long-term.

All of this is possible with conventional analog video or SDI. But these workflows are really optimized for network-based technology because the centralized archive is closely related to the computer client server model. In this model, multiple clients connect to a central server to access desired content on the server. Content is automatically routed to and from the central archive using the self-routing nature of packetized computer networks.

Deep archive

In Figure 1, the archive is shown as a single storage device. But this is because Figure 1 is a 2-D drawing. When you look at the archive in 3-D, you can see that it consists of several

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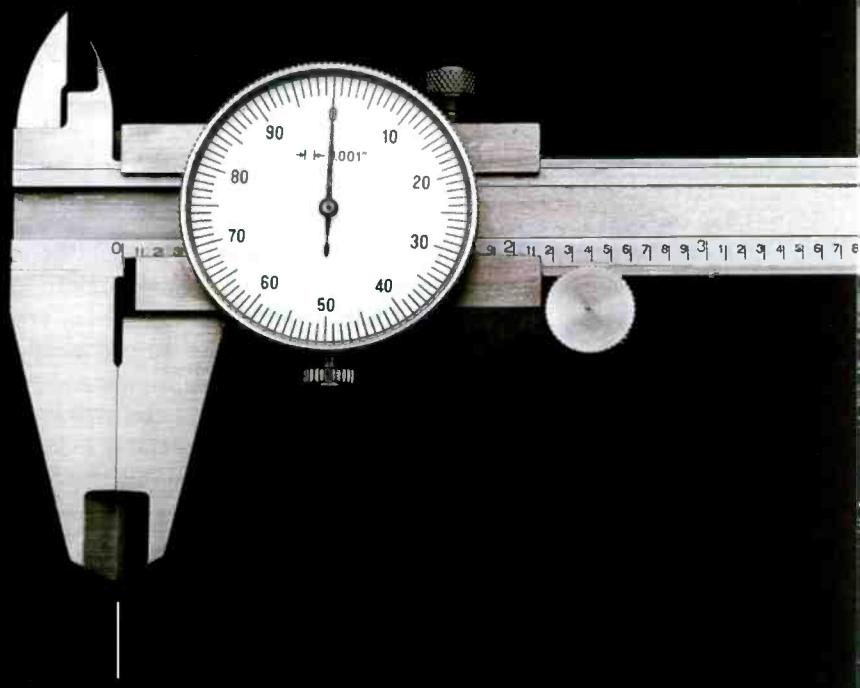

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different layers. (See Figure 2.) These layers are divided according to storage cost and access time. There is almost always an inverse relationship between these two components.

RAM storage is the top layer. Clearly, if video is cached in RAM, access times are extremely short. But while memory costs have dropped precipitously over the last few years, it is still expensive. In systems that require fast access times and that have a small number of popular items, RAM

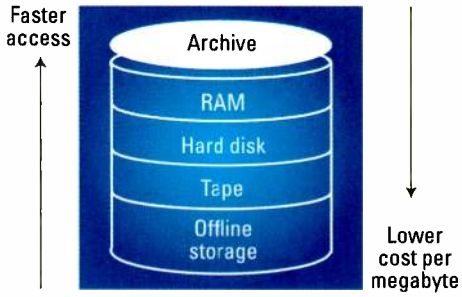

Figure 2. The four common storage elements in an archive system are RAM memory, hard disk, tape and offline storage.

cache can be the best way to achieve high system performance. RAM is always the first component in any archive system, even if it is not explicitly called out.

The second layer of the archive is hard disk. Several years ago, some industry pundits said that disk technology had reached the end of the road. Despite these predictions, performance continues to increase, and prices continue to fall. It is not uncommon to find disks spinning at more than 10,000rpm, which was considered a high speed several years ago. This high rotational rate allows the head to pass over the desired data much more quickly, decreasing access times. It also allows the data to come off the head much faster, allowing video to be read and written in real time.

The third layer in these systems usually consists of tape. There was a time when the difference in price between disk and tape was about 100:1. Disk was so much more expensive than tape that systems were designed with a minimum of disk and a large amount of tape. But that has changed, and disk now occupies a much larger portion of the overall archive. Generally, the archive requires removable media at some point, and that is almost always tape. Large systems frequently employ robots to transfer tapes to and from drives.

The fourth layer is what most people would think of as a traditional archive — removable media on shelves. The media is typically film, videotape or data tape. At this layer, cost savings is the primary concern. The offline archive should be stable, and it should have good storage density at a low cost.

Archiving in the networked environment

Networked archives require specific design considerations. The archive is accessed through a dedicated file server over high-speed network connections. This server is optimized to serve large files. File systems, buss structures and other internal components are all designed to maximize throughput. In the past, little processing would occur in the server. These days, it is not uncommon for the server to perform file conversion on the fly, flipping the content into the appropriate format for the destination device.

With the advent of AAF and MXF, there is the potential to greatly increase the intelligence of the content stored in these archives at all levels. The metadata associated with an AAF or MXF file can stay with the file throughout the archive process. Should the database for the archive be lost, the database can be at least partially recovered using the metadata stored with the content. Also, as AAF and MXF content arrives at one of these systems, the metadata can be read from the file and used to populate the database so that preliminary data is available on every asset in the system.

The migration issue

One issue with any archive is how to migrate the content from one media type to another. The Hollywood crowd likes to point out, and rightfully so, that one answer is to eliminate obsolete media. An excellent archive format is 35mm film. However, analog videotape has presented serious challenges. Generation loss renders some material useless after only two or three migrations. The situation is better with data.

Digital storage, particularly computer data storage, allows the information on the media to be separated from the media itself. After all, when it comes to content, saving the media is not important.

Some time ago, a member of the Society of Motion Picture and Television Engineers, Dr. Juergen Heitmann, proposed systems that would automatically migrate content in archives from old media to new media. Dr. Heitmann recognized the disconnect between media and the content stored on the media. He proposed a data tape robot system that could accommodate different-sized tapes and different tape decks. The archive would copy content from old tapes to new ones in background when the system was not busy retrieving content for users.

Archiving in the networked world has the power to change workflows, increase access to content and allow broadcasters to get the most out of their content. BE

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

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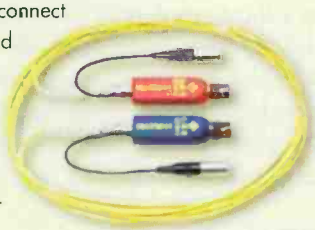

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HD editing on the go

Powerful new laptops let editors perform portable NLE.

BY STEVE MULLEN

Today, DV and DVCPRO (25Mb/s, 50Mb/s and 100Mb/s) are routinely edited on laptops. Depending on your perspective, this either increases the pressure to edit 24/7 or affords you the luxury of working at a location of your choosing. With the dramatic increase in the use of MPEG-2-based HD, many editors are now looking for laptops that provide the performance necessary for portable nonlinear editing.

HD challenges

There two types of MPEG-2 HD: HDV (either 720p or 1080i) and XDCAM HD. HDV is available in a range of frame rates and is relatively simple to support. The 1080i version (HD2) literally has the same data rate as DV. Therefore, storage requirements and disk bandwidth are identical to DV, DVCAM and DVCPRO. However, because of the nature of long-GOP MPEG-2 media, the requirement for processing power is significantly greater than that required by intraframe codecs — no matter their bit rate.

The increased computational load is required at two points in the editing process. Whenever native HDV is viewed or processed by special effects, the MPEG-2 data stream must be decoded. In the case of multistream effects, all streams must be decoded. With the current generation of computers, multistream long-GOP editing has been computation bound so there has not been a concern about laptop disk performance.

When, however, intermediate codecs are used, because HDV is recompressed to a far less efficient codec, the requirement for RAID 0 has ruled out the use of most laptops. As we will learn later, new laptops that incorporate powerful processors will enable a greater number of HDV streams to be handled. This, in turn, will increase the requirement for higher bandwidth hard disks, including RAID 0.

The more significant issue is the processing load required whenever the HD signal must be encoded using an interframe codec. Obviously, one such codec is HDV (or XDCAM HD), but there are others. In my experience, Microsoft's VC-1 codec delivers the highest quality at the lowest bit rate. Although strongly supported by Apple, AVC has not yet been used for commercial HD DVD or Blu-ray discs. But like VC-1, AVC requires enormous number crunching capability during the encoding process.

As many of us know, exporting a timeline to HDV can require a painfully long encode time. With Blu-ray burners already on the market, the current near-real-time process of creating an NTSC DVD will soon be replaced by an overnight encode job.

HD hardware solutions

Moving the entire HD production process to a laptop will require significantly more powerful laptops. Almost a year ago, Intel introduced a powerful chip called Core Duo, which features 151 million transistors, a 2MB L2 cache and two CPUs on one chip (dual cores). All Core Duos are 32-bit processors.

Apple recently moved to Intel-based processing using Duo chips. The 65nm chip offers optimized performance per clock cycle, while drawing no more power than a Pentium M. There are multiple versions of the Core Duo: T2300 (1.66GHz), T2400 (1.83GHz), T2500 (2.0GHz) and T2600 (2.16GHz).

The chip's front side bus (FSB) clock speed is 533MHz or 667MHz. Maximum FSB bandwidth is

New, powerful laptops, like this Apple MacBookPro, which includes Intel Core 2 Duo chips for 64-bit operation, offer more NLE ability when on remote.

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5.3GB/s, which means DDR2-533 RAM (PC2-4200/4300) will be fast enough, unless the laptop has an Intel GMA950 graphics performance accelerator (GPA). If it has one, DDR2-667 RAM (PC2-5300/5400) should be installed.

Manufacturers are already upgrading laptops to include the second generation of the chip, called Core 2 Duo. It has 291 million transistors and is also built using a 65nm process. It features an FSB bandwidth of 8.5GB/s. Although DDR2-533 RAM has a bandwidth of 8.5GB/s, it may introduce "wait" states, so DDR2-667 RAM (PC2-5300/5400) should ideally be installed when using this processor.

Except for the entry-level versions, which you should avoid, all models have a 4MB L2 cache and support Intel's 64-bit instruction set (EM64T) plus SSE3. EM64 support enables Apple's OS X to return to 64-bit operation.

You may wonder why Intel released two seemingly identical processors in a little over six months. The answer lies in Intel's goal to design processors that can manage the maximum possible number of instructions per clock cycle while using the minimum energy consumed per instruction.

New processors, such as those in Intel's Core series, offer the increased ability to expand NLE abilities on a laptop and include functions once only possible from a desktop computer.

This required five architectural advances to the way a processor handles instructions and data:

- *Wide Dynamic Execution.* This enables a processor to perform four parallel processes simultaneously.
- *Advanced Smart Cache.* This means that both cores can access the huge 4MB L2 cache where data in use is stored. Each core can obtain, or exchange, data without having to access the FSB or RAM.
- *Smart Memory Access.* This allows each core to obtain or exchange data without having to access FSB or RAM. A core processor has eight "prefetcher" units: two data and one instruction prefetcher per core plus two prefetchers as part of the shared L2 cache. A prefetcher obtains data that might be needed using speculative algorithms.
- *Intelligent Power Capability.* This turns off unused processing units and even single transistors. Another key to reducing consumption power is Intel's Enhanced SpeedStep, which reduces the clock speed when the system is idle or under a low load.
- *Advanced Digital Media Boost.* The most important to video production, this supports encoding, transcoding and compression. These functions all use vectors — a series of values that are modified by the same streaming SIMD extensions (SSE) operation. Intel has extended the SSE instruction data width to 128-bits.

There are three high-power versions: T7200 (2GHz), T7400 (2.16GHz) and T7600 (2.33GHz). The Core 2 Duo's FSB clock speed is 533MHz or 667MHz. Core 2 processors can shut down unnecessary parts of a processor. According to Intel, Core 2 Duo offers more than a 20 percent performance increase for processor-intensive tasks as compared to previous-generation laptops with Core Duo processors.

Of course, CPUs alone do not make a computer. Every laptop is built around a chipset that glues the processor components together. Intel now offers the 945GM and 945PM (part of the current Napa platform) and will soon offer the 965GM and 965PM Northbridge chip. (The 945GM and 965GM include the Intel GPA.)

The newer 965 (part of the Santa Rosa platform coming out early next year) offers the ability to run DDR2 RAM at 800MHz (for the coming 2.4GHz T7700 Core 2 Duo that will have an 800MHz FSB), support for 2GB memory chips (allowing 4GB using two SO-DIMMs), DirectX 10 compatible graphics, and up to a 50 percent increase in video performance over the 945.

Support for 4GB of RAM in a laptop is going to remove one of the last obstacles to moving compositing applications from a desktop to a laptop. The Santa Rosa platform's Southbridge (ICH8M chip) will support three Serial ATA II (3Gb/s data rate) ports and 10 USB 2.0 ports.

In the next nine months, laptop computers will undergo RAID technology advances that will further improve their performance, allowing them to support not only MPEG-2, but also AVCHD and AVC-I.

It's more than the CPU

In the next nine months, laptop computers will undergo RAID technology advances that will further improve their performance, allowing them to support not only MPEG-2, but also AVCHD and AVC-I. In addition, both Blu-ray and HD DVD burners will become a critical component of laptops.

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Sony is now shipping its second-generation Blu-ray equipped laptop — the 8.4lb, 2GHz T7200-based, $3550 VAIO VGN-AR270 CTO. It features 2GB of 533MHz (PC2-4200) RAM, 17in WUXGA (1920 x 1200), GeForce Go 7600GT with 256MB VRAM, and a PCMCIA slot that will accept P2 cards. The AR270 has a pair of 120GB 5400rpm SATA drives in a RAID 0 configuration. (Those with extreme power lust can purchase a 2.33GHz T7600 equipped AR270 for $4100. RAID 0 storage options go up to 400GB.)

Blu-ray drives support blue-laser (BD-ROM, BD-R and BD-RE) and red-laser (DVD-R, DVD+R, DVD±RW, DVD-RAM write, CD-R and CD-RW) operation. The ability to burn red-laser DVDs with AVC and VC-1 encoded content should enable one to create high-definition SL/DL DVDs that can be played on an HD DVD player. Likewise, the AR270 should be able to play these discs. However, Sony does note that high bit-rate AVC and VC-1 encoded DVDs cannot be played on the machines.

It seems inevitable that ... one of these chips will find its way into a laptop.

The Sony laptop can be ordered with Windows XP Professional and supports Blu-ray using InterVideo's WinDVD BD and Ulead's BD Disc Recorder. It can drive HDTVs and 5.1 audio systems using its HDMI and SP/DIF ports.

Our future

Intel has already announced a Core 2 Quadro that packs two 2.66GHz Core 2 Duo chips with 8MB L2 cache. The four cores are packed inside a single package. Reports claim H.264 and WMV-HD encoding performance increased up to 80 percent when compared to the 2.66GHz Core 2 Duo.

When 45nm and 32nm technology is implemented, the four (or more) cores can be placed on a single die. It should then be possible to manufacture a "mobile" version.

Where is Intel going? Work is already being done on an 80-core design. Its projected performance is expected to hit one teraFLOP. It seems inevitable that someday, one of these chips will find its way into a laptop. I can't wait. BE

Steve Mullen is owner of Digital Video Consulting, which provides consulting and conducts seminars on digital video technology.

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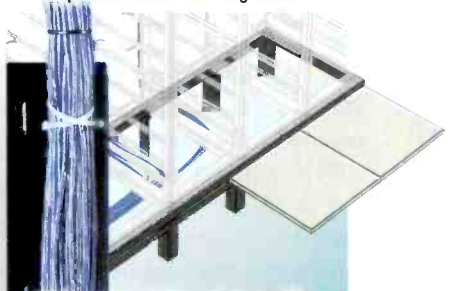

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Distorted 3GHz

High frequency does not guarantee high performance. Time domain parameters could be slowing you down.

BY STEVE LAMPEN, SUDHEENDRA PRASAD AND DALE REED

You've just hooked up new SMPTE 292-rated cable assemblies between your HDTV cameras and control surface. You fire everything up and experience tiling, slow motion and skipped frames — anything but a high-definition image. But the cables and connectors exceeded the spec. They were supposed to be capable of beyond 3GHz. So, what happened?

Evaluating the transmission components based only on suppliers' claims of high-frequency performance omits several critical signal characterization factors. These factors, in combination with frequency, will determine whether or not an HD transmission system delivers on-spec performance.

The data rate race

The wireline and connector business has, until recently, fueled a frequency race. The more-is-better philosophy is that designing cable and connectors to transmit at frequencies that provide headroom well in excess of the digital data rate will ensure HDTV signal quality.

When the transition to digital began, there was a good reason to emphasize frequency. The scrambled NRZI encoding scheme implemented for SD digital video (and carried over to HD) uses voltage transitions (1Hz = 1 bit) to represent the zeroes and ones. As data rates increased, so did the fundamental frequency; the 1.485Gb/s data rate for uncompressed HD thus requires a fundamental frequency of 750MHz. But it's more difficult to pass digital signals than analog ones, so testing signal transmissions to the third harmonic of the fundamental frequency (2.25GHz) became commonplace as a way to ensure output quality.

SMPTE realized it had a problem with harmonics. The 750MHz specification does not deal with how large a pipe needs to be to carry the signal. When testing an HD signal at the 750MHz fundamental frequency, what comes out of the scope looks like a sine wave — not the square wave that represents a true on/off pulsed digital signal. Why does this occur? What else should broadcast engineers be looking and testing for?

What goes out must not come back

After frequency, the next characteristic that needs to be tested is insertion loss — the total amount by which power received is less than power transmitted after a device has been inserted. Insertion loss applies to the entire connector/cable system and manifests as a decrease in amplitude. Measured in dB, the sources of insertion loss include the connector/cable's conductor, the dielectric material, signal reflection within the connector/cable and radiation external to the connector/cable.

The next characteristic that must be evaluated is return loss, for which the primary culprit is impedance mismatch. Unlike analog transmission, the margin of error in digital transmission is a razor-thin 1dB. The good news is that it's easier to recover a missed zero or one than to recover a waveform. The bad news is that if you go outside that range, you've fallen off the digital cliff.

Inside that 1dB margin is where the digital artifacts, such as tiling, pixelating and arrested/retarded motion, arise. That's why it's absolutely critical for HD transmission that cable assemblies deliver a return loss performance of –20dB or better. (Note: SMPTE recommends the return loss for cables to be better than -15dB from 5MHz to 1.5GHz, with the upper frequency limit raised to at least 3GHz for HD.)

The problem is return loss creates standing waves within the wireline. The voltage standing wave ratio (VSWR) indicates the presence of

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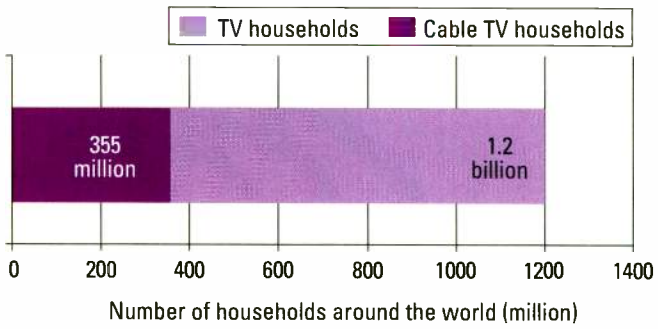

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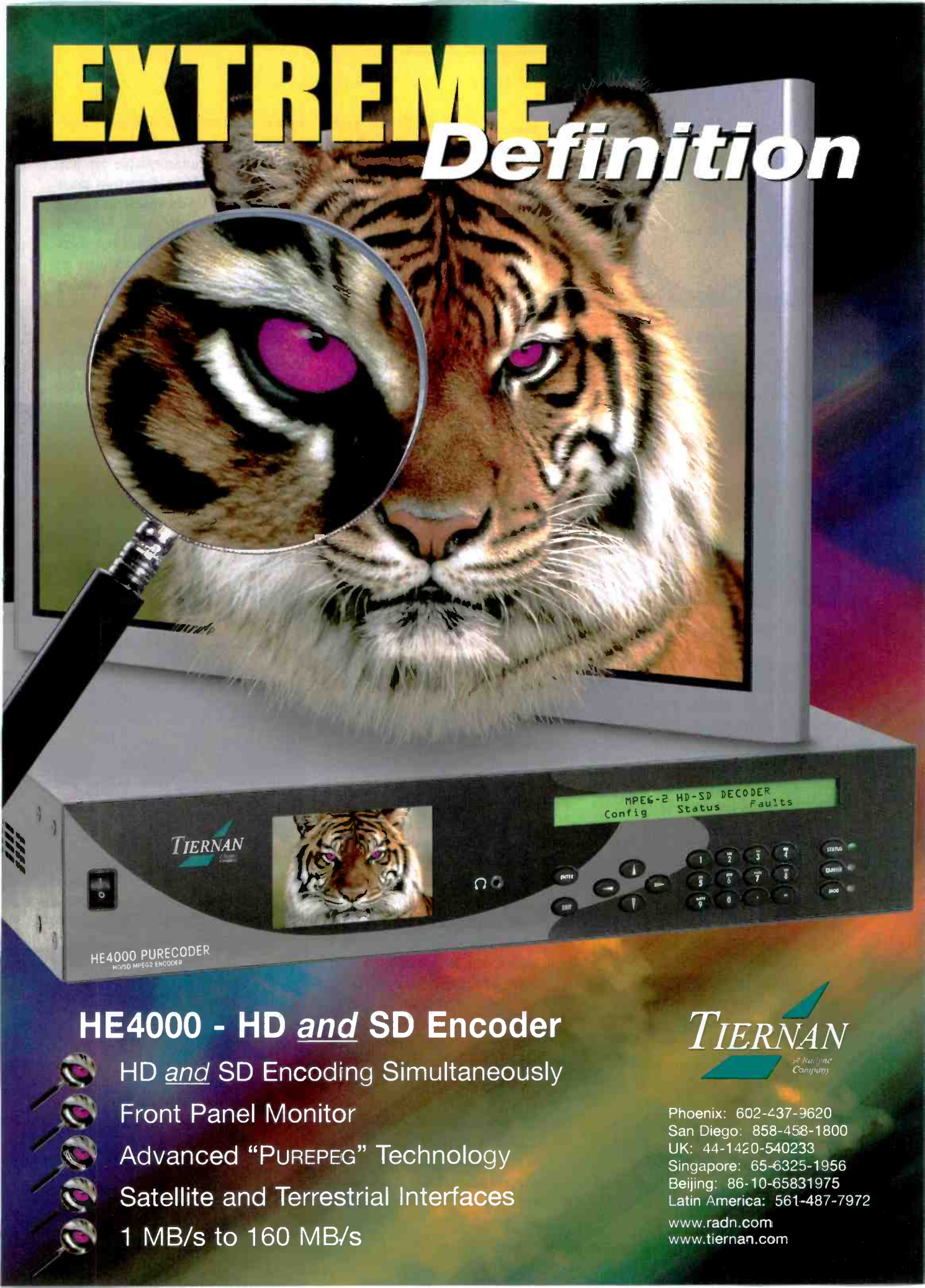

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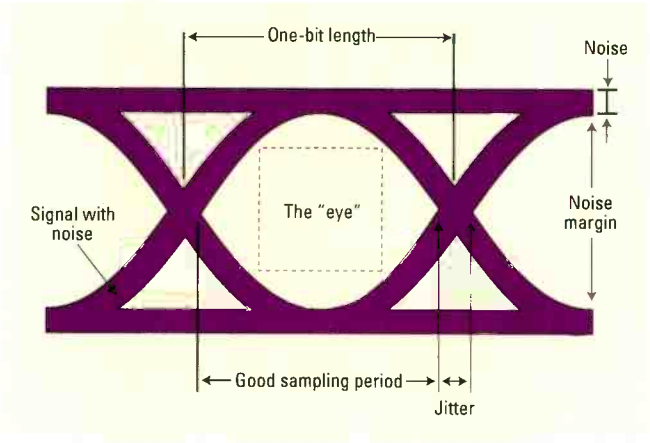

Figure 1. Eye test components

Figure 2. Ideal eye pattern test

standing waves. VSWR is a unitless ratio relating reflected voltage to incident voltage. VSWR is most pronounced at impedance mismatches. In a worse case scenario, the reflected wave is equal to the incident wave and 180 degrees out of phase, resulting in a perfect standing wave in which no signal passes through.

Manufacturing cable that is true 75Ω impedance across the full run length is difficult, which limits how much consistency can be engineered in. In practice, though, how that cable is deployed and handled has a lot more to do with the actual return loss than what's designed in. The performance of a perfectly good cable can be severely denigrated if it's installed incorrectly, stepped on, run over or overbent. Many users introduce distortion into the wireline simply by tightening wire ties with a gun around cable bundles or raceways at precisely spaced intervals, which introduces predictable harmonic distortion.

There are two easy ways to avoid this problem. First, use Velcro ties instead of plastic, being careful not to distort the cable jacketing. And, second, randomly space the wireline ties to eliminate the possibility of induced harmonic reflections.

A clear eye for a clear image

Cable manufacturers' specifications are generally missing the distance over which the cables will meet the SMPTE 292 spec. Similarly, understanding the active electronics' responsibility in delivering clean signal to spec vs. the connector/cable system frequently isn't dealt with thoroughly. Of greatest concern, though, is that there are parameters usually left out altogether that, within the frequency requirements of SMPTE 292, will indicate whether or not an HD transmission will deliver. Time domain factors include rise/fall time, amplitude, jitter, DC offset, overshoot and noise. Of these time domain parameters, rise/fall time and jitter are the most critical to digital transmission, in addition to where significant variation in performance within and between systems can occur.

Using an eye chart test is the best way to measure how clean a digital signal is when it passes through a component or an integrated system. As shown in Figure 1, the eye chart gives a visual depiction of one-bit length, and the eye pattern is created by the overlapping waveforms in opposite polarity. The width of the displayed waveform indicates the level of noise in the signal. And the width of the intersection points of the waveforms represent the amount of jitter present in the signal. The distance between the bottom and top of the eye represents the noise margin; the greater the distance, the lower the noise level.

The eye pattern displayed on the test equipment in Figure 2 represents an ideal eye — clean waveforms with little if any distortion, wide noise margin or narrow jitter overlaps. Figure 3 illustrates an unacceptable eye test. Noise and waveform distortion cause the system to be incapable of telling the zeroes from the ones. Figure 4 shows a better eye pattern, but there is still too much noise and jitter to deliver consistent broadcast-quality HD video. This is the state in which excessive digital artifacts, such as tiling and motion stops, would occur. Figure 5 shows an acceptable — but not ideal — eye pattern. There is enough

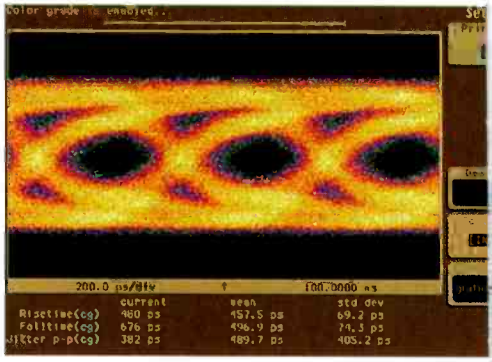

Figure 3. An example of a poor eye test

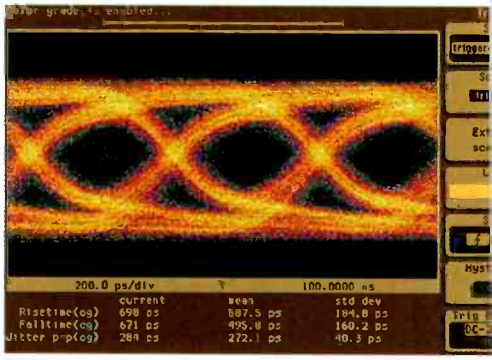

Figure 4. This eye test is better than Figure 3, but it still contains too much noise and jitter.

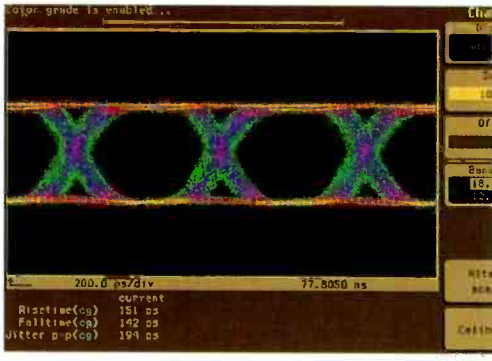

Figure 5. While not ideal, this eye test is acceptable for broadcast-quality video.

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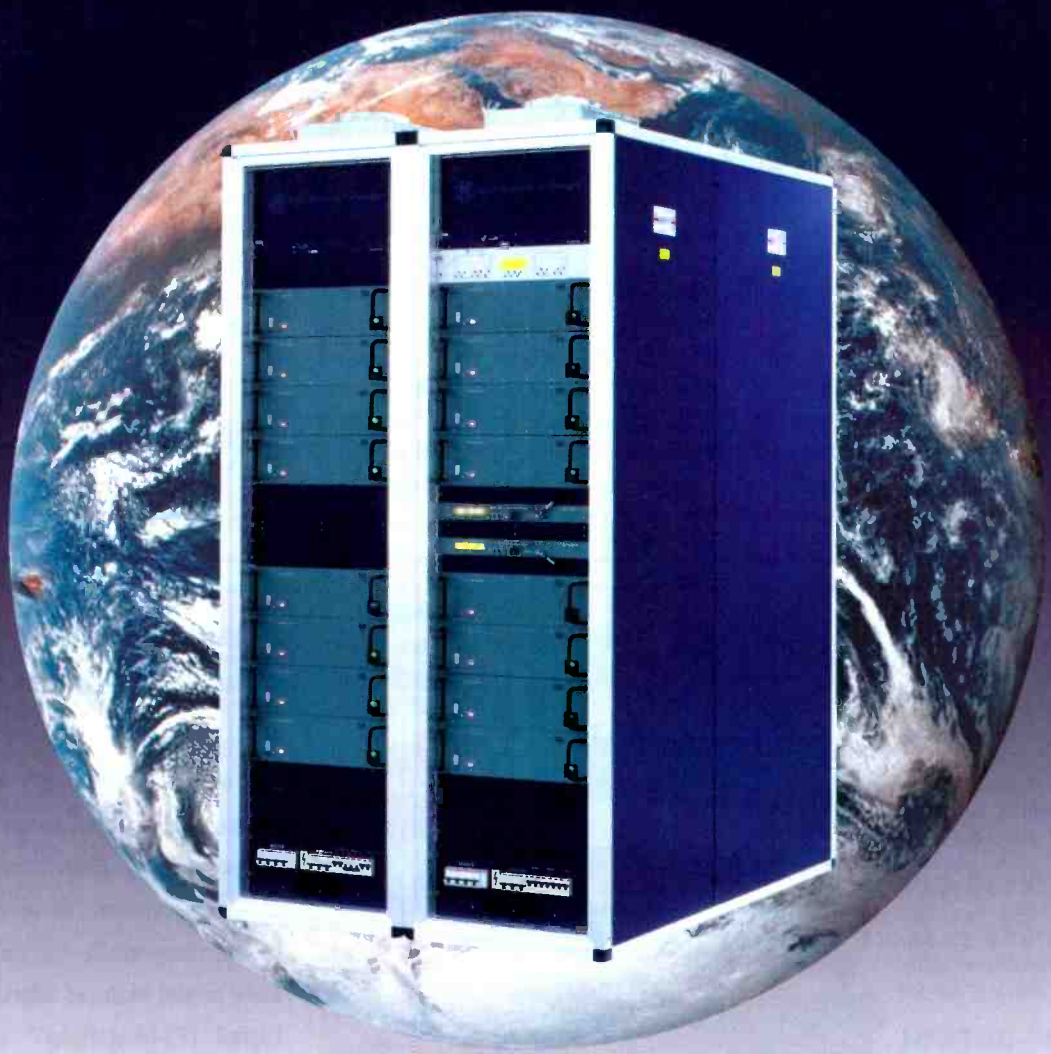

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separation between the waveform overlaps to indicate that the system is able to clearly distinguish the zeroes and ones, but the visual indication is that the jitter (the overlap areas) is perilously close to the point at which the HD image would be of unacceptable quality.

It's a question of balance

Emphasizing frequency capacity as the primary HD engineering criterion without considering the time domain parameters increases the chance of over-engineering or under-engineering. This can make the difference between consistent, clear signal transmission and endless workarounds.

When considering alternative components and sources for your HD network, ask the supplier for information on time domain performance as well as frequency domain. Be discriminating, and ask for specific data that backs up manufacturers' claims. In particular, ask for eye diagrams, rise/fall times and noise levels. Understand the conditions under which manufacturers' testing is done. Do side-by-side testing of components and systems to eliminate variations — controlling for test methods as well as test conditions.

This doesn't mean components and equipment rated above 1.5GHz have no value. Digital signals are harder to pass than pure RF, which is probably why the third harmonic rule came into practice. Cables rated at 2GHz with –20dB return loss are in common use, and better cables can deliver up to 3GHz with –22dB/–23dB return loss. Some high-frequency connectors will deliver 3GHz at –30dB return loss, which is better than most video cables. Cable assemblies and active electronics that have headroom to accommodate potential changes in standards is a comfort factor that engineers appreciate.

Don't just look at frequency. Rise/fall time, jitter and noise are critical performance factors unique to digital signal transmission. This is especially true for HD transmission because it's done in real time, unlike packet-data IP transmission over Ethernet. If you lose packets because of errors, you are guaranteed to get them back, but in HD, if you lose data, it's gone.

The good news is that it is possible to know what your current components and active electronics deliver in the time domain today — and what you will need to acquire in the future to get the results you need. In HD transmission, the path to consistent, crystal clear picture quality is a clear eye. BE

Steve Lampen is multimedia technology manager for Belden, Sudheendra Prasad is engineering manager for 360 Systems and Dale Reed is senior vice president of marketing and sales for Stratos International.

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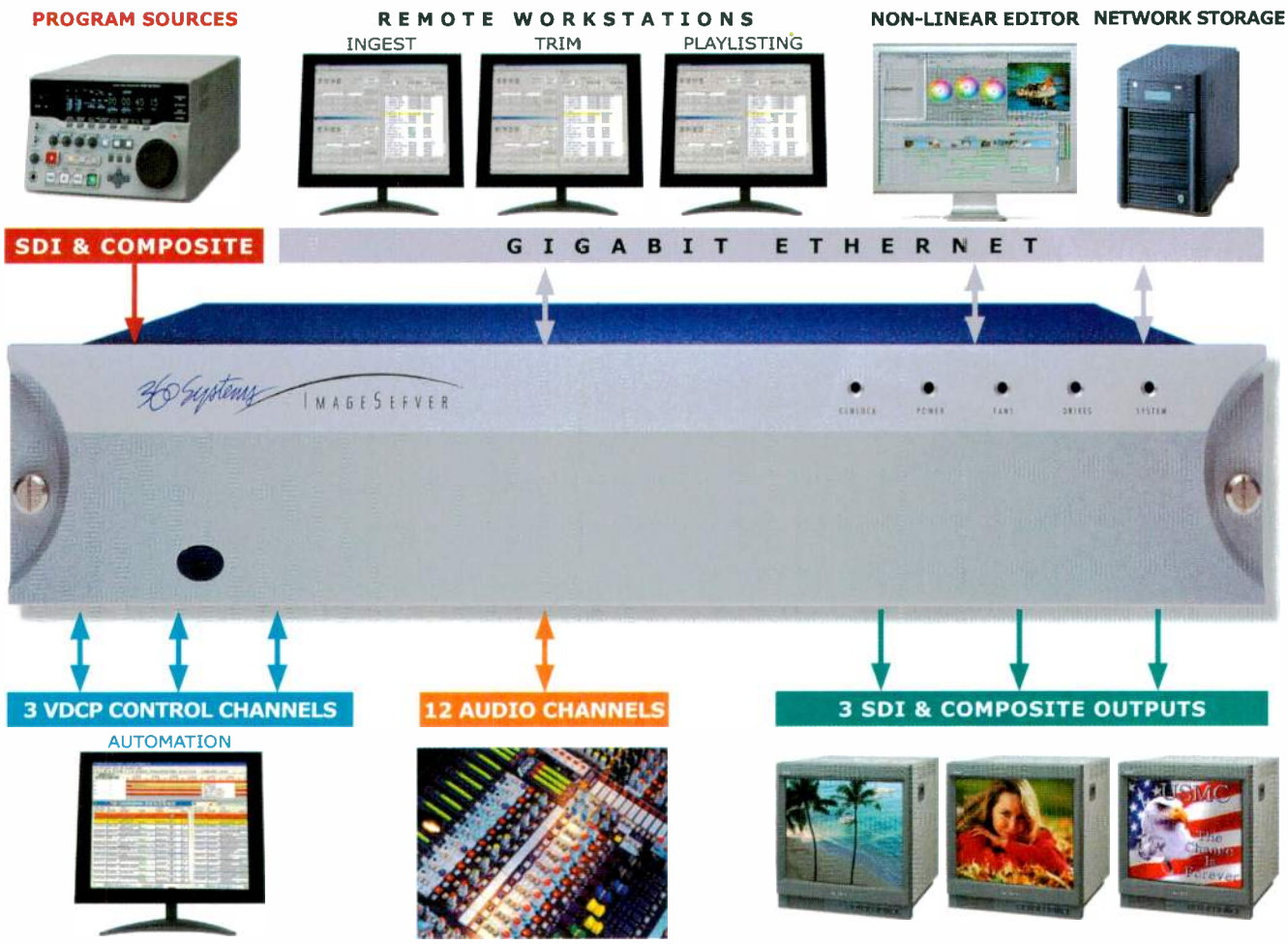

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THE END OF TELEVISION AS WE KNOW IT

BY BRAD DICK,
EDITORIAL DIRECTOR

For those who experienced the early days of television with its black-and-white images, limited channels and snowy pictures, today's television resembles "Star Wars" technology. Black-and-white shows like "Hopilong Cassidy," "Sky King" and "The Ed Sullivan Show" were hits.

Sometimes the picture was snowy, but that was normal and expected. Viewers were satisfied with three channels, with maybe only one being in color. Stations stopped broadcasting at midnight because, after all, who watched television overnight?

Today's television experience, with high-definition pictures, multichannel sound, sports, prime-time serials, documentaries and even HD local newscasts, seems light years from yesterday's technology. Yet, even brighter days may be ahead. To understand how this industry will get there, it's worth examining the structural changes that broadcasters will need to make.

Institutional changes

Today's viewers expect 100 TV channels, all in color, some in HD. In addition, viewers expect their entertainment centers to provide special features, including pay-per-view, video-on-demand, exclusive sporting events and even caller ID.

In most communities, the competition is between cable and satellite. Broadcasters used to deliver 100 percent of the viewing audience OTA. Today, less than 15 million TV homes use an OTA signal. The rest connect by cable, satellite and, soon, IPTV. (See Figure 1 on page 46.)

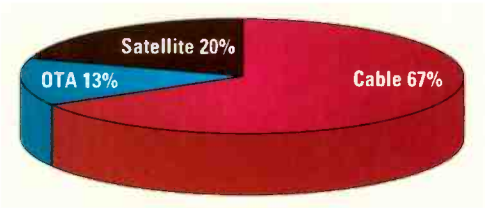

Figure 1. Americans receive their television from one of three sources; OTA local stations, cable or satellite. Fortunately for broadcasters, the number of viewers moving to cable has stabilized. Figure courtesy "Television Disrupted."

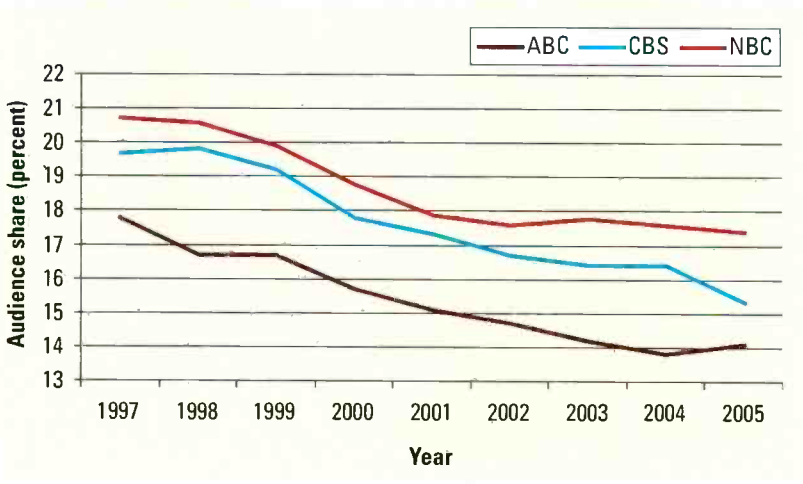

Figure 2. The big three broadcast networks continue to lose viewers to cable news networks and broadband. Figure courtesy The State of the News Media 2006.

Why have broadcasters moved from the driver's seat to the back seat? What can be done to maintain or improve station revenue? Will cable, satellite, telco and broadband relegate broadcast television to the equivalent technological status of AM radio?

Today's demanding viewer

There are an estimated 110 million total TV households. Out of those, 73 million are connected to cable, 22 million use satellite, and the rest receive OTA transmission. It's anyone's guess how IPTV from the telcos will affect these numbers.

The average cable viewer receives 91 channels of programming. Most of the larger multiple systems operators (MSOs) and multichannel video programming distributors (MVPDs) will gladly supply hundreds of video and audio channels into the home — if you can pay for it. When that happens, the local station is no longer one-third or one-fifth of the viewer's options; it's often less than one-one-hundredth. It's pretty hard to maintain visibility in such a crowded field.

Today's viewers no longer tune to broadcasters' programming like they

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used to. Last year, 57 percent of TV viewing was from cable networks, not broadcast networks. Original content is moving to cable. For example, the NFL sold the hit program "Monday Night Football" to ESPN. Those games are now shown only on cable, with home team OTA exceptions.

Fortunately for broadcasters, even as the number of content channels has increased, so has viewing time. Last year, the average home watched more than five hours of television per day. That represents a 2.5 percent increase over the previous year. Experts say that even with the draw of alternative entertainment platforms, such as mobile video, IPTV and broadband, TV viewership will continue to grow at about 2 percent per year through 2008. Despite all the media options, viewers still use their televisions three to four times as much as they do computers or video games.

Advertiser expectations

As broadcasters lose viewership, advertisers increasingly complain about paying more for less. Figure 2 on page 46 shows the average early evening news share for the three broadcast networks. An advertiser may have been able to reach 20 percent of the audience 10 years ago, but today, that advertiser reaches only about 15 percent — and at highly increased prices.

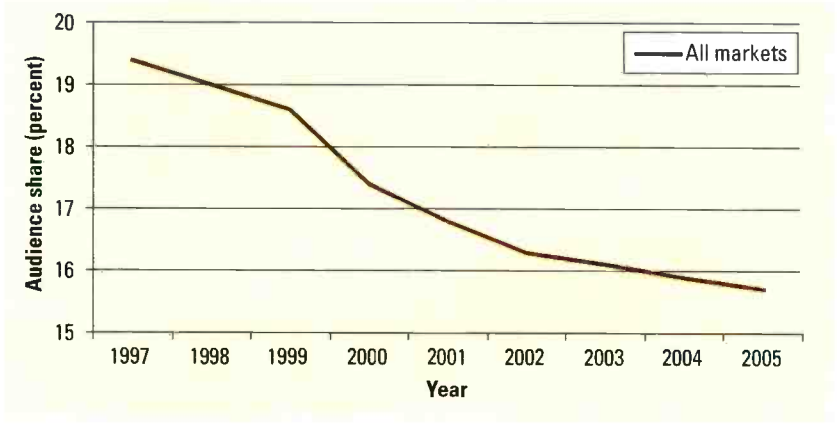

Figure 3. Local TV station newscasts continue to lose market share, primarily to the cable news networks. The mobile audience could help recoup these lost viewers. Figure courtesy The State of the News Media 2006.

Local newscasts haven't fared much better. (See Figure 3.) Note the precipitous drop in viewership starting in 1999. While the rate of loss has diminished in recent years, local TV viewership is still declining.

Cable has an audience almost twice the size of broadcast, yet it collects only 30 percent of today's advertising revenue. Advertising executives say that this difference between performance and revenues makes the market prime for significant change.

On the upside for broadcasters, cable penetration has reached saturation. (See Table 1.) For the past five years, cable audiences have hovered around the 68 percent penetration level, with only a 2 percent change. Last year, penetration dipped by 0.5 percent.

Meet the new viewer

Is there opportunity for broadcasters in all this gloom and doom? The simple answer is yes, but realizing the potential revenue will require a different kind of station operation and new workflows. (See "Equipment list" on page 50.) The keys to success are new technology, staff flexibility and management's willingness to try different ideas.

Younger audiences are increasingly media savvy. They want more control over what they watch. They are the first to use PVRs, portable media players and

Year	Cable households (in thousands)	Percent of U.S. households that own televisions
2001	69,490	68.0
2002	73,230	69.4
2003	74,430	69.8
2004	73,860	68.1
2005	73,930	67.5

Table 1. The number of cable households in the United States has not changed greatly in the last five years, fluctuating between 67.5 percent and 69.8 percent since 2001. Figure courtesy The State of the News Media 2006.

broadband television, selecting content and scheduling it for delivery according to their needs. (See Figure 4.)

At the recent *Broadcast Engineering* News Technology Summit, David Payne, senior vice president and general manager for CNN.com said, "Younger audiences demand a different experience. Give them what they want on the schedule they want."

Mobile gold mine

One interesting broadcast opportunity may exist in serving mobile viewers. Mobile television is frequently discussed, but rarely understood — especially when it comes to understanding the role of broadcasters. Yet, new information indicates that broadcasters can play a key role in the deployment of mobile television.

Last month, Nokia released an in-depth report called "This box was made for walking: How will mobile television transform viewers' experience and change advertising?" The report shows that broadcasters can become an integral part of this service. Specifically, it says:

- By 2011 mobile television will have more than 500 million subscribers.
- Mobile television will complement,

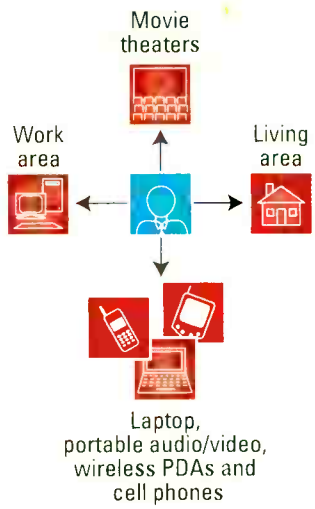

Figure 4. The new generation of viewers is more tech savvy, consuming media from a variety of sources and locations. Media must be customized for the players and the consumers' interests. Figure courtesy "Television Disrupted."

Equipment list

Broadcasters need to modify their workflow to provide viewers with mobile television. Using a sneakernet and linear editing techniques are neither fast or efficient enough to enable multichannel, mobile and streaming technologies. Let's look at some of the equipment that will be needed.

Automation

A multichannel, building block automation design is a must. Another option may be the one-box-per-channel solution. The system must accept business office drivers for scheduling and output commands to servers, for play-to-air, play-to-Web and play-to-mobile channels.

Allow for multiple play to air channels. While the station may only need an analog and digital channel now, expect more air channels to be added later.

Be sure the automation system can ingest multiple feeds, perform QC, and stage them for play without operator intervention. You will also need to build an as run log for billing on each channel.

Don't forget that sometimes the station will broadcast in HD, and other times in SD, with additional channels. The automation system must be able to make the proper multiplexer switches without visual or audio impairments. This can be more difficult than it may seem if the initial planning isn't done correctly.

Storage

Buy only what you need today. Storage costs are dropping, so don't pay today's prices for tomorrow's needs. Just be sure you can add capacity in modular chunks. Don't settle for a server that can only be upgraded with a forklift.

Format conversion

The streaming and mobile channels will need format and scan conversion. Again, these functions must be automatic and foolproof.

The images may also need to be groomed for proper display on small screens. Several companies have demonstrated equipment that has the intelligence to identify key image features and perform real-time zoom to them.

This type of function is key in light of mobile viewers' needs. Images must be properly groomed for display on small screens.

not replace, traditional television.

- Local content will be the most-watched type of mobile program.

These three points should catch the attention of broadcast general managers and engineers. They show that mobile television may be an opportunity rather than a threat.

The report says that consumers will use their mobile devices to watch familiar content, such as news, weather, entertainment and sports. After local news, the second most popular programs are likely to be network newscasts.

Prime time for mobile viewing will be 6 a.m. to 9 a.m. and 6 p.m. to 8 p.m. Stations supplying news to a mobile deliverer will have to package and turn around newscasts quickly. There won't be time for lengthy post production.

Viewers will use their mobile devices while they commute (not drive) or have wait time. Studies also show that up to one-half of the users will watch mobile television at home. Lunch breaks also proved to be a popular viewing time.

Viewers will snack on video for short periods rather than watch full-length programs. Content for small screens must be packaged for proper display. Simply shrinking your wide-screen HD image to fit a 2in x 4in screen isn't sufficient. Such packaging would be easy but worthless because the focal points would remain too small for mobile viewing. (See Table 2.)

Instead, mobile content must be reformatted for smaller screens. Newscasts must focus on talking heads and close-ups, not widescreen or studio two-head shots. Graphics need to be short, snappy and large.

Current television that is repackaged	New TV content	Prime times
Much shorter, concise news briefs	Talking heads, close-ups	6 a.m. - 9 a.m.
User interactivity of reality television and game shows	Snackable content	Midday prime
User-generated content	Mobisodes	Midday
Segmented programs	Visual spectacle	6 p.m. - 8 p.m.
	Local content	

Table 2. What will people watch? People will watch a combination of original broadcast content, plus new content specifically made for mobile consumption. This content must be supplied in snack-sized segments. Figure courtesy Nokia.

Mobile viewers also want customization, much like they get from TV Web sites. Viewers who don't care for sports might be intolerant of having to watch 30 seconds of last night's game. Let viewers choose what they want to see, and then deliver it.

Mobile television will require shorter ads, typically five or seven seconds. This will necessitate new production techniques. Copywriters will have to shorten copy, use larger, easy-to-read graphics and get to the point quicker.

One upside is that content can be interactive. Consumer-initiated ads will be popular with both viewers and advertisers. Also, location-dependent ads will be possible, as two-way media players will be equipped with GPS positioning.

An issue that is sometimes overlooked is the two-way video nature of the mobile platform. Expect viewers to not only view your content, but also to be willing to supply you with content. Mobile players will come equipped with high-resolution cameras and video transmission capability. Technology already exists to automatically ingest mobile phone news clips. Think of the news possibilities.

Finally, while these viewer needs may sound like challenges, the benefit is the first-rate audience they bring. Research shows that the 18- to 34-year-old mobile audience is a highly desired demographic by advertisers. This audience tends to be tech savvy; they're the ones driving YouTube and other personal video Web sites. These folks are ready to spend money and aren't intimidated by technology.

Resources

- Palmer, Shelly, "Television Disrupted," Focal Press.
- Orgad, Dr. Shani, "This box was made for walking: How will mobile television transform viewers' experience and change advertising?," Department of Media and Communications London School of Economics and Political Science, commissioned by Nokia.
- "The end of television as we know it: A future industry perspective," IBM Business Consulting Services, 2006.
- The State of the News Media 2006, Project for Excellence in Journalism, *www.stateofthenewsmedia.com/2006.*

The analog turn off

Broadcasters should view the death of analog as an opportunity to recapture their lost audience. It represents a once-in-a-lifetime chance for TV stations to give viewers a free OTA multichannel experience. Viewers will be excited to learn that their favorite OTA station can now provide them with up to six programs simultaneously — in addition to prime time HD.

Right now, OTA audiences are miniscule, so the next two years are the perfect time to try new ideas. There aren't 500,000 viewers watching Channel 4.3, so if it crashes, big deal.

Experiment. See what works in your community. Look for partners. Develop video podcasts. Soon cell phones will be able to capture and store both streaming and video clips. Viewers will charge their cell phones overnight, and when they wake up, the phones will have already have downloaded the morning news and other personalized content.

This is an exciting time in our industry. While some complain, "It's the worst of times," others see just the opposite. To them, the challenges are exhilarating and will lead to a successful future. One thing is for sure: The end of television as we know it is truly at hand. Martha would say, it's a good thing. BE

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The American DTV PLATFORM

BY PHILIP J. CIANCI

This month marks the 10th anniversary of the FCC's formal adoption of the American DTV standard. For those of us who work in this industry, this anniversary represents a good point to look back at the technological journey that brought us to this solution.

The beginning

The genesis of high-definition television (HDTV) is generally attributed to NHK. At the 1981 SMPTE Conference in San Francisco, NHK demonstrated what it called a Hi-Vision analog HDTV transmission system. The technology was initially designed not for home reception but as a satellite link. The system was based on an analog PAL composite video signal that had been scaled up to 1125 lines with 60 fields. The transmission link required 20MHz of bandwidth.

SMPTE attendees were stunned by the high-resolution images. Some recognized that they were viewing the future of over-the-air television. For them, this was an exciting development. Others were less enthusiastic. Some saw the demonstration as an attempt by the Japanese to set standards for the U.S.

The U.S. effort to establish an HD transmission standard began with the creation of the ATSC in 1982. The committee was initiated at the direction of the Joint Committee on Inter-Society Coordination (JCIC). The ATSC was given the task to develop voluntary technical standards to replace the 50-year old NTSC standard. The initial ATSC committee included members from the EIA, IEEE, NAB, NCTA and SMPTE.

In September 1984, the State Department submitted an ATSC-recommended 1125/60 proposal to the CCIR for a worldwide HDTV production standard. Motivating the action was the feeling that a global HD production standard would benefit the U.S. TV industry for international program distribution.

This proposal was adopted in 1985 by Study Group 11 and was passed on to the plenary assembly for further consideration. With heavy resistance from Thomson and Philips in particular, in 1986 the CCIR postponed any action on the proposal until 1990. Some feared that an NHK-based proposal would kill the MAC systems under development. It was also seen as an attempt by Japan to dominate the consumer electronics economy.

While the ATSC persisted and attempted to gain support for the 1125/60 Japanese standard, U.S. broadcasters were turning their attention to over-the-air transmission of HDTV.

The Grand Alliance HDTV system in the David Sarnoff Research Center Field Lab in early 1995. Images courtesy Glenn Reitmeier Collection, David Sarnoff Library.

Why develop a U.S. HD standard?

The motivation to develop an American HDTV transmission standard was influenced by many factors, including the potential loss of TV spectrum to mobile services. Local stations were certainly less interested in providing HD services at this point than just protecting their future spectrum.

Certainly the U.S. consumer electronics industry under the leadership of the Consumer Electronics Association (CEA) was keen to see a new entertainment technology develop. While the CEA was publicly supportive from a U.S. perspective, the reality was that America had little entertainment

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ORT-3442-1	3.4–4.2 GHz
ORT-95012750-1	0.95–12.75 GHz

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manufacturing left in this country. As the HD standard was debated, virtually all television set manufacturing was being moved outside U.S. borders.

There was also a pride issue. American engineers were loath to have Japan set the standards for the key U.S. entertainment industry. In addition, broadcasters thought that broadcasting HD might also help stem the loss of viewers to cable. NTSC was technologically antiquated, as the high-definition demonstrations clearly showed. Finally, broadcasters, NAB and the CEA recognized that the NTSC standard was old and needed to be replaced.

The FCC starts the process

In July 1987, the FCC issued its First Notice of Inquiry on Advanced Television Service. Later that year, the commission appointed a 25-member advisory panel, calling it the Advisory Committee on Advanced Television Service (ACATS). Chaired by former FCC Chairman Richard E. Wiley, the panel, which included Joe Flaherty of CBS, was charged with reviewing the technical issues and then recommending an advanced television system to the FCC. Twenty-three systems, many only existing in simulations, were submitted and competed for the blessing of the FCC and adoption as the U.S. standard.

One proposal, Sarnoff's Advanced Compatible Television (ACTV) system, required a two-step approach to HD. Another came from the Philips laboratory and was called High Definition System – North America (HDS-NA). This represented an adaptation of Multiple Analog Commanding (MAC) technology. Both systems provided NTSC compatibly that met the FCC's NTSC compatibility requirement, but required more than a standard 6MHz transmission channel.

Two of the proponents, MIT and Zenith, advocated an alternative called simulcasting. In a simulcast approach, a channel is used to convey an independent advanced television signal that is not NTSC-compatible. To receive advanced television, only the simulcast channel needs to be received. The concern was whether HDTV could be achieved within a single TV channel.

The initial 23 systems were reduced to six during "Hell Week" in November 1988. ACATS now realized a laboratory was necessary to properly test the surviving proposed HDTV systems. With the broadcasters' backing, the committee built the Advanced Television Test Center (ATTC).

In March 1990, the FCC ruled in favor of simulcast HDTV. Broadcasters would be granted a second 6MHz channel for HDTV broadcasts. At some time in the future, NTSC transmission would cease and the second channel would be returned for reuse and auction.

The switch to digital

Some of the engineers involved with these early systems realized that an analog transmission scheme would not meet the FCC's interference requirements, especially when scaled to national proportions. They began looking at a digital solution.

General Instrument (GI) beat everyone to the punch and announced it had built an all-digital HD system. GI also claimed that its system could compress HDTV into a 6MHz signal. Now that was something significant. Not only could an all-digital system be built, it would also fit within the current NTSC channel allocations.

By 1990, broadcasters, the NAB, the consumer industry and the FCC were pushing for a working solution. The proponent HDTV systems were only in the R&D prototype stage. Demonstrations were under limited, controlled conditions. Confirmation that one of these systems could successfully be deployed nationally was still to be estblished.

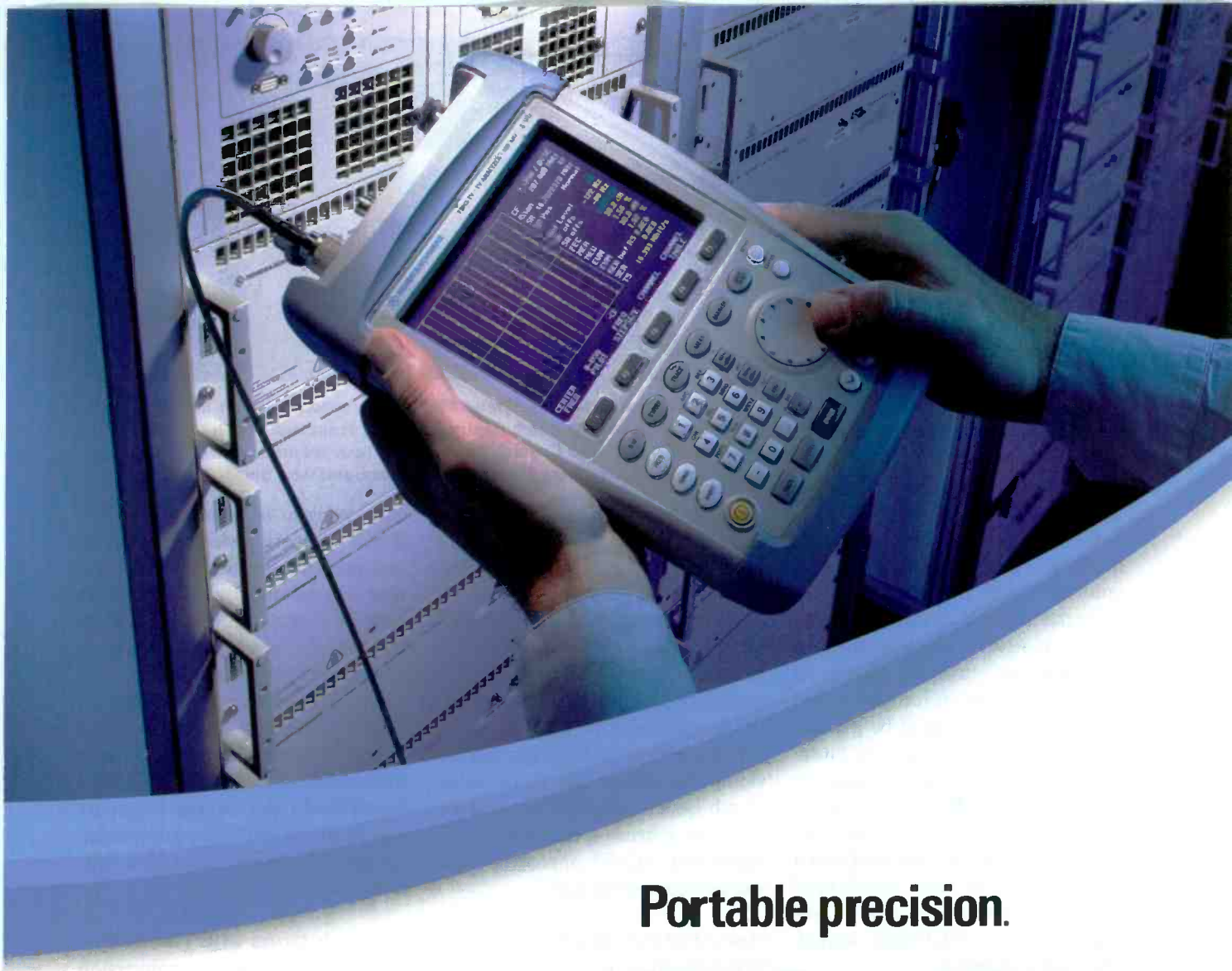
By now, the players realized there were only two possible outcomes from the current battle for supremacy. First, a company's proposal might be selected as the winning design, and the company would reap billions in licensing fees.

The second, and more likely scenario, was that a company's proposal would be rejected. Not only would the company's R&D money already spent be lost, but more importantly, the billions in licensing fees they hoped to reap would be forever lost. So, when faced with getting all of the pie or none of the pie, seven of the companies decided to cooperate. Through a combined approach, they would hedge their costs and increase the odds of getting at least something for their efforts.

Four groups resulted and developed digital systems. (See Table 1.) NHK also submitted its analog system for consideration. Proponent testing was scheduled.

Proponent	Members	Proposed system	Scanning format	Source coding	Modulation
Advanced Television Research Consortium (ATRC)	Philips/Thomson/ Sarnoff/CLI	AD-HDTV	1050/59.94/2:1	MC-DCT	AA-QAM
	Zenith/AT&T	DSC-HDTV Digital Spectrum Compatible	787.5/59.94/1:1	MC-DCT	4-Level-VSB
American Television Alliance	GI/MIT	DigiCipher	1050/59.94/2:1	MC-DCT	16/32-QAM
American Television Alliance	MIT/GI	CC-DigiCipher	787.5/59.94/1:1	MC-DCT	16/32-QAM

Table 1. ATTC Round 1 proponent systems



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The tests begin

After the first round of proponent tests were completed, the NHK analog system was eliminated.

The ACATS decided that only digital systems would remain under consideration. It also decided that no one system was sufficiently satisfactory. The four groups of players were asked to submit proposed system improvements and undergo another round of tests.

The Grand Alliance

By late 1992, as improvements made each system virtually indistinguishable from each other, it seemed likely that the ACATS was going to be unable to select a winning proposal from the four remaining players. At this point, the players recognized that the only way each could be guaranteed to receive a portion of future licensing revenues was for them to cooperate and form a single entity to finish the project. Thus, the Grand Alliance (GA) was formally established in May 1993. The seven members of the Grand Alliance were AT&T, General Instrument, MIT, Philips, Sarnoff, Thomson and Zenith.

This arrangement solved two issues. The first was that sharing patents between Grand Alliance members ensured that everyone would receive at least a share of the profits. From the FCC's viewpoint, with only one system to consider, the commission was provided with political cover. The commission wanted no potential for a repeat of its embarrassing 1953 color standard reversal and 1982 AM stereo fiasco. This became the politicians' win-win scenario.

The technical leaders of the Grand Alliance are shown here on March 31, 1995, in the David Sarnoff Research Center Field Lab. Front row: Ralph Cerbone, AT&T; Jae Lim, MIT; and Aldo Cugnini, Philips. Back row: Wayne Luplow, Zenith; Glenn Reitmeier, DSRC; Bob Rast, General Instruments; and Terry Smith, DSRC.

For engineers, the GA became a logical, technically sound architecture that incorporated the best features from each of the four proponent prototypes.

The remainder of 1993 was spent defining system architecture and dividing the design and construction of sub systems among GA members. Once the system's specifications were established, ACATS approved them, and a prototype was built.

National Information Infrastructure

Often lost in the telling of HD's development is the influence the National Information Infrastructure (NII) initiative had on prototype system design. The NII was Washington-speak for what would later become the World Wide Web.

Key among the NII's requirements was high-digital interoperability with other systems. In many respects, the ATSC transport system became the core platform and helped extend services beyond audio and video. A/65 PSIP, the A/90 Data Broadcast Standard and A/9x data services standards series have resulted from this capability.

The GA spent much of 1994 developing a working prototype. AT&T and GI developed the MPEG video encoder, and Philips the MPEG video. Sarnoff built the transport encoder and Thomson the transport decoder. Zenith built the modulation/demodulation system.

Key solutions still needed

Performing format conversion proved to be an early issue. Converting between 1080i and 720p in real time had never been done before, but it was also an important aspect of the final test procedure. This required the design and construction of a format converter.

Two format converters were available. The first was developed during the competition phase by the ATTC and

Beyond Balance

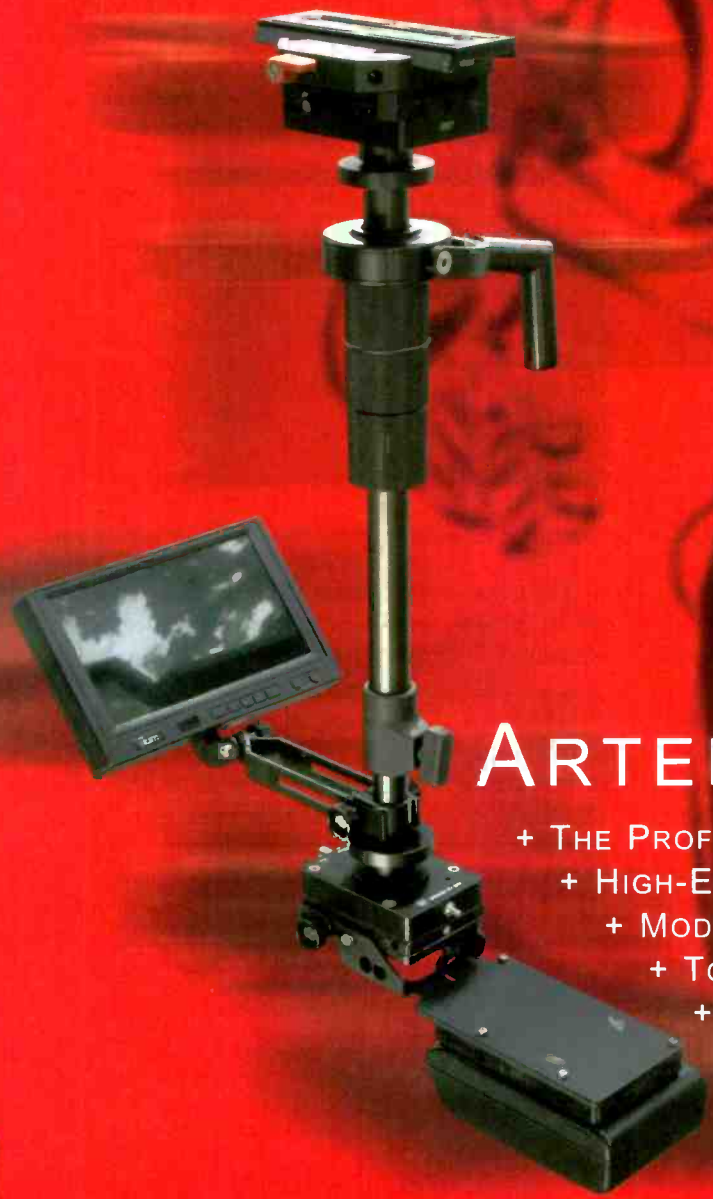
Side-to-side module

Gimbal

Lower sled module

Cordura vest

Spring arm



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built by Tektronix. It was expensive, having cost approximately $600,000. The second was developed by the Grand Alliance, with the design and construction shared across companies.

The battle for progressive scan

In November 1995, the ACATS recommended the ATSC Grand Alliance system be accepted by the FCC. While broadcasters thought the path was now clear, the computer industry had not yet begun to fight. Scheming behind the scenes were two groups, the PC folks and the film industry. The computer industry contended that to promote interoperability between DTV and PC devices, any ATSC standard should rely exclusively on progressive displays. The film industry demanded that movies be broadcast in their original aspect ratio. Thus, just at the point broadcasters thought the issues were almost resolved, two outsiders began to throw stones on the entire process.

Reed Hundt, FCC chairman was sympathetic to the computer industry's position. The Computer Industry Coalition on Advanced Television Service (CICATS) had not participated in the formal standards development process. But that didn't stop it from lobbying hard through 1996 to get progressive scanning adopted as part of any standard. The result was that the FCC refused to act on ACATS' proposed DTV standard.

#	PIXELS/ Line	LINES/ Frame	ASPECT RATIO	Refresh Rate (Hz)	SCAN MODE
18	1920	1080	16:9	30	Interlaced
17	1920	1080	16:9	30	Progressive
16	1920	1080	16:9	24	Progressive
15	1280	720	16:9	60	Progressive
14	1280	720	16:9	30	Progressive
13	1280	720	16:9	24	Progressive
12	704	480	16:9	30	Interlaced
11	704	480	16:9	60	Progressive
10	704	480	16:9	30	Progressive
9	704	480	16:9	24	Progressive
8	704	480	4:3	30	Interlaced
7	704	480	4:3	60	Progressive
6	704	480	4:3	30	Progressive
5	704	480	4:3	24	Progressive
4	640	480	4:3	30	Interlaced
3	640	480	4:3	60	Progressive
2	640	480	4:3	30	Progressive
1	640	480	4:3	24	Progressive

Table 2. 18 ATSC video presentation formats

Final agreement

In late 1996, FCC Commissioner Susan Ness demanded that the warring groups — the GA, CICATS, Consumer Electronics Manufacturers Association and Film Coalition — enter negotiations to resolve the remaining contentious issues.

Once again, politics came to the rescue. The ATSC initially developed the infamous Table 3 with 18 different resolution and scan rates. (See Table 2.)

However, in an effort to streamline the standard and simplify displays, it had been removed from the final ATSC proposal. Commissioner Ness got the committee to add the table back into the standard. This change resolved the concerns from the computer industry.

The Film Coalition held steadfast, demanding that a film's original aspect ratio be protected. However, being a small group without lobbying funds and big names, its opinion got little attention. Its concerns were steamrolled by the Ness-forced negotiations.

So, after a long and arduous HDTV standards quest, on Christmas Eve 1996, the FCC adopted the proposed ATSC digital television terrestrial broadcast standard.

Key provisions of the adopted standard include: MPEG- 2 video compression; ATRC derived packetized transport; Dolby's AC-3 multichannel audio; and Zenith's 8-VSB transmission system.

Into the analog sunset

In the 10 years that have passed since the standard's adoption, DTV transmissions now cover the U.S. Cable operators offer HDTV services on virtually every system, and HD satellite broadcasts have a national footprint.

The final step in this transformation is scheduled for February 17, 2009. On that day, broadcasters will turn off their analog transmitters for the last time.

Today, most prime-time programming is produced in HD. DTV has reached 30 percent household penetration and is predicted to top 80 percent by 2009. Vouchers for digital-to-analog converter boxes will be subsidized by the government to enable every household in America to continue to receive over-the-air broadcasts after the analog shutdown.

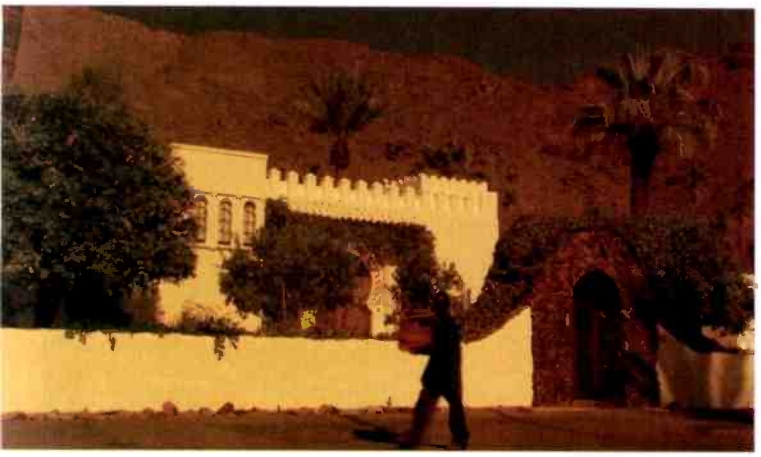
Beyond the commercial success and DTV's rapid market penetration, the fact that the system has a layered architecture may be the most important aspect of platform. Each of the layers — presentation, compression, transport and transmission — has already been augmented or replaced by other, newer technologies. Because the U.S. DTV system is so flexible, Americans can expect it to continue to take advantage of new developments and provide a long-lived service to viewers, which will help ensure that it has a long and successful life. BE

Philip J. Cianci has been in the TV business for 21 years and has done circuit design in the Grand Alliance ATSC prototype system. He is seeking first-person memories from engineers and technical personnel who participated in any phase of HDTV R & D, early broadcasts, standards committees, facility construction and equipment manufacture for an insider's view book. For more information about this effort, to contribute or comment about this article, visit www.HDTVArchiveProject.com.

HD in post

part 2

BY L.T. MARTIN



A look at four workflows designed for high-definition editing and finishing.

One of the reasons many consider post production the most exciting arena for high-definition content creation is the burgeoning number of choices for editing and mastering HD projects. Last month's "Production Clips" column ("HD in post, part 1," November 2006) depicted case studies at three high-definition editing and finishing facilities. Below are four more facility case studies, each using a different software-based system to complete its high-definition project.

Cinergy Creative

At the beginning of this year, Adobe Systems released Adobe Production Studio (part of its Creative Suite family). The bundle includes After Effects 7.0 for effects creation, Adobe Photoshop CS2 for image manipulation, Adobe Encore DVD 2.0 for authoring, and Adobe Illustrator CS2, a vector-art creation software for paint and rotoscoping. Recently, Adobe announced that the bundle's audio tool, Audition 2.0, is being replaced by the beta version of Soundbooth, an audio tool for soundtrack creation. (Audition will continue to be developed separately from Production Studio.) For pure editing, the key component of the software bundle is the Premiere Pro 2.0 NLE application, which gives full control over HD mastering.

Adobe software is at the heart of the Hollywood visual effects/post-production company Cinergy Creative.

Visual effects and post-production company Cinergy Creative mastered the HD elements of the film "Phat Girlz" using Adobe Premier Pro 2.0.

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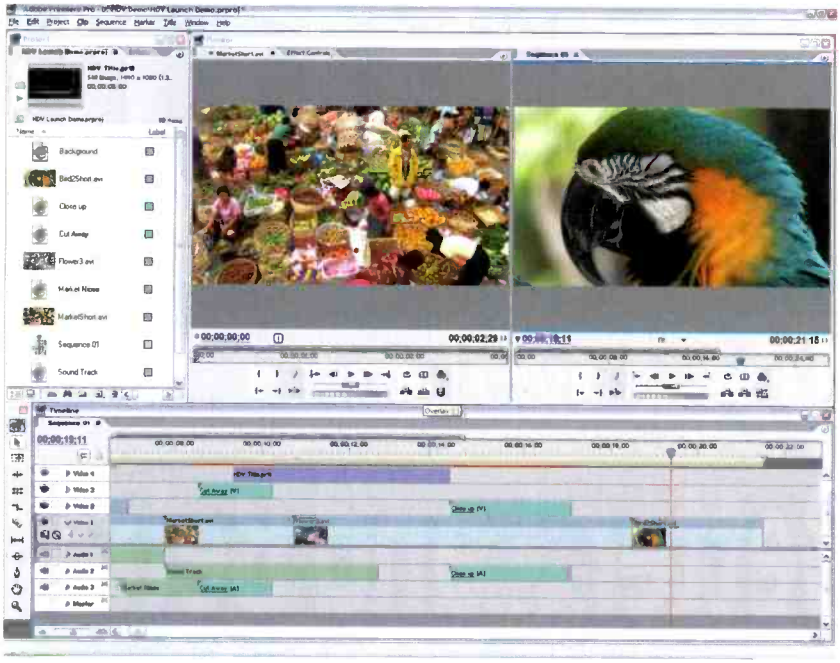


Adobe Premiere Pro 2.0 is part of the Adobe Production Studio. The bundle's Dynamic Link feature allows users to move content easily between programs.

Creative director Leslie Allen says his Adobe Production Studio applications and Premiere Pro editing software satisfies his client's needs from commercials to theatrical films. Four years ago, Allen chose the editor because it was one of the first software-based editing applications that could create 5.1 surround mixes. Now he is using version 2.0 to master HD elements for such TV projects as CBS' "The Amazing Race" and the Sci Fi's "The Outer Limits," as well as current feature films, including "Phat Girlz" and "El Muerto."

The Adobe Dynamic Link feature — shared by all Production Studio modules — allows Allen to move elements from one application to another without rendering. For example, during previsualization on "American East," Allen's client watched as he quickly brought in sketches from Photoshop and used Dynamic Link to fine tune them in After Effects.

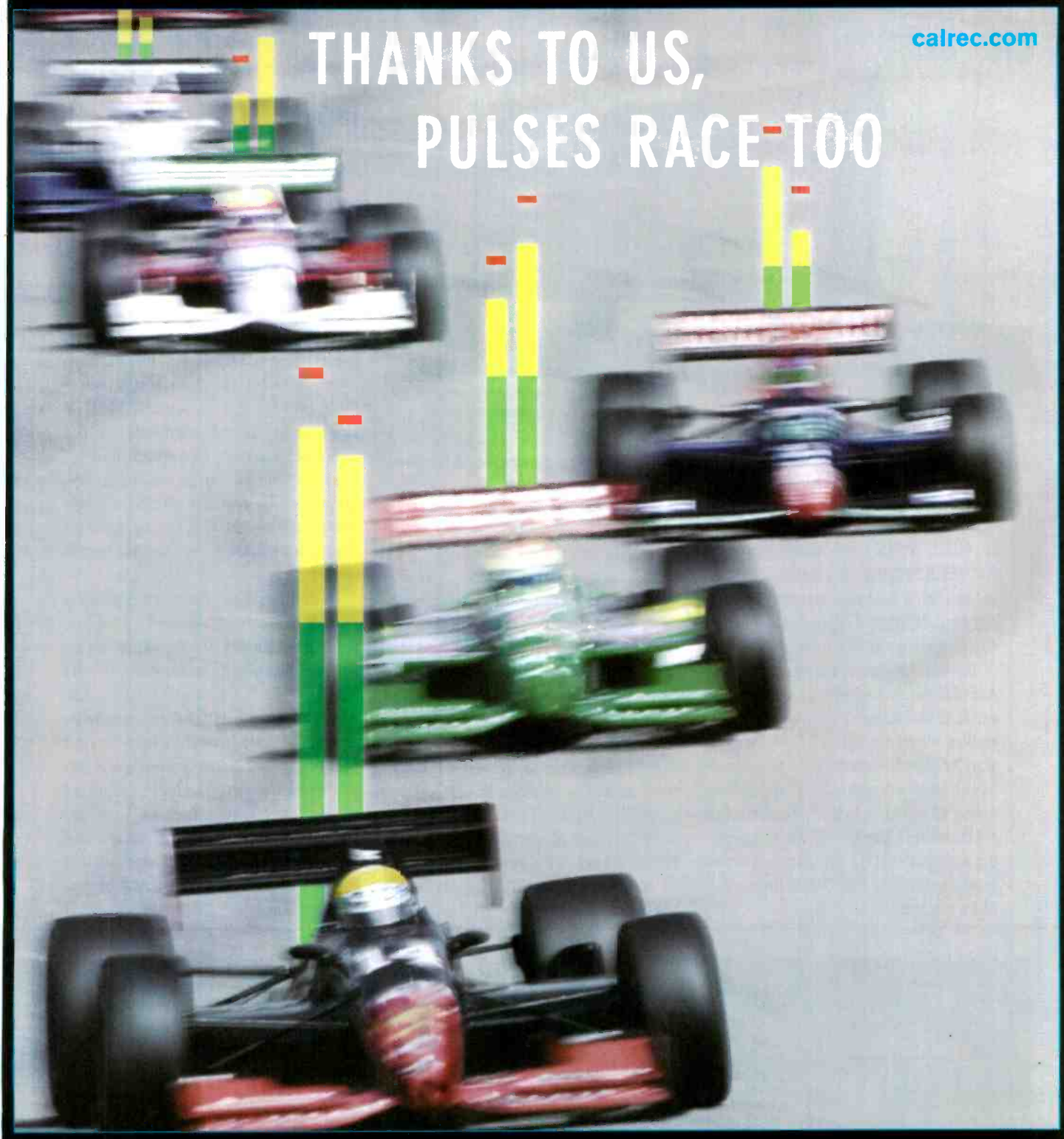
Allen has found that today's NLE offerings provide more options for a fraction of the cost of Cinergy Creative's legacy hardware-based post systems. Of course, it helps that his facility is using 2.5TB of fiber-optic RAID storage to move files between workstations. With that much material dedicated to his film projects ready at hand, Allen says that Premiere Pro lets him master HD and even 2K projects with the same flexibility he used to expect in standard definition.

KRON-TV

One of the key attractions that led Grass Valley Group to acquire Canopus at the beginning of 2005 was the acclaimed quality of its HD codecs developed by Canopus' founder Hiroshi (Hiro) Yamada. Those codecs are a major reason KRON-TV, the PBS affiliate in San Francisco, has selected EDIUS as its primary editing software. In fact, Jim Swanson, director of KRON's local programming, oversees 60 edit systems using EDIUS Pro software for the station's remote productions. In addition to all of the station's SD news packages, KRON has five EDIUS systems dedicated to HD projects, including "Henry's Garden," "Bay Café" and "Bay Area Backroads." Most of these are shot with Sony HDV-Z1U cameras recording the long-GOP HDV format on mini-DV cassettes.

But for a new home show called "Bay Area Living," Swanson's production team has also recently introduced a Panasonic AG-HVX200 camera that records 110Mb/s DVCPRO HD video on 8GB P2 cards at about one minute of HD material per gigabyte. Several of the EDIUS Pro laptop systems have been upgraded to the broadcast version so they can ingest the MXF files recorded by the AG-HVX200 directly from its P2 cards without any transcoding. To start posting "Bay Area Living" in HD with this system, his editors take their laptops into the field loaded with EDIUS Pro software and transfer HD video from the P2 cards the laptop's hard drive at over 2X speed as soon as each card's capacity

Joey Altman (left) is the host of KRON-TV's "Bay Café," one of the San Francisco station's HD projects that relies on five dedicated Grass Valley EDIUS systems.



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Putting Sound in the Picture

To take its monthly magazine show from HD to SD, WEDU-TV upgraded its Harris VelocityQ NLE to the VelocityHD system.

is filled. With two cards in each AG-HVX200, the off-loaded card then rotates back into the camera, and the editor can begin logging and cutting the footage on the laptop.

Back in the studio, editors finish "Bay Area Living" in high definition and output it to the station's on-air server. The station currently uses EDIUS Pro version 3.6, but Swanson plans to upgrade to the latest version 4.0 software soon. Using all off-the-shelf equipment, this NLE software lets KRON finish a growing number of HD programs at a cost level that would have been impossible just a few years ago.

WEDU-TV

In Tampa, FL, at PBS station WEDU-TV, Dax Bedell has been editing the monthly magazine show "A Gulf Coast Journal with Jack Perkins" for two years in standard definition. But this season the show switched to high definition. The show is shot in the Sony HDCAM format. Bedell now uses a Harris VelocityHD system, an upgrade from WEDU's previous SD VelocityQ NLE, to post the show for broadcast on the station's HD channel. The system is capable of handling two streams of 10-bit high-definition video in real time, and Bedell has the ability to post an entire show in HD without any rendering delays.

With its Altitude hardware, the system has a three-wheel key-frameable color corrector (primary and secondary) and, thanks to an intuitive software interface, presents thumbnail "EyeCons" representing all visible layers in an edited sequence based on the current play head position. This gives Bedell a constant visual reference along with associated SMPTE time code for all elements in the timeline, making the alignment of specific frames across multiple layers especially easy. In addition, audio EyeCons display a close-up view of the audio waveform at the play head's current frame.

Bedell has also just started posting "Small Business Academy" — a show structured around interviews interspersed by roll-in packages — on the VelocityHD. Until the station's full high-definition control room can be finished, Bedell uses the multicam capability of the NLE to simulate a live line cut of each episode. He digitizes all the iso camera footage into the system and simply switches back and forth between cameras. The show can then be mastered to HDCAM in real time for air.

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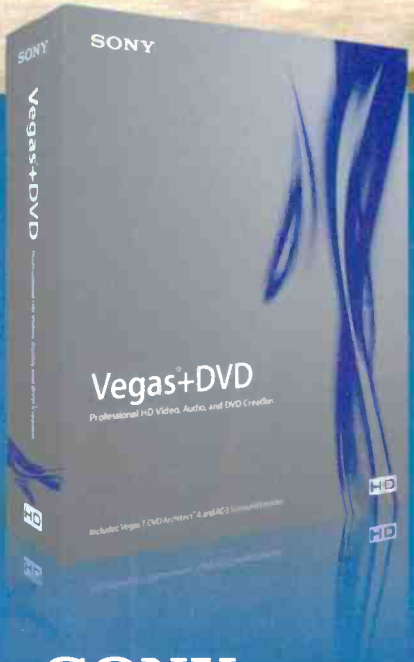

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Zoe Creative Services

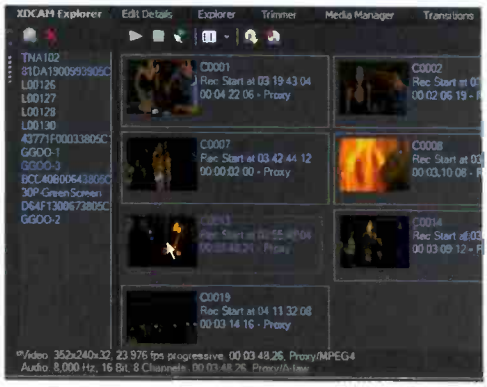
Although Sony introduced its turnkey XPRI high-definition editing system in 2001, it's the software-based Vegas NLE system that Sony purchased from Sonic Foundry in 2004 that has created a buzz for HD finishing. Having started as an audio-only tool, the recently released version 7 can print multichannel 60i, 50i and 24p masters to HDCAM tape over HD-SDI using the supported AJA or Black Magic Design cards. In addition, it allows users to create high-definition Windows Media files for computer playback and MPEG-2 compliant files for the Sony Blu-print authoring system for Blu-ray discs.

Tim Duncan, senior editor at Zoe Creative Services in Nashville, TN, uses the XDCAM Explorer function built into Vegas to import all the proxies from a complete 23GB XDCAM disc for what used to be called offline editing and then re-conform an entire project from the full-resolution XDCAM source material. When finished, he simply writes the project back to the XDCAM disk to create an HD master.

Vegas even has a "Takes" function that adds all associated alternate takes to each clip on the timeline so if substitutions need to be accessed during mastering, every available option can be displayed with a single click. To see if it could be done, Duncan pushed the system to display 1000 takes with the help of some third-party plug-ins but he usually limits it to a couple of dozen layers to prevent confusing his clients.

Duncan recently mastered an HD music video by country star Marty Raybon. The video was shot in XDCAM and edited completely in Vegas. Duncan shot the video in multiple takes and was able to set up a 25 angle multicam configuration in a 5 x 5 split screen with an on-screen tally light identifying the selected window.

When done, he output a standard-definition version for DVD and VH1 cablecasting and also an HD master on XDCAM disc for the MHD, a new high-definition music channel from MTV Networks. About the only feature Duncan values as much as Vegas 7's high-definition video format flexibility, including native HDV rendering to disc, is its ability to import and export 5.1 ATRAC audio files as well as up to 32 WAV channels as a single file. That's enough to keep this Nashville editor singing. BE



The XDCAM Explorer window in Sony Vegas allows Zoe Creative Services to quickly choose files to import.

L.T. Martin is a freelance writer and post-production consultant.

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MPEG-2 to H.264 TRANSCODING:

BY SANTHANA KRISHNAMACHARI AND KYEONG HO YANG

The MPEG-2 compression standard has been widely deployed in video distribution infrastructures, such as cable and satellite networks, as well as in several consumer applications, such as DVDs and DVRs. For more than 10 years, end-to-end systems have existed, with several million interoperable encoders, multiplexers and set-top boxes deployed. The need to transcode to and from the MPEG-2 format has arisen.

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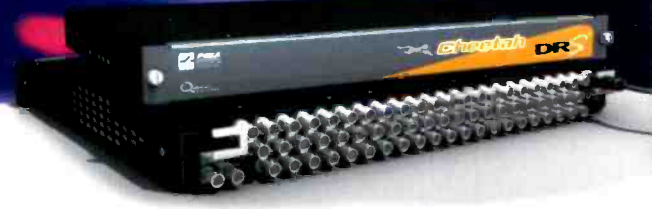

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Cheetah DRS allows broadcasters to place input frames in equipment racks near satellite ingest from receivers, VTRs, or servers, while placing output frames closer to studio gear for distribution into audio consoles, or master control. This keeps cable runs extremely short, preserves signal quality and reduces cable costs, time of installation and maintenance. Additional inputs or outputs can be added by changing cards or increasing frames in any location. Format flexibility in the Cheetah DRS allows a mix of AES and Analog, Synchronous and Asynchronous audio, with support for Dolby-E.

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The need for transcoding

The following three scenarios describe the need for transcoding.

First, improvements in compression techniques have resulted in mature new standards that offer significant bit rate gains of 30 percent to 50 percent over MPEG-2. Investments made in legacy devices that can only handle the MPEG-2 format and the existence of large amounts of content that was created using MPEG-2 necessitate that multiple standards will coexist for several years before the eventual conversion to a single standard.

Second, emerging IPTV deployments of video over bandwidth constrained last mile will result in part of the content distribution chain migrating to H.264, thereby creating a need for efficient transcoders. (See Figure 1.)

Third, new applications, such as high-definition video and real-time broadcast video over handheld mobile devices, require that the same content be made available in several spatial resolutions and frame rate formats. This can be achieved by recreating the same content in several formats. Alternatively, it will be more efficient to create the content once and transcode it to different formats and resolutions as needed. (See Figure 2.)

Finally, improvements in programmable processor technologies, such as the DSPs and FPGAs, have made it possible for video processing vendors to field products that can handle multiple existing formats and field-upgrade the products for future emerging standards.

Types of transcoding

Several forms of transcoding are possible, depending on the specific parameters of the compressed bit stream that are modified during the transcoding process. They include:

- *Bit rate transcoding.* This process changes the bit rate of the compressed bit stream while keeping the resolution, frame rate and the encoding format the same. MPEG-2 bit rate transcoders, also called rateshapers, have been widely deployed today, and they employ efficient, high-density rateshaping by primarily operating in the discrete cosine transform (DCT) domain.
- *Format transcoding.* This entails converting the compression format — for example, converting an MPEG-2 bit stream to an H.264 bit stream.
- *Resolution transcoding.* This involves the conversion of coded spatial resolution — for example, converting a standard-resolution bit stream to common intermediate format (CIF) resolution for a mobile application.

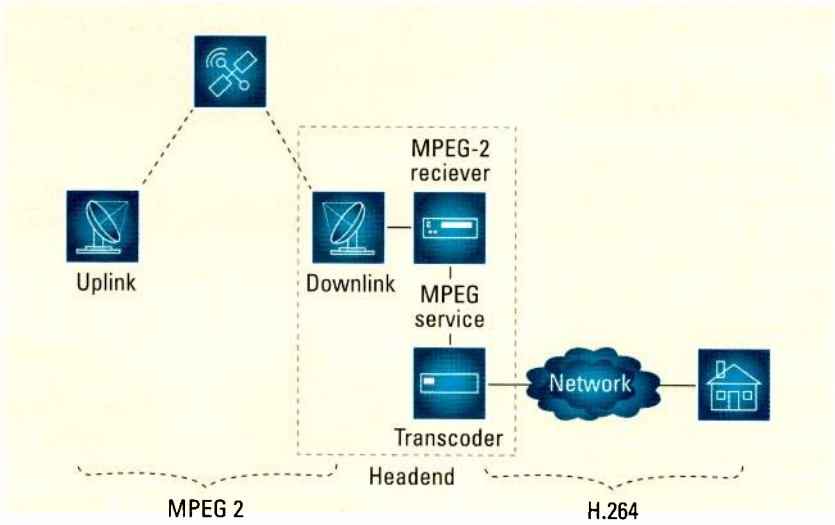

Figure 1. Format transcoding for IPTV architectures

Transcoding challenges

This article primarily focuses on the issues and challenges associated with format transcoding from MPEG-2 to H.264. Although MPEG-2 and H.264 use similar techniques of motion compensation, transformation, quantization and entropy coding, there are several basic differences between the two standards that make the transcoding operation challenging.

Several new features available in H.264, such as multiple reference frames, smaller block shapes and spatial intra prediction, have no corresponding information in the MPEG-2 bit stream. The use of spatial prediction in I-slices in H.264 makes the transcoding of the MPEG-2 I-frame substantially more complex than the simple re-quantization techniques that have been used by the MPEG-2 rate transcoders. The approach to transcoding MPEG-2 to H.264 is expected to progressively follow three approaches, which are presented below.

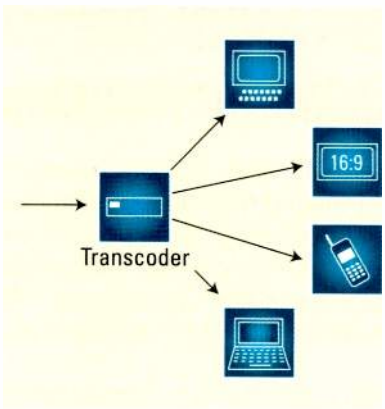

Figure 2. Resolution transcoding to support multiple display devices

Decode and re-encode

The simplest approach to transcoding is to completely decode the MPEG-2 bit stream and then re-encode it with an H.264 encoder. The decode operation can be performed either externally or as a part of the H.264 encoder. System issues, such as handling SCTE-35 digital program insertion (DPI) messages, will require that the decode and encode operations be tightly coupled.

The quality of transcoding with this simple approach will not be high. Figure 3 shows a comparison between direct encoding and transcoding. The figure shows the PSNR (a measure of mean square error between the input and decoded output) values computed at different bit rates. The PSNR numbers are obtained by averaging the results over 18 different sequences of varying content type and complexities. The top plot shows the performance of direct encoding using an H.264 encoder. The bottom plot shows the performance of transcoding where the video is originally coded with MPEG-2 at 4Mb/s, decoded and then re-encoded with the same encoder used for direct encoding. Transcoding can result in up to 20 percent loss in compression efficiency.

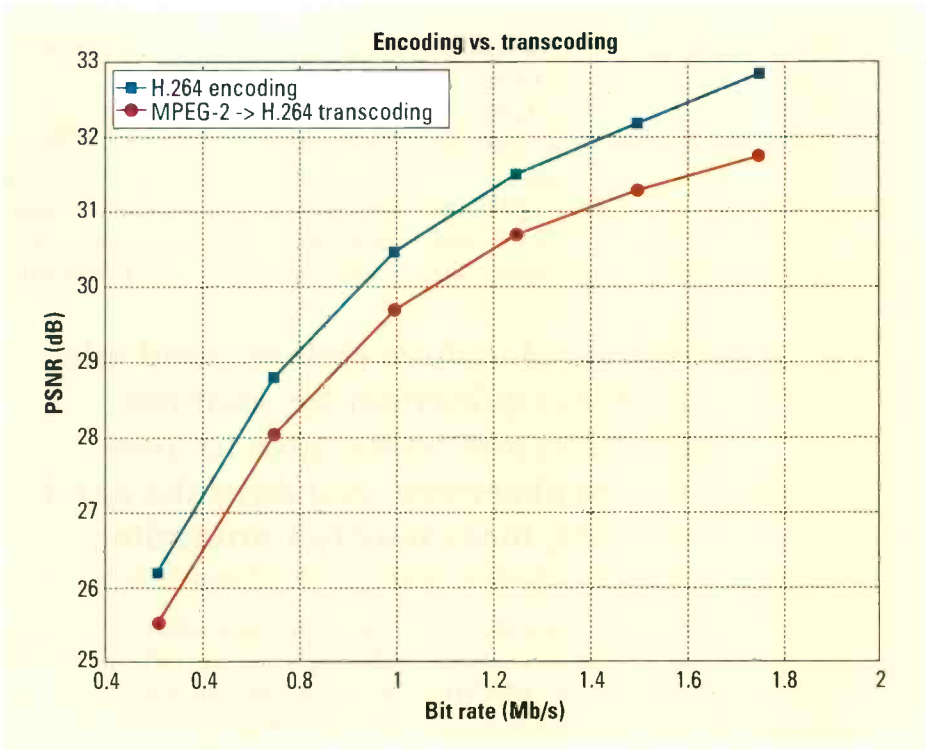

Figure 3. Performance comparison between direct encoding and transcoding

Decode and information reuse

Similar to the previous approach,

the incoming MPEG-2 stream is decoded and then re-encoded using an H.264 encoder. However, here the relevant information available from the MPEG-2 bit stream is reused.

Although there are significant differences between MPEG-2 and H.264, including block shapes for motion compensation, block sizes for transformation and motion search ranges, there is still useful information available in the input MPEG-2 bit stream that can be exploited by the H.264 encoder to improve transcoding quality and reduce computational complexity.

Reusing the picture type (I, P or B) information from the MPEG-2 bit stream can provide substantial improvement in transcoding quality. Because MPEG-2 encoders code I- and P-pictures at a higher quality than B-pictures, better transcoding efficiency can be achieved if the H.264 encoder can align the picture type with that of the input stream.

Other information such as motion vector values and coding mode decisions can be reused to reduce complexity of transcoding. The H.264 encoder can use the quantizer values and the number of bits used to encode a given picture obtained from the input MPEG-2 stream for bit allocation and rate control decisions. Reuse of information as described here can be similar to two-pass encoding, where the results of the first pass of encoding are used to drive the decisions in the second pass.

Coexistence of various coding standards, and the requirement for multiple resolutions and frame rates for new emerging applications, will drive the need for efficient, high-density transcoding.

Transform domain processing

Transform domain processing is commonly used in the MPEG-2 bit rate transcoding applications mainly to reduce computational complexity and to avoid the loss of accuracy due to repeated DCT and inverse DCT operation.

With the use of integer transforms in H.264, there is no penalty because of repeated forward and inverse transformation operations. Performing complete transcoding in the transform domain may be unrealistic because of the substantial differences between MPEG-2 and H.264. However, computational complexity reduction can be achieved in certain operations, such as the I-slice transcoding in the transform domain by combining the inverse DCT operation in MPEG-2 with the forward integer transform of H.264.

Conclusion

Coexistence of various coding standards, and the requirement for multiple resolutions and frame rates for new emerging applications, will drive the need for efficient, high-density transcoding. Transcoders are expected to progress from simple decode/re-encode devices to more complex integrated systems that reuse information in the input bit stream and achieve higher density by employing selective transform domain processing techniques. BE

Santhana Krishnamachari is vice president of advanced engineering and Kyeong Ho Yang is technical manager of video algorithms group for EGT.

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A letter from the publishers

Consumers are flocking to HD. Nearly 20 million HD television sets were sold this year. The CEA says that this year, HDTV will have outsold analog sets by more than 89 percent.

In addition, nearly 47 percent of all TV households (TVHH) in the United States plan to buy an HDTV in the next 12 months. The overall market value for HD sets will reach $65 million by 2009. Kagan Research says that of all digital TV sets sold this year, 85 percent will be HD.

Cable HD subscriptions will soon reach 6.6 million. By the time analog goes dark in 2009, the number of cable HD subscriptions is predicted to exceed 30 million.

Satellite HD consumption is also growing. Last year, there were 1.8 million HD satellite subscribers. With the increased HD programming being provided by broadcasters and satellite vendors such as DirecTV, the number of satellite HD subscribers will reach 19 million by 2010.

Broadcasters' content is what's driving this rapid HD growth. With more than 1500 stations broadcasting digitally, consumers can now "see" the HD difference.

With all this positive news on HD, ask yourself: What is your station doing to drive the wave of HD? Have you implemented an HD workflow? Are you planning now for local HD newscasts, HD local commercials and even HD weather?

The solutions you'll need are being shown now at this year's High Definition Summit.

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HD Production 3

HD News 10

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HD production has exploded on the production scene with full-on capabilities for motion picture, sports and independent video applications.

HD: Changing the production scene

Movie producer, director and HD pioneer Randall Dark says it's arrived. Sports teleproduction service providers concur. Even those who shoot and edit music videos and TV shows agree. HD production has hit its prime.

In the past, producers had to make compromises because the high-definition equipment they needed wasn't available. But today, with high-definition cameras small enough to mount behind a transparent backboard, matte boxes designed to mount on the front of an HDV camcorder and prime lenses for the highest cinema-quality HD cameras, the stage is set for uncompromised HD production — regardless of the application.

"Three years ago, I would have said there were still missing pieces," said Dark, president and cofounder of HD Vision Studios in Los Angeles. "But we've got so many companies that have come to the table. It's not just Sony; it's Panavision, Panasonic, Arri and (Grass Valley's) Viper. You've got an incredible variety of state-of-the-art cameras from cutting-edge companies. I don't think anybody now can look at the technology and say it's not prime time, and it's not affordable."

Impact on movies

While movies with broad distribution and large budgets, such as producer George Lucas' "Revenge of the Sith," garner much of the attention given to high-definition and electronic cinematography, it's at the other end of the spectrum that HD's greatest impact on moviemaking may be felt.

"High definition is one of the most important technologies to

"I don't think anybody now can look at the technology and say ... it's not affordable."

— Randall Dark, HD Vision Studios

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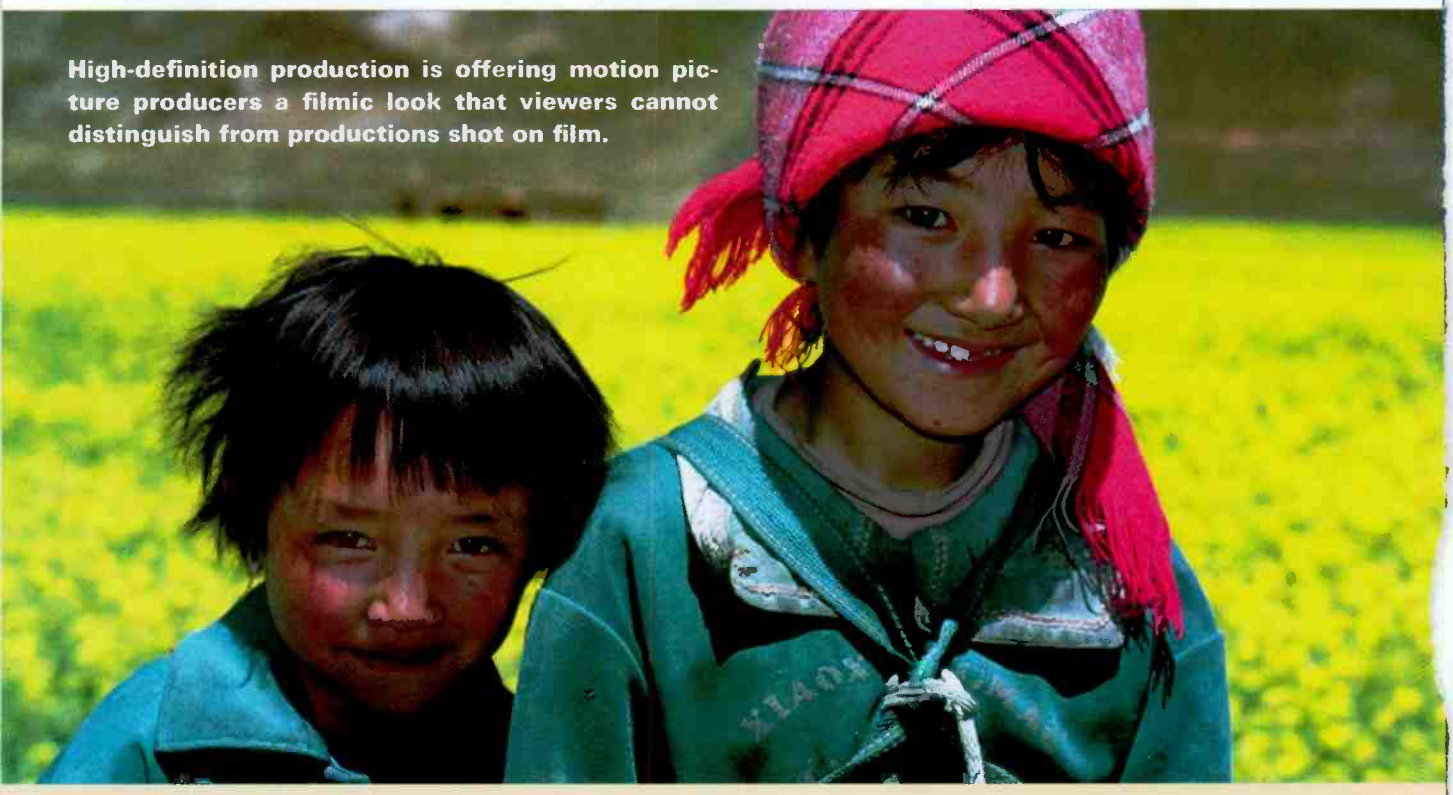


High-definition production is offering motion picture producers a filmic look that viewers cannot distinguish from productions shot on film.

come along because it helps level the playing field," Dark said. "Because of the cost structure of high definition, you're going to see many new voices being able to express themselves because they can get into the game at a much lower price point. I think that's going to change and improve the quality of storytelling."

Freed from the heavy financial burden that shooting in film places on a movie's production budget, producers with low budgets can now turn to HD as an affordable alternative.

"Numbers don't lie," Dark said. "I shot 57 hours of HD footage in 14 days for my independent movie 'Closing Escrow'. When you compare the HD tape I used to the cost of the raw film stock, developing, processing and transferring, the numbers are staggering."

For a movie with a $100 million budget, film charges may only account for 5 percent of the total budget. But for features that cost less than $1 million to make, the cost of film can amount to 30 percent of the overall budget, he said.

"I'm not saying that high definition is perfect for every type of feature film, but we had to pull the trigger because we were doing a lot of improv comedy," Dark said. "I firmly believe film is an art form, and high definition is an art form, and to compare the two at a subjective, creative level does each art form an injustice.

"It is apples to oranges. When you talk about an artist painting with a paintbrush, he decides whether he wants oil, acrylic or charcoal. That being said, I find as an artist I use high definition because I'm also a businessman, and I know that by using high definition, I can get a much better, cost-effective finished product, and the consumer cannot tell what paintbrush I used."

Sports production

For the most part, all of the technology needed to teleproduce a sporting event in high definition is available.

"We've had a complete front-to-back high-definition solution for sports for about the past 18 months," said Jeffrey Joslin, chief

"We've had a complete front-to-back high-definition solution for about the past 18 months."

— Jeffrey Joslin, NEP Supershooters

engineer for NEP Supershooters.

NEP Supershooters is a mobile facilities company that supplies broadcast and cable networks with some of the largest, most advanced teleproduction trucks in the industry. For example, ESPN contracts with the company for all of the production capabilities needed to present "Monday Night Football" in HD and SD.

Over the past couple of years, HD production and sports have become nearly synonymous at most high-profile sporting events. Televised sports, which typically attract a large number of viewers, have helped popularize high definition. Sports shot in high definition provide viewers with sharp images, a wide aspect ratio and 5.1 surround sound, all which make them feel like they're at the game.

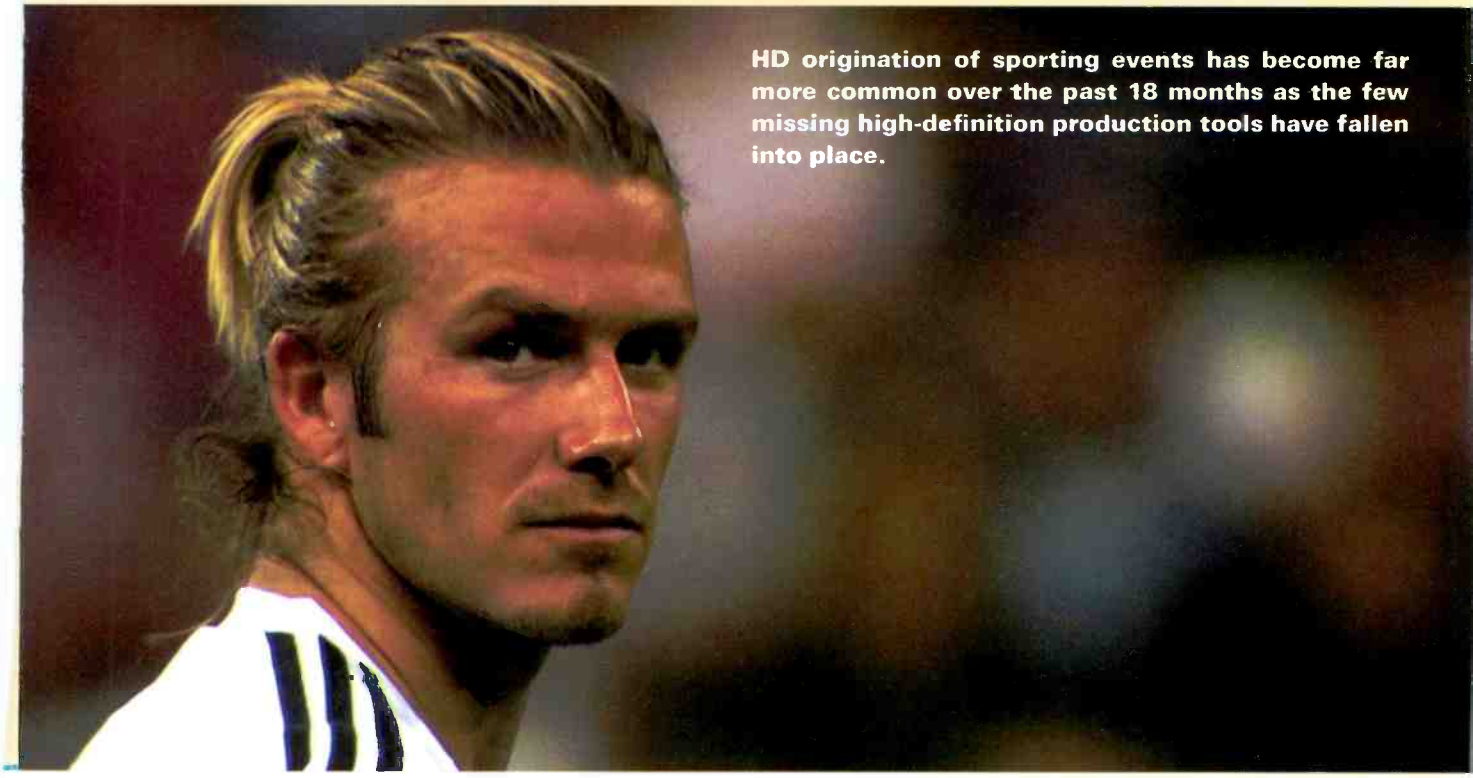
But along with the great production values of high-definition sports come a unique set of challenges. For example, while all of the pieces are in place to produce sports in high definition, it's important for the industry to address latency in wireless HD cameras, Joslin said. HD RF camera latency is generally the result of delays from compressing and encoding video before transmission. It can be as much eight frames or more, he said.

Such delays can limit directors' creative choices — particularly when covering a sport such as golf, where long fiber-optic or Triax cable runs connecting camera positions at distant holes with the teleproduction truck are frequently impractical.

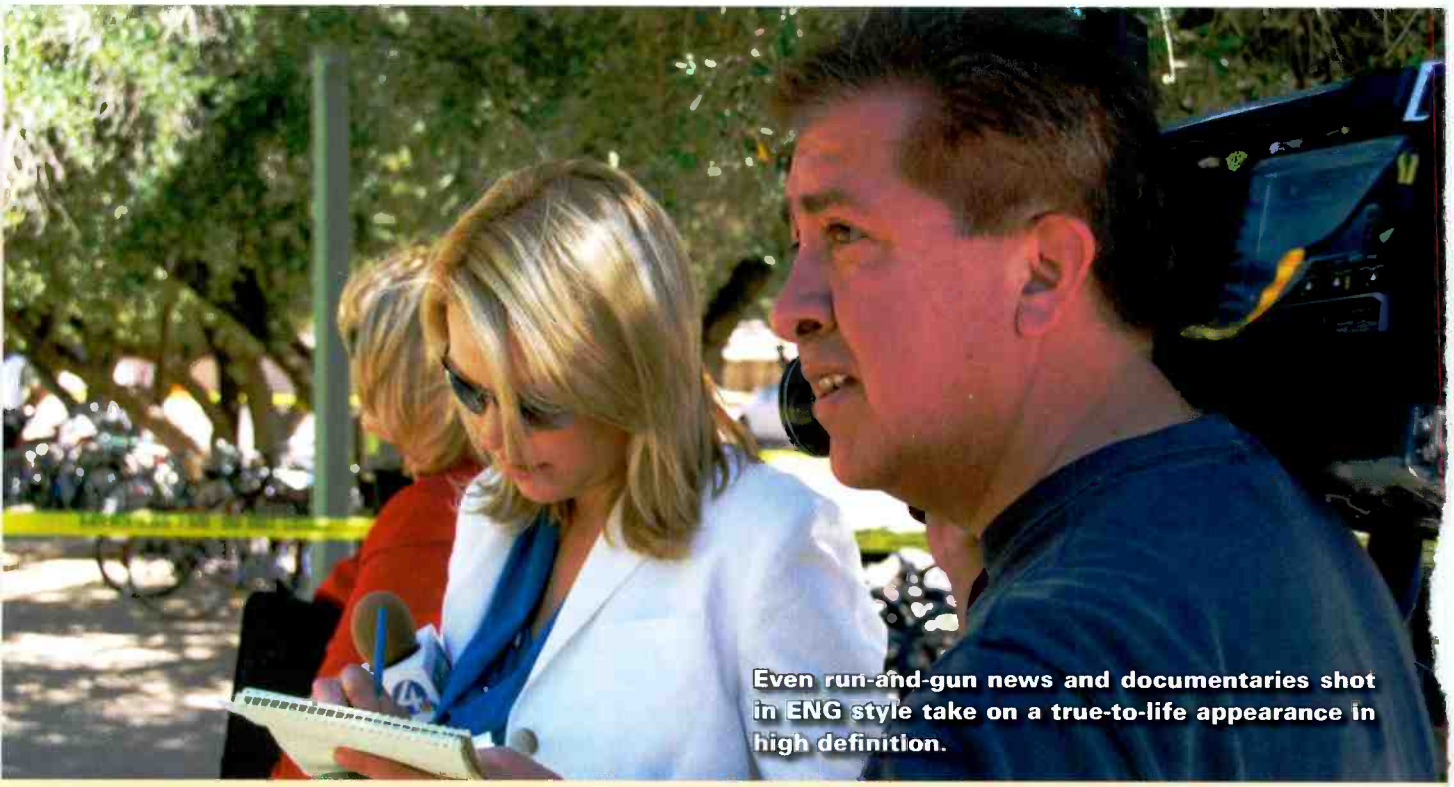
According to Joslin, other challenges are coming into focus as HD sports production becomes more pervasive. Among the most notable are the best ways to mic and mix 5.1 surround sound for various sports; the recent availability of no-feature-compromise HD graphics and how to integrate them into the SD feed most viewers see; and building a comfort level among camera operators and the production crew with using 16:9 viewfinders and monitors.

Other productions

High definition may be reworking the math of motion picture



HD origination of sporting events has become far more common over the past 18 months as the few missing high-definition production tools have fallen into place.



Even run-and-gun news and documentaries shot in ENG style take on a true-to-life appearance in high definition.

"[HDV] gives us an edge over just shooting in NTSC."

— Rick Shaw, Pinlight

production, but it's HDV that's transforming the economics for thousands of independent producers and video professionals.

Typically based on 1/3in imagers, these camcorders support a wide variety of frame rates (23.876fps, 29.97fps or 59.94fps), scanning types (interlaced and progressive) and resolutions (1080 and 720 lines). Many even offer HD-SDI output to allow recording to devices other than HDV format VTRs.

Competitively priced, HDV camcorders make it more practical for producers on tight budgets to achieve a filmic look.

One such producer is Rick Shaw, president of Pinlight in Hollywood, CA. Since acquiring the Canon XL H1 HD, Shaw's production company has shot several projects in the HDV format, including a music video for singer Rickie Lee Jones.

His most recent work with the camcorder is a development project about Bigg Slice, a custom car builder who regularly creates specialty vehicles for rapper Snoop Dogg and the L.A. Lakers. Shaw said using the HDV camcorder on this project offers a competitive advantage.

"It gives us an edge over just shooting in NTSC," he said. "For a long time, I shot on the Sony DSR-130 DVCAM in NTSC. It has a great picture, but the Canon XL H1 HD gives us the ability to go either way. We can go HD or NTSC."

Shaw said using the HDV camcorder delivers the performance necessary to please clients and attract new business.

It's often said that HD is the biggest technological change in television since the introduction of color. The same could be said of its impact on production — not just in how television and movies are being made, but also what can be made and how it will look.

"We were shocked last night when we were looking at some of the older NTSC footage we had shot and comparing it with HDV footage we just shot," Shaw said. "It looked so old next to the HDV images. The NTSC pictures were one-quarter the resolution of HDV. It was an eye opener, and I never want to go back go NTSC." END

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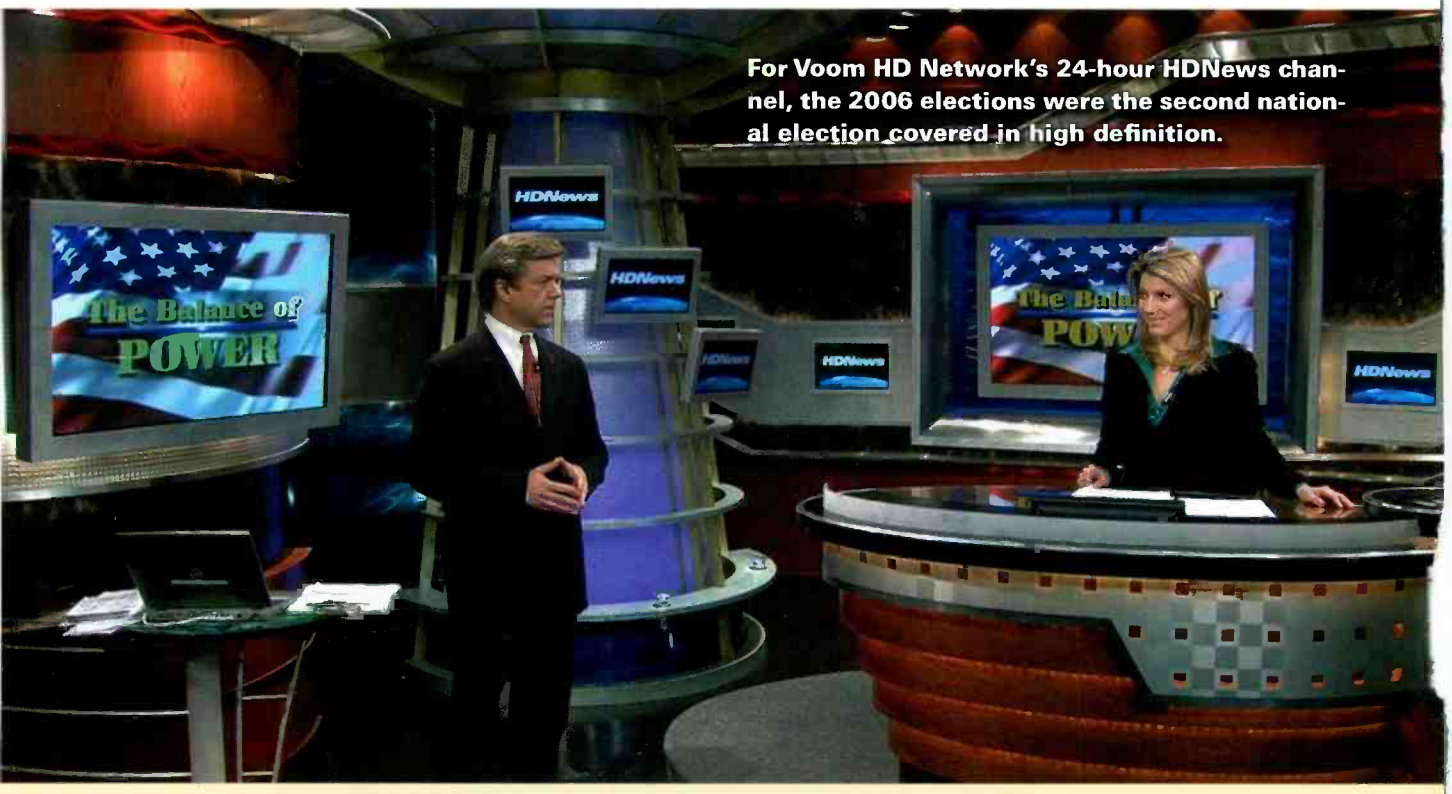

For Voom HD Network's 24-hour HDNews channel, the 2006 elections were the second national election covered in high definition.

"There's a hunger and a need out there for this high-definition content."

— Milan Krainchich, HDNews

Going HD with local newscasts

Slowly momentum is building for HD news on the local level. Every few weeks, another local station goes on-air with a high-definition newscast. Major station groups such as Gannett and Cox Television, as well as some network-owned stations, have led the most recent push.

While the specific reasons for launching HD news vary, it's easy to see why many stations believe now is the time.

For example, Leichtman Research Group has reported that one in six U.S. households has at least one HDTV compared with two years ago, when this figure was one in 14.

Kagan Research has predicted that by 2010, 180 million HDTV sets will have been sold to U.S. consumers, accounting for 81 percent of all TV households.

Given new HDTV viewers' proclivity to switch the channel to HD programming rather than watch old SD favorites, it's understandable why launching HD news locally is becoming a priority.

"There's a hunger and a need out there for this high-definition content," said Milan Krainchich, director of operations for HDNews.

HDNews, distributed as part of the VoomHD high-definition programming lineup, has delivered high-definition news 24 hours a day since its launch in 2003. In Krainchich's view, a "critical mass is forming" for HD among viewers.

"I believe that critical mass is essentially there or is about to be there now," he said, "and it's strong enough for stations to start making this transition."

The good news for stations switching to local HD news today

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Reporters can use the Avid NewsCutter Adrenaline to edit news in high definition.

"The premium for HD capability has really come down to ... only a 5-, 10- or 15-percent premium."

— Bill Thompson, Anystream

is that the premium vendors have charged for HD acquisition, production and playout equipment is giving way to more mainstream pricing, said Bill Thompson, director of broadband products for Anystream.

"In the early '90s, [if] you decided you wanted to implement any kind of HD workflow, on a piece-by-piece basis, each functional block that you were going to buy for your production chain and your air chain would cost X if it were SD, and if it were HD, it would cost 2X," Thompson said. "So, we see across nearly every product category that the premium for HD capability has really come down to the point where maybe it's only a 5-, 10- or 15-percent premium."

For stations due to replace aging equipment in the news department, that's not too heavy a burden to bear.

"Some stations have to replace equipment anyway," said Andrew Warman, Harris product marketing manager, servers. "They look at HD and realize that if it's done in a particular way, there's really not going to be that big of difference between delivering HD and SD news versus SD anyway."

Added Bryan McGuirk, president of Enterprise Services for SES AMERICOM, "It is driven by capital expenditure cycles. News organizations reinvest in equipment from time to time. If that time comes up right now, you'd be crazy not to put HD gear out there."

Even for stations not yet ready to replace their entire news infrastructure, there are affordable strategies.

"Frankly, we've seen a lot of stations do it in a cost-effective way by switching to 16:9 in SD and upresing their content successfully so that they have the benefits of that footprint on the HD side," said David Schleifer, Avid Technology vice president of broadcast and workgroups. "There are a lot of ways to skin this cat, and stations are taking different approaches."

Serving two audiences

Despite the rosy picture for HD households, there will remain millions of television viewers whose only way to watch is via free, over-

the-air television.

The Government Accountability Office is one of several entities supplying information to guide the National Telecommunications and Information Administration as it works out the specifics of its digital-to-analog converter box reimbursement coupon program. It has estimated that there are 45 million broadcast-only sets in homes relying exclusively on over-the-air television and another 28 million such sets in homes with satellite or cable.

Clearly, that means local stations will have to deliver SD and HD news to serve both audiences for the foreseeable future.

In general, stations could approach the challenge in one of three ways: produce in SD and upconvert for their HD audience; produce in HD and downconvert for their SD audience; or create separate workflows for both, which is the most expensive approach and, therefore, the least likely to happen.

To HDNews' Krainchich, the choice is clear.

"Do everything in HD," he said, "and then try to introduce the standard definition at the very end as a downconvert in your master control."

Not only will this approach maximize quality for both the HD and the SD audience, but it will also maintain efficiency in news production.

"Put as much as possible into one consistent HD workflow," he said. "It is when you are mixing and matching that you run into the most problems and complications — whether they're operator problems, production problems or maintenance problems."

Regardless of the approach, conversion will be necessary, and that has a little known consequence: a slowdown.

Avid's Schleifer said, "The process does introduce added time into the workflow because you are asking the system to change the media. Quite frankly, a lot of other solutions don't highlight this, leaving customers to realize later on that there will be some big transcoding and conversion steps to tackle."

Transcoding aside, stations that

"There are a lot of ways to skin this cat, and stations are taking different approaches."

— David Schleifer, Avid Technology

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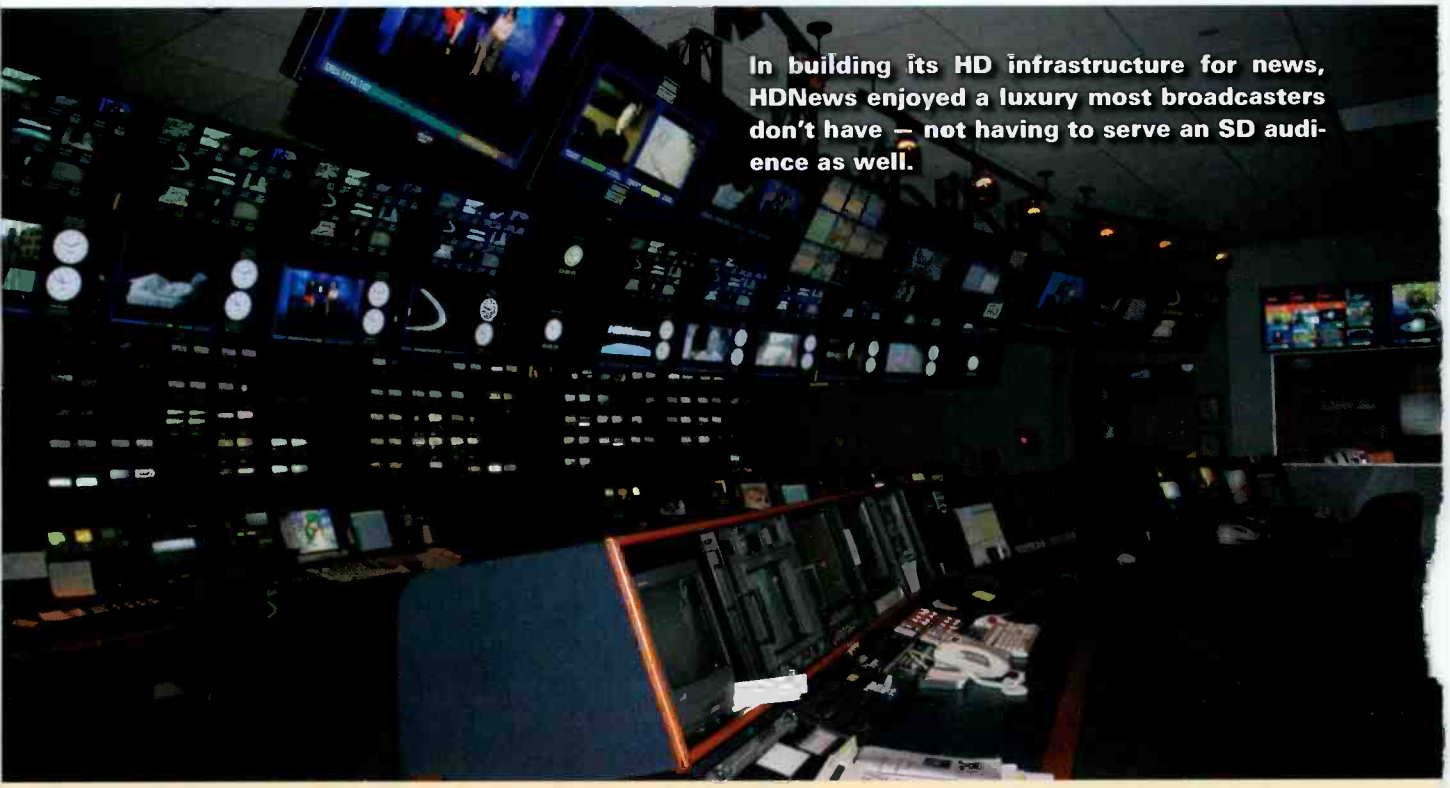


In building its HD infrastructure for news, HDNews enjoyed a luxury most broadcasters don't have — not having to serve an SD audience as well.

"... it is pretty slim pickings for ENG cameras that do HD and SD."

— Andy Warman, Harris

are looking to launch HD news must determine whether or not their existing infrastructure will support high-definition news production.

"Stations that use SD file-based newsroom systems are probably in reasonable shape depending on the system," Warman said. "Certainly, if they have GigE infrastructure, then they are going to be in good shape."

He continued, "A lot of HD machines are in the bit rate range of SD anyway. So, IMX HD falls right into the HDV/IMX SD range in terms of its bit rate. From that point of view, if people are already on the bandwagon of using IMX or HDV or DV25 as file-based, everything is in the same ballpark on the file-based side of things anyway if they choose IMX or similar technologies."

However, HDNews' Krainchich cautioned that stations should fully assess their existing infrastructure for HD before committing to using it.

"You need to build an up-to-date and robust infrastructure operation from the start so that you can continue to grow it and not build an HD operation that can't be expanded," he said. "My perspective is to build the right infrastructure at the outset so you have head room."

HD acquisition

News starts in the field, and that's exactly where stations should begin their HD news transition, Krainchich said.

"My approach, having thought through it in various scenarios, is to start in the field with newsgathering," he said. "Buy HD cameras. Buy HD editing. This will also enable a station to begin to build an HD video archive."

Warman said, "On the camera side of things, it is pretty slim pickings for ENG cameras that do HD and SD, but they are there, and they work very well. You can pick up a $4000 or $5000 camera that does SD and HD, depending on what you need at the time, and in a lot of cases, it's probably OK for news."

Added Krainchich, "Given its extreme low cost, HDV definitely has a place. However, for the larger markets, it is not the format of

choice for newsgathering."

In his view, HDNews, and other larger market stations launching HD news operations will seek out ENG formats with larger imaging chips.

"We still want 2/3in broadcast-quality cameras going out with the crews so they can get the best performance and results," he said. "But if you get HDV video, you're not going to turn it down."

With several competing formats available for acquisition — each of which comes from manufacturers with superb reputations — how should a station choose?

"The key is for the station to analyze its workflow, analyze and understand how it wants to edit and with what equipment it wants to edit, including in the field in ENG and SNG trucks, in a bureau, or on the road," Krainchich said.

"I think all those factors should be weighed when deciding on what camera format a station adopts because it's not just about the camera technology; this decision ripples throughout the operation," he said.

Does HD news matter?

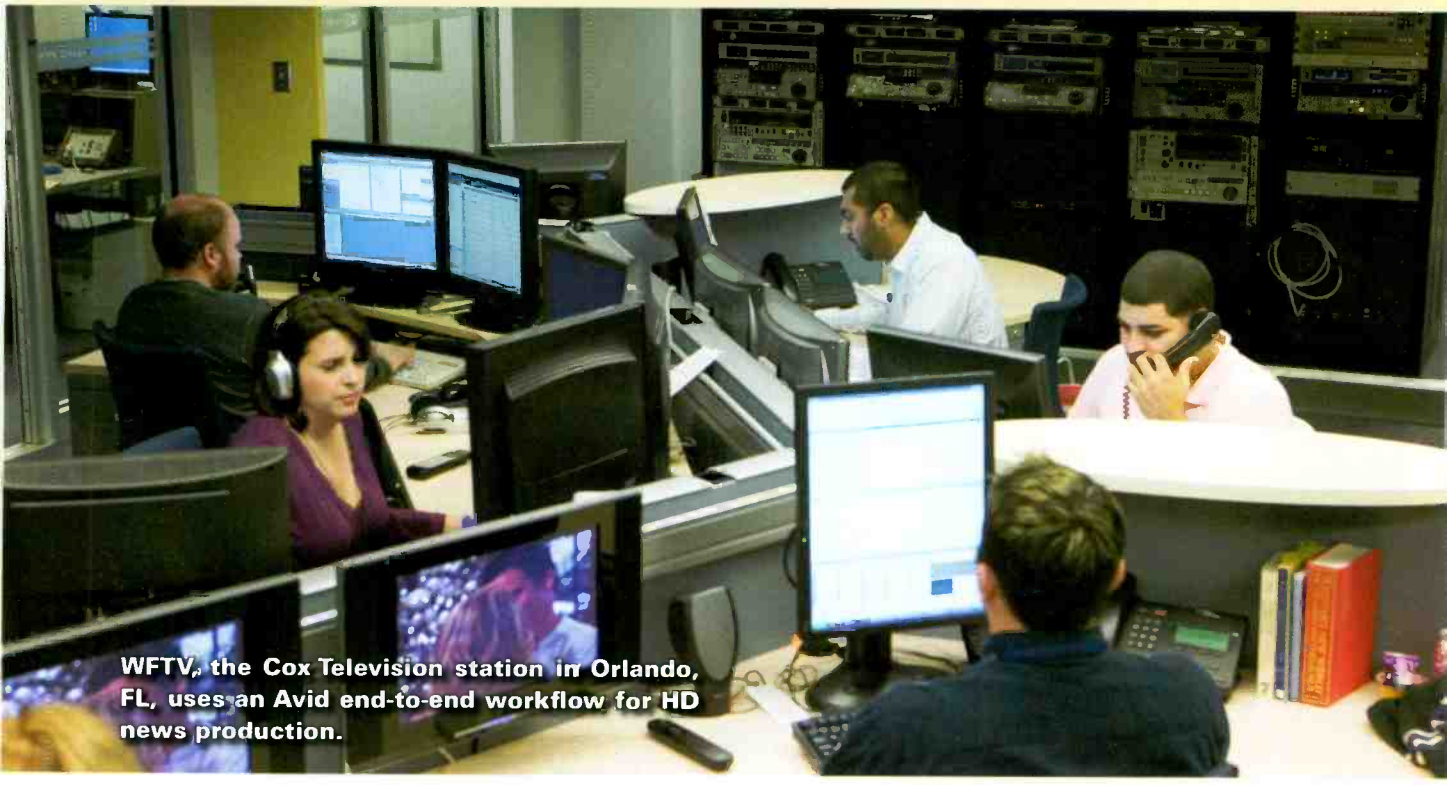
At a recent industry gathering, there was a noticable urgent tone as news technologists and executives discussed the presence of new competitors vying for news viewers and how television stations should compete. In talking out how stations could contend with these new competitors, little emphasis was given to high definition. That begs the question: Does HD news matter in light of new competitors?

"The viewer values high-quality production, quality journalism and a quality presentation with high journalistic standards, including all of the production elements that the best of news broadcasting has to offer," Krainchich said.

"In turn, that quality news production is not going to be hurt by these competing outlets, at least not in the near future. But, stations are going to have to work hard to stay in the game, even reinvent themselves to some degree. Going to HD is one of the steps stations can use to draw in and retain viewers." END

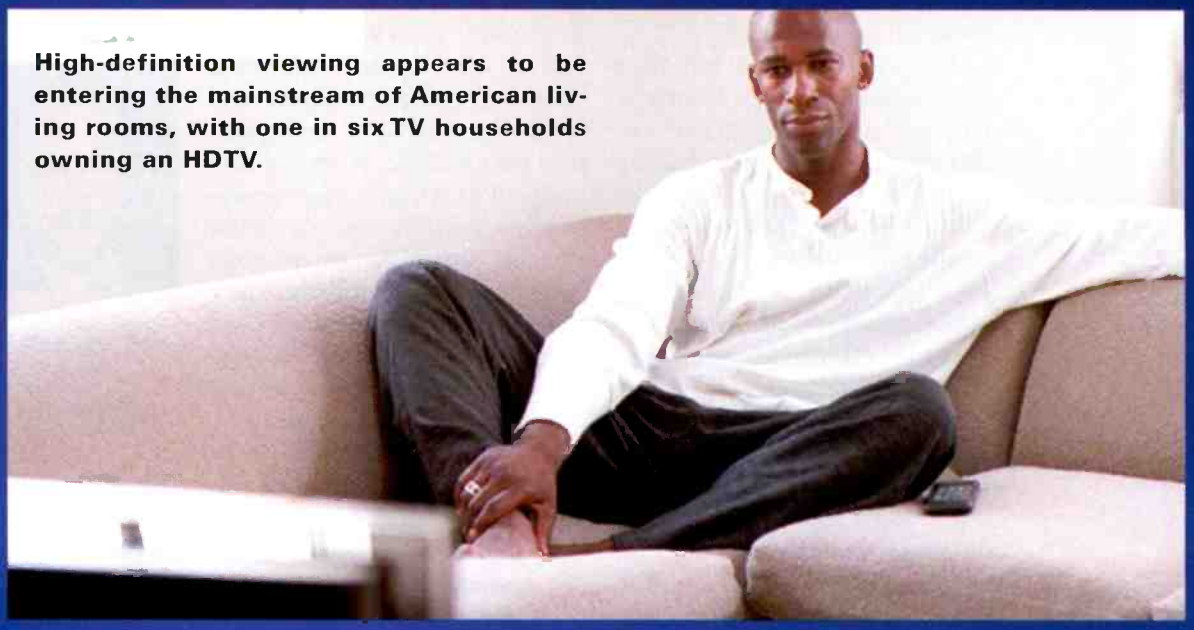
"Going to HD is one of the steps stations can use to draw in and retain viewers."

— Milan Krainchich, HDNews



WFTV, the Cox Television station in Orlando, FL, uses an Avid end-to-end workflow for HD news production.

HD SIDEBAR:



High-definition viewing appears to be entering the mainstream of American living rooms, with one in six TV households owning an HDTV.

Stats point to HD strength

The transition to HDTV among U.S. viewers is in full swing, and along with consumer adoption of high-definition television comes a dizzying array of research and forecasts.

While it's difficult to know with certainty exactly what consumers intend to do, it appears clear from the research that HDTV is in its ascendancy in the United States. According to research from the Leichtman Research Group (LRG), one in six U.S. households now has at least one HDTV compared with one out of every 14 two years ago.

Consumer attraction to flat panel plasma and LCD displays is contributing to the switch to HDTV. A recent report from tech researcher iSuppli says the market for LCD TVs will grow worldwide by 27.5 percent a year until 2010, when it will be worth $84 billion.

The latest statistics from DisplaySearch show continued growth of plasma panel sales as well. In the third quarter of 2006, plasma shipments reached 2.8 million units, 17 percent higher than the same quarter last year. If forecasts for plasma panel sales for the fourth quarter are met, 2006 plasma panel shipments will rise 49 percent year-over-year to 10.7 million units.

HDTV continues to drive plasma panel shipments, with the HD share rising from 73 percent in the second quarter to 79 percent in the third on 28 percent growth. The HD share is expected to reach 86 percent in the fourth quarter on 23 percent growth, according to DisplaySearch.

Demand for high-definition will be high this holiday shopping season, according to The NPD Group. The research group says HDTV sales have increased 52 percent in unit volume and 39 percent in dollar volume from January through September this year compared with the same period in 2005. Sales of HDTVs during November and December 2005 topped $2.2 billion, with more than 1.4 million units sold. The NPD Group expects 2006 to see continued HD holiday shopping growth.

Repeat HDTV buyers are becoming more common, too. According to LRG, 26 percent of HDTV owners now have more than one HDTV — up from 11 percent last year — and 29 percent of HDTV owners are likely to get another HDTV in the next year, compared with 18 percent last year.

While the growing adoption of HDTV is impressive, LRG also finds high definition still remains to a large extent, the province of higher income households. Recent LRG findings show only 6 percent of households with annual incomes under $30,000 have HDTVs compared with 38 percent of households where yearly income exceeds $100,000. END

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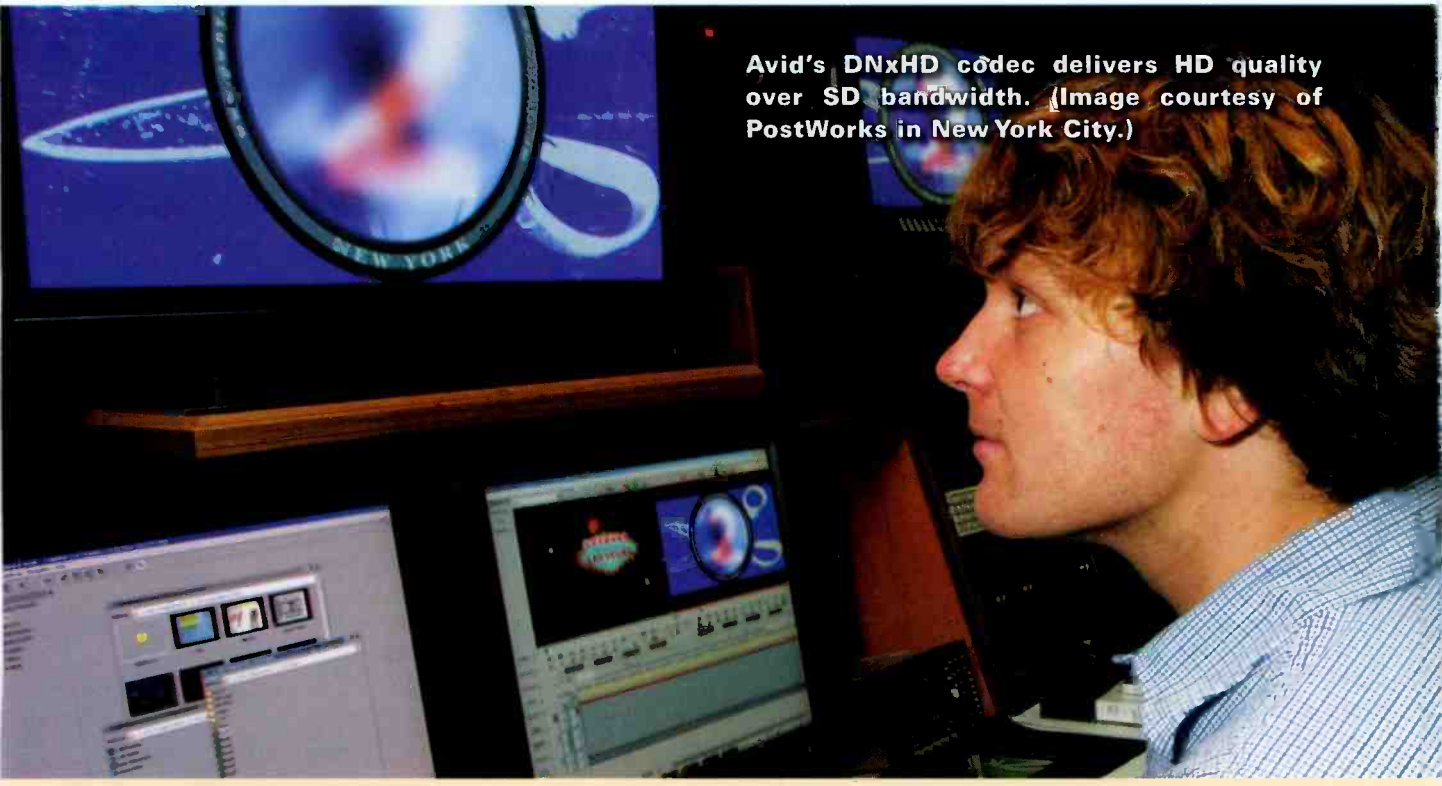

Avid's DNxHD codec delivers HD quality over SD bandwidth. (Image courtesy of PostWorks in New York City.)

HD post: Challenges and opportunities

"By doing a rough cut [in] real-time when we were shooting, ... not only did we know what we had in the can, we had it sequentially.'"

— Randall Dark, HD Vision Studios

HD post production presents new challenges and opportunities for efficiency and workflow.

How to integrate HD solutions for editing, graphics and effects into an SD facility to avoid creating "HD islands," what to do with finished material and assets long term, and how to make the most of existing infrastructure to support new HD business are the main challenges. The opportunties of working with HD include the ability to fix material before post and improved efficiencies in ways that were never possible with film.

Post begins in the field

While shooting movies and other programming in HD can produce significant savings in film-related expenses, it also can create savings and efficiencies in post by transferring functions typically done in post production to the field.

For example, Randall Dark, president and cofounder of HD Vision Studios in Los Angeles, took advantage of the immediacy of monitoring scenes shot in HD for his independent feature "Closing Escrow" to minimize post expenses.

"We were feeding an Apple G4 as we were shooting," he said. "We were doing a rough cut as we were shooting the scenes. By doing a rough cut [in] real time when we were shooting, when we wrapped that set, not only did we know what we had in the can, we had it sequentially, and we were able to fine tweak it."

The process improved Dark's efficiency during editing and provided a way to reduce the hours spent color correcting his movie.

"We were color timing in the field," he said. "Even though for

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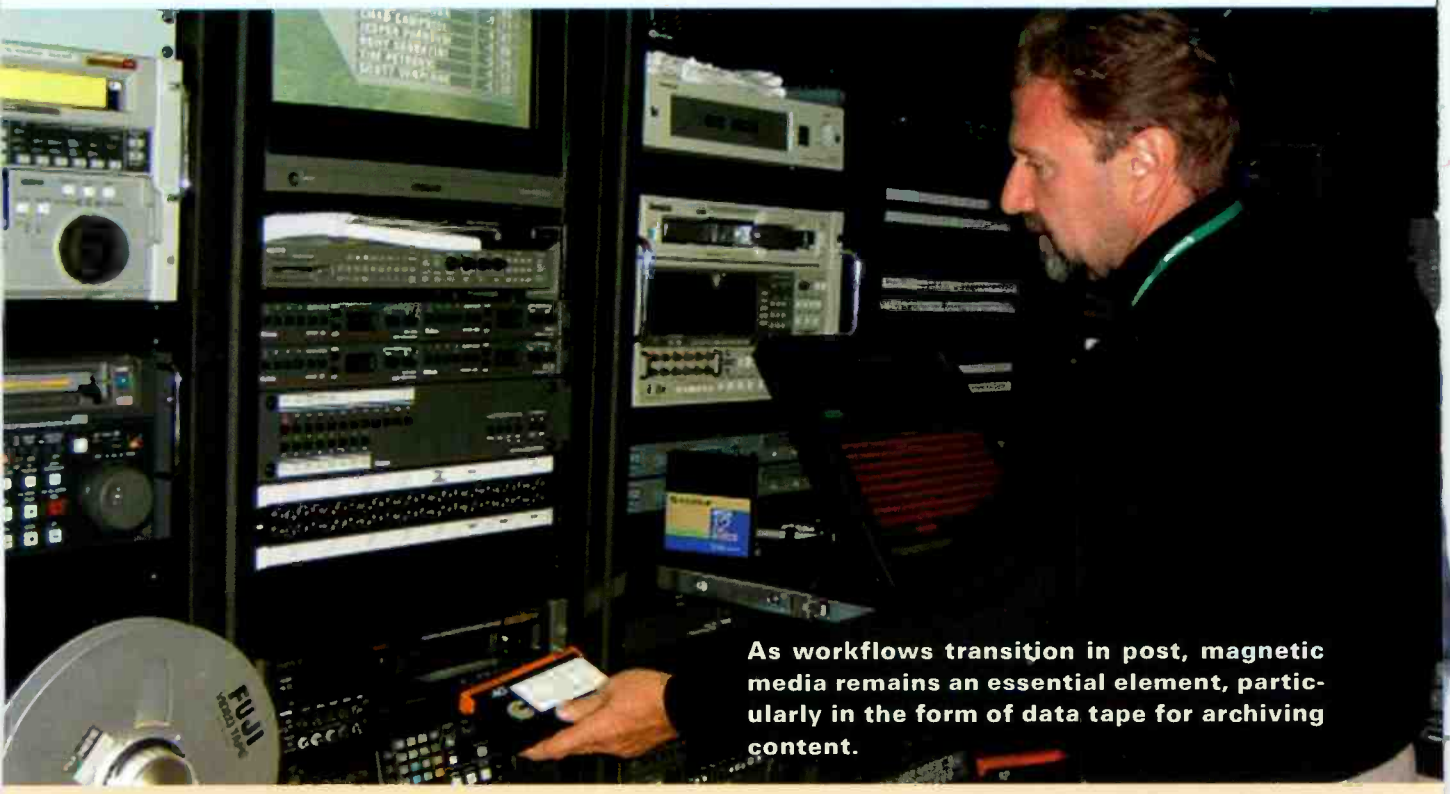


As workflows transition in post, magnetic media remains an essential element, particularly in the form of data tape for archiving content.

"The primary issue in post is how to manage HD content."

— Matt Feury, Avid Technology

the last 20 years I've always had my own cameras and post production [equipment], which makes it is very easy for me to go into post, you want to save money."

Comparing scenes on video monitors in the field and adjusting camera setup to match colors reduced the time Dark had to spend color timing in post.

HD post challenges

HD also presents its own set of challenges in post. For example, integrating HD capability into an SD facility can be expensive and present workflow issues, according to Matt Feury, Avid Technology senior product marketing manager.

"The primary issue in post is how to manage HD content," Feury said. "With post facilities already outfitted with storage and network infrastructures to support standard-definition work, making a wholesale jump to HD can be too costly, and the result is that HD post production becomes an island within the facility."

Likewise, managing different aspect ratios presents a challenge in post, especially when downcoverted SD material with a 4:3 aspect ratio is used for offline editing, and the final project is conformed for an HD master with a 16:9 aspect ratio, he said.

Compression also presents challenges. In post, there's a desire to operate in creative workgroups and share large HD files among members of that group. But moving large HD files among members of the group can be difficult, thus the need for compression.

"A key part of working with HD is how efficiently you are able to compress signals so that they are manageable in a workgroup setting, yet still deliver images that could be considered mastering quality," Feury said.

Avid's solution is its DNxHD codec, which Feury said provides HD quality at SD bandwidth.

"Using this codec, production teams can grow into HD workflows without having to over-burden or overhaul their existing storage infrastructure, all without sacrificing image quality," he said.

While the Avid DNxHD codec

is widely used inside post houses and broadcast post facilities, it can present broadcasters, who can face severe time constraints, with some challenges, said Bill Thompson, Anystream director of broadband products.

Pointing to NBC's HD production of the 2006 Winter Olympics from Torino, Italy, Thompson said the amount of time between when the network received HD files for posting in New York City and when it broadcast its evening coverage was so short that using the typical DNxHD setup presented an unacceptable bottleneck.

"Taking Avid DNxHD files and playing them to air through a Grass Valley or Omneon server is a computationally intensive process," Thompson said. "It involves decoding the DNX codec, which is proprietary, and re-encoding it to high definition MPEG-2 files. That is a pretty slow process, and in many cases, it's slower than real-time."

To overcome the hurdle, Anystream worked closely with Avid to transcode DNxHD files into MPEG-2 files at a rate two to three times faster than real time. Doing so required Anystream to develop a new "grid-scalable processor" architecture that chops DNX material into short segments, sends each to one of several computers on the grid working in parallel on transcoding, and then seamlessly splices the pieces back together.

"By implementing it in this kind of approach, our users can scale and achieve whatever throughput they want based on how many computers they want to apply to the problem," he said.

Post archiving

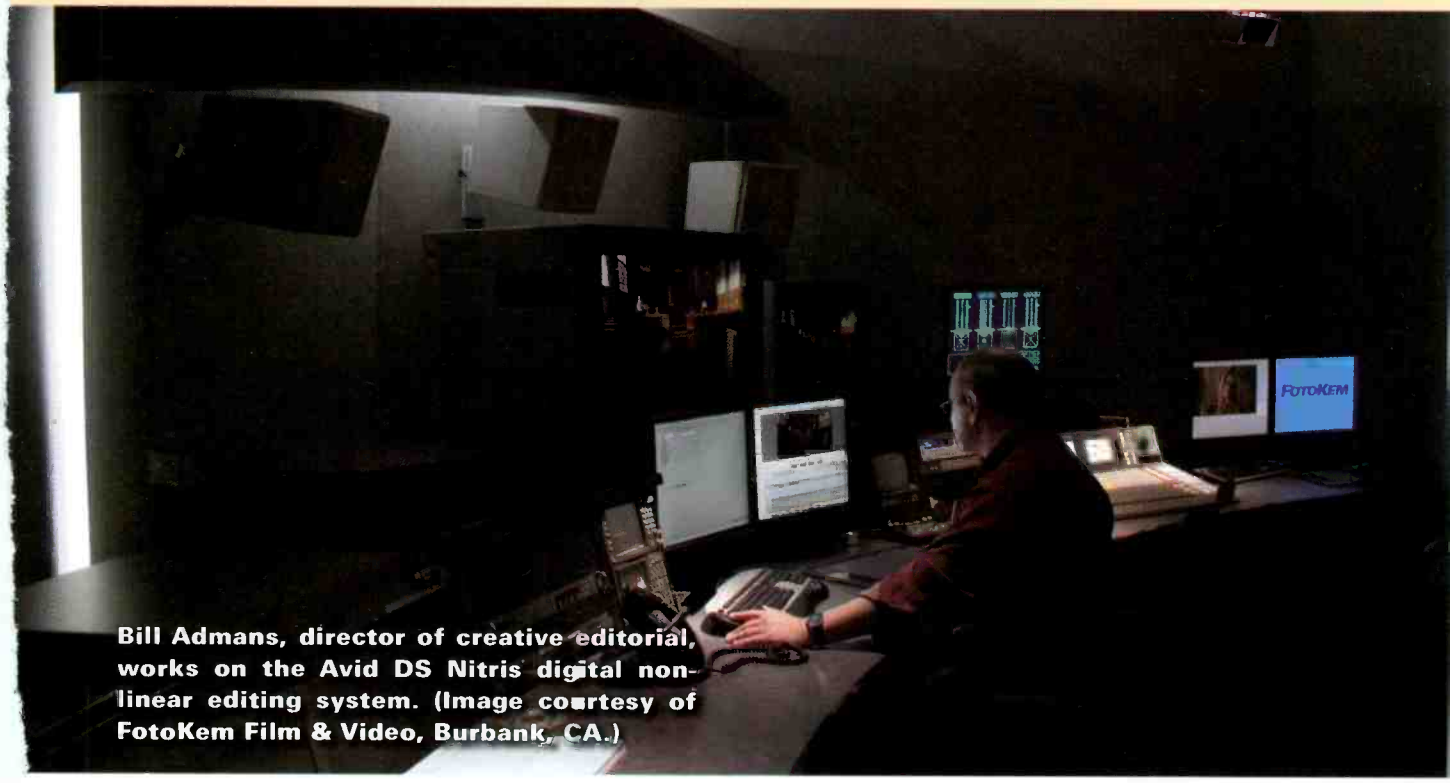
Given the influence of IT in post , it would be easy to think that tape's role is diminishing. Nothing could be further from the truth, said Tom Daly, Fujifilm Recording Media Division director of marketing.

"Tape usage as we go forward is going to actually increase," he said.

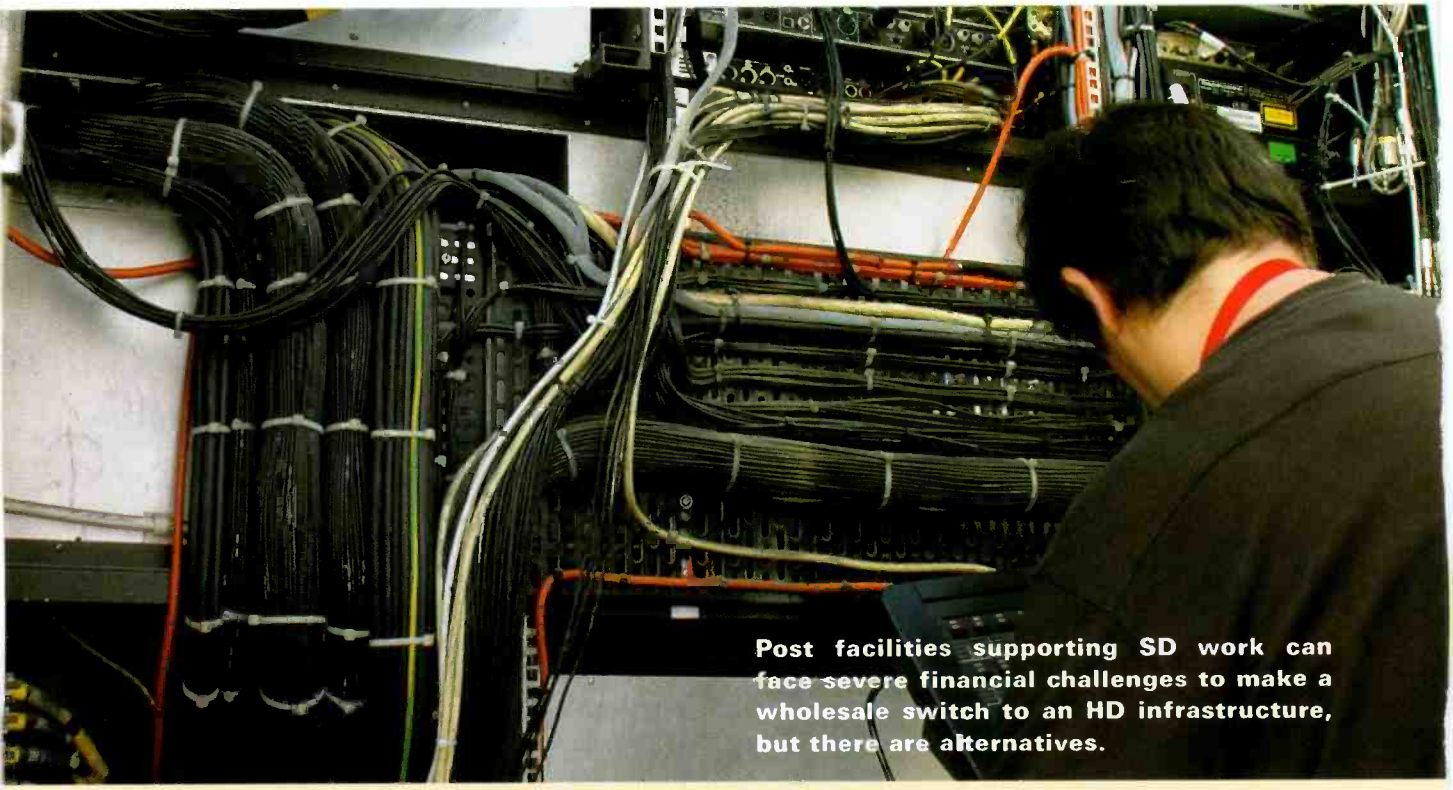
That's because while file-based workflows may diminish the need for videotape, they increase the need for data tape for archiving content, said Jim Hegadorn, Fujifilm Recording Media Division

"By implementing it in this kind of approach, our users can scale and achieve whatever throughput they want.'"

— Bill Thompson, Anystream



Bill Admans, director of creative editorial, works on the Avid DS Nitris digital nonlinear editing system. (Image courtesy of FotoKem Film & Video, Burbank, CA.)



Post facilities supporting SD work can face severe financial challenges to make a wholesale switch to an HD infrastructure, but there are alternatives.

"We have what amounts to a transfer stream data mover between disk and data tape over fiber."

— John Hoehn, IBM

director of technical services.

"The end result is your finished piece, and where is that going to reside?" he asked.

Hegadorn thinks data tape is the clear answer because it's the least expensive long-term storage medium available.

A unique example of the value of data tape storage for archiving material is the IBM ASI Solution. Since April 2005, FOX Networks has used the solution primarily to archive 720p HD feeds for FOX Sports coming from an ASI router. To the router, the IBM server in use looks like ports.

"When the feeds reach our servers, we start recording to disk," explained John Hoehn, senior consultant/senior IT architect for IBM. "We take the payloads out of the ASI streams — the MPEG-2 transport streams — and we're actually storing those bits on disk."

For FOX, 73Mb/s, which includes the MPEG-2 payload of 64Mb/s and 9Mb/s for control, are stored. The extra bits keep track of changes in the bit rate and let the system reconstruct the original ASI stream when the transport stream is recalled from disk or tape.

"We have what amounts to a transfer stream data mover between disk and data tape over fiber," explained Hoehn, "so the only thing that is really throttling the transfer rate is the number of tape drives."

At FOX, eight IBM servers are connected to four tape drives.

"That works well in an archive sense for moving off all the high-definition NFL games, NASCAR, 'American Idol' and MLB by 6 p.m. the day of broadcast," he said.

Beyond the archive, tape still has a place in post.

"Since the dawn of nonlinear editing, tape has played a role in film offline," said Feury. "Now, with the increasing affordability of HD, filmmakers can still take advantage of the relative low-cost and flexibility of tape as a workprint but with a high-quality image that allows for actual dailies to be viewed out of the offline editing system. They can do this without worrying that any problems within the images captured to film are being masked by the offline videotape." END

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SES AMERICOM feeds 290 channels, including those in HD, to IPTV headends and satellite subscribers as part of its IP-Prime.

MPEG-4 AVC: The HD format of the future

MPEG-4 AVC's ascendency won't be fully realized until "people write off ... the MPEG-2 investment they've made."

— Kurt Reigelman, Intelsat

Whether distributing programming via satellite to headends, transmitting programming via direct broadcast satellite to viewers, or sending content down fiber, coax or twisted pair to the home, there is an interesting set of choices when it comes to transporting HD video and audio.

The sender of the digital high-definition program wants to deliver the quality of the image needed to satisfy the receiver's expectation about what a high-definition image should look like. However, the sender must find efficient ways to do so that minimize bandwidth to keep costs in check — and in the case of IPTV distribution, it's a challenge to deliver high-quality HD images at all.

This exercise in balance requires the sender to choose how much digital compression to apply without harming viewer-perceived quality. The pace at which new algorithms emerge to allow greater compression without harming quality sets up other business choices, such as when to scrap the old in favor of the new.

For example, MPEG-4 AVC can achieve significantly greater compression and bandwidth efficiency than MPEG-2, but because of investments, the latter isn't going away anytime soon.

"The MPEG-2 investment is not to be underestimated," said Kurt Riegelman, senior vice president of sales, Americas, for Intelsat. There's a large amount of capital that's been spent and is still being spent on MPEG-2,"

MPEG-4 AVC's ascendancy won't be fully realized until "people write off or amortize the MPEG-2 investment they've made," he said.

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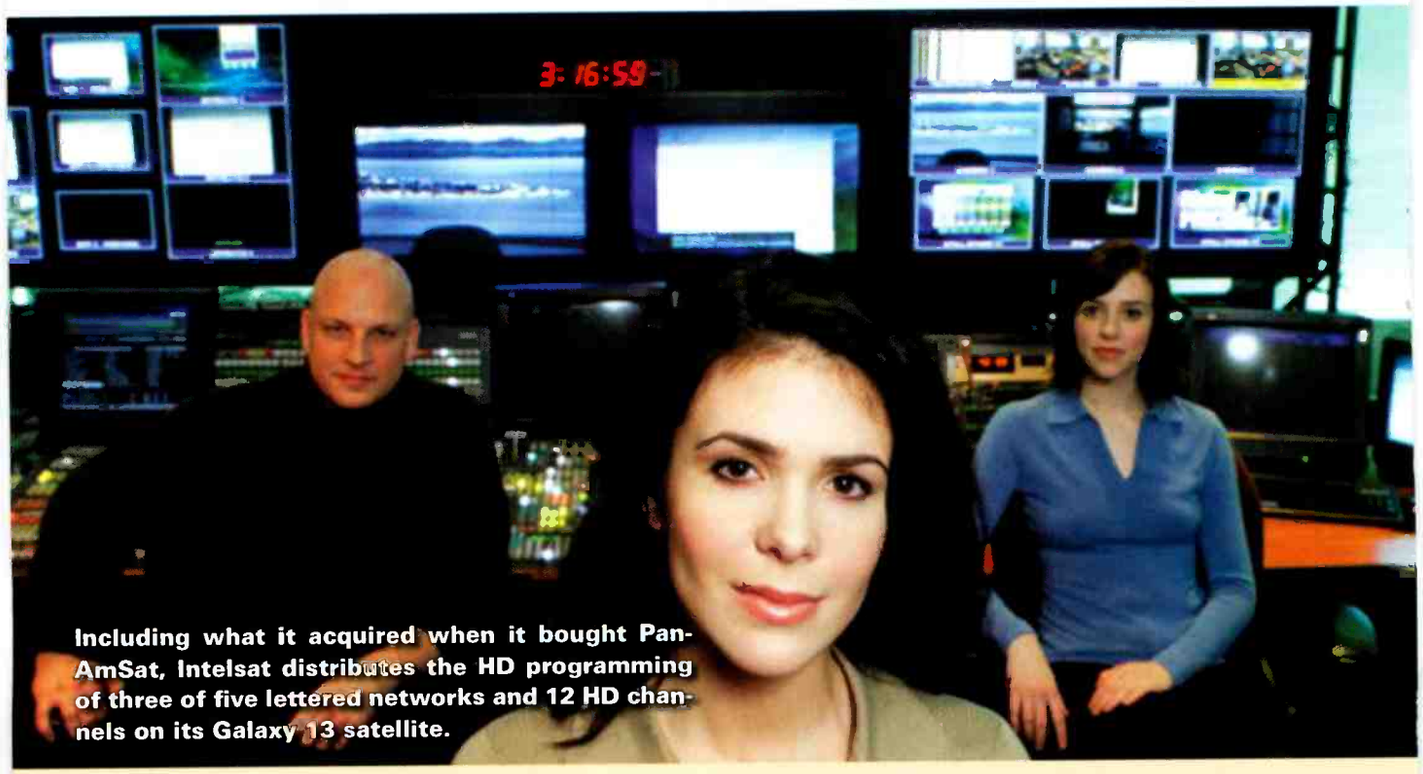

Including what it acquired when it bought PanAmSat, Intelsat distributes the HD programming of three of five lettered networks and 12 HD channels on its Galaxy 13 satellite.

MPEG-4 AVC is a driver for "creating space for HD in the near future."

— Bryan McGuirk, SES AMERICOM

Competitive compression technology aside, the fundamental choice for HD program distributors remains: How much compression is too much? Or, how far can distributors push the compression envelope until viewers push back?

"The market is going to take care of this," Riegelman said. "When you enter your high-def tier and look at the quality of the different channel offerings, I think over time, the quality of the channel is going to drive the viewership. So really, it's up to each individual programmer to assess what kind of quality product he or she wants to deliver."

New kid in town

MPEG-4 AVC, which promises significant improvements in compression and bandwidth use over MPEG-2, is emerging as an important player on the HD landscape.

MPEG-4 AVC is a driver for "creating space for HD in the near future," said Bryan McGuirk, president of enterprise services for SES AMERICOM. "We've been delivering to Bell South encoded (MPEG-4) H.264 Part 10 video for the past year," he said. "We've been doing trials, and we're expanding toward the end of the year."

Currently, SES AMERICOM delivers 290 channels as part of its IP-Prime service to satellite subscribers and IPTV headends using the advanced codec technology.

But MPEG-4 AVC is still in its early days, and it shows, said Andrew Warman, product marketing manager, servers, for Harris.

"A lot of the AVC encoding systems we've seen aren't actually that good in quality at the 10Mb/s or 12Mb/s range," he said. "It's fairly disappointing."

However, MPEG-4 AVC is still a young technology, having made its first appearance in spring 2004. To put that in perspective, MPEG-2, which is largely responsible for ushering in what is now a mature DVD movie market, was established in 1994.

"I can say there is a lot of improvement that can be made," Warman said. "We see the same sort of thing when we work on the software-based encoding side, taking raw coding algorithms and doing a lot

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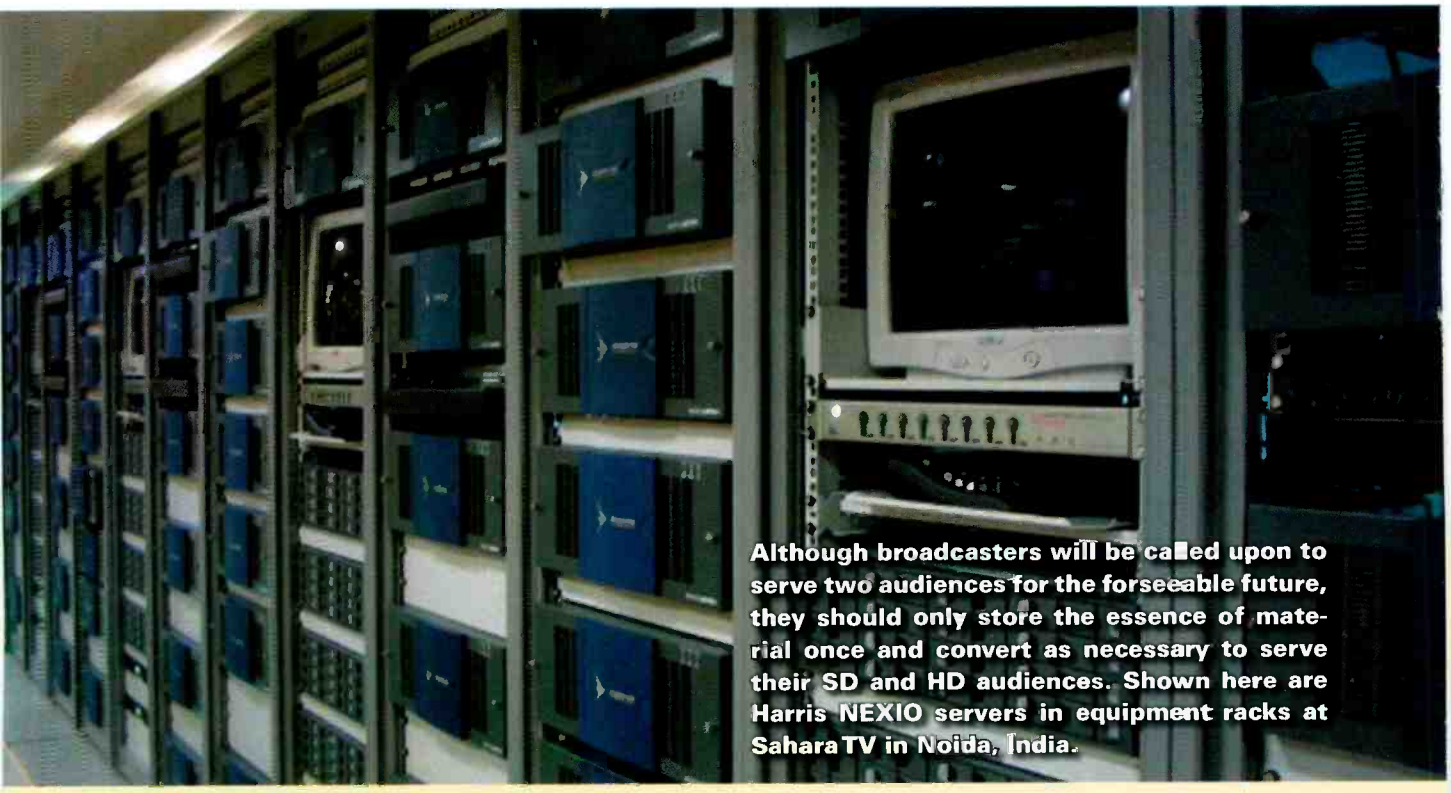

Although broadcasters will be called upon to serve two audiences for the forseeable future, they should only store the essence of material once and convert as necessary to serve their SD and HD audiences. Shown here are Harris NEXIO servers in equipment racks at SaharaTV in Noida, India.

"IPTV operators certainly are looking at MPEG-4 as a way to be competitive."

— Bill Thompson, Anystream

of optimization on our own to improve speed and image quality. Our experience so far tells us that there's still room for further optimization, so it's going to get better."

Quality vs. bit rate isn't the only issue that needs to be resolved, Riegelman said.

"I think MPEG-4 over time has tremendous advantages," he said. "A lot of programmers now are sort of hesitating to implement it. Many are holding off until they understand the licensing situation better."

According to Riegelman, some programmers fear that all of the entities that had a hand in creating MPEG-4 are not fully represented in the licensing agreement and could show up at a later date asking for money.

Critical to the future

To a certain degree, the quest to solve the compression vs. quality equation is complex. If too much compression begins manifesting as blocky pictures, frozen frames or signals lost, it's easy enough to back off. Unless of course, you're a telecommunications company banking on using a legacy network of twisted copper pairs to deliver HD programming as part of a triple-play service offering, including voice, data and video.

"IPTV operators certainly are looking at MPEG-4 as a way to be competitive," said Bill Thompson, director of broadband products for Anystream. "It allows them to deliver one or more HD streams in a bandwidth equivalent to what's consumed by MPEG-2 HD streams."

With MPEG-4 AVC, IPTV operators could support two simultaneous HD program streams to the home as well as SD channels, voice and data, without rebuilding their entire network infrastructure. Thus, the incentive for IPTV operators to distribute MPEG-4 AVC is strong. One sign of strong MPEG-4 demand is Turner Broadcasting System's decision to encode its program networks as MPEG-4 for delivery to IPTV operators.

Throughout the industry, playout servers reside at the source of this MPEG-2 and MPEG-4

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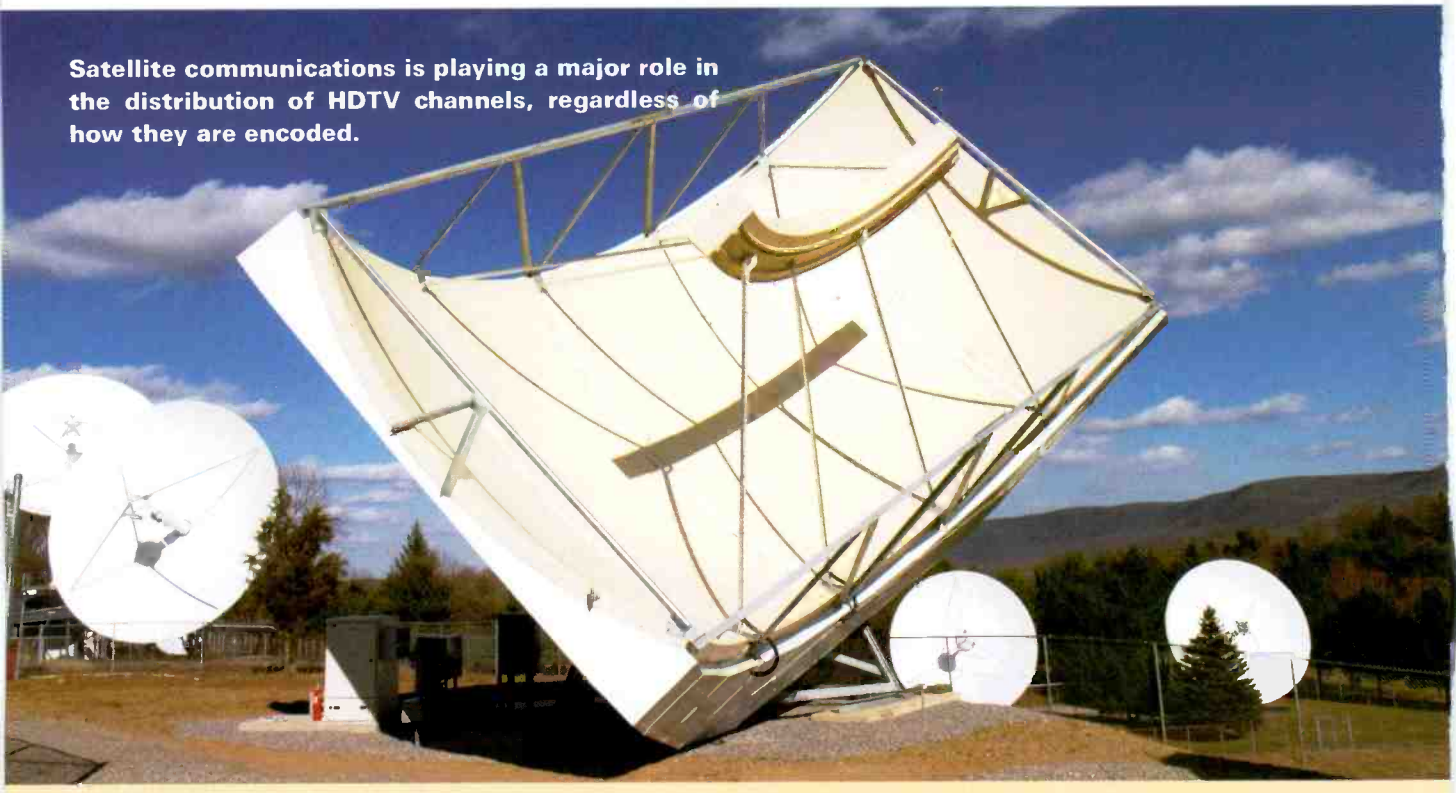

Satellite communications is playing a major role in the distribution of HDTV channels, regardless of how they are encoded.

"The broadcast server business is becoming more enterprise IT and less traditional broadcast."

— Andrew Warman, Harris

encoded material. Often called to playout HD and SD at the same time, these servers should store the essence of a particular piece of media and convert to the right format and aspect ratio as needed, Warman said.

"We tend to direct customers to use shared storage," he said. "At the end of the day, the SAN helps because there's only one pot to put everything in."

According to Warman, the color of that pot is changing.

"The broadcast server business is becoming more enterprise IT and less traditional broadcast, and I think that will continue. The whole issue of repurposing SD, HD, mobile television and IPTV will move use more into an enterprise infrastructure than a broadcast one," he said. "Today, you look around, and you see a lot of separate pieces glued together. It's complicated, and it's expensive, but as we push more toward an IT infrastructure, the number of individual systems will drop because you can roll a lot of the infrastructure into integrated systems that already have a lot of the features you need to serve multiple layers of distribution."

Fade to black

As HDTV becomes the format of choice for viewers, the volume of HD programming will increase. With that comes the need to distribute the growing amount of HD shows over today's infrastructure.

Today's widely used compression technologies are meeting the current need even as MPEG-4 AVC begins to improve and thrive. The advanced codec, particularly when used to compress HD, is heavily dependent on the power of the processor in use, according to Warman.

"So obviously improvement in processing power is huge because it will make the job of dealing with MPEG-4 and MPEG-4 AVC a lot easier down the road," he said.

Given Moore's Law, it's easy to predict that MPEG-4 AVC's performance will advance significantly by 2008. The only question is whether or not it will be enough to handle the number of HD networks at that point. END

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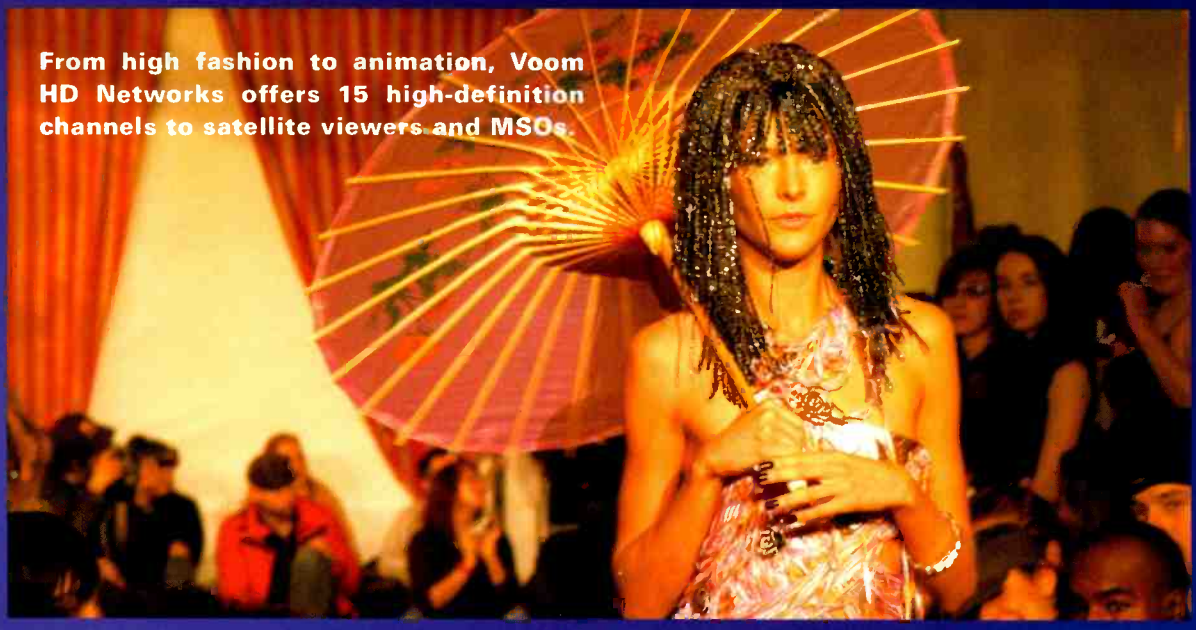

From high fashion to animation, Voom HD Networks offers 15 high-definition channels to satellite viewers and MSOs.

HD comes of age

At this very moment, HDTV may be transitioning from what marketing gurus like to call the "early adopter phase" to the "early mass adoption phase" in the United States. Rainbow Media's Voom HD Networks is aiming to make its brand of HDTV meaningful to the millions of new HD viewers who are coming online.

Initially, Voom HD focused on filling the void in HD content during high definition's earliest days, when there were few other pervasive sources of HDTV programming. Today, the network delivers 15 editorially-relevant HD channels to viewers via satellite and its MSO partners.

"You know, in the early days, it was almost enough to be able to supply beautiful images and not worry so much about the storytelling or the depth of the content because people were wowed by how clear the picture was on their HDTV sets," said Greg Moyer, general manager for Voom HD Networks. "Now we are deeply involved in producing and coproducing many more series and specials that are great television, regardless of the fact that they've been designed to maximize the impact of HD."

Offering a wide range of channels — from Animania HD to Worldsport HD — Voom HD Networks is positioning itself to win a fair share of the new high-definition viewers who are expected to buy an HDTV this holiday season.

NDP Group, which tracks retail sales, recently reported that it expects sales of HDTVs this holiday season to outpace those from last year's holiday season, when 1.4 million HDTV sets were sold.

With Black Friday (the Friday after Thanksgiving) sale prices of less than $1000 for a 32in LCD HDTV, and $1800 for a 50in HD plasma, such optimism may be warranted.

That's great news for Moyer.

"Voom is in the business of producing channels that are built for the high-definition era," he said. "We are available only in HD, and we take that freedom to really maximize the impact of our programming for the high-def medium."

As the HD network is positioning itself for the mass adoption of HDTV among U.S. consumers, it hopes to capitalize on increasing demand for high-definition programming abroad.

"We are seeing the exciting beginnings of HD television in many areas around the world," Moyer said, "and the relevance for us is we are both providing the programming and in some instances providing full 24-hour channels. As countries open up platforms for HD, Voom programming or Voom channels will be among the first expressions of high definition that people in other countries will see." END

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Obor Digital's Zeus

The system provides control over your broadcast engineering and IT services.

BY ROB CALDWELL

Every broadcaster has unique equipment and programming requirements, and obviously unique content. However, the engineering, IT and operations groups all share complex yet common operating challenges.

Those operating challenges include tracking and managing millions of dollars worth of equipment, determining how long that equipment will last and how much it will cost, managing the maintenance and servicing of that equipment, and providing help desk communications to the staff that uses those devices. Additionally, broadcast and IT equipment have unique complexities, including software versions, options, plug-ins, systems, and document and drawing management.

Designed specifically for broadcasters, Obor Digital's Zeus is an enterprise-wide centralized technology management system. It is a practical and intelligent fully integrated management tool that provides full control over your broadcast engineering and IT services. The system allows a facility manager to always know exactly where equipment is located, who has worked on it and its complete service history.

It also will help manage inventory and parts, determine which software versions and components are installed on any device, and how much each device is really costing you. The SNMP interface has the ability to automatically generate work requests from equipment self diagnostics, before an engineer even knows a problem exists.

The system is a powerful Web-based application that provides physical asset management, software and hardware tracking, help desk, inventory tracking, and SNMP integration.

Zeus was developed using Microsoft .NET, and SQL server. The Web application eliminates the hassle and headaches associated with traditional desktop client/server applications. The platform requires minimal client hardware. Web applications allow functions to seamlessly open up to multiple departments from locations around the world. Internet Explorer is the client.

The system was designed from the ground up to be robust, scalable and, most importantly, modifiable by the customer. The software is user-configurable; there is no need to hire an outside integrator or vendor.

It is role-based, allowing different users to have different privileges. The system's lifecycle matrix allows everything in the system to be tailored to fit the exact workflow of any facility. The user workflow is logical and intuitive. New service requests can be routed to a supervisor for assignment to an engineer, or they can go into a pool of service requests that engineers can grab. There are no complicated procedures associated with adding users. Just like any smart Web application, new users can register themselves and view the status of submitted tickets.

The fully integrated, physical asset management functions are equally strong. Broadcasters and IT professionals require more than just basic asset information; they need to know the current value and warranty information, track what components are installed, manage the installed software, track software keys, and be able to see the complete history of each asset, including labor and parts used.

The system does more than just manage assets and workflow; it also provides inventory management.

Designed specifically for broadcasters, Obor Digital's Zeus is a practical and intelligent fully integrated management tool that provides full control over your broadcast engineering and IT services.

A work request function allows engineers to record tasks they've performed, as well as lists parts pulled from inventory for repair. Parts are automatically decremented from inventory, and status reports are always available to be sure critical parts are always in stock.

Few broadcast purchases can show positive ROI. Using average salaries for a service requester, an engineer and an engineering supervisor, without a computer-based solution, the cost of a typical work order is $72. With Zeus, that same process costs less than $8 per work order. In addition, the system can reduce repair time by providing the engineer a knowledge base of previous work.

Obor Digital's Zeus seamlessly integrates a facility's physical assets, inventory, and work request management into a single, powerful, flexible, Web-based solution. It was designed and built by broadcasters for broadcasters. Powerful component and version controls, custom fields, a configurable lifecycle matrix, and many other user-configurable features are included. BE

Rob Caldwell is president of Obor Digital.

Belden Brilliance

The A/V cabling provides reliability and weight savings in a new HD truck.

BY KIP COATES AND DAVE KENNEDY

Dome Productions in Toronto recently launched Trillium, a new mobile production studio. The truck is equipped to provide complete turnkey HDTV production and transmission services on a contract basis to clients covering professional sporting events, as well as concerts, awards shows and other high-profile public performances. Trillium is the eighth mobile in Dome's fleet and the third high-definition, multiformat mobile production studio designed by the company in the past three years.

Dome Productions in Toronto recently launched Trillium, the eighth in its fleet of mobile production studios and the third mobile truck equipped for turnkey HTDV production and transmission services.

Inside the truck

Building and equipping the trailer took nine months, with three months of that devoted to cable installation and a final month for systems configuration and testing. When the design and engineering plans were completed, Dome selected Toronto-based FCI Technical Installations for the broadcast system installation. Over the past decade, the company has installed all of Dome's production fleet and also provided prebuilt and on-site installation services for the Bell ExpressVu satellite network and for various broadcasters at the past six Olympic games.

When it came to the hundreds of thousands of feet of A/V cabling required to support the truck's complex applications, Dome wanted a thoroughly tested product with consistent quality and reliability. The company chose Belden Brilliance cables.

The entire digital production and transmission studio is housed within an over-the-road trailer truck that measures 53ft long by 8ft 6in wide and 13ft 2in high. A 5ft expansion side extends over nearly its entire length. The truck is capable of supporting 1080i, 720p and 24p HD formats in widescreen 16:9 or traditional 4:3 for standard definition. In addition, Trillium is fully equipped to provide 5.1 surround sound.

The trailer's layout includes a back deck in the audio room for easy add-on of additional gear required for larger productions. Functional spaces inside the trailer include distinct areas for audio, production, VTR and VIDEO/TX.

The mobile has a production monitor wall with an Evertz 10 output virtual monitor driver system and 47 conventional color monitors. A multiformat HDTV digital mobile facility requires an extensive array of electronic equipment, including video tape recorders, cameras and lenses, audio console, intercom/communications equipment, routers, servers, switchers, microphones, interconnect and other system equipment.

The biggest challenges in designing and installing a full-service mobile production truck are the interior space limitations and the over-the-road weight constraint of 80,000lbs. The space has to accommodate all of the cabling, production and transmission equipment, a high-powered air-conditioning system, and workspace for a crew of up to 25 people. Everything must be well-thought out to be clean, compact and efficient. Accomplishing this requires ingenuity and creativity. For example, in this truck, the AC return air ducts act as a conduit for some of the cabling.

Equipped with rack-mounted HD transmission encoders, decoders and modulators, the mobile is typically used by clients providing their own production and transmission crews. Some clients ask Dome to source camera and production crews. The need for HD trucks is growing, especially for sporting events. To ensure reliable performance, Dome conducts extensive testing of the system and performs its own certification before contracting the unit out to clients.

Cabling the mobile broadcast infrastructure

Approximately 371,000ft of Belden Brilliance A/V cables have been installed in the Trillium mobile digital

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A total of 371,000ft of Belden Brilliance A/V cables were deployed in Dome's mobile production studio. The blue, yellow and green cables shown here are Belden 1505A precision video coax cables. The purple cables are Belden 1855A miniature video coaxes.

production truck. Specifically:

- 150,000ft of miniature coaxial video cable (1855A)
- 57,000ft of precision video coaxial cable (1505A)
- 35,000ft of DigiTruck subminiature coax for broadcast mobile trucks (179DT)
- 78,000ft of line level analog audio cable (9451)
- 14,000ft of RG-11/U type video triax cable (1857A)
- 1000ft of shielded multipair snake cable (8777)
- 36,000ft of Cat 5e UTP cable for data transmission (1583R)

Belden sweep tests and certifies these video coax cables to 4.5GHz to ensure superior return loss performance, even at higher frequencies. And the DigiTruck (179DT) cables are lightweight, crush-resistant precision video coax designed specifically for use in mobile broadcast trucks where load-weight and space are prime concerns. The cables deliver high-quality performance in analog, SDI, HDTV and AES/EBU digital audio transmissions. Because of the sheer volume of audio cable in and out of the patchfields, and the physical limitations of the cable pathways, this tiny coax increased capacity, in addition to providing weight savings.

Mobiles keep busy

After the truck's inaugural event covering NBA Toronto Raptors basketball, Trillium was contracted to cover a variety of high-profile events in a wide range of locations, including NHL hockey in Montreal and Ottawa; Major League Baseball in New York, Toronto and Chicago; and a Coldplay concert in Toronto. BE

Kip Coates is marketing manager of entertainment products and Dave Kennedy, project manager for the Dome Production project at Belden.

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Film and Video Production in a Multi-Platform World

SoundField's DSF-2

HD broadcasters transmit from a single mic in multiformat surround and stereo.

BY PIETER SCHILLEBEECKX

To help HD broadcasters meet the challenge of producing audio in 5.1, SoundField introduced the DSF-2 digital microphone system. It offers a means of creating surround in a variety of formats with a simultaneous, phase-coherent stereo feed for SD transmission. The DSF-2 digitally processes audio for outputting phase-coherent audio in simultaneous mono, stereo, mid-side and surround formats.

How it works

SoundField microphone systems all comprise a multicapsule microphone and associated decoder, and output audio as a proprietary four-channel signal known as SoundField B-Format. Three of these channels describe the space around the mic in three dimensions, as though recorded by three figure eight microphones placed at right angles to one another. The fourth provides an overall reference signal for the others, as though recorded by an omnidirectional capsule.

The four channels in the B-Format are phase coherent. This is achieved by mounting the four matched capsules in the microphone head as closely together as possible in a tetrahedral array. Of course, the capsules cannot be located at precisely the same point in space, which is ideally what is required to create point source phase-coherent output signals.

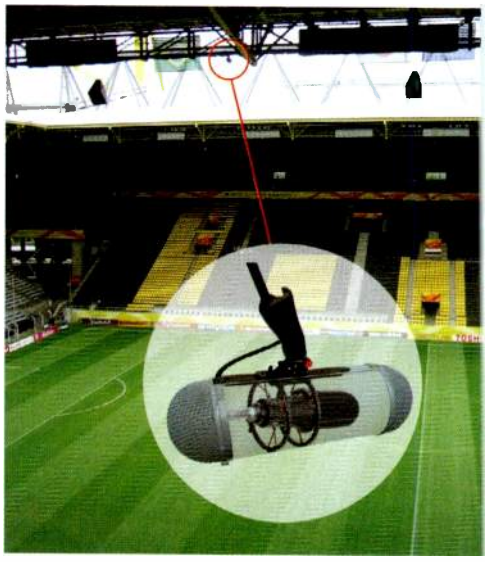
However, because the distance of the four capsules from the center of the tetrahedral array is small, known and constant, it is possible to post process the output of each capsule, generating four signals that correspond to those that would be created by recording at exactly the same point at the center of the array. This eliminates phase problems between the four constituent channels of the B-Format signal, and is central to the SoundField concept, as it allows them to be combined without any unpleasant-sounding phase artifacts, the usual drawback of multimicrophone or other multicapsule systems.

Simultaneous decoding into different formats is also possible. The B-Format signal can even be recorded to a suitable four-channel storage medium and decoded later. This allows broadcasters to determine the precise output format at a later date, and leaves the door open for future broadcasting standards by decoding into new surround formats such as 7.1.

By altering the balance of the four channels in the B-Format signal, it is also possible to change the mic's effective pickup pattern continuously from omnidirectional through cardioid to figure eight, and to change the virtual orientation of the mic. Thus, for example, a mic may have its pickup pattern tailored to become more or less directional, and shut out or admit more background noise, or it may be virtually moved or rotated without requiring the operator to touch the mic itself.

These options are easily accessed from controls on the microphone's associated decoder and are useful in outside broadcast situations, where the mic often cannot be accessed or adjusted once broadcasting has begun. Interestingly, this audio zooming and virtual rotation of the mic can still be carried out by post processing a stored four-channel B-Format signal with a SoundField hardware processor or software plug-in long after the recording has been made.

Another advantage of the design is that the microphone head can be placed at distances of up to 300m from its decoder without a drop in signal quality. Moreover, the decoder can be up to 1km from its associated broadcast vehicle, which is particularly useful at some sports venues, where the trucks can never get very close to the events themselves.



The DSF-2 captured sound at Dortmund stadium in Germany during the 2006 World Cup.

Recent projects

The DSF-2 first saw use at the 2006 World Cup. It was installed by Host Broadcast Services at the 12 German stadiums involved in the tournament and provided crowd and venue ambience in 5.1 and stereo, respectively, for HBS' HD and SD coverage. The stereo SD output was taken straight from the outputs on the mic's processor, while the mic's digital B-Format signal was routed to the International Broadcast Centre in Munich, passed through a SoundField SP451 decoder there to convert it into 5.1, and then distributed worldwide as part of the HD transmission. BE

Pieter Schillebeeckx is the head designer for SoundField.

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Camera support

The success of today's systems relies on a balance of technology and physics.

BY JOHN LUFF

Mechanically mounting a camera to a support device and controlling over pointing seems like a relatively easy task. The camera needs to be securely fastened, and the support needs to be stable with the weight applied. But as with all things, this concept becomes more complicated when the details are considered. Today, modern technology and thoughtful engineering have considerably advanced camera support.

Friction

A tripod and pan head work together to allow the camera operator to accurately point the lens at a scene while facilitating smooth movement. Zero friction would create a disaster. The lack of human muscle control would cause unstable operation, particularly when wind or other factors add mechanical loads to the assembled mechanical system. Instead, a degree of controlled friction must be applied if physics and physiology are to cooperate successfully.

This friction is accomplished in the pan head. Camera support systems must be designed so that the center of gravity of the camera is allowed to maintain the appearance of perfect balance at all tilt angles.

In a post head, the camera's center of gravity is placed precisely on the center of rotation of the tilt mechanism. By doing this, as the camera tilts, gravity acts precisely the same at all angles, allowing the camera to remain stable in any position. Further, the force that must be applied to move the camera is consistent at all times.

Post heads were once quite popular for production use. However, they tend to be large and expensive. Today, they are commonly used in robotics.

Springs for balance

Other approaches to the issue of tilt over center are equally effective. Adding springs to the tilt mechanism can provide resistance that is proportional to the angle. In effect, this creates a balancing force that precisely compensates for the force of gravity.

This approach has been used for decades to allow pan heads to adapt to cameras of varying sizes by adjusting the spring tension.

In the most modern designs, the tilt and pan have an adjustable friction, which is often modified by a viscous fluid acting on the axis of rotation. This creates a smooth action, which has an adjustable resistance. In some sophisticated pan heads, the amount of friction and the balancing force are shown in a digital readout, so setting a pan head for a specific camera is much easier. By combining the springs with a camera mechanism, the counterbalance can be much more accurate and progressive in action, a feature common in high-end pan heads for large and heavy field/studio cameras.

Choosing the right combination

Technology does not completely overcome physics. Large and heavy cameras often cannot be balanced at all tilt angles. Review the specifics of the intended application to ensure that the pan head chosen will adequately accommodate the combination of lens and camera.

Most manufacturers can provide charts that assist in evaluating the suitability of the pan head to the chosen camera/lens combination. However, these charts are often hard to obtain, so it's a good idea to talk with a technical representative from the support equipment manufacturer to make sure suitable choices are made.

Figure 1 shows the ability of one pan head to accommodate full tilt

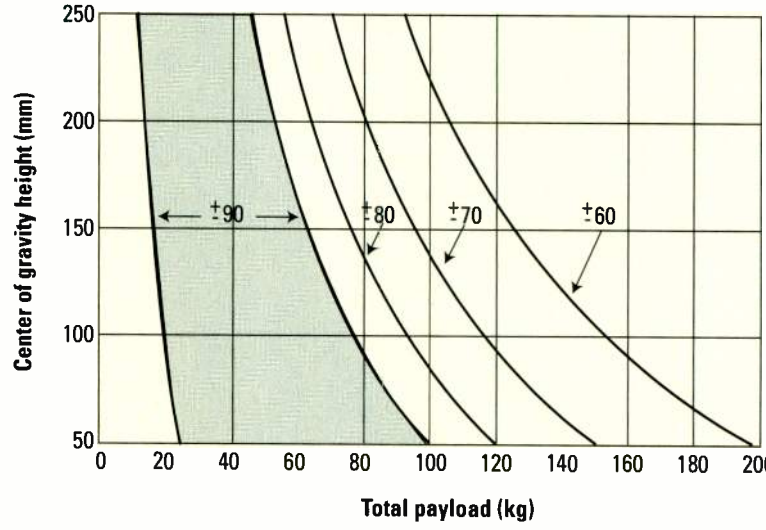

Figure 1. An illustration of the relationship between tilt range, center of gravity and weight

Figure 2. An example of a Mitchell Mount for pan heads

range only with certain combinations of total weight and height of the center of gravity.

Choose a pan head that is intended for the weight range. Again, Figure 1 shows that lightweight cameras are not suitable. With the advent of lightweight consumer crossover cameras, such as HDV camcorders, choose much lighter duty pan heads to ensure a good match between camera size, weight and the pan head.

Structure

The structure under the pan head is another important element of camera support. The studio pedestals of the 1950s were often nearly the weight of the camera. Lead weights on complicated pulleys provided counterbalancing to the camera mass. This of course meant that the camera/pedestal combination weighed about half a ton. One time while I was taping, the cables on my camera/pedestal combination snapped.

As cameras got smaller and lighter, air balancing was introduced. This incredibly smooth process allowed for a wide range of weights. Air-balanced systems are still the Mercedes of the industry, with costs to match. Some manufacturers offer up to four-stage lift columns, along with models that can be folded up for field use.

Field tripods must be extremely strong and light enough to be carried. The high end of the camera weight scale includes heavy steel or aluminum tripods suitable for heavy-duty use. Modern material science has provided more lightweight options, including alloys and carbon fiber, which provide the strength of steel without the mass. Carbon fiber, though light, strong and durable, is expensive. Like pan heads, tripods must be chosen for the weight range of the intended camera.

Finally, make sure the pan head and tripod have the correct mating surface. Heavy-duty tripods for field cameras often have a Mitchell Mount, which is a carryover from cinematography. (See Figure 2.) Usually the mounting is a bowl that allows the pan head to be leveled independently from the tripod. Bowl sizes range from 75mm to 150mm, requiring careful planning for the complete system.

Lastly, it is valuable to note that the group Vitec Group in the UK owns several of the manufacturers of both tripods and pan heads. There are many products available that cross brand boundaries, giving you the freedom to choose the brand you prefer and still get the product you desire. BE

John Luff is a television technology consultant.

Send questions and comments to: john_luff@prismb2b.com

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Associate Director, Broadcasting Service (Technology & Planning), WSIU/WUSI-TV (PBS) WSIU/WUSI/WVSI-FM (NPR), Southern Illinois University Carbondale: As 'technology officer' responsible for planning & managing all technological aspects of SIUC Broadcasting Service including overseeing daily technical operations, technology staff, planning for and specifying equipment purchases, FCC compliance and planning for future uses of communications technology. Required: Bachelor's degree required in Electronic/Electrical Engineering, Communications Technology, or related field, Master's Degree preferred. Five years of Communications Technology Management experience and demonstration of knowledge and proficiency with broadcast and other high-tech communications required. Also required: excellent time management, teamwork, the ability to work under pressure and handle multiple projects simultaneously, well-developed leadership and management skills, and valid driver's license. Experience in public broadcasting preferred.

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A whole new world

An evolution causes engineers to learn new tricks.

BY PAUL MCGOLDRICK

During the nine years that this column has run in *Broadcasting Engineering*, the video world has significantly changed.

Old technology

Nine years ago, the studio was still basically analog. Programs were made using cameras that had first-generation CCD pickup devices, recordings were still all tape, desk controls were analog and tactile, and editing was entering new nonlinear arenas. The digital world included expensive special effects units. And in the world of standards converters, the few players that existed were regarded in awe because of the seeming magic involved.

The companies that exhibited that magic then haven't come very far now. The imagination has dried up. Some companies have gone away because they could not accept that their $50,000 box could be replaced with $500 software.

Back to the future

Today, it is extremely difficult to buy an SD, studio-quality camera. They exist, but broadcasters are encouraged to buy HD cameras using 1/2in CCDs. And as always after an Olympics year, there are many "only used once in Torino" bargains available.

Few operations use tape. Servers distribute the content. Linear editing has gone the way of the dodo. Continuity of program and commercials is now done with preprogrammed switches. And the digital elements of operations are now completely embedded in products.

Standards conversion consists of a world of network processors with massive, multiple-watt burning ICs that have hundreds of pins and come from startup vendors in Silicon Valley that don't know — nor seem to need to know — what luminance and chrominance are.

The engineers of yesteryear

Broadcast engineers used to be patient people who could tinker and maintain, find solutions, keep machines running with duct tape, understand and set levels, see degradation in images, and answer any technical questions. They were respected, but underpaid.

Now, those same engineers run several call letter stations, look after cable headends, are on call 24/7 for the transmitters, are looked down on by management and are still underpaid. If station engineers are lucky, they might have a couple of fresh graduates who better understand the digital stuff so they can focus on maintaining the last shreds of analog, especially the transmitters.

Today, it seems we no longer train broadcast engineers to know the entire industry. Little work today is hands-on.

Many of the engineers in my generation have retired, become consultants or accepted that the only role they have left is in a management position. But I don't accept that I am ready to be put out to pasture. I have tried to maintain a working understanding and overview of our changing industry.

I am of the era when engineers experienced adrenaline at least once during a work shift. Whether it was replacing an image orthicon tube in a camera on the studio floor during a live production of the original "Doctor Who" or losing a UHF transmitter's final stage power amplifier during peak viewing hours, it was all very real.

And it was time-controlled. Once the event was over, it was done with. There was no "fix it in post" mentality, because there was no post.

An expanding industry

The changes that have occurred during the last nine years are momentous. For example, events such as the annual NAB conference are really no longer about broadcasting. They are about a huge blanket media that I am not at all sure I want to completely understand in the future. And no one person can understand the gamut of the industry — perhaps because it is clearly no longer a single industry.

No one person can understand the whole gamut of the industry — perhaps because it is clearly no longer a single industry.

I write extensively on the Internet. Embracing that new medium has been one of the new tricks that this old dog has learned successfully. Today, that is bringing me the adrenaline I remember from those earlier days of broadcasting. And I've realized I need to spend my time in the studio.

So, after nine years, this is my last "EOM" column for *Broadcast Engineering*. This is my end of message. Thank you, readers, for your many responses and comments over the years. Take care out there. BE

Paul McGoldrick is an industry consultant on the West Coast.

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

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