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NOVEMBER 2005

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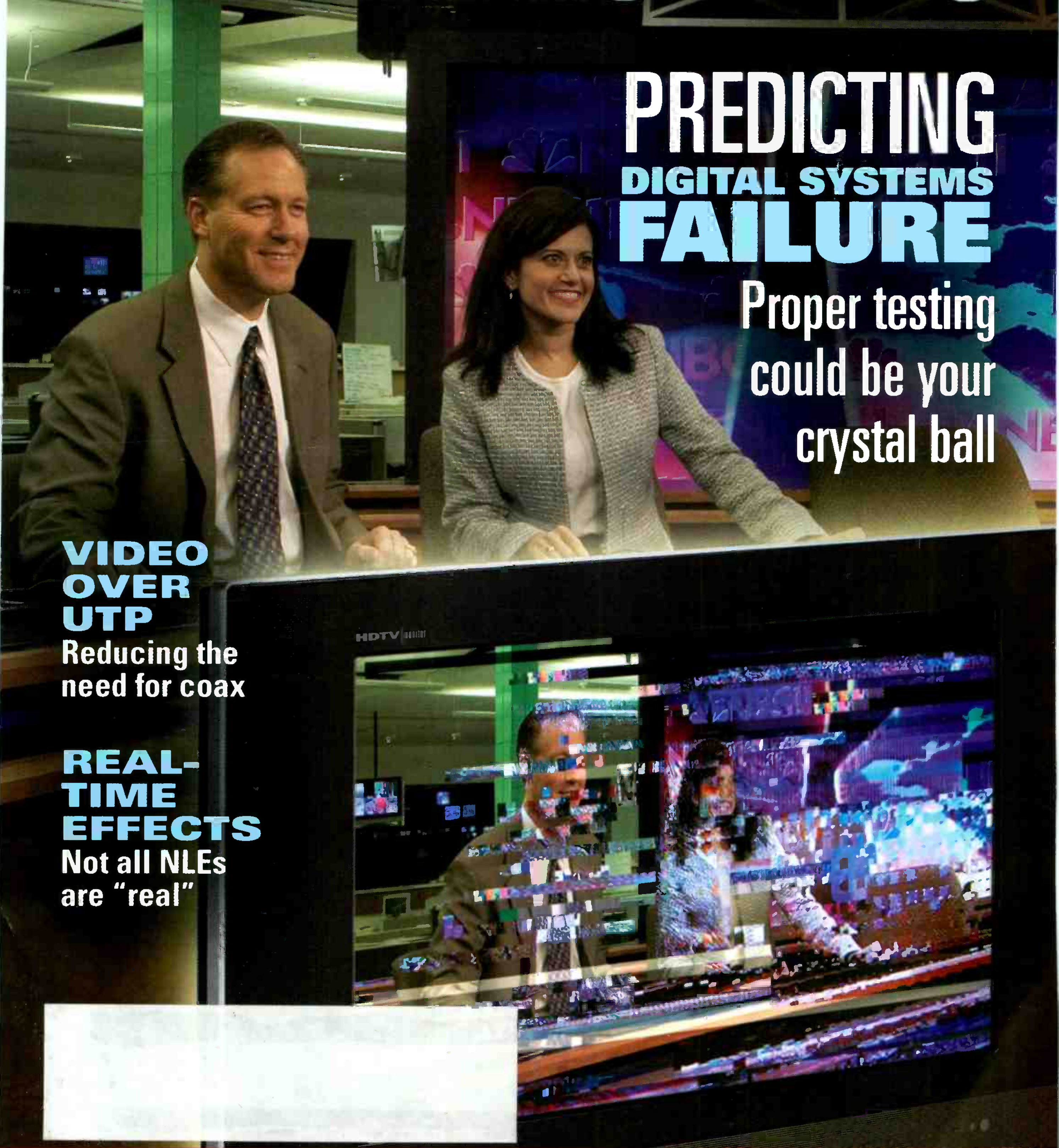
THE JOURNAL OF DIGITAL TELEVISION



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Proper testing could be your crystal ball

VIDEO OVER UTP

Reducing the need for coax

REAL-TIME EFFECTS

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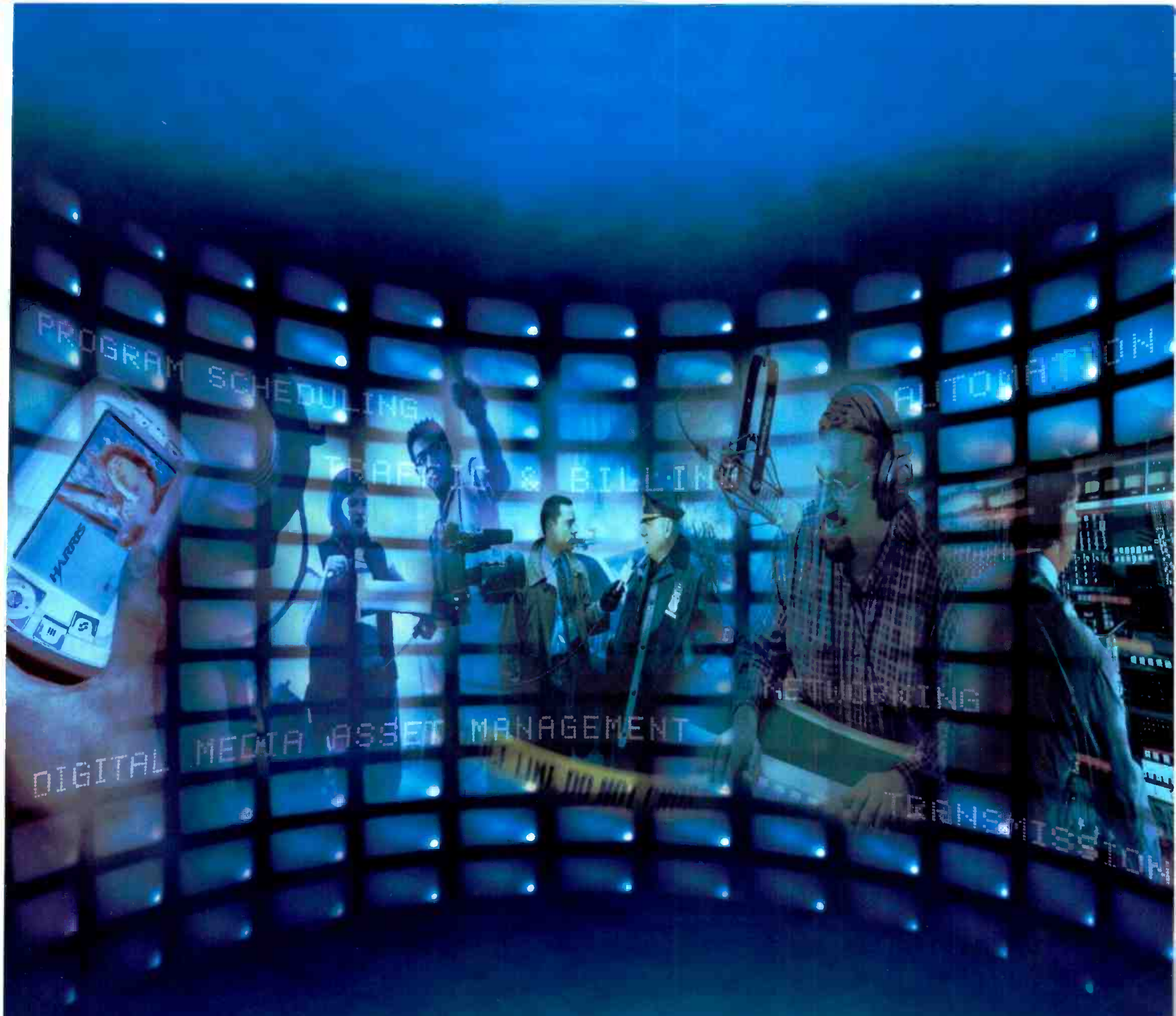

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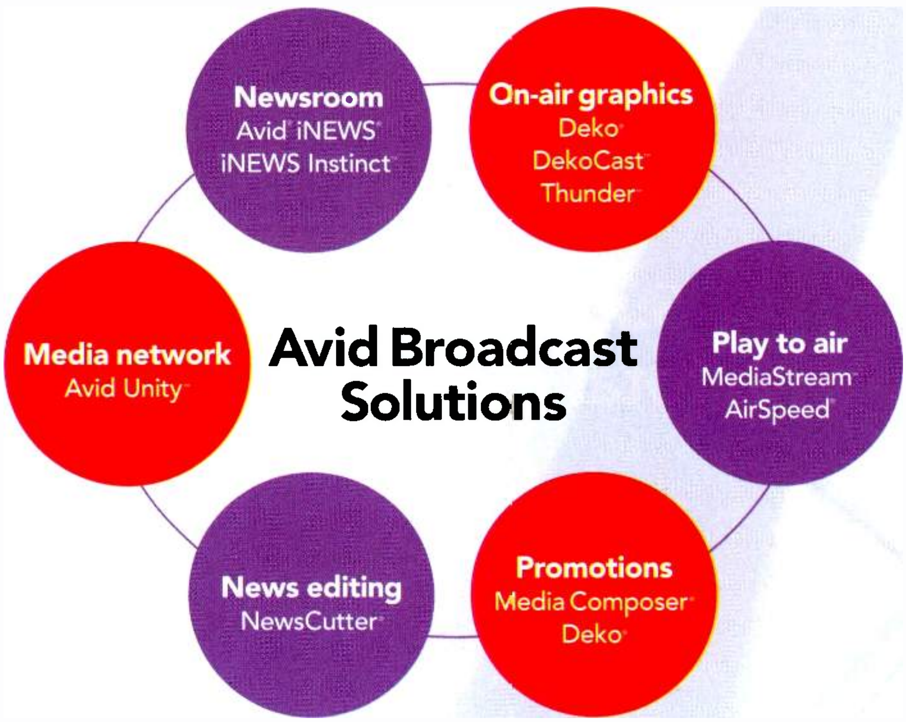

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THE JOURNAL OF DIGITAL TELEVISION

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FEATURES

ON THE COVER:

The DTV transition brings the capability of higher-quality signals, as well as new types of test and measurement needs. Cover concept and simulated digitally distorted image courtesy Tektronix. Studio photo courtesy KNTV/NBC11 and Ascent Media; photography by John Benson.

BEYOND THE HEADLINES

DIGITAL HANDBOOK

(continued on page 8)


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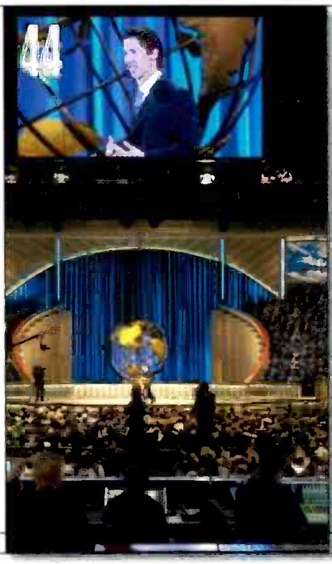
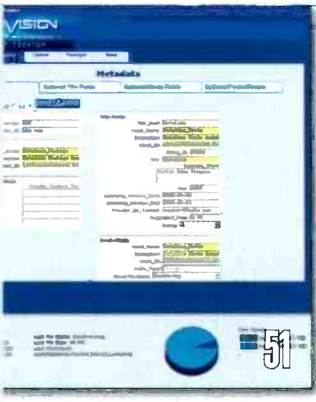
Systems Design & Integration





New Products & Reviews

Departments

Freezeframe

Fill in the blanks:

________ ________ is the entire time between the end of the active picture time of one line and the beginning of the active picture time of the next line. It extends from the start of the front porch to the end of the back porch.

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

Question courtesy Tektronix 2005 Desktop calendar.

Live
traffic reports

Have you seen the insurance commercial about inattentive driving? The opening scene shows a fast-paced, multitasking, businesswoman curling her eyelashes with one of those torturous looking clamp things while she's tooling along the six-lane highway *and* talking on her cell phone. She then applies lipstick and fluffs her hair. At the same time, she's answering questions, jotting notes on a dashboard-mounted note pad and checking her computer. All the while, she's threading through traffic, ignoring everyone else.

At the last moment, she says to the person on the phone, "Hey, gotta go. Here's my exit." Then she rips across the highway, cutting off traffic to make the exit. Cars honk, swerve and crash as she tootles off the screen.

While I couldn't help but laugh at the commercial, there was a bit of "Oh, my gawd," too.

The very next day, I passed a driver with a cell phone cradled between her neck and shoulder. She held a clipboard against the steering wheel with her left hand and wrote with her right. I can only assume she steered with her knees.

Here are some facts. Sixty percent of cell phone use takes place while driving. And, 8 percent of drivers are on their cell phones. Reaction time for these talking drivers is 30 percent slower than for drivers not talking on a cell phone. A driver using a cell phone is as dangerous as a drunk driver with a 0.08 percent blood alcohol level.

And there are at least two more reasons to be concerned about cell phone usage from a car. At the recent *Broadcast Engineering* News Technology conference, several panelists emphasized the advantages of licensing a station's content to the new outlets. Companies like Sprint, with its MobiTV, and Verizon, with its VCAST, are eager to have access to broadcast content, and they don't care where it's watched.

If that's not enough to scare you, the term *broadcast video* has a whole new meaning. New technology will let cell phone users not only watch programs, but actually *transmit* live video back to TV stations. IceMobile claims its *Videocall2TV* will "enable viewers to express themselves instantly by making video calls from their 3G mobile phones to TV programs and participate in the shows with live video images."

Two-way, interactive, live video from cell phones in cars, restaurants — even restrooms! Oh, my gawd! We're doomed! Even a seven-second delay couldn't save a station's backside with this kind of programming.

Can't you just see it? Road rage raised to a whole new level. The broadcaster runs live cell phone video showing the latest road rage or traffic congestion. There are prizes for the best (worst) coverage or event. Now drivers become competitive to see who has been in the worst traffic jam.

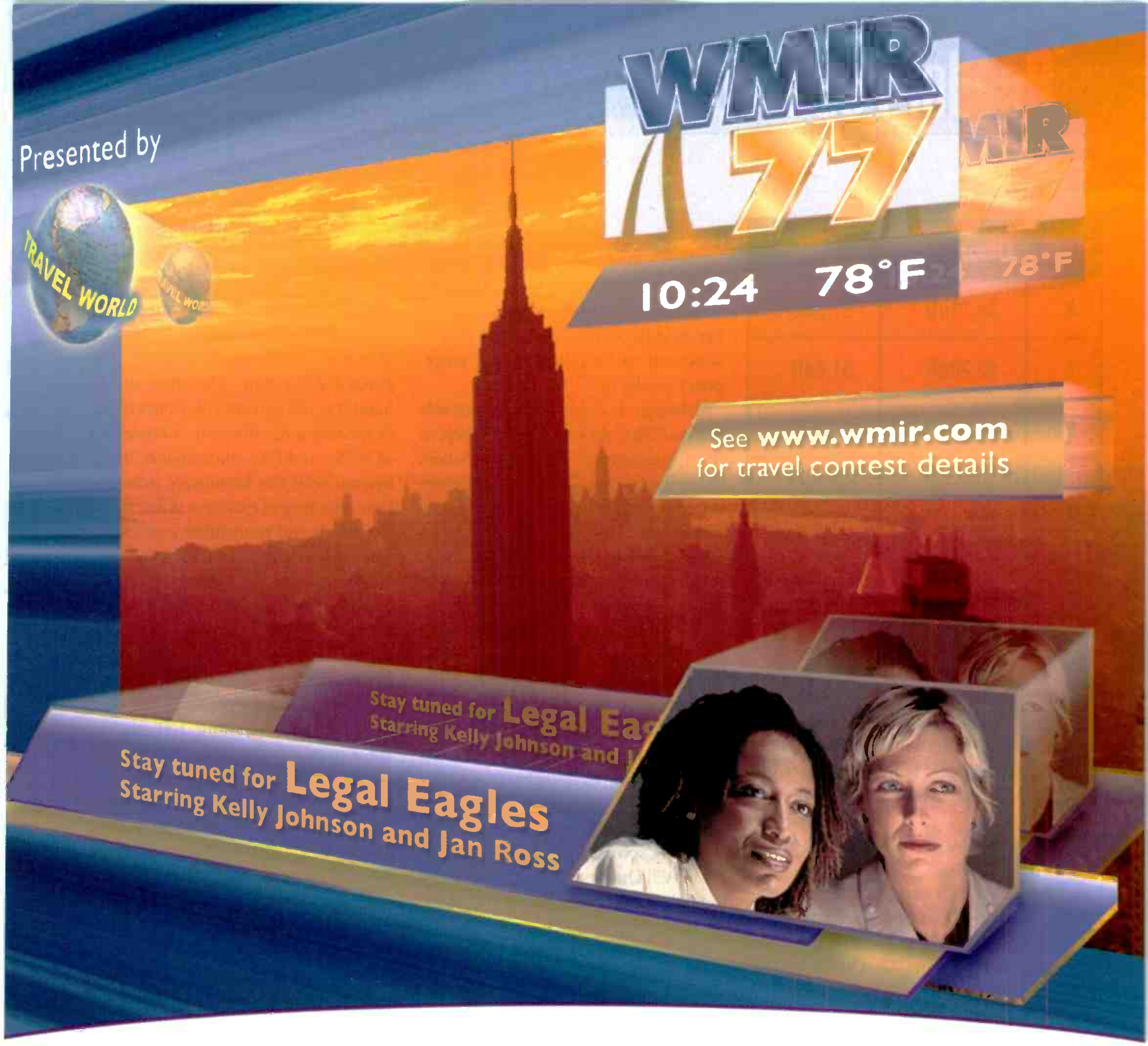
"Okay, I'll show you road rage," says one driver as he rams the guy in the Beemer who just won the contest. That driver ups his anger and decides to pursue the offending driver. Car number three witnesses the events and gives chase, thereby causing another wreck. All this is being broadcast not from a helicopter, but live from inside the cars. Oh, the inhumanity of it …

If there's an upside to this, I suppose it's that these real-time video broadcast feeds will give a whole new meaning to the phrase "live traffic reports." BE

Brad Dick

editorial director

Send comments to: • editor@primediabusiness.com • www.broadcastengineering.com



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HDTV: MAKING IT HAPPEN

Bits	Theoretical	Measured
8	58.31dB	57.9dB
7	52.29dB	51.9dB
6	46.27dB	45.88dB
5	40.25dB	39.86dB

Calculated versus measured SNR

Correction factor

Michael Robin:

Will the 15db correction factor used with SNR peak-to-peak luminance/peak noise still be a good number for HD? Would this change if the resolution went from an 8-bit HD to a 10-bit HD sample? Is there an exact way to calculate this factor?

MAXIME CARON
CBC/RADIO-CANADA MONTREAL

Michael Robin responds:

Read my article on digital video noise in the March 2005 issue of *Broadcast Engineering*, page 22. There's a table comparing the calculated SNR with the measured SNR using a 15dB correction factor. The measured SNR correlates well with calculated SNR.

Beyond the headlines

Editor:

I was amused by the July 18 edition of *Broadcast Engineering's* Beyond the Headlines e-newsletter.

One article, titled "What happens to TV spectrum after the return?," discusses the emergency public use of the returned spectrum. Another article discusses Rohde & Schwarz supplying transmitters for Qualcomm MediaFLO.

Why was this amusing? Because Qualcomm is planning on putting "up to 100 channels of high-quality video and audio programming" on the spectrum currently occupied by UHF TV channel 55. That's right in the middle of the spectrum that is supposed to be returned for "emergency public use."

Although I respect the honorable Senator McCain's intentions, there is the appearance of impropriety when, according to the second article, there is no pressing need for the "emergency public use." However, there is a company that would like to start getting a return on its investment by selling its digital programming.

That brings up another point: Why are traditional broadcasters being forced from the upper UHF channels if another company can just come in and use one of them for broadcasting "video and audio programming?" Also, are there going to be different rules for traditional broadcasters and Qualcomm? After all, both send "weather forecasts, sports clips, cartoons and the like." Will Qualcomm have to send out EAS alerts and keep a public file? It will be interesting to watch.

The opinions expressed are my own and not that of my employer.

MARK D. BULLA
CHIEF ENGINEER, WNUV-TV

Editor's response:

The key difference between broadcasters and Qualcomm is that what we do is free to viewers. Qualcomm will offer a subscription service.

Don't forget: Qualcomm isn't one of those big, nasty mega content owners that's trying to rule the world either. Perhaps that justifies Senator McCain's actions. Can you say free air time?

Color bars

Michael Robin:

Why are 75 percent color bars used in the PAL system?

KISHORE MAATV
INDIA

Michael Robin responds:

The 75 percent color bars are used in cases where some element in the TV distribution chain cannot handle 100 percent color bars. The difficulty in handling 100 percent color bars is due to the frequency division multiplexing of NTSC and PAL chrominance information with the luminance information, resulting in excessive video signal amplitude and transmitter overload.

Because standard camera-generated video signals are unlikely to reach chrominance signal levels equal to those of 100 percent color bar signals, under normal operating conditions, the transmitter will not be overloaded. Early videotape recorders also had difficulties in handling 100 percent color bars.

Current digital equipment and systems don't have this problem, so A/D and D/A converters are aligned using 100 percent color bars signals. Problems may arise when synthetically-generated video signals, resulting in excessive analog video signal amplitudes, reach an analog NTSC or PAL transmitter. These problems will disappear with the imminent demise of analog television. BE

July Freezeframe:

Q. Which of the following NTSC test signals can be used to measure chroma/luma gain and delay? Color multipulse, FCC composite, Modulated bar, Multipulse 100, NTC-7 composite
A. All of the above

Winner:

Gregory Chambers, WSIL-TV

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 bdick@primediabusiness.com

It's only software

BY CRAIG BIRKMAIER

For seasoned veterans of the broadcast industry, the traditional concept of a video encoder has been — and in many cases still is — a piece of hardware that takes in a video signal and encodes it for emission via the transmitter.

In the analog world, this typically involves taking analog component signals from a camera (RGB) or a piece of component production gear (Y, R-Y, B-Y) and compressing the wideband analog components to fit in a 6MHz NTSC broadcast channel. NTSC encoders are typically built into products so that the analog baseband outputs can be routed throughout the plant and mixed with other NTSC signals.

As described in October's Download column (see "Web links" on page 18), the transition to DTV has been accompanied by new ways to think about video encoding and the proper point(s) in the signal flow of a DTV facility where encoding takes place. Unlike baseband analog signals, compressed digital signals cannot be mixed. They must first be decoded to digital component baseband signals.

For most DTV broadcasters, a real-time, hardware-based MPEG encoder sits between the output of the master control switcher and the input to the DTV transmitter. A far smaller group of broadcasters is moving to systems that splice emission-quality MPEG-2 streams to manage traditional master control tasks.

But software encoders are proliferating outside of the world of DTV broadcasting. Chances are that they are going to play a key role in the future of program delivery, much like they do today in the production of those tiny plastic DVDs that are filled with movies and episodic television programming (without the commercials).

If you are in the business of delivering program files to consumers, software encoders may offer important advantages over real-time hardware. Even if you are in the business of delivering real-time program streams, if they are not live events, there may still be an advantage to using a software encoder and then playing out an optimized file.

The most important distinctions between software and hardware encoders are time and image quality.

Time vs. quality

The most important distinctions between software and hardware encoders are time and image quality. The reality is that digital video encoders are only software — algorithms that run either on dedicated chips optimized for real-time applications or general-purpose CPUs.

To make things even more confusing, most digital compression standards do not specify how an encoder should work; they define the syntax of a properly encoded bit stream so that a compliant decoder can turn the stream back into digital component video for display. Product developers are free to do anything they want, in terms of encoder design, as long as their products produce compliant bit streams.

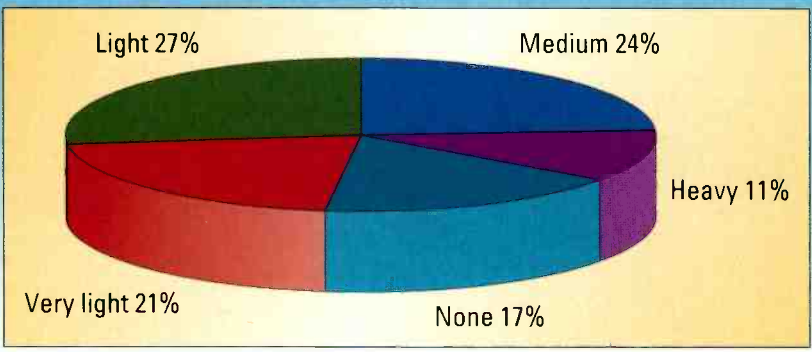
The problem with real-time encoding is time. A new field or frame must be encoded in 1/24th of a second or less, depending on the field or frame rate of the digital source. The time-consuming part of most compression algorithms are the routines used to build predictions of what an image should look like, using already decoded frames that occurred both before and after the predicted frame.

MPEG-2 uses block-matching routines, which can either be done fast or

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

Percent of American on-demand usage

11 percent of Americans are heavy on-demand consumers



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DOLBY®

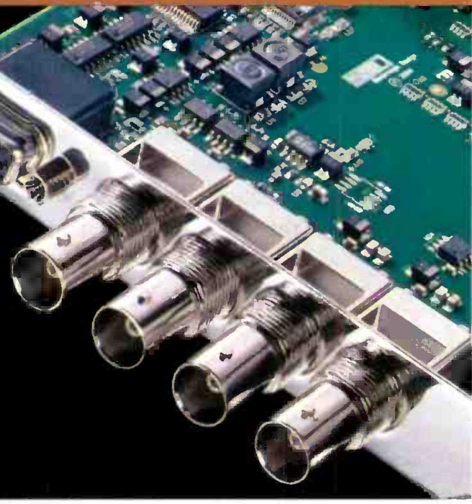
No longer just an MP3 player, the new iPod from Apple allows users to watch home movies, music videos and television shows on a 2.5in color screen. The iTunes store lets users download five popular shows, such as "Lost" and "Desperate Housewives," as well as six shorts from Pixar Animation Studios.

done well. The new H.264 compression algorithm adds significant complexity to these prediction routines and allows for more anchor frames to be used to build the predictions. When time is a factor, these routines may be truncated, but the predictions will not be as good as they could be. The net result is that it will take more bits to send the differences between the prediction and the actual frame. When the channel bandwidth is fixed, this often results in the generation of compression artifacts.

On the other hand, with a software encoder, the prediction routines take as long as is necessary to produce a desirable result. And, if the quality is still not adequate, a compressionist can use additional tricks to improve the delivered image quality, such as forcing I frames at scene transitions or applying pre-filters to reduce the information content so the encoder can produce high-quality images at the available bit rate. Many hardware encoders use pre-filters to reduce information content as well.

When someone goes to the trouble to do the best possible job of encoding, it would seem appropriate to allow the consumer to realize the benefits of that work. That's exactly what happens when you watch a movie on a DVD.

But broadcasters who place the emission encoder at the end of the operations chain can undo all of this extra effort. If a source is encoded with high quality, then decoded for mixing in the master control switcher, the resulting quality may be severely reduced by the real-time encoder at the output of the switcher. Today, all of the commercial networks — except FOX — send their affiliates contribution-quality video, Blackmagic Design **DecKLink**™



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This amazing video card features 10 and 8 bit SD-SDI, HD-SDI down conversion, analog composite and component I/O, balanced analog audio I/O, DV, JPEG, internal keyer, genlock and so much more. Now available with PCI-Express.

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Blackmagicdesign

Visit our website **www.blackmagic-design.com** or call your local DeckLink dealer for more information typically encoded at 45Mb/s for HD and some fraction of that for SD. Because of the higher bit rate, contribution-quality video is typically quite good, but that quality is reduced when it is encoded at emission bit rates.

Clearly, there are benefits to proper optimization of digital compression, but these benefits can only be realized when those optimized bits are delivered to the consumer. This is where emerging business models come into play.

Where do you want your content to go today?

The era when a broadcaster could focus all of his or her resources and attention on the delivery of one program stream is drawing to an end. Today we often hear that the success of broadcast DTV will depend on multicasts. Increasingly, broadcasters are looking to deliver multiple programs in their DTV multiplex, not to mention the need to make some content available via alternative distribution media, such as a station's Web site or a cell phone-based video service.

As described in last month's column, consumers are becoming program directors. With electronic program guides and personal video recorders, viewers can now capture programs and watch them at any time. If a program is being delivered to a local cache, it would seem appropriate to make certain that the encoded bits are properly optimized for the delivery channel at the best quality level possible given bandwidth constraints. This may mean one form of encoding for video is sent to mobile devices, such as cell phones, a higher-quality level is for Internet downloads, and the highest-quality level is for HD programming delivered via DTV broadcasts. Software encoders are often the best choice when it is necessary to generate multiple versions of your content.

Apple and DISH Networks have entered the video download business and introduced portable video players. The new iPod uses H.264 and MPEG-4 compression for video files that are sold via the Web-based iTunes store. The store now offers more than 2000 music videos for download and several hit ABC series, which are available the day after broadcast. The PocketDISH players work with a standard DishPVR, allowing files to be transferred to the portable players for use anywhere, anytime.

DISH Networks entered the portable video player arena with its PocketDISH, available in three models. The units allow users to transfer programs from their DISH Network DVRs for viewing on the go. Like the iPod, users can also store music and photos on the units.

Equally important, most of the new opportunities to expand the reach of your content are being driven relentlessly by the continuous evolution of software encoders and decoders. When Apple or Microsoft releases a new version of QuickTime or Windows Media, it is not uncommon for several hundred million decoders to be downloaded in a month.

Apple continues to have a loyal following of video content creators for both the Mac and PC platforms, in large part because of the QuickTime digital media architecture. This architecture supports a long list of proprietary and standards-based codecs for audio, video and still images, and it allows manufacturers to extend the capabilities by providing their own plug-in components. (See "Web links.") The QuickTime container format forms the basis for the MPEG-4 file format, enabling sophisticated local video composition capabilities when the entire MPEG-4 standard is used.

Microsoft has taken a proprietary route with Windows Media technologies (see "Web links.") and has succeeded in getting its VC-1 compression technology adopted for the next generation of HD DVD products and many IPTV deployments.

The bottom line is that software encoding and decoding is going to play an important role in the future of television. In a world where people are moving from surfing 500 channels of TV to searching for and caching the programs they want, delivering high-quality video files optimized for a wide range of playback devices may be critical for survival. BE

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

SEND Send questions and comments to:
craig_birkmaier@primediabusiness.com

Web links

"Viewers: The new program directors"
http://broadcastengineering.com/mag/broadcasting_viewers_new_program

Apple QuickTime
www.apple.com/quicktime

H.264 FAQs
www.apple.com/quicktime/technologies/h264/faq.html

MPEG-4 products and services
www.mpegif.org/products/mpeg-4.php

Microsoft VC-1
www.microsoft.com/windows/windowsmedia/forpros/events/NAB2005/VC-1.aspx

BEYOND THE HEADLINES

Children's programming rules

BY HARRY C. MARTIN

A little more than a year ago, the Office of Communications of the United Church of Christ (UCC), led by former FCC commissioner Gloria Tristani, challenged the license renewal applications of two Washington, D.C., area television stations on the grounds that they had failed to provide sufficient educational and informational children's programming under the FCC's rules.

In September 2004, the UCC filed petitions to deny two more Cleveland-area television stations. The UCC petitions allege that both WUAB-TV and WQHS-TV failed to comply with the Children's Television Act (and associated FCC rules) because the programs were not educational or informational. This claim was based in large part on the opinions of UCC members and staff who watched episodes of the programming in question and evaluated them based on the UCC's criteria.

Although the Children's Television Act and the associated FCC rules direct broadcasters to serve the educational and informational needs of children, the FCC has left the actual programming choices up to the discretion of individual licensees. From the programs that the FCC has previously cited as educational (e.g., "Saved by the Bell"), licensees generally appear to have broad discretion in selecting programming that is educational or informational fare.

The UCC is, in effect, asking the FCC to substitute its judgment for that of the licensees of WUAB and WQHS. The approach urged by the UCC would place the FCC in the role of evaluating programming content and, more ominously, regulating on the basis of that evaluation. This raises the question of how the FCC, under the First Amendment, could determine how good a program must be to pass muster under the children's programming rules.

The FCC has not acted on the UCC's first two license renewal challenges, and it is unlikely that we will see action on the new petitions any time soon. It also is uncertain when the FCC will resolve the many challenges to its new children's programming rules.

Regardless of how these matters are resolved, stations are cautioned to review their children's programming. Television stations are required to air at least three hours of programming that qualifies as core children's programming per week. To qualify as core, a program must:

1. have as a significant purpose serving the educational and informational needs of children ages 16 and under
2. be aired between the hours of 7:00 a.m. and 10:00 p.m.
3. be regularly scheduled on a weekly basis
4. be at least 30 minutes in length
5. have an educational and informational objective and the target child audience as specified by the licensee in writing in its Children's Television Programming Report (FCC Form 398)
6. be identified on-air and in program guides as educational or informational.

In addition, beginning Sept. 19, 2006, TV stations are required to identify a core children's program with the symbol "E/I" on screen *throughout the program's entire broadcast*. Licensees facing upcoming license renewal applications will need to ensure that the required Children's Programming Reports have been properly prepared and filed in a timely manner with the FCC. BE

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

SEND Send questions and comments to:
harry_martin@primediabusiness.com

Dateline

Dec. 1 is the deadline for TV stations in Colorado, Minnesota, Montana, North Dakota and South Dakota to file their 2005 license renewal applications, biennial ownership reports and EEO program reports. TV translator stations, LPTVs and Class A TV stations in these states must file renewal applications on Dec. 1. Class A TV stations also must file EEO program reports.

Dec. 1 is the start date for pre-filing renewal announcements for television stations in Kansas, Nebraska and Oklahoma, in anticipation of renewal application filing on Feb. 1, 2006.

Dec. 1 is the deadline for the filing of biennial ownership reports by television stations in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.

Dec. 1 is the deadline for all DTV licensees to file a report on FCC Form 317, identifying the ancillary or supplementary DTV services they have offered during the previous year. Where fees were charged for such services, licensees must remit 5 percent of their gross fees to the FCC in connection with filing Form 317.

Audio multiplexing

BY MICHAEL ROBIN

Delivery of television to private homes requires the transmission of video and audio signals. This requires some form of multiplexing of the two messages for transmission down a common communications path, e.g. medium, circuit or channel. Early developments resulted in the concept of frequency-division multiplexing (FDM). The advent of digital technology brought with it the concept of time-division multiplexing (TDM).

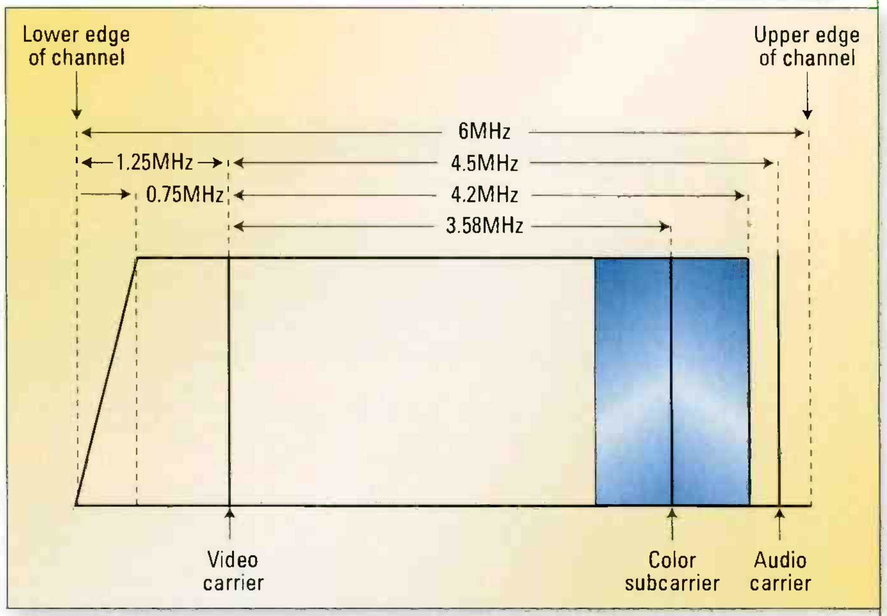

Figure 1. Details of an NTSC transmission channel

Typical FDM applications

In 1941, when television came of age in the United States, the VHF, and later the UHF, spectra were organized into 6MHz channels, carrying separate video and audio carriers, with a spacing of 4.5MHz. The video carrier uses negative amplitude modulation, with a vestigial lower sideband of 0.75MHz and a full upper sideband of 4.2MHz. The audio carrier is frequency modulated and has a p-p deviation of ±25kHz.

The receiver amplifies the two carriers in a single intermediate frequency (IF) amplifier. The video detector recovers the original 4.2MHz video spectrum and creates a 4.5MHz beat (intercarrier), amplitude modulated by the video information and frequency modulated by the audio information. A limiter removes the amplitude modulation of the 4.5MHz intercarrier, and an FM detector recovers the original audio information.

When color was added in 1953, the color information was transmitted by amplitude and phase modulation of a suppressed chrominance subcarrier with a center frequency of about 3.58MHz, an odd multiple of half the horizontal scanning frequency. The chosen subcarrier frequency resulted in frequency domain interleaving of the two spectra, resulting in a minimal crosstalk between them.

Figure 1 shows the FDM spectrum of an NTSC channel. In 1984, the FCC adopted the BTSC Stereo TV format, which is similar to FM stereo but has the ability to carry two additional audio channels, namely the

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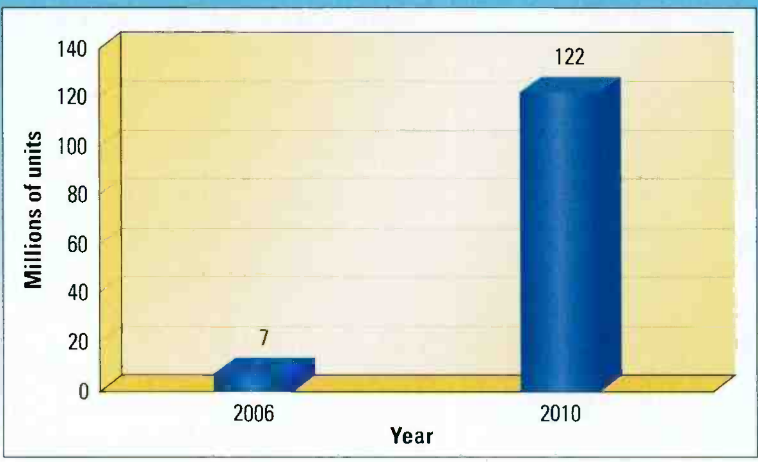

Source: TDG Research www.tdgresearch.com

secondary audio program (SAP) and a low-fidelity audio channel.

Left plus right mono information is transmitted in the same way as in stereo FM. A 15,734.25Hz pilot is used, which allows it to be phase-locked to the horizontal scanning frequency (fH). A double sideband suppressed carrier, at twice the frequency of the pilot, transmits the left minus right stereo information.

The SAP channel is located at five times the pilot frequency and is frequency modulated. It may be used to carry a second language or an independent program source.

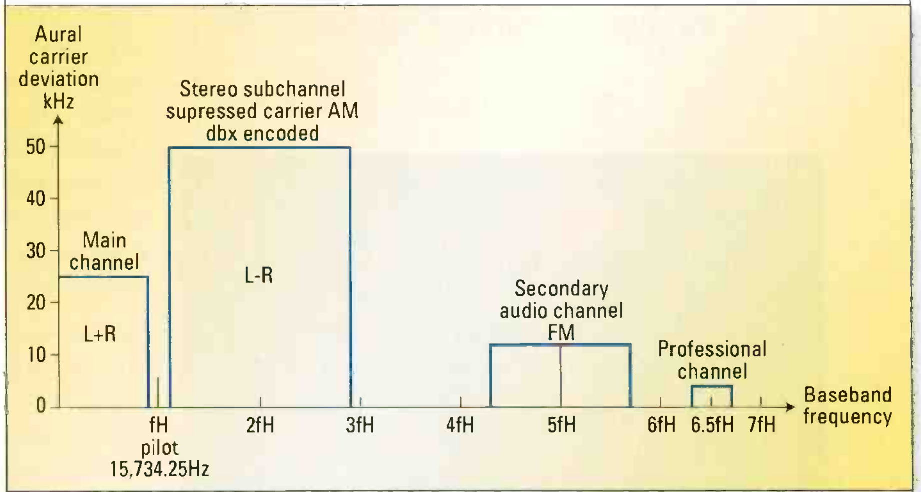

Figure 2. BTSC signal baseband spectrum

A professional audio channel may be added at 6.5 times the pilot frequency ... for data or voice messages.

Finally, a professional audio channel may be added at 6.5 times the pilot frequency. This is a low-fidelity channel used for data or voice messages. FDM is popular with television people. Figure 2 shows the BTSC baseband spectrum.

Typical TDM applications

An important TDM application is the insertion of digital audio signals into a digital video data stream. This is possible because the digital video data streams have a considerable amount of overhead. This is due to the fact that the horizontal and vertical blanking intervals are empty, except for four words of data identifying the end of the active line (EAV) and another set of four words identifying the start of the next active line (SAV). The rest of the horizontal blanking interval is available for the insertion of ancillary data such as digital audio.

The 4:2:2 component digital standard can easily accommodate eight AES/EBU signals (eight stereo pairs or 16 individual audio channels) and leave a considerable amount of overhead for other uses. The ANSI/SMPTE 272M document defines the manner in which AES/EBU digital audio data, AES/EBU auxiliary data and associated control information is embedded into the ancillary data space of the bit-serial digital video conforming to the ANSI/SMPTE 259M standard.

The 4:2:2 525/59.94 component digital signal can accommodate 268 ancillary data words in the unused

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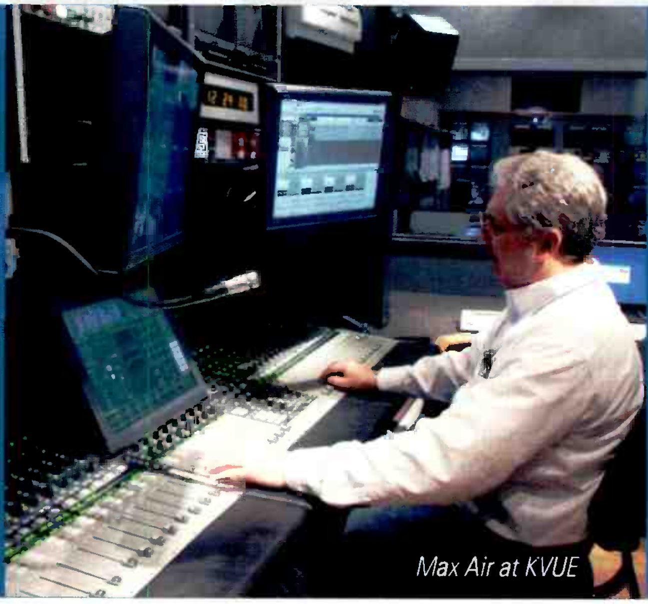

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data space between the EAV timing reference and SAV timing reference.

Figure 3 shows the ancillary data packet structure for the 4:2:2 component digital interface. Each packet can carry a maximum of 262 10-bit parallel words. A six-word header precedes the ancillary data and contains a three-word ancillary data flag (ADF), marking the beginning of the ancillary data packet (values are 000, 3FF, 3FF, respectively), an optional data identification (DID) word identifying the user data, an optional data block number (DBN) word and a data count (DC) word. A variable number of data words, not exceeding 255, follows. The packet is closed by a checksum (CS) word, allowing the receiver to determine the validity of the packet.

Multiple, contiguous, ancillary data packets may be inserted in any ancillary data space. They must follow immediately after the EAV to indicate the presence of the auxiliary data and the start of a packet. If there is no ADF in the first three words of an ancillary data space, it is assumed that no ancillary data packets are present.

Figure 4 shows an example in which two data streams (AES/EBU data stream 1 and AES/EBU data stream 2) are formatted for embedding into a 4:2:2 525/59.94 component digital signal. Here are the steps involved:

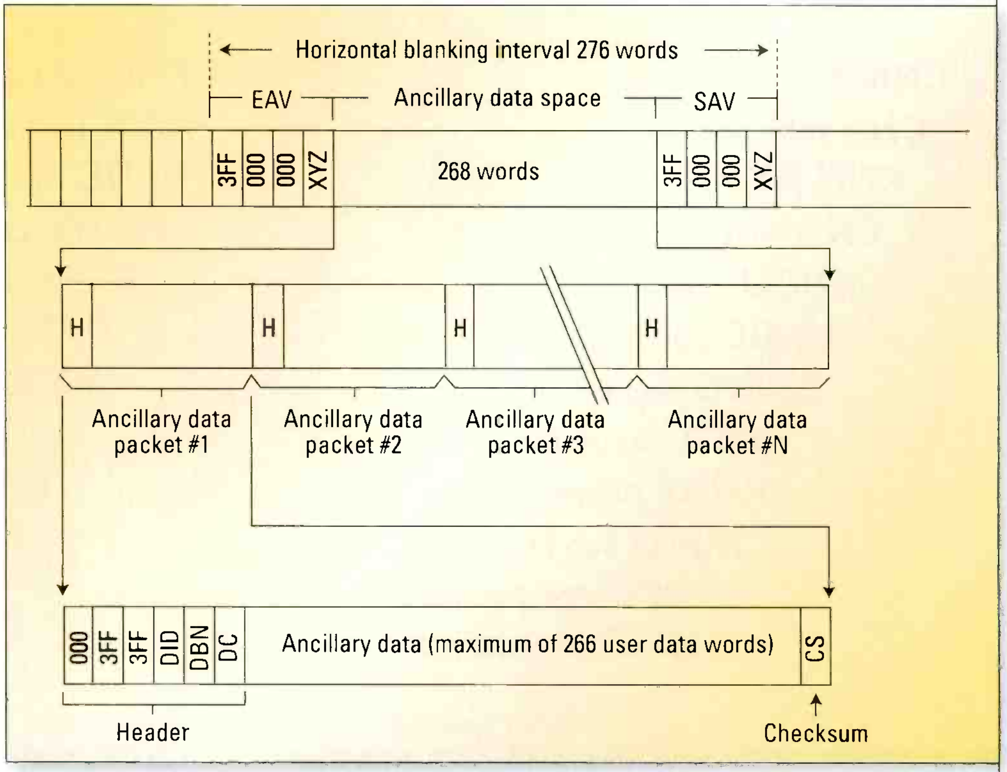

Figure 3. Ancillary data packet structure for 4:2:2 525/59.94 format

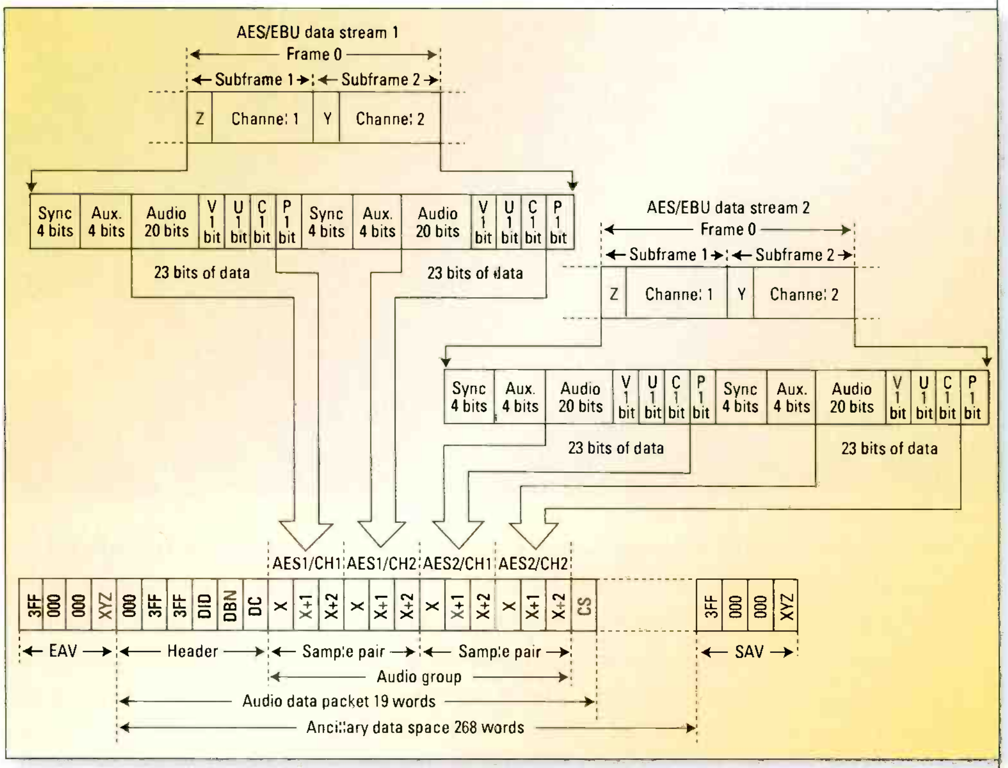

Figure 4. Audio data packet formatting from two AES/EBU data streams

- A six-word header starts the audio data packet.
- To begin the embedding sequence, frame 0 of AES/EBU data stream 1 provides data from its subframe 1 and subframe 2. Each of these subframes is stripped of the four sync bits, the four auxiliary bits and the P bit. The remaining 20 bits of

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Bit address	Word X	Word X+1	Word X+2
b9	not b8	not b8	not b8
b8	audio 5	audio 14	P
b7	audio 4	audio 13	C
b6	audio 3	audio 12	U
b5	audio 2	audio 11	V
b4	audio 1	audio 10	audio 19 (MSB)
b3	audio 0 (LSB)	audio 9	audio 18
b2	channel 1	audio 8	audio 17
b1	channel 0	audio 7	audio 16
b0	Z	audio 6	audio 15

Table 1. Formatted audio data structure

audio and the V, U and C bits — a total of 23 bits of subframe 1 — are mapped into three consecutive 10-bit words identified as X, X+1 and X+2 of AES1/CH1.

- The 23 bits of subframe 2 are similarly mapped into three consecutive 10-bit words identified as X, X+1 and X+2 of AES1/CH2.
- AES1/CH1 and AES1/CH2 form a sample pair.
- To continue the embedding sequence, frame 0 of AES/EBU data stream 2 provides data from its subframe 1 and subframe 2. These data are similarly reduced to 23 bits and result in sample pair AES2/CH1 and AES2/CH2.
- The two consecutive sample pairs form an audio group.
- The 19-word audio data packet closes with a CS word.
- Subsequent horizontal blanking intervals will accommodate frame 1 of AES/EBU data stream 1 and data stream 2, frame 2 of AES/EBU data stream 1 and data stream 2, and so on until the 192 frames (each constituting one AES/EBU block) of each of the two AES/EBU data streams are embedded.
- From then on, a new block of 192 frames coming from the two AES/EBU data streams will be embedded, and the process will continue.
- At the receiving end, the packets are extracted and fill a 64-sample buffer from which the original data are extracted at a constant bit rate and reformatted.

If the video signal has to feed a production switcher for further processing, the audio has to be demultiplexed and processed separately.

Table 1 shows the audio data structure represented by the three 10-bit data words. Two bits indicate the channel number, and a parity is calculated on the 26 bits, excluding all b9 address bits.

Conclusion

The distribution of digital audio and video signals inside a TV studio complex using a single coaxial cable is advantageous if the multiplexed signal does not have to be processed separately — if the product is ready for distribution or transmission. However, if the video signal has to feed a production switcher for further processing, the audio has to be demultiplexed and processed separately. This may prove to be awkward and costly.

If the signal has to exit the production area for distribution or transmission to other locations, the data stream has to be demultiplexed and encoded into an MPEG data stream in order to fit the capabilities of the chosen common carrier. Whether to embed is a decision that requires a clear understanding of the predictable and unpredictable operational and distribution requirements. **BE**

Michael Robin, fellow of the SMPTE and former engineer with the Canadian Broadcasting Corp.'s engineering headquarters, is an independent broadcast consultant located in Montreal. He is co-author of "Digital Television Fundamentals," published by McGraw-Hill and translated into Chinese and Japanese.

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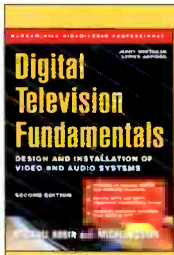

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RAID for broadcast

BY BRAD GILMER

By now, most broadcasters have heard the term RAID. RAID stands for redundant array of inexpensive disks. Typically, RAID systems work by storing a little bit of extra information called parity bits along with the regular data. If a disk fails, these parity bits allow the array to rebuild data.

This month we will focus on key features and considerations for RAIDs used in the broadcast and post-production environments.

There are a number of features that are important in generic RAID applications. The following are a list of features and considerations that are especially important for broadcasters who are contemplating using RAID in their facilities for video and audio content.

It is extremely important that you monitor the health of the RAID array on a regular basis.

Easy access to drives

All of us have seen RAID arrays that have large numbers of drives right at the front of the storage device. But I have seen some RAID implementations where the drives were buried deep inside the storage system. I would argue that this design negates the purpose of having the RAID in the first place. If you have to shut the system down entirely, take the equipment out of the rack and unscrew a lot of hardware to get to the drives, then you might as well have a single disk.

Hot-swappable drives

Many RAID arrays are designed so that drives can be replaced while the unit is still in service. If the objective of having a RAID solution is to avoid downtime, then this feature can be key.

Hot-swappable drives have special connectors that are designed to break and make connections in a specific order so that components are not destroyed as the drive is removed or installed. Many people think that hot swappable also means that the drive will automatically rebuild (see next point); however, this is not necessarily the case.

Rebuild in background

This feature allows the data on a drive to be reconstructed from the data on other good drives in the array. As noted above, RAID arrays can recreate missing data on the fly so the application never notices a drive has failed.

RAID arrays can also put this capability to work to recreate the data and write it to a new drive once it is installed in the array. Of course, you would expect this functionality to be available. But be careful. You may or may not be able to rebuild the data on the new drive without having to shut down the array. This used to be an exotic feature, but it is becoming much more common. If this functionality is important to you, be sure to ask for it.

Online spare

When a drive fails, the extra drive can be put online — in some cases, automatically. This can be a valuable option for critical RAID arrays. Remember, however, that the drive will still have to be rebuilt. Because there is no way to know in advance which drive will fail, it is impossible to have the extra drive ready to go at a moment's notice.

SNMP and other remote monitoring

This is one of my favorite topics when it comes to RAID arrays, and it is one I would encourage you to think about carefully. If one of the characteristics of a RAID array is to keep on working even when a drive fails, how will you know when a drive fails? If you lose a drive in a RAID array and then lose another drive in the same array before the first drive is replaced and rebuilt, will the RAID array keep working?

The answer to the first question is that you will not have any notice that a drive has failed if you are not monitoring the RAID's status. The answer to the second question is that the RAID will not keep working if a second drive fails.

It is extremely important that you monitor the health of the RAID array on a regular basis. In some cases, RAID monitoring is built into the application. If a drive quits, the application lets the operator know. But many times, especially when using generic (non-broadcast) applications, there is no notification to the user that a drive has failed. With that said, every RAID array I have ever seen has provisions for monitoring drive status, and almost all of them have remote monitoring provisions.

Be sure to incorporate monitoring of RAID arrays into your overall maintenance system. If you fail to do this, you are wasting the value of RAID. Eventually, two drives *will* fail. When they do, you will be in the same position you would be in with a single large drive.

As Figure 1 on page 32 shows, the vulnerable period begins when a drive

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in an array fails and lasts until the drive has been replaced, rebuilt and is back online. If, during this vulnerable period, another drive fails, then the RAID array will fail and data will not be available. If you are not monitoring the health of your RAID systems on a regular basis, the time from drive failure to replacement may become exceedingly long, exposing you to a potential complete RAID failure.

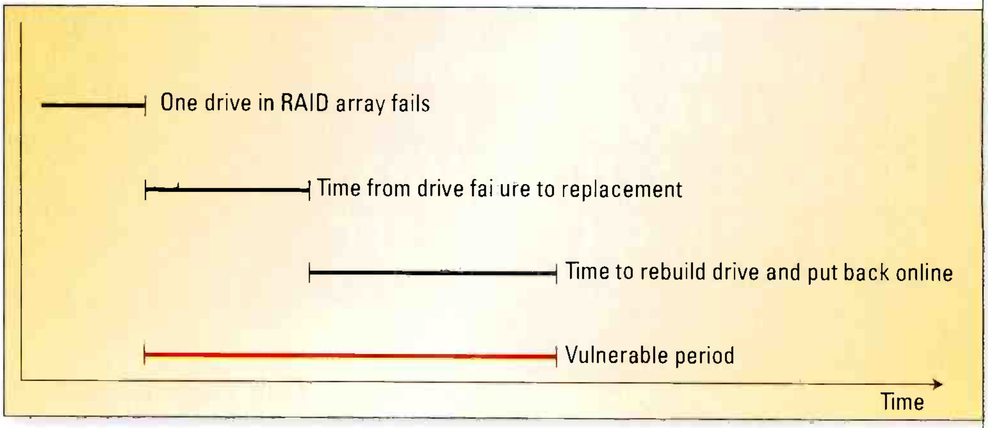

Figure 1. The vulnerable period begins when a drive in a RAID fails and lasts until the new drive is installed, rebuilt and back online.

Dual power supplies and redundant cooling

Dual power supplies and redundant cooling are quite common in RAID arrays. If you have an important service that you want to protect with a RAID array, be sure your array has these features.

The array should continue to work with a failed cooling fan. I have seen a number of RAID arrays that incorporate fan speeds and temperature alarms into their remote monitoring facilities. Because drives can fail when they get too hot, it can be important to have remote monitoring on cooling systems.

Redundant controllers

If you are looking to eliminate downtime, then you should look at the entire system, not just at the disks.

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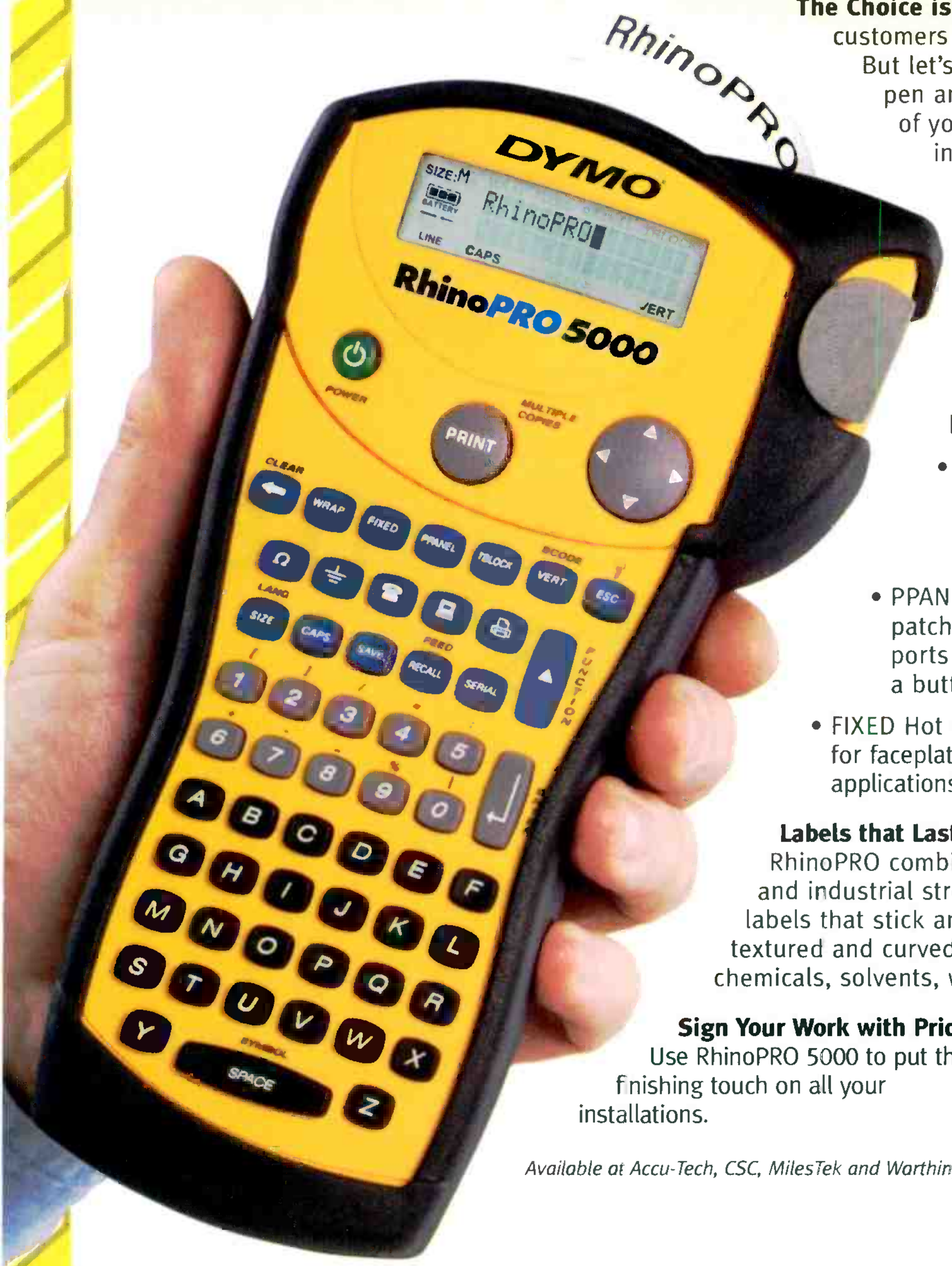

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RAIDs were developed to provide redundancy for rotating storage media, and they perform this task well (especially when vigilantly monitored).

However, electrical components do fail, and a RAID array connected to a single controller will not protect you from a controller failure. The disk controller is the electrical interface between the computer and the storage unit. In many higher-end systems, you can purchase a second controller as an option. If one of the controllers quits, the other takes over. Occasionally, you will see this described in literature as dual redundant controllers, but this seems a little redundant to me.

Rebuild time

It's important to know how long it takes your system to rebuild after a drive replacement. The more time it takes to rebuild and place a new drive online, the longer you're exposed.

If during the rebuild time you lose another drive, the entire RAID system will fail. While the chances of experiencing two drive failures within a few hours of each other are remote, it is important to know that during the rebuild time, your system is vulnerable.

Testing

The best way to know for sure that your RAID system supports the features you expect is to test it. Assuming your system supports hot swapping and rebuilding in background, try the following:

1. Pull out a drive while the system is in operation (hopefully during commissioning tests, and not when it is actually on-air!). Does the system keep running normally? Do you see any indication that the drive has failed either in the application running on the RAID or on your monitoring system?
2. Plug the drive back in. Do you see any indication that the drive has been installed either in the application running on the array or on your monitoring system? Does the drive begin rebuilding by itself, or do you have to do something to initiate a rebuild? How long does it take before the drive is online again and ready to use?

RAID systems are great examples of how broadcasters can leverage IT technology to create more reliable platforms for their applications. But it is important to understand the features available and how they work to be sure that you get the expected performance from your array. BE

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

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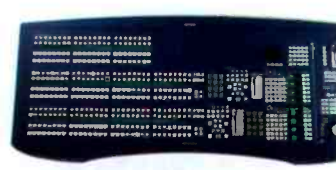
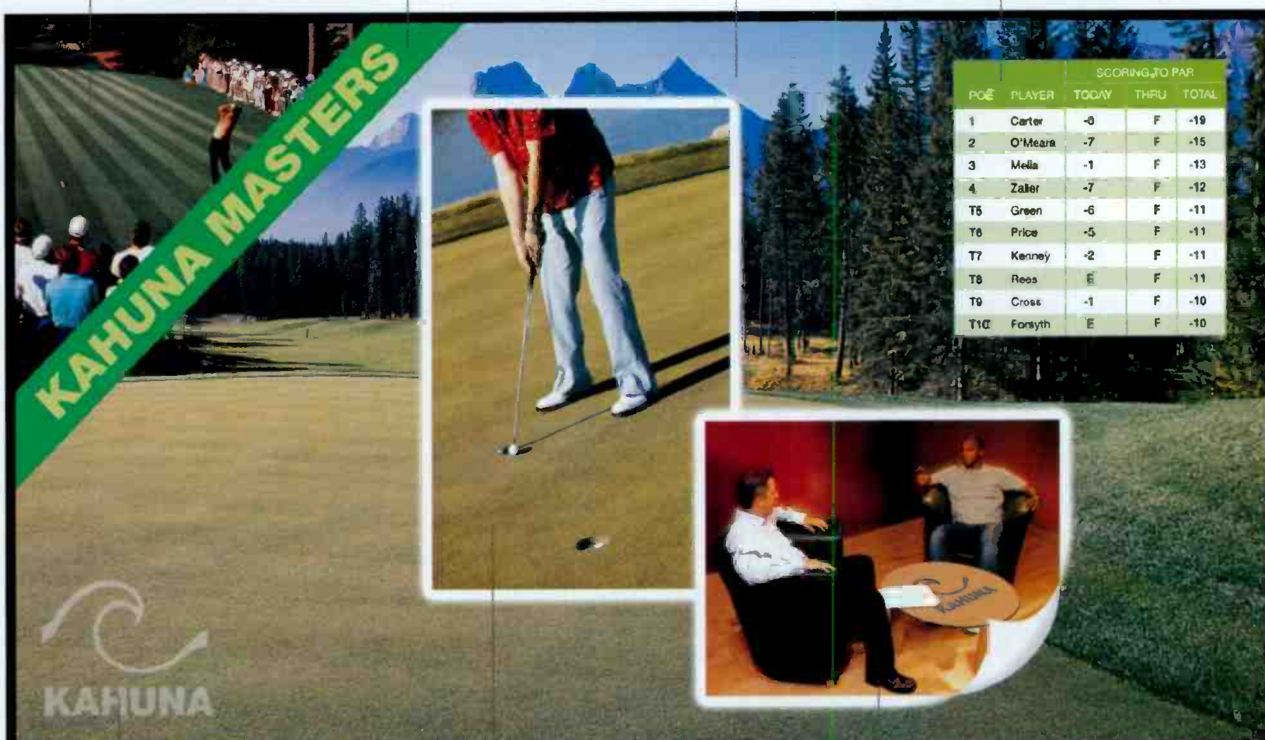


2 M/E Control Panel

KAHUNA INTEGRATES SD SOURCES INTO HD PROGRAMS WITHOUT UPCONVERSION

Example of HD Output from a Single M/E Using Mixed SD/HD Inputs

HD background B | **Wipe bar provided by Utility Bus** | **HD background A** | **SD character generator output using FormatFusion and resize engine**



Animation via one of the internal clip stores | **SD hand held camera shot using FormatFusion and resize engine** | **HD camera studio shot 'squeezed back' using picture resize engine and HD 3D DVE page turn effect**

Kahuna is the first production switcher system in the world to offer simultaneous standard definition and high definition operation in the same mainframe with the same control panel.

Even more remarkably, thanks to a new technology called FormatFusion, it enables you to integrate any SD material, such as camera feeds, graphics or archives into live HD productions, seamlessly, without the need for upconversion.

The most advanced production switcher in the world deserves the best support. That's why we've designed Kahuna Care. It's a package of service options designed to ensure that Kahuna continues to meet your operational requirements at all times.

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FORMATFUSION

NLE rendering: Multiple solutions

BY STEVE MULLEN

Back in the linear age, the words *render* and *real time* were not uttered as FX was incorporated into productions. Even in the early days of the nonlinear age, these concepts were not required.

That's because while the media was stored on nonlinear devices and a computer controlled the editing process, special effects were performed in a DVE and CG that was controlled by the controller. The media stream never entered the computer. (See "Post-production evolution," in *Broadcast Engineering's* August 2005 issue.)

As computers became faster, it was possible to route video through the computer. An A/D converter digitized the audio and video. It was now possible to perform dissolves and wipes. Wipes were performed by bit-BLT operations that simply moved one array of video across another. For anything more complex, video was still passed to an external DVE. It was definitely necessary to produce 3-D effects using external hardware.

Eventually, the operations performed by a box could be performed on a computer board. From there, the circuitry shrank to a single IC that could be mounted on the board that digitized video and audio.

Then, two types of FX could be employed. Simple wipes were performed by the computer's CPU. Complex FX were performed by ICs. Although both types of effects were rendered (most folks only talked about the computer effects as rendered effects if the effects' video stream were to be recorded to videotape), naturally the rendered effects had to be real-time effects.

In an effort to drive NLE prices lower, engineers realized that there was a distinction between preview video and recorded video. This set the stage for another type of effects — real-time rendered effects that were not of final recordable quality.

There are four fundamental techniques employed to produce previews — each with its own advantages and disadvantages. The fundamental division is between the use of render buffers and the use of quality reduction. Both of these categories exist in two forms: static and dynamic.

Static render buffer

As it became cost-effective to equip computers with large amounts of RAM, it became practical to render effects at less-than-real-time speed into a RAM buffer. Upon pressing "preview play," the buffer was filled. Then, the RAM buffer would play out the video to both RGB and NTSC/HD monitors. The output rate would be exactly 29.97fps. Sony Vegas uses this approach. The disadvantage is obvious: the disturbing wait before playback.

Naturally, the move to HD has only exacerbated the problems of working with a static buffer. Because of the huge increase in frame size, rendering time increases many fold. And naturally, the buffer must be significantly larger — large enough that only a 32-bit OS can allocate and manage the buffer.

Dynamic render buffer

To eliminate the delay before a video preview begins, a far more sophisticated design was developed by Canopus. Upon initiating a preview, the PC's processor decompresses one or more video streams to 4:2:2 YUV frames. Then, based on the structure of the timeline, effects are rendered in the correct order to each frame. The PC's processor renders all effects.

Each rendered, uncompressed frame is then stored in a large buffer held in system memory. Using double buffering, the buffer is drawn upon at exactly 29.97fps and sent to both an overlay on the RGB monitor and to the NTSC/HD analog output.

When there are no FX, the buffer fills with rendered frames. When the effect workload is light, the buffer will not be emptied. At intermediate workloads, the number of frames in the buffer will slowly drop over time. If, however, a complex effect — or a combination of effects — is encountered, the buffer may be emptied quickly.

Sandra Scagliotti uses the Canopus EDIUS Pro 3 for native editing and real-time processing to mix video content for Vaterman Broadcasting's NBC and ABC affiliates in Ft. Meyers, FL.

Effect placement is critical. During playback on a fast machine, when no effects are being output, the PC processor will render effects further down the timeline and fill the buffer. This makes the spacing of effects important for real-time operation.

A complex effect can be kept in real time if preceded by a period without effects. If, however, demanding effects are placed too close together, real-time output may not be maintained. While this FX technology can work beautifully, it is impossible to guarantee a real-time preview because it depends on the nature of the timeline itself.

A variation of this technology is background rendering. Apple's Final

Cut Pro and iMovie use this technology. As soon as an effect has been defined (or after a defined period of time), rendering begins with output to a double-buffered disk file.

If you are the type of person who writes with spell check turned off so as not to interrupt the flow of words, this is a great system, especially because it is so easy for the render task to be spawned to one or more threads — something dual-core processors are perfectly equipped to handle. Conversely, if you like to fine-tune each effect before moving on, background rendering will be of little value to you.

Static quality reduction

Media 100 engineers first implemented a scheme that enabled transitions to be previewed by only working with one field from each stream. (Only working with fields is not practical with MPEG-2 because an entire frame must be decoded to obtain video.)

Pinnacle's Liquid Edition PRO is an example of a system that uses a graphics processor unit to support real-time review of many video streams. The screen capture above is of the editing interface, showing A-B windows, the open timeline and the source files.

Other variations on this approach are to reduce the amount of data rendered by using only every other horizontal pixel or to drop frames as needed, which results in playback stuttering — even though the effect may be claimed to be real time. A better approach would be to simply skip every other frame, thereby outputting smooth 15fps video.

Dynamic quality reduction

Rather than choosing a fixed real-time product strategy, it is possible for an NLE's rendering engine to analyze a timeline and generate a rendering approach that maximizes real-time performance. To maximize performance, the engine can define the rendering technique to be employed for every frame. (Final Cut Pro uses this approach.)

The editor can select strategies that maximize video quality or optimize preview frame rate. When the former is selected, the engine will not need to operate at 29.97fps, though every effort is made to keep playback smooth.

Conversely, to achieve perfect playback, obvious options are to skip fields or use every other pixel on a line. This degrades quality as needed to keep preview speed at 29.97fps.

By selecting neither constraint, the engine maximizes both image quality and playback quality. One downside to Apple's technology is that as part of its approach in reducing image quality effect, features are simply dropped. For example, a blur on a transition's edge is eliminated.

Avid offers a similar type of rendering engine. However, no effect features are eliminated to increase performance. These types of subtle distinctions make it impossible to compare NLEs based on the number of real-time effects or the number of real-time streams.

Hybrid approaches

Clearly, if a corporation is willing to invest the necessary engineering resources, it is possible to develop rendering engines that combine multiple technologies. Vegas, for example, offers several levels of image quality reduction. It would be possible to combine this approach with dynamic rendering quality. Dynamic rendering quality could also be combined with a dynamic render buffer so that it would be less sensitive to timeline complexity.

Hardware remains

Pinnacle's Liquid Edition PRO supports real-time preview of many video streams by using a graphics processor unit (GPU). Data streams are transferred from disk via the PCI bus to buffers in system RAM. The PC's CPU grabs the data directly from system RAM and decompresses it.

For complex 3-D effects, uncompressed video from system RAM is transferred via the AGP bus to graphics RAM. The GPU on the AGP card then generates the complex effects. By using a GPU to render effects, not only are complex effects rendered rapidly, but also the total data transfer load is balanced between two separate PC busses — PCI and AGP.

After the GPU renders effects, the resulting uncompressed frame is held in graphics RAM. This is a perfect location. From here, the frame can be output via the graphics card's DVI/VGA port to provide an editor with a real-time preview. It can also be output as real-time analog video.

Hardware returns

While it is possible to compress DV using a computer's CPU, real-time HD MPEG-2 encoding is far from being a reality. This can cost many hours of encoding before a timeline can be recorded.

A potential solution is to incorporate a hardware MPEG-2 encoder. Although this will add cost and perhaps prevent HDV laptop editing, it has two advantages. Obviously, it enables direct HD recording without an encoding delay. It also supports the output of an MPEG-2 TS stream via FireWire to an HDV camcorder that in turn converts it to an HD analog component output for display on an HD monitor. An alternative, provided by the Canopus EDIUS NX, is a PCI board that outputs SD/HD analog component video.

When hardware DV and MPEG codecs are incorporated in an NLE, these systems will function much like linear editors of the last century when every type of output was real time. BE

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

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Lakewood Church

designs for a live and TV audience

Lakewood Church began with its first meeting in a feed store on the outskirts of Houston in 1959. The church eventually moved to a more suitable building, and its congregation grew through outreach in the community, books written by founding pastor John Osteen and a weekly television program. Upon Osteen's death in 1999, his son, Joel, took over. Since then church attendance has tripled.

The church property and the local infrastructure, such as local roads, parking and other considerations, could not handle the growing congregation. Traffic was backed up for miles. Add to this the burgeoning international television outreach, and the church knew it needed something bigger. The church signed a 60-year lease with the city of Houston for the former Compaq Center and home of the Houston Rockets. After nearly two years of planning and construction, the new church opened in July of this year.

The church can hold 16,000 people in the main sanctuary and hosts an advanced television production

With the addition of Avid workstations and extra digital Betacam machines, Lakewood Church can simulteanously create multiple versions of its program.

BY TIM WETMORE

facility that feeds programming to an international audience of 200 million people in more than 100 countries. The renovation of the entire arena cost about $95 million.

Lofty goals

The fundamental goal of the television production facility was to be able to produce the highest-quality digital audio and video programs without interfering with the live audience's experience in the sanctuary. The church produces three programs: a half-hour show; an hour-long program with music, requiring a sophisticated audio facility; and a one-hour live Spanish program.

And though the church primarily intended the facility to serve as a source for recorded television programs and for DVD production, there are occasional live broadcast feeds that needed to be taken into account as well. When these issues were under consideration nearly two years ago, the church's technology decision makers, including Jon Swearingen, director of broadcast media, and Reed Hall, director of audio development, chose Beck Associates as the integrator.

Having reviewed a lot of their work, and knowing they worked well with the Russ Berger Design Group, which would be designing the broadcast studio, Swearingen considered it a win-win situation. The church's engineer, Andre Guidry, was instrumental in bringing the parties together, designing the facility and specifying most of the gear with input from Beck.

The initial idea, in addition to gutting the entire facility and rewiring it with fiber, involved constructing and wiring a new, connected building to house the actual production gear. The new building is attached to the old arena on the side opposite the sanctuary. The media center takes up the entire fifth floor of the new building.

Bearing in mind that these are live services and production cannot interfere with that experience, set design, lighting design and sight lines for cameras were important issues. The design team chose eight camera locations within the arena. And even though the church is currently running SDI, the design team opted for Sony HDC-900 high-definition models to prepare for the future. In fact, the complete facility is AES- and SDI-compliant. Acquisition is on digital Betacam.

Because signal runs were going to be long — running from the main sanctuary to the adjacent television media center — everything had to be pushed through fiber with almost no copper in the entire facility. The designers avoided analog routing because of the distances, so there is only one analog router and everything is converted at the device. Cable paths were minimized both to save money and maintain quality.

Three jibs were placed in the sanctuary to offer unique views of the services. The jibs are located by the stage, halfway back in the arena seating and in the rear.

All cable is upgradeable to HD, so when the switch from SDI is made, the facility won't have to yank out a lot of it. The designers also had the foresight to use DAs that handle HD, so those won't have to be swapped out later.

Even though the design criteria dictated that the 16,000 live attendees have great sight lines, the message is also broadcast to a worldwide audience. Three specially constructed jibs placed in the sanctuary offer unique views of the services and increase production value. One jib is located by the stage, one is halfway back in the arena seating, and a third is at the rear.

Heavenly sound

Among the important challenges to address in such a cavernous arena were the architecture and acoustical issues. The Russ Berger Design Group also looked at the live sound design. The issues here may be unique to this type of television production, as each TV program is also essentially a live music event with big JBL Line Array speakers positioned around the stage. This created challenges for recording the audio and video.

As the television production design continued, the church requested that the Russ Berger Design Group also oversee the live acoustics analysis. They worked hand in hand with Audio Analysts out of Colorado, and they came back with more than $1 million in recommendations for correcting problems. That was later modified to more than $500,000 in acoustics treatment, with emphasis in isolation of the underside of the arena so they could have programming in a separate room while the service was going on. Most important, the air design had to be reconfigured and bass traps used throughout.

Three Euphonix System 5 consoles, which feature high-quality four band EQ, dynamics, surround sound and a powerful automation system, provide the facility's audio.

Because music is involved in the live service and in two of the three televised programs, the audio recording function was a critical element in the success of the facility design. The audio for the entire facility is centered around three Euphonix System 5 consoles, all working off the same engine.

All signals coming off the stage are directed to a room adjacent to the stage, where they are converted to digital signals and sent via fiber to the media center. The signals then are returned via fiber to the FOH position for the live feed. The broadcast feed is mixed on a separate System 5 and recorded for tape-delayed broadcast.

Equipment list

ADC patch bays
Alesis Masterlink CD recorder
AMD dual-core AMD Opteron processors
Avalon 727 microphone pre-amplifiers
Avid
- DS Nitris video editor
- Symphony video editor
- Media Composer Adrenalin video editor

Cobalt 5018 serial digital to analog converters
DK Technologies MSD600 audio monitor
Doremi V1m video server
Euphonix System 5 audio consoles
Facilis TerraBlock 7.2TB video servers
Fujinon HD camera lenses
Genelec 1037C and 1032A 5.1 speaker systems
John Hardy 1032A two channels of mic preamplifier
JBL Professional VerTec Service Line Array speakers
Kurzweil KSP8 effects processor
Leitch FR-6804-1 mounting frame and power supply
Lexicon MPX 1 effects processor
Neumann KM 184 microphones
NVISION NV8256 Plus digital video router
Panasonic AG-850 edit controller
Sanyo PLV-70 projector
Sony
- HDC-900 HD cameras
- PVM-96 video monitor
- DMX-R100 audio console
- DVS-7000A production switcher
- DVW-500 digital VTRs
- BVW-75 Betacam SP VTRs

Steinberg Nuendo digital audio workstation
TASCAM
- CD-A700 CD/cassette player
- DA-98, DA-88 and DA-38 eight-track recorders
- CDR-1000 CD burner

Tektronix VM 700 scope and monitor
Telex/RTS intercom
Tubetech CL1B compressor

Lakewood Church

The track load is impressive: 106 tracks for an hour and a half at each service. They are recorded into custom-designed computers running Nuendo software on the Windows XP Pro operating system with triplicate backup and have experienced no latency problems. Designed by Brian Tankersley, Lakewood's audio systems director, and Advance Design Kentucky Computers, the rack-mounted computers are based on dual-core AMD Opteron processors. They are interconnected via Windows networking and gigabit Ethernet.

After experimenting with dual fiber SAN with 12 drive arrays and with a few guys pulling audio simultaneously, they decided that an affordable system configured like that wouldn't work. So a distributed, redundant system was devised with seven computers running Nuendo with 2TB of storage per system. Operating at 24-bit/48kHz, the systems take audio directly from the mic pre-amps, digitize it and store it. The concept is that storage is cheap, and it provides redundancy.

The uniqueness of AMD's processor architecture allowed Tankersley and his team to replace two single-core Opterons with AMD's latest chip, the dual-core AMD Opteron, into the existing sockets in their current workstations.

Also, with the dual-core processors, the systems can be easily upgraded. But with the current configuration, the performance has been staggering no matter the demand from Nuendo and any number of plug-ins, all with no latency issues. The church is currently running seven of these custom computers with plans to add three more soon and further plans to continue to swap to upgraded processors as new ones come out.

Once recorded to Nuendo and remixed and edited, audio is then pushed to Avid systems. Presently, a network is being installed to handle this, but until it's finished, the tracks are imported to the systems via disk.

Regarding the Avid systems, the decision to go with one Symphony, one DS Nitris, and two Media Composer Adrenaline systems was a question of workflow. Prior to the new facility, the church had been using nonlinear systems in a limited way. With the addition of Avid workstations and extra digital Betacam machines (now totaling seven), capacity to create simultaneous versions of the shows was achieved. When the taping is finished, all three shows are edited at the same time on Sunday evening and sent out on Monday.

Refining the message

The editing rooms also called for designs to be ergonomic and have appropriate acoustical treatment on the walls and doors to maintain low noise levels and create a positive environment for the editors. All computers are located in a central machine room, and all rooms are isolated from each other to avoid cross-bleeding.

The centerpiece of the video editing rooms is the Facilis TerraBlock server system, which combines intelligent drive management software with low-cost SATA drive technology and fiber channel connectivity. The base server unit combines the server, storage and direct connections for fiber clients, avoiding the need for an external switch.

Even though Lakewood Church runs SDI, Sony HDC-900 high-definition cameras were installed to prepare for the future. The facility is AES- and SDI-compliant.

Routing for the facility is handled by NVISION, chosen because of the features offered, such as routing and converting analog to SDI. The cost-effectiveness was also in line with what Swearingen and Guidry had specified.

With only 18 months to complete the facility from its inception, the team worked feverishly. Major architectural renovations and construction of the new building were occurring at the same time as the electronics and live audio installations, leaving the team with about eight weeks to complete 16 weeks' worth of work in order to meet the July 16 live broadcast. In the end, there were few technical issues and the facility met its goals better than expected. BE

Tim Wetmore is a freelance writer based in New York City.

Design team

Lakewood Church
- Andre Guidry, chief engineer
- Reed Hall, director of audio
- Jon Swearingen, director of broadcast media
- Brian Tankersley, senior producer, director of audio technologies

Consulting groups
- Advance Design Kentucky Computers
- Audio Analysts
- Beck Associates
- Russ Berger Design Group

Self-service
on demand

BY SEANA RUBIN

Business is looking bright for providers of on-demand content. Within the next few years, the increased popularity of on demand will likely require current content providers to supply hundreds of hours of content per month, while content providers new to on demand will likely supply dozens of hours per month.

Content providers have typically outsourced on-demand content creation. However, given that vendors charge as much as $1000 per content hour and can take up to three weeks to provide content, it is not surprising that many providers are bringing content creation in-house.

Other content providers are eager to enter the growing market for on demand, but do not have a simple way to produce content. And service providers are looking for ways to easily create local on-demand content or encode and convert broadcast TV feeds into a digital format for on-demand playback on network personal video recorders. Fortunately, new software is available that automates the content creation process and streamlines operations, which saves money, ensures high-quality content and gives providers control of their content.

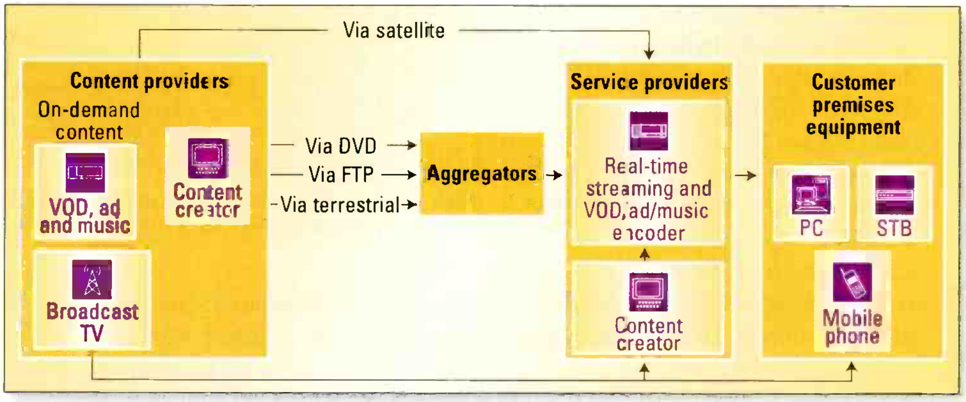


Figure 1. An overview of the content creation process, from file creation to distribution to a content aggregator or service provider. The content is then delivered to customers.

Content creation

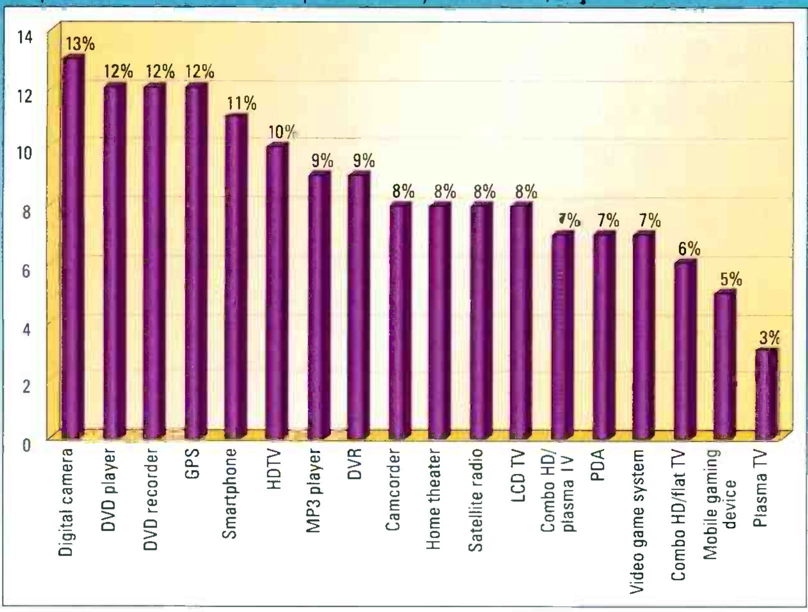
On-demand content creation is the process of converting analog content into digital media, adding metadata to the content files and creating a media package for delivery. (See Figure 1.) An engineer uses either an external encoder or PC-based encoding hardware interfaced to a tape player via an Ethernet connection or serial cable, respectively. The engineer views the content on a TV monitor that is interfaced to the tape drive and determines the mark-in and mark-out settings for the content.

Analog content is then sent via a serial digital interface from the player to the encoder, where it is converted into a digital file. This encoded content can then be edited. In this step, such content as ads, previews and posters can be added to the file. Then, the

FRAME GRAB A look at the consumer side of DTV

Electronic device purchases for 2006

10 percent of Americans plan to buy an HDTV; 9 percent a DVR



Source: AvantGo www.ianywhere.com

required CableLabs-compliant metadata is added to the file manually or imported from a spreadsheet.

In this step, using content creation software with built-in intelligence streamlines the creation of repetitive and rule-based metadata to dramatically decrease the time needed to create media packages. (See Figure 2.) With this software, even an engineer unfamiliar with CableLabs standards can easily create the required metadata. Once packaged, the file is ready for distribution via satellite, overnight delivery or an FTP site.

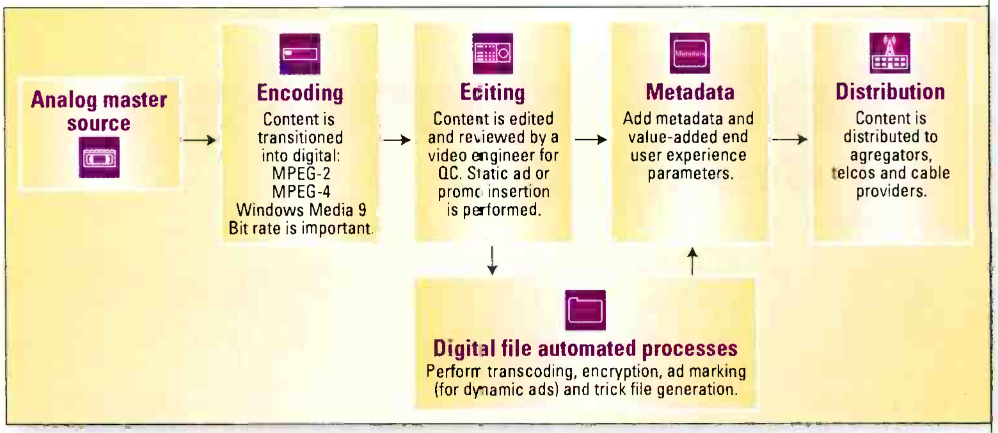


Figure 2. With automated solutions, one engineer can handle the entire content creation process, from encoding and editing to distribution.

Transcoding

Transcoding is the process of converting digital content into multiple formats, such as MPEG-2, MPEG-4, H.264 and Windows Media 9. In the future, transcoding will become increasingly important because content will need to be reused for multiple purposes. The need for transcoding is driven by convergence and the idea that multiple service providers will require on-demand content in various formats.

Transcoding can be performed manually by converting and encoding the content into multiple digital formats. Then, the content is edited and reviewed and the metadata is added. The engineer must then perform these same actions for each format and each file type, which can be a time-consuming and costly process.

A better approach is automated transcoding, which converts files automatically. First, an engineer encodes and edits a master file, typically in MPEG-2, to ensure that the information is encoded at the highest quality setting. Other software can then convert the master into other formats as needed. The final content is then ready for distribution.

Tips

Content providers must evaluate their current needs and consider the demands they will face in the near future. Some items for consideration include:

- *What kind of editing program will be used to edit your digital content?* The editing software that is required varies according to file type, and it is necessary to understand your digital media editor choice, such as Adobe Premier or MediaXpress. Certain editors only edit in certain formats. For example, an MPEG-2 editor may not edit Windows Media 9. Consider choosing one format for editing content before you begin to transcode, which will minimize the number of times you need to touch the content.
- *What are your future plans for distributing SD and HD content? Will you distribute a combination of both?* Think about where you will be in 12 to 24 months. If you want to provide HD on demand in the short term, it would make sense to acquire HD encoding capability. However, if HD is far on the horizon, SD encoding would be an appropriate first step.
- *How many different copies of a similar piece of content will you maintain?* In many cases, a single copy of a piece of content will not be suitable for all content distribution needs. Many times, different versions of the content — with variations, such as ads that can be used to market to targeted audiences — are required for movie theaters, airplanes, cable networks and DVDs, for example. Rather than supplying one copy of the content, the content provider will need to supply multiple versions. Content creation software simplifies the creation of multiple versions.
- *How many hours of on demand are being encoded on a per-month basis today? How many hours of on demand content will need to be encoded in 12 months?* Analysts and industry experts predict that worldwide users of on demand

If providing HD on demand in the short term, it would make sense to acquire HD encoding capability. However, if HD is far on the horizon, SD encoding would be an appropriate first step.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will surpass 30 million in the next few years. To meet the demand, many content providers expect that they will soon need to ramp up their production efforts and produce far more content than they are currently handling today. When future costs are considered, an in-house solution can substantially reduce the cost of creating content.

OpenVision Content Creator, a solution for creating CableLabs-compliant on-demand packages, simplifies and automates encoding, editing and the creation of metadata.

advance and can prevent costly and time-consuming retransmission. Users must be able to easily edit content, such as removing R-rated material or inserting ads, quickly and easily.

Most important, software should be based on open standards, which ensure easy integration into production environments and compatibility with existing hardware and software solutions. Open standards also eliminate the need to make additional software and hardware purchases. When carefully selected and properly implemented, the right content creation software will realize a return on technology investment and will help meet future demands. **BE**

Must-have features

To maximize savings, content creation software must be suitable for use by staff with all levels of experience. It should be comprehensive enough for use by an IT or video specialist, yet intuitive and simple enough for a less technical person to easily learn. Software must meet the technical requirements of each service provider and support the encoding of content within multiple formats.

Software can support quality assurance efforts by allowing users to preview content in its final format prior to delivery. Software with automated metadata verification locates errors in

Seana Rubin is the communications manager for IMAKE.

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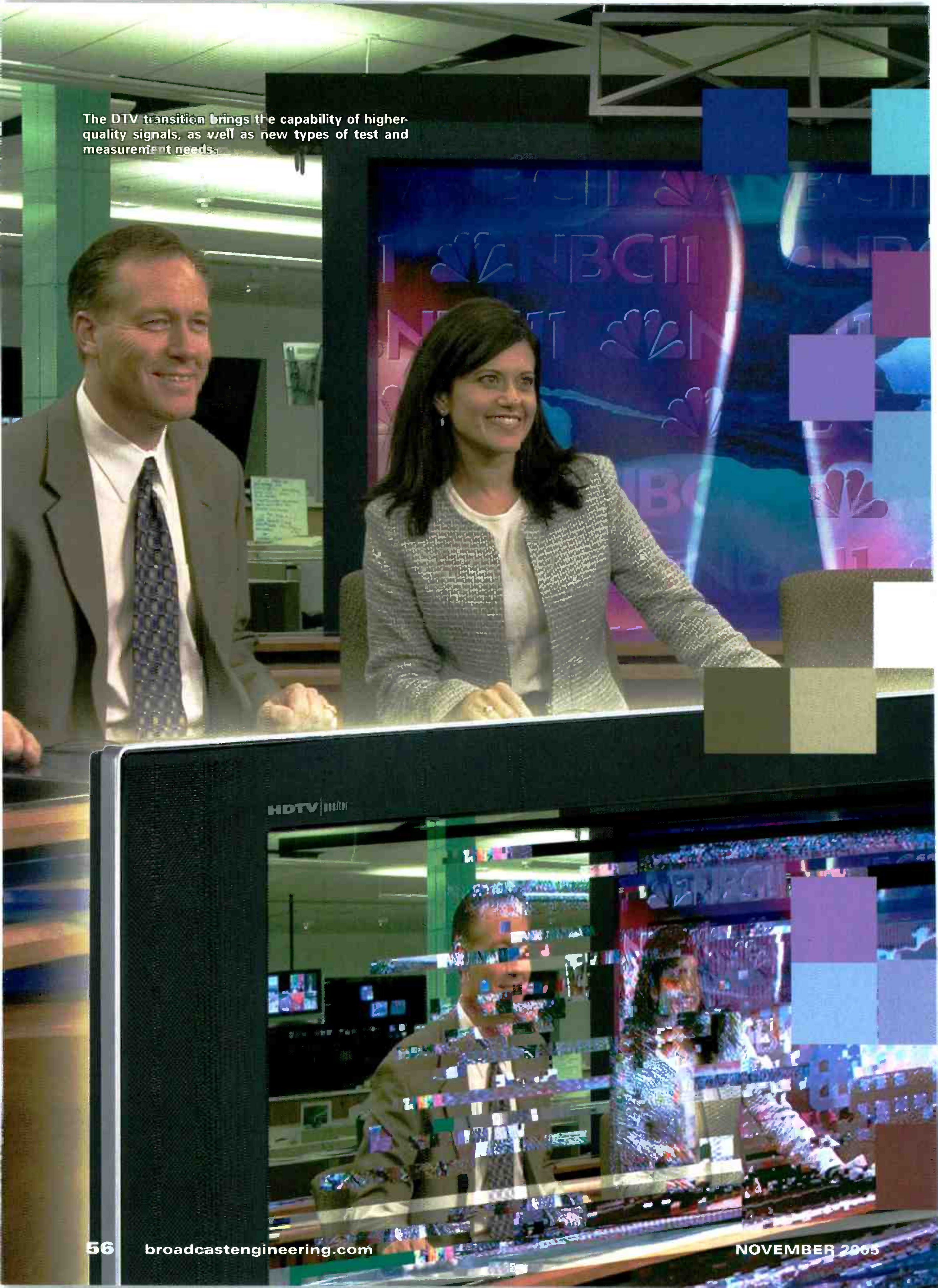

The DTV transition brings the capability of higher-quality signals, as well as new types of test and measurement needs.

Avoiding the digital cliff

Predicting the future health of your digital system

BY MIKE WAIDSON

The DTV transition created a number of challenges for TV broadcasters. There is mounting competitive pressure from alternatives to terrestrial broadcast TV stations, and today's station is a collection of diverse and complicated technologies.

Multilayer and multiformat facilities are the norm. Baseband signal measurements, MPEG monitoring and RF analysis each contribute to painting a picture of the health of the broadcast signal for the station engineer. The engineer's job is to make sure content is delivered, and there are several critical parameters that require close scrutiny in each layer, such as jitter, timing, ancillary data and audio.

The transition from analog to digital, and now HDTV, introduced new challenges to ensure the transmission of the signal from the camera through to RF modulation, be it cable, satellite or terrestrial TV. Broadcast systems are now multi-standard and multiformat, with a large number of interfaces between islands of analog, digital SD or HD-SDI and MPEG-compressed systems.

This introduces a new series of testing and monitoring methodologies. Digital picture encoding, DVB and ATSC program specific information (PSI) and system information (SI), and complex digital RF modulation schemes all add to the need to monitor key system health indicators at all layers of the transmission chain. If a system fails, the pathology of failure is different from an analog system. Failure at the digital cliff is sudden and has less understood precursors.

There are, however, a series of key system parameters that can be monitored at all layers of the broadcast system to help maintain a safety margin for error-free, reliable transmission. Moving forward, it's possible for systems to become predictive, proactive and preventive through setting multiple triggered monitoring points that provide trend analysis. The result may be the construction of an early warning of your system's approach to the digital cliff.

The layered model

Today's digital transmission systems can be thought of as five basic layers: analog, SD and HD uncompressed serial digital, compressed digital (MPEG-2, VC1, H.264), RF transmission, and command and control. Any one of these layers can generate failures in the transmission chain, which will propagate down the chain, causing picture and sound degradation or loss. Clearly, an accumulative error budget exists for the total transmission system. Therefore, it's necessary to look at the key health indicators and error budget within each layer that could impact that layer and the following links in the system.

Ultimately, the goal is to move from reactive monitoring, where station staff fixes a problem once it occurs, to predictive monitoring, which provides warning of incipient failure and time to fix the issue before it becomes a visible problem. In the digital domain, this is possible by continually monitoring these trends in parameters such as program clock reference (PCR) timing and modulation error ratio (MER) as precursors of failure.

Key performance indicators

The keys to transmissions in a facility, whether analog or digital, are signal level and timing. Effective monitoring of these parameters in both the analog and digital domains ensures sufficient headroom at all stages of the transmission chain, whether it be SDI timing, eye diagrams or PCR measurements in the MPEG domain.

For any system, long-term reliability starts with the installation of infrastructure for HD-SDI signals. This requires correct cabling, termination and installation of the cable in order to prevent kinks or undue stress to the cable. These steps will allow the high-speed 1.5Gb/s signal to be properly transmitted without disruption from unwanted reflections caused by impedance changes. Getting this right from day one pays long-term dividends in reliability.

Synchronization and timing

Synchronization is a fundamental and critical procedure in video facilities. Every device in a system must be synchronized to successfully create, transmit and recover video and audio. The complexities of operating an analog and digital multi-standard, multiformat environment require flexibility to achieve and maintain synchronization.

Television timing (using black burst as the reference) has always been critical, but the addition of tri-level sync in HD can complicate systems' timing in a hybrid facility. As a result, facilities with multiple formats require a variety of generator solutions. If that's not enough to worry about, digital audio places even more demands on a facility because these signals need to be referenced to video sync to maintain defined relationships between audio and video. All this requires careful system design to ensure synchronization between all processing equipment.

The focus, therefore, is careful calculation of the propagation delay between various devices caused by cable lengths. In addition, you must account for any processing delay of the equipment through which a signal might pass.

After you've achieved error-free transmission throughout the digital paths within your facility, examine the quality of source material as it's delivered to the facility. Modern digital waveform monitors can monitor serial digital source material upon ingest. Some models generate a compliance log against time code listing any errors. These errors should be rectified before further processing. Figure 1 shows an error log of video and audio errors present within an incoming signal. Note the errors are related to the time code of the event, making further examination easier. Logged errors include input signal or external reference signal missing; color gamut error; EAV/SAV missing or mismatch with line number; SAV placement error; CRC and EDH errors, code word violations or field and line length errors; and ancillary data and closed caption present/absent errors, parity errors or checksum errors.

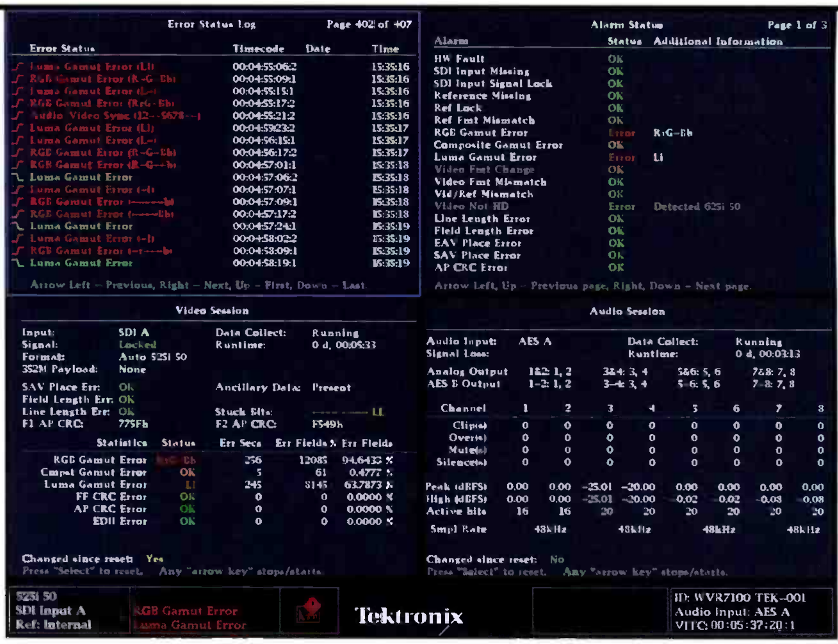

Figure 1. Alarm status display showing error log, alarm status, and video and audio sessions

Eye diagrams and jitter

Eye diagrams displayed on a waveform monitor are the key tool for monitoring both amplitude and jitter on SD and HD-SDI signals. The height and openness of the eye give a clear indication of the health of the measured signal.

The SMPTE standards (259M, 292M, RP184, EG33) recommended practice RP184 provides definitions and measurement procedures for jitter and defines measurement specifications for the electrical characteristics of the signal. Figure 2 on page 60 shows an eye diagram of an HD signal with automated measurements of the eye parameters.

Signal amplitude is important for two reasons: because of its relation to noise and because the receiver estimates the


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required high-frequency compensation (equalization) based on the remaining half-clock frequency energy as the signal arrives. If an incorrect amplitude signal was applied at the sending end, an incorrect equalization would be applied at the receiver, causing signal distortion. While poor transmissions with eye closure are potentially recoverable by modern equipment with good front-end equalizers, they are likely to lead to sparkle artifacts, line dropouts and eventually freeze frames and black pictures.

Digital processing can add cyclic redundancy codes (CRC) to the digital data stream to provide a simple means of error checking the video signal. By monitoring the CRC values, a measurement device can report the number of errors. If your system notes errors every minute or every second, this would be a clear warning the system is close to the digital cliff. An eye display should be used to isolate the problems in the transmission path.

MPEG monitoring

Among the many elements of the MPEG transmission layer, there are three that need constant monitoring: PCR timing and drift, continuity count errors, and PSI/SI tables for correctness and repetition rates. PCR clock recovery is fundamental to MPEG transmission because it allows a set-top box to recover the reference 27MHz (±30ppm) clock used to derive system timings. Jitter and long-term drift in this clock will ultimately lead to set-top boxes failing to display the transmitted video.

The DVB standard TR 101 290 measurement guidelines specify in detail the proper PCR measurement methods for both jitter and drift. Measurements include accuracy (PCR_AC), overall jitter (PCR_OJ), frequency offset (PCR_FO) and drift (PCR_DR). (See Figure 3 on page 62.) The standard also defines guidelines for testing PSI/SI table presence and repetition rates.

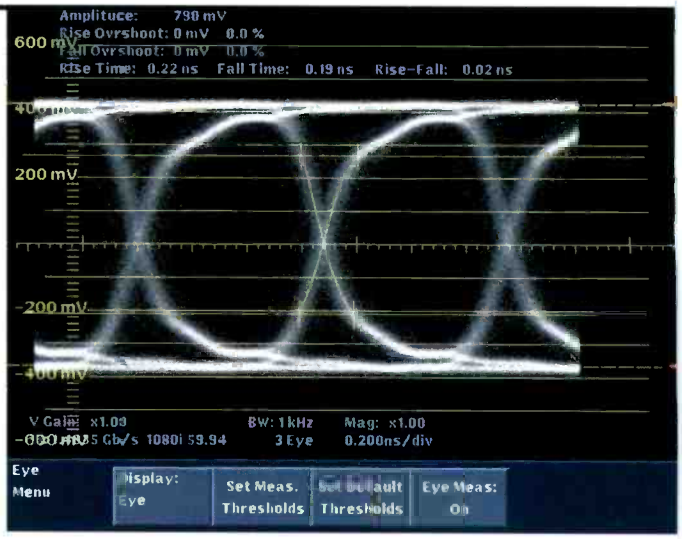

Figure 2. HD eye measurement with automated eye measurement parameters

Continuity count errors provide an indication of dropped packets, which are a common problem in video distribution. Dropped packets mean loss of information from the transport stream, which can lead to decoder problems. Monitoring continuity count errors gives an indication of potential problems in the video distribution network and enables remedial action to be taken before decoders experience visible failure.

These measurements can be performed in real time by an MPEG transport stream monitor. When equipped with multiple threshold alarms, the device provides trend-based, predictive monitoring, resulting in a good early indication of failure. Warnings are available prior to the onset of the digital cliff. Most real-time monitors also provide transport stream recording on user defined triggers, such as PCR timing. This practice allows detailed offline analysis of both timing and PSI/SI issues when they occur.

A key tool for PSI/SI monitoring is

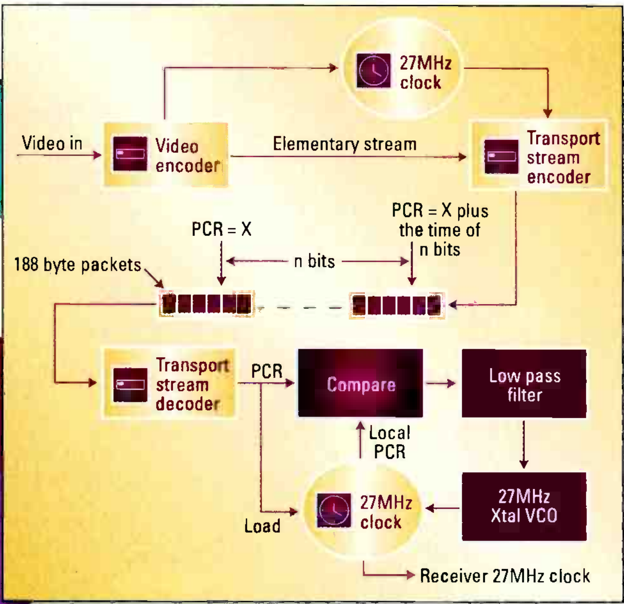

Figure 3. System health can be monitored by checking key PCR parameters of timing accuracy and drift.

monitoring time-defined reference templates. The results can then be compared against the actual transmission. PCR timing, continuity count errors and PSI/SI content and repetition rates should be monitored 24/7 by transport stream monitors located at the stream entry point and after each MPEG manipulation point in the system.

RF monitoring

Modern digital RF cable, satellite and terrestrial broadcast systems behave differently when compared with traditional analog TV. Once reception is lost, the path to recovery isn't always obvious. The problem could be caused by MPEG table errors or merely from the RF power dropping below the operational threshold or the cliff point. RF problems include satellite dish or low-noise block converter issues, terrestrial RF signal reflections, poor noise performance, channel interference and cable amplifier or modulator faults.

The following RF parameters are important for transmission health:

- *RF signal strength.* How much signal is being received?
- *Constellation diagram.* This diagram characterizes link and modulator performance.
- *Modulation error ratio (MER).* MER is an early indicator of signal degradation and represents the ratio of the power of the signal to the power of the error vectors expressed in dB.
- *Error vector magnitude (EVM).* This is a measurement similar to MER but expressed differently. EVM is the ratio of the amplitude of the RMS error vector to the amplitude of the largest symbol expressed as a percentage.
- *Transport error flag (TEF).* The TEF is an indicator that the TEF FEC is failing to correct all transmission errors. TEF is also referred to as Reed-Solomon uncorrected block counts.

Improving on bit error ratio

MER is designed to provide a single figure of merit for the received signal. It gives an early indication of the ability of the receiver to correctly decode the transmitted signal. In effect, MER compares the actual location of a received symbol (as representing a digital value in the modulation scheme) with its ideal location. As the signal degrades, the received symbols are located further from their ideal locations and the measured MER value will decrease. Ultimately, the symbols will be incorrectly interpreted, and the bit error rate will rise. At some point, the signal reaches the threshold or the dreaded digital cliff.

The key to maintaining a reliable digital broadcast system is careful monitoring at all levels and formats. Check the key indicators to the health and long-term stability of your network continuously. Then, use the predictive trend analysis of jitter, amplitude and timing to catch system deterioration before your audience knows there could have been a problem. BE

Mike Waidson is a video applications engineer for Tektronix.

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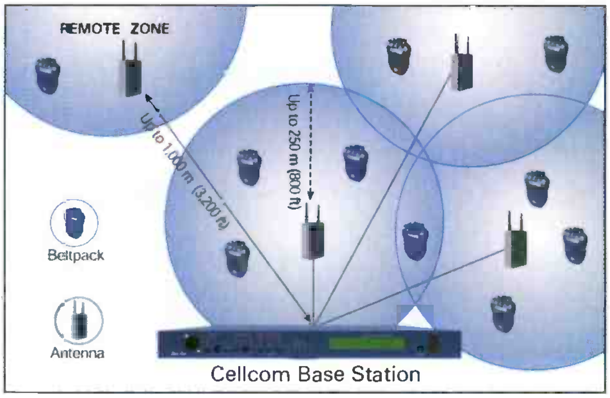

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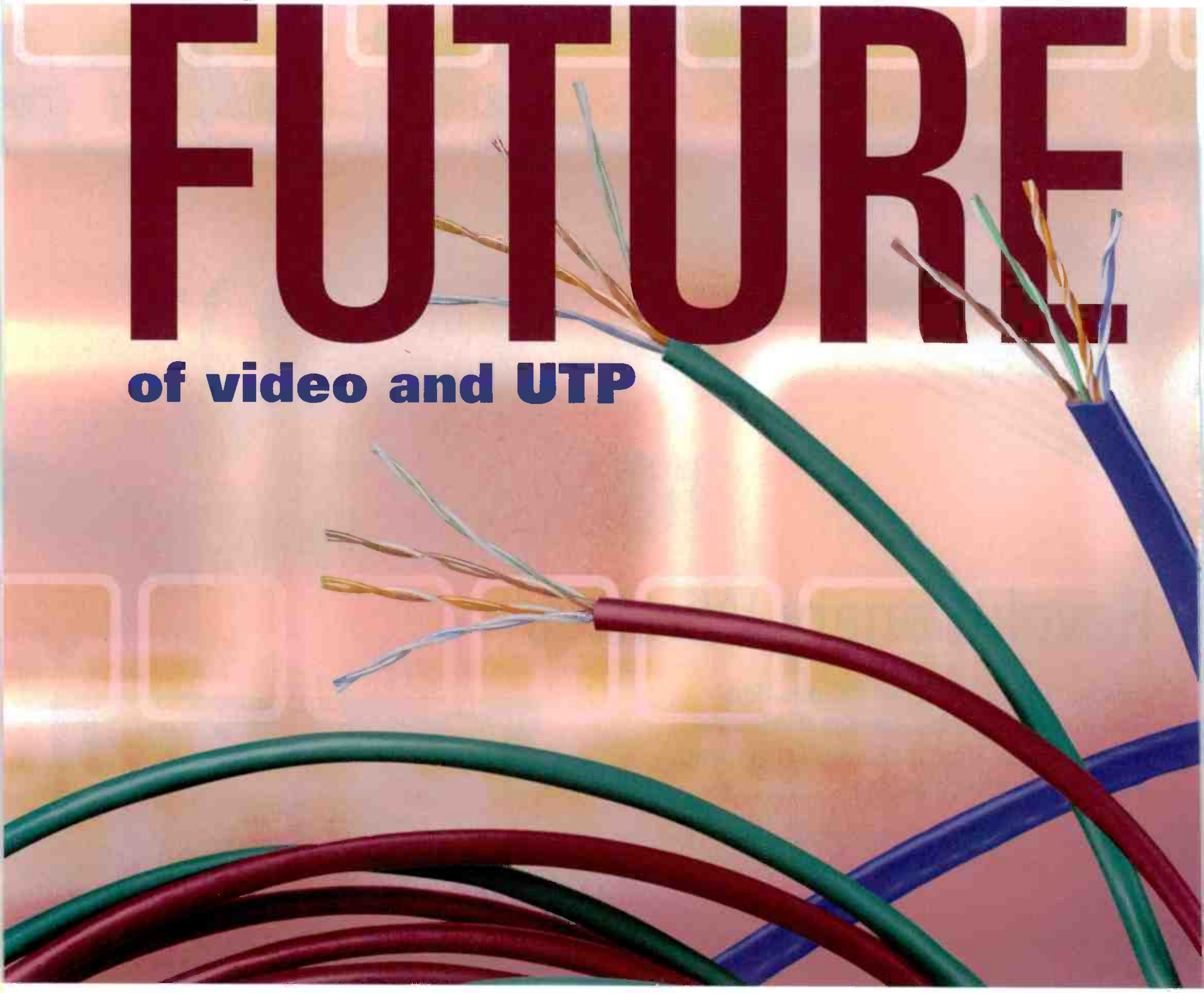
The FUTURE of video and UTP



In the first article of this series on UTP cable, I discussed using it for video. But one aspect we didn't talk about was multiple video streams. After all, UTP normally comes four-pairs to a cable. Does that mean you can run four video streams simultaneously? Well, yes, sort of.

What about crosstalk between pairs? In the original article of this series, last September, we mentioned that the crosstalk at analog audio frequencies was vanishingly low, even -95dB on a Category 5 patch cable, and unreadable on Cat 6. But video is not audio. What's the crosstalk for video frequencies?

This is where the specifications for UTP cable come in handy. For frequencies greater than 1MHz, there are a slew of parameters to check out. They are part of the standard for all cables (EIA/TIA568-B.2). And if the measurements don't fall on the precise frequency you want, such as the 4.2MHz bandwidth of analog video, you can easily extrapolate. So what is the pair-to-pair crosstalk of UTP at 4.2MHz?

Well, that's only half a question, because there are many kinds of crosstalk in UTP — near-end crosstalk (NEXT); far-end crosstalk (FEXT); and power-sum (PS) versions of NEXT and FEXT, where three pairs are energized and one is read. So, PSNEXT would be a good choice to compare, because we're talking about running four videos

BY STEVE LAMPEN

Photo: Because of UTP's economy over coax, many system designers are turning to UTP transmission equipment to distribute component RGB video. Shown here are Belden's Brilliance VideoTwist UTP cables.

down the four pairs.

PSNEXT for Cat 5 and 5e at 4.2MHz is -53dB. But what number do you want? Is -53dB good video crosstalk or bad? I've talked to a lot of video engineers about this, and occasionally I see a reference on this subject. Most want to see -60dB crosstalk.

If -60dB PSNEXT is good, then what is -53dB PSNEXT? Not so good? It depends on the kind of video quality you're sending on the cable. If this is an analog surveillance camera (or four surveillance cameras on one cable), then -53dB is probably the most noiseless surveillance picture quality you've ever seen!

If you're shipping analog video around your home, -53dB is better than anything you ever got off air, and maybe even off cable. If you're talking about analog video in a professional installation, then -53dB just doesn't cut it. In which case, you switch to Cat 6 cable, which has a PSNEXT of -63dB at 4.2MHz.

And there's a second factor to consider in a multiple-pair cable. What if you use the four pairs to deliver four parts of a single signal? After all, that's what they do with Gigabit Ethernet. The signal is divided among the four pairs and combined at the other end. In this case, the timing is critical. This is measured as delay skew or just skew. In the data world, the four parts of the signal must arrive within 45 nanoseconds (nsec) of each other.

In the video world, we too have divided signals. They're called "component" signals, such as RGB. They too have to be recombined, and the timing of the signals is critical. In RGB, the signals have to be within 40nsec of each other. It's interesting that these two numbers — 45nsec for data and 40 nsec for RGB — are so close!

Table 1 shows how the cable length affects skew. Does Table 1 mean that you can go thousands of feet running RGB? Absolutely not. The attenuation of these cables is the same as it has always been, based mostly on the 24 AWG of the pairs. (Cat 6 can be 23 AWG, even 22 AWG).

What the numbers above tell you is that as your RGB signal is fading away, it is perfectly in time. Few installers would run these cables farther than 250ft, so they might want tighter skew for better resolution, such as a projector in a large auditorium. Table 1 shows that, to a great extent, lower and lower skew does not give you much, because you can't go far enough to use it.

And the ultimate expression of this quest for low skew is the "no-skew" cables that are currently available. While it is impossible to build a cable with *no* skew, there are four-pair cables with typical skew of 0.5nsec/100m and a maximum of 2.2nsec/100m. The distance then to 40nsec, as shown in Table 1, is ridiculous. Can you go a mile on this cable? No. But, as the signals fade into the sunset, boy, are they in time!

Timing (Delay skew based on different types of cable)	RGB distance
45nsec	292ft
40nsec (example, standard Cat 5 cable)	328ft
35nsec	375ft
30nsec	437ft
25nsec (example, Belden 1872A/1874A)	525ft
10nsec	1312ft
9nsec	1458ft
2.2nsec (example, Belden 7987R and 7987P)	5963ft

Table 1. The relationship between cable length, cable type and skew

The real problem with no-skew cables is that in order to arrive at these amazing numbers, manufacturers have had to use four pairs with identical twisting ("lay length"). Unfortunately, this results in terrible crosstalk. It won't even pass Cat 3 requirements. (That's now standard telephone cable.) So no-skew is not really data cable at all. It is useful for RGB or VGA applications (or related systems), and that's it!

It is no surprise then that some manufacturers have gone in the other direction. Why not make a cable that will meet Cat 5e or 6, but with ultra-low skew? And, indeed, there are cables that meet Cat 5e with a maximum skew of 9nsec/100m, and Cat 6 cables with a maximum skew of 10nsec/100m. They're also listed in Table 1. You can use them as data cable and as RGB/VGA cables. The photo on page 64 shows each of these cables. The flat blue cable is Cat 6/low skew, the green one is Cat 5e/low skew, and the purple one is identical pair no-skew.

One obvious failing of UTP is that you don't have enough pairs to do RGBHV. You can do combined sync, RGBS, on four pairs. And there are some baluns that put one of the sync signals on green (remember sync on green), so you can run five signals on four pairs.

Four-pair UTP is cheap when compared with RGB-bundled coaxes.

Four-pair UTP is cheap — even Cat 6 cable is inexpensive — when compared with RGB-bundled coaxes. If your equipment is set up to run twisted pairs and RJ-45 connectors, the cost savings can be attractive. But, if you are adapting coax-based equipment to run on UTP, you have to add the cost of the baluns at the source and destination. And there's the reliability

Signal	Sweep Frequency
SVGA	61MHz
XGA	100MHz
SXGA	173MHz
UXGA	245MHz

Table 2. Common frequencies of VGA and its cousins

factor of more equipment and more connectors to fail than just cable alone.

Many designers and installers want to run not just RGB but Video Graphics Array (VGA). This may be run like RGB, but it is not RGB. For one thing, it is a progressive scan signal. For another, it comes in different resolutions (i.e. bandwidths and sweep frequencies). Table 2 shows some of the common frequencies of VGA and its cousins.

Table 2 immediately shows a problem. Cat 5 and 5e are specified in the standard only to 100MHz. A few manufacturers test beyond this spec, but many do not. So if you put SXGA or something with an even high-sweep frequency on Cat 5 or 5e, what will happen?

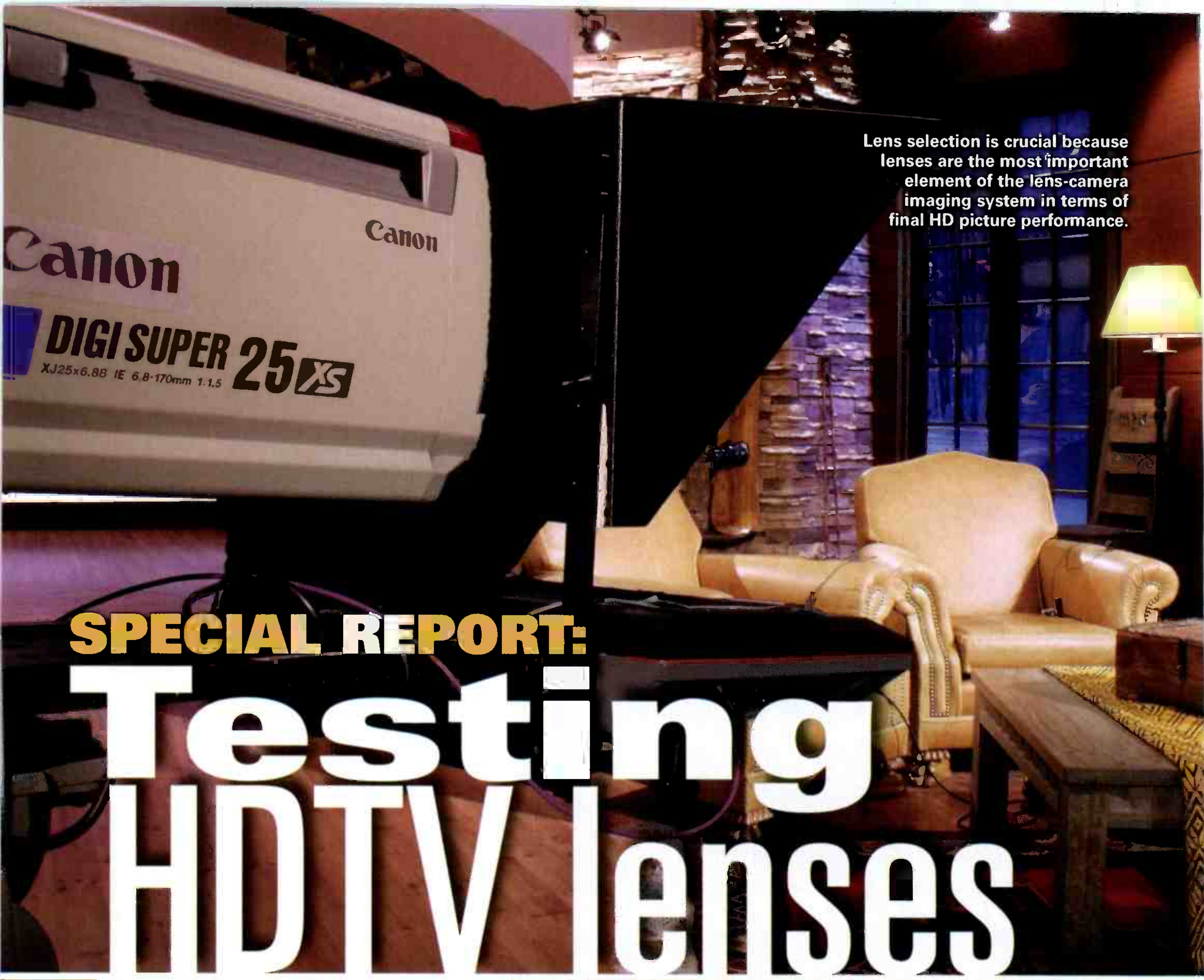
Well, that's the point: You don't know. It could work just fine. Or, the results could be horrible. You just don't know. You really have to see if the cable you're using is tested to the appropriate frequency for your application. Or, you could just move to Cat 6, which is specified out to 250MHz.

Of course, there are many formats beyond those in Table 2. The simple rule is that the cable you use must be tested and verified out to the frequency you need. This is one of those "gotcha" situations when using existing older Cat cables for non-data applications.

If you have comments or suggestions, or wish to continue this discussion offline, just send an email to editor@primediabusiness.com. **BE**

Steve Lampen has worked for Belden for 14 years and is currently multimedia technology manager. He holds an FCC Lifetime General License, is an SBE Certified Radio Broadcast Engineer and a BICSI Registered Communication Distribution Designer. His latest book, "The Audio-Video Cable Installer's Pocket Guide," is published by McGraw-Hill.

Steve Lampen's latest book, "The Audio-Video Cable Installer's Pocket Guide," may be ordered directly from the publisher's Web site at *www.mcgrawhill.com* or from Amazon at *www.amazon.com*.



Lens selection is crucial because lenses are the most important element of the lens-camera imaging system in terms of final HD picture performance.

SPECIAL REPORT:

Testing HDTV lenses

BY LARRY THORPE AND GORDON TUBBS

Conventional testing of competing high-definition lens-camera systems generally favors the camera, with lens testing often being cursory at best. Lenses are often misperceived as a necessary appendage to the chosen camera or to be pretty much equal in performance regardless of the model or brand.

In reality, the opposite is true. Lenses are not equal in performance. They are much more than an appendage to the camera. They are arguably the most important element of the lens-camera imaging system in terms of final HD picture performance.

Given that there are five major camera manufacturers and at least three major lens suppliers, it must be acknowledged that choosing the optimum HD lens-camera system from the many possible combinations for a specific production application poses a significant logistical challenge. Some simplification to the overall approach is warranted. It is suggested to give the first priority to choosing the camera. If the assumption is made that all high-end HD lenses are good, then an arbitrary initial choice of one lens (that meets the operational requirements) to support the camera selection makes sense. Using this one lens on all competing cameras will help expose the overall performance differences between the contending cameras (assuming, of course, that some appropriate technical measurements are made).

Having finally chosen the camera that best meets performance and operational needs, the end user can now turn attention to the competing lenses and assess their differences using that single camera of choice. The test procedures to be described will be based on the quest for the lens exhibiting the best overall performance optimization.

While the professional lens system has many important imaging parameters, there are five key attributes for any HD lens the end user should carefully evaluate. All five will invariably differ to some degree between lenses from the world's major manufacturers. They are:

- sensitivity
- contrast
- resolution
- color reproduction
- geometrical distortion.

Lens sensitivity

The spectral transmittance of

similar lens types made by different manufacturers will not be the same. Therefore, any two contending lenses having the same *f*-number *are likely to have different optical speeds* (*f*-number by definition assumes 100 percent transmittance efficiency [1]). This needs to be carefully accounted for in any side-by-side test between different lenses. The precision of a given lens calibration can be established using known optical techniques (involving light meters, etc.).

However, the simplest test of the transmittance efficiency of a given lens is to fully open the iris and record the video level (at 0dB master gain setting) of a gray scale test chart under a given scene lighting level. If two competitive lenses are sequentially mounted on a single HD camera and this simple measurement made on each (with fixed lighting level and fixed camera gain), this will quickly reveal the maximum relative aperture performance for each.

Lens contrast

The contrast performance of an HD lens bears significantly on the overall subjective picture quality. At one extreme is the optical noise floor of the lens, determined by the manufacturer's control of flare and veiling glare.

With today's 2/3in HD camera signal-to-noise ratios in the vicinity of 54dB (which translates to a contrast ratio capability of 500:1), it is imperative that the associated HD lens have a contrast ratio performance for nominal exposure that exceeds this. There are new gray scale test charts that facilitate accurate exploration of the contrast ratio performance of a lens-camera system. (See Figure 1.)

This examination does entail meticulous adjustment to the overall transfer characteristic of the camera to ensure optimum reproduction of the lowest black steps of the chart. This must, of course, be done with one chosen lens imaging the chart. Swapping to the other contending lenses — without any readjustment of the camera settings — should expose pertinent differences between the lenses in terms of any optical limitations at the lowest extremes of illumination.

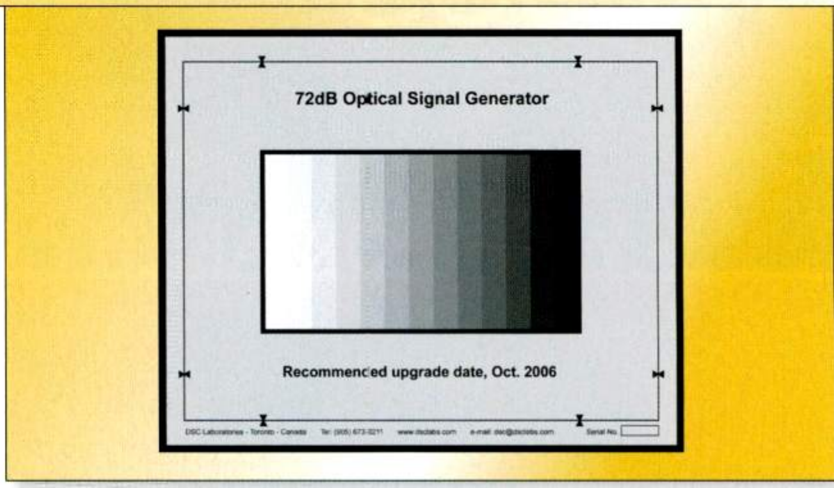


Figure 1. A wide dynamic range gray scale chart specially designed to explore lens-camera contrast ratio capabilities

At the other illumination extremity, the behavior of a given lens when stimulated by strong light sources (studio lights, the sun, etc.) should also be carefully explored. This can be done in a studio by observing all optical phenomena that manifest themselves when high-intensity light sources are directly imaged by the lens-camera.

Equally important is the behavior of the lens when these light sources are placed off-axis just outside the image area and the camera is subsequently panned vertically and horizontally. This exercises the design strategies that manage off-axis bright light rays. The observations will differ between lenses, and the end user must decide which behavior is more acceptable.

Lens resolution

As discussed in January [2], the modulation transfer function (MTF) performance of the lens-camera system is an assessment of how that imaging system's contrast behaves with increasing spatial detail. Contrast performance is inextricably intertwined with the visual sharpness capability of the HD imaging system. The *shape* of the system MTF curve is of great importance here. Thus, the test should seek establishment of the MTF profile, with four measurements as indicated in Figure 2.

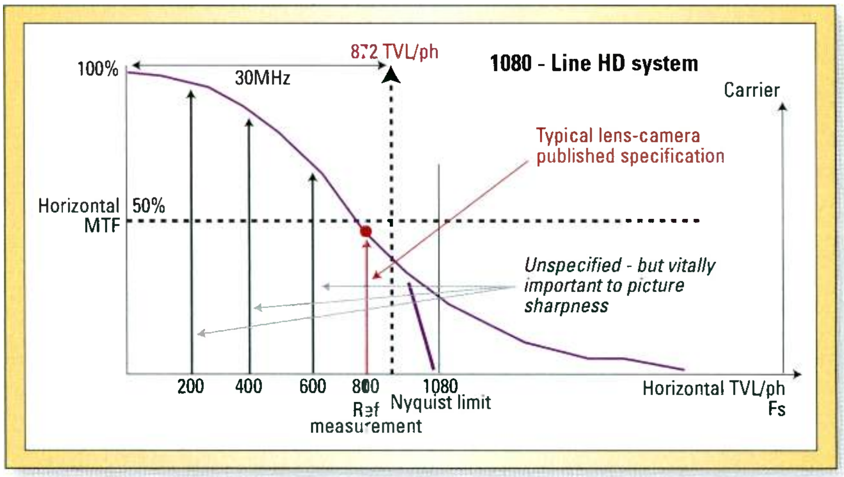


Figure 2. Measurement of the lens-camera system's depth of modulation at picture center should be carefully recorded for the four spatial frequencies shown.

It is essential that this measurement be made on an HD waveform monitor (connected to the HD SDI output of the camera system). An HD studio monitor should *never* be used to evaluate MTF; the best contemporary

HD monitors typically have a limiting resolution of only 1000 television lines per picture height (TVL/ph) and, as such, their own MTF profile exhibits a substantial roll-off across the important HD passband.

There are a variety of commercially available 16:9 image format test charts that can support such an MTF measurement. (See Figure 3.)

Carefully used in conjunction with a waveform monitor, this will allow an MTF profile to be recorded and later plotted. (Special attention must be paid to flat lighting and to physically aligning the test chart for absolute horizontal and vertical alignment with respect to the camera.)

The first comparative assessment of an HD lens MTF should be made on the luminance (Y) video signal at picture center where MTF is at its highest. All camera nonlinear processing (gamma, knee, etc.) should be removed. The test starts with a gain adjustment of the waveform monitor so that the 50 TVL/ph horizontal burst precisely fills the 100 IRE scale, which becomes the 100 percent spatial contrast reference.

This is followed by slight panning of the camera to sequentially position each of the four spatial frequency bursts at the center of the image plane and carefully record the amplitude of each (relative to that of the 50 TVL/ph burst). This pre-calibration and measurement is then repeated for each of the contending lenses.

An MTF profile can then be plotted from these four measurements. The lens-camera MTF profile with the highest belly across the 200 TVL/ph to 800 TVL/ph band to the plotted curve will produce the higher picture sharpness.

Assessing the MTF dynamics of an HD lens

As outlined in March's lens article [3], all lenses exhibit variations in MTF as their three operational controls (iris, zoom and focus) are exercised during a production. Accordingly, the testing of a lens should, to the degree possible, anticipate this and be reflective of the actual usage anticipated for the lens and camera.

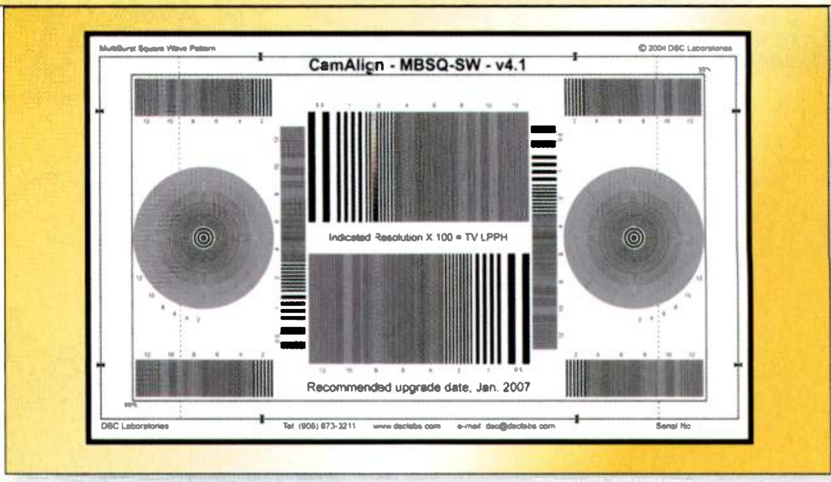


Figure 3. An example of a useful multiburst test chart to facilitate measurements of HD lens-camera MTF

At a minimum, tests on MTF at three focal lengths (spanning the typical focal range anticipated in the specific intended usage of the lens-camera system) should be made. These should include the expected regular close-ups, medium shots and wide-angle shots. These measurements will expose how a specific lens has been optimized for picture sharpness.

There are, however, some logistical issues relating to these tests. While the HDTV broadcast news set is perhaps a relatively simple set, it does serve as a useful and simple illustration of the issues. (See Figure 4.)

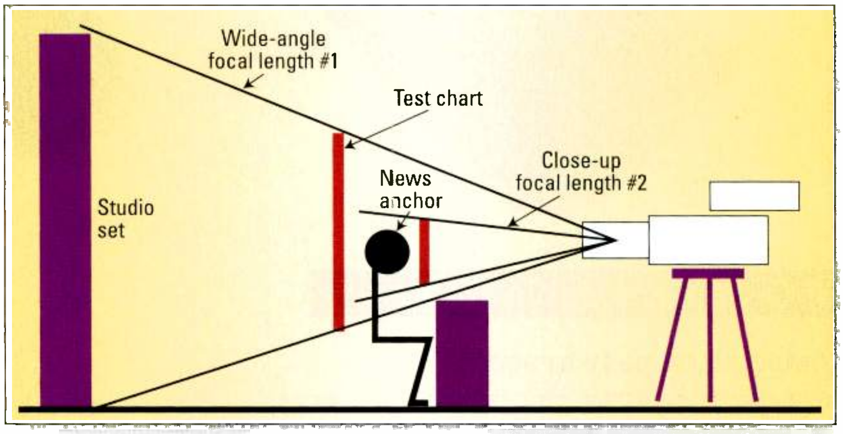


Figure 4. Suggestive of a news studio with two primary focal lengths and exposing the issue of test chart size

As can be deduced from Figure 4, the assessment of MTF at the focal length for the anchor close-up is relatively straightforward in that a normal-size test chart can be readily used. However, the measurement at the wide-angle setting requires a much larger chart that ensures its position does not intrude into the minimum object distance (MOD) of the lens. Fortunately, such charts are available. (See "Suppliers of HDTV test charts" on page 75.)

These tests should be conducted at two lens iris settings: one at the iris setting that provides nominal exposure at the studio illumination anticipated for normal production (typically in the *f* 2.8-4.0 region) and a second with the iris wide open. This will reveal the design strategies for each lens in terms of inevitable MTF variations with aperture setting.

Evaluating corner-to-center sharpness

While the lens designers typically concern themselves with a multi-point

Suppliers of HDTV test charts

- DSC Laboratories (Canada), *www.dsclabs.com*
- ZGC (USA), *www.zgc.com*
- Dai Nippon Printing (DNP) (Japan), *www.dnp.co.jp*

optimization of MTF over the image plane [3], the end user really need only be concerned with two primary regions: the central region and the corner regions, as indicated in Figure 5. An assessment of the sharpness behavior in these two spatial regions will constitute an effective summary of the success of the lens manufacturer in implementing their respective MTF optimization strategies. This involves a separate check on corner focus relative to picture center and then corner MTF (when it is sharply focused).

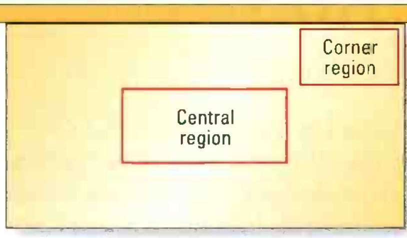


Figure 5. Corner focus should be checked when the picture center is in focus, and separately, each corner MTF should be recorded when the corners are refocused.

References

[1] Larry Thorpe and Gordon Tubbs, "Management of light transmission," *Broadcast Engineering*, May 2005.
[2] Larry Thorpe and Gordon Tubbs, "HDTV studio lens design," *Broadcast Engineering*, January 2005.
[3] Larry Thorpe and Gordon Tubbs, "Management of MTF," *Broadcast Engineering*, March 2005.
[4] Larry Thorpe and Gordon Tubbs, "Chromatic aberrations," *Broadcast Engineering*, July 2005.
[5] David Corley and Shirley Li, "Controlling image quality in a digital world," *SMPTE Journal*, 9/04, Vol. 113, No. 9, pages 293-306.

Evaluating lens corner focus

This test is a scrutiny of the curvature of field aberration that is inherent to all lens systems. While this cannot be made zero, it can certainly be minimized in a good optical design. A test chart has been developed that has a large Siemens focusing chart in its center to facilitate a convenient lens back-focus adjustment followed by a precision lens-camera center image focus. (See Figure 6.)

The chart has, in addition, four radial multiburst charts in each corner, spanning the critical 200TVL/ph to 800 TVL/ph HD spatial frequency region. With picture center sharply focused, the four corners should be closely inspected to assess the degree of defocus relative to center. The chart easily reveals any differences between the corners, and these should be noted. This chart also serves to quickly reveal any chromatic aberrations [4] that might be present in the picture extremities.

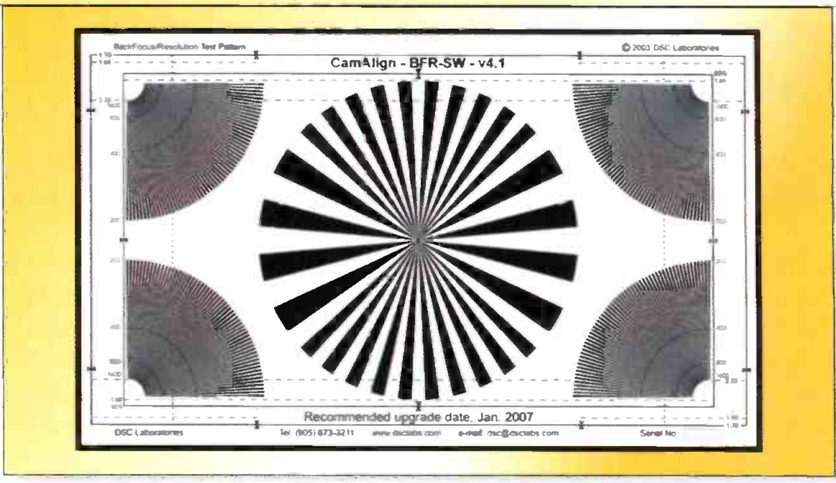


Figure 6. Test chart to facilitate examination of corner focus and corner MTF assessment

Evaluating lens corner MTF

While this measurement is closely related to the preceding measurement on corner focus, there is a difference. Measuring corner MTF is a supporting examination of the lens-corner resolution performance. It constitutes an examination of the MTF characteristic in each corner *when it is focused*. This tells how well the optical design has been able to optimize MTF across the image plane.

For this test, each corner should be carefully focused in turn using the multiburst test chart shown in Figure 3 on page 74, which contains a multiburst in each corner. Each of these four multibursts is used to evaluate the MTF behavior within these corner regions over the 200 TVL/ph to 800 TVL/ph spatial frequency region. (See Figure 6.)

While it might be asked why this secondary test on corner MTF is useful, it should be borne in mind that racking focus can be a common creative action during production. It may well be that an initial focus might be on a

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person or scene object located in the picture center, but that shot could be followed by a focus pull to another person (or portion of the scene) located in one of the corner regions. It is important that that corner scene content appear with a sharpness close to that at the picture center.

Color reproduction

As discussed in May's lens article [1], the spectral response of the HD lens is one of four critical elements defining the final color reproduction characteristics of the HD lens-camera system. The other three elements are the beam-splitting optics of the camera, the spectral response of the camera imagers and the linear matrix designed by a given camera manufacturer.

While all of the lens-camera combinations should meet the prescribed SMPTE 274M/296M colorimetry standard (when the camera operational controls are set to their detent positions), there will still be subtle differences in terms of the color gamut that each HD lens-camera system can reproduce. These are a consequence of the separate design preferences of both camera and optical manufacturers and inevitable tolerances in the spectral responses of lenses, prisms and image sensors [5]. Because color is a quite subjective topic (even though a rigorous color science does exist), the final conclusion usually reduces to the subjective preferences of the end user. For that reason, HD lens testing should always include a careful comparative evaluation of color reproduction characteristics.

The comparative HD lens test for color reproduction

Assuming that the end user has already made a prior choice of an HD camera, then three of the four variables that bear on color reproduction are now predetermined. Only the lens contribution remains to be evaluated. The lens testing should be done on an A/B basis — using the selected HD camera — by separately evaluating each lens on that single reference camera.

Prior to these evaluations, each lens-camera combination should be carefully white-balanced. This is an *essential* step because competitive lenses will have different RGB transmittance characteristics that *must* be normalized by restoring the reference white that establishes the proper color-taking behavior of each lens-camera combination. Then, and only then, will the subsequent evaluation of a wide range of colors be valid. The comparative evaluation of lens contribution to color reproduction should be done with camera color correction zeroed out and with the camera linear matrix switched in.

The camera should be set up in a properly lit studio and a careful overall balance made on a gray scale chart. A variety of color test charts are available that support formal comparisons on vectorscopes.

From a production viewpoint, it is important to also explore a wider range of real-world colors on a carefully calibrated monitor. It is essential that this be *the* HD monitor planned for use in the production control room during normal program origination.

The test colors should include objects that are highly saturated, medium saturated and pastels, as well as materials that might be germane to a specific production (different ethnic skin tones, special colored clothing, particular set materials, etc.).

As this exercise becomes much a subjective evaluation, the production team should be active participants. Discussions will inevitably ensue on the perceived reproduction of certain colors. It will probably require a degree of consensus, as it is rare for two people to fully agree on color reproduction. It regularly becomes a discussion of the degree of accuracy of reproduction of certain colors versus the perceived pleasing nature of such color reproduction.

Clearly, the HD camera can allow additional color adjustments to enhance the color reproduction to the taste of the production team. However, as the intent of this test is to search for *differences* in the competing lens contribution to color reproduction, it is important that the HD camera system remains in its "technical norm" detent mode.

Geometrical distortion

Geometrical distortion exists to some degree in all lenses. Terms such as *pincushion* and *barrel* describe the general shape of the common geometrical distortions. High-performance lenses have made significant strides in minimizing such aberrations.

The wider the angle of the lens, the more challenging the task of reducing such distortion. A quick evaluation of a lens can be as simple as zooming to the widest angle of the lens while imaging a studio set containing scene content that is orthogonal in nature, such as doors, windows, desks, pictures or any special feature (having straight horizontal and vertical edges) of the studio set that is regularly visible during normal production. Any two lenses can be readily compared on this basis. A 1 percent difference in geometric distortion can readily be noted under such subjective test conditions. Test charts exist that facilitate objective measurements of geometric distortion. BE

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

IPTV: Next-generation delivery of the television experience

BY MATTHEW GOLDMAN

Internet protocol television (IPTV) embodies next-generation technologies for delivering real-time and interactive television to the home or business, and it's available today.

This is not the low-resolution, sometimes jerky video that is commonly broadcast on the Web to computers. While IPTV does make use of Internet protocols and is carried over broadband networks, it differs from Internet video in that IPTV delivers broadcast-quality programming to a customer's TV over a network with quality of service guarantees. The general-use Internet has no such guarantees in place.

The technology behind IPTV is hidden from the viewer. From a customer's perspective, IPTV is similar to cable TV or direct-to-home (DTH) satellite service in the sense that he or she watches programming on a TV set, not on a PC, and selects channels using a remote control, not a computer mouse.

With the aid of an electronic program guide, the viewer selects a channel on the remote control and, from his or her perspective, that channel simply appears on the TV set. The viewer can enjoy linear real-time programming or engage in personalized interactive services, such as movies or other video-on-demand content, hard-disk type program recording, shopping and more.

While things may appear straightforward from a customer's point of view, the technology behind IPTV is anything but simple. There are four main elements to an IPTV system: a streaming headend, the core network, the last-mile access to the customer (fiber or a form of DSL) and the equipment located at the customer premises.

Streaming headend

In many respects, the streaming headend resembles that for cable or DTH. Figure 1 on page 82 shows a functional block diagram of a typical video headend architecture.

Much of the programming, like national feeds of ESPN or HBO, is received via digital satellite and descrambled, but it is kept in the digital TV-compatible format in which it was transmitted. Other content sources may arrive via microwave, fiber or terrestrial antennas. A local studio can supplement the national feeds. These additional sources often require encoding of the programming to a DTV-compatible format. The ubiquitous encoding format used today for DTV is MPEG-2 video compression. The locally encoded and selected national feeds are aggregated and groomed to form an IP stream for delivery to the core network.

The headend also typically contains conditional-access and/or digital rights management systems (to control which subscribers are entitled to view selected content), VOD and other servers, streaming health monitoring equipment, and content insertion and automation systems. In addition, it can contain the portal or middleware software that handles presentation, services and authentication. Figure 2 on page 82 shows some of the specific equipment (descramblers, IRDs, encoders, servers, IP streamers and switches) incorporated in the IPTV headend.

The core network

To create the television experience viewers are accustomed to, the network must provide a signal that is free from glitches, lockups, dropouts and other problems. This is accomplished by ensuring that there is sufficient bandwidth and differentiated handling of services based on specified quality of service guarantees for the broadcast-quality streaming video.

Last-mile access

While the network may have wide bandwidth, the last mile to the customer premises may not. There are two last-mile technologies generally used in delivering IPTV: fiber to the home or business and digital subscriber line (DSL).

With fiber, bandwidth is not an issue. Fiber can easily carry MPEG-2 signals in both SDTV and HDTV formats. However, providing fiber to all of a telco's customers is a vast undertaking, which involves extensive redesign, construction and

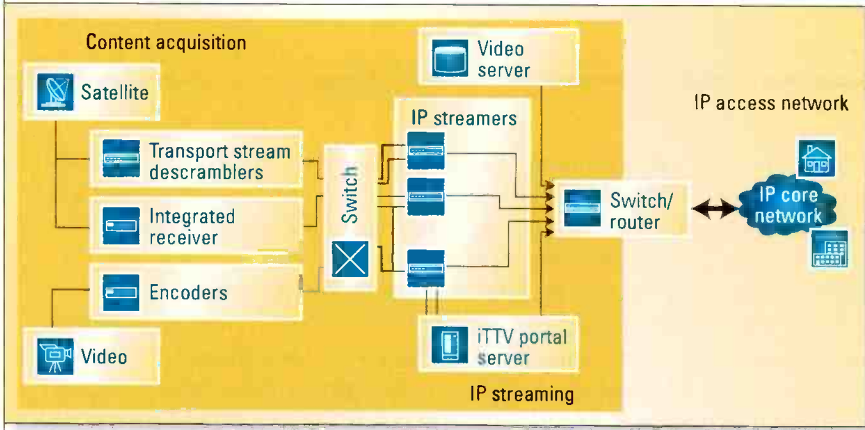


Figure 1. A functional block diagram of a typical video headend architecture

rewiring the drop from the street to the customer premises. Because of this, fiber is not as common as DSL.

DSL provides a broadband connection on existing twisted pair cabling, making life that much easier for the telcos by repurposing the existing drop wiring. However, DSL and its advanced forms are bandwidth limited. A typical residential asymmetric digital subscriber line (ADSL) service today may offer a bandwidth between 1.5Mb/s and 6Mb/s.

Bit rates vary with distance. If there is old wiring or wiring that is pigtailed or spliced in any way, the bandwidth will be reduced.

MPEG-2 is the ubiquitous encoding format today for both SD and HD. But in a network such as ADSL with constrained bandwidth, the bit rate for MPEG-2 is too high. HD in MPEG-2 requires roughly 12Mb/s to 18Mb/s just for the video part — not taking into account audio and data — and clearly won't fit into the bandwidth available with ADSL. SD in MPEG-2 requires approximately 2Mb/s to 4Mb/s. Therefore, the delivery of more than one channel to the customer premises (for viewing on a second or third TV) is not practical.

That's where the next generation of coding (compression) technology comes in. Both MPEG-4 AVC (ISO/IEC 14496-10/ITU-T Rec. H.264) and proposed SMPTE 421M VC-1 (industry standardization of Microsoft Windows Media Video 9) can code HD into 6Mb/s to 10Mb/s and SD into the 1Mb/s to 2Mb/s range, for equivalent picture quality to the higher bit rate MPEG-2. Now we're getting closer.

DSL technology is also leaping ahead.

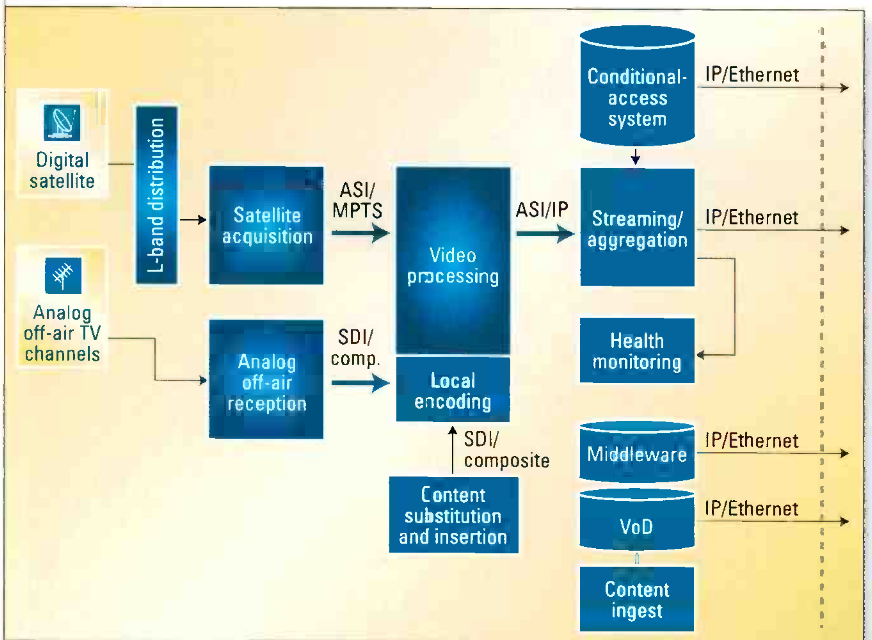


Figure 2. Some of the specific equipment—descramblers, IRDs, encoders, servers, IP streamers, switches—incorporated in the IPTV headend

A new access network technology called ADSL2+ will allow bit rates (again varying by distance) in the 14Mb/s to 20Mb/s range. One channel of MPEG-2 HD could just about fit, but there would not be enough bandwidth to offer broadband service of support for more than one channel to be viewed on other TVs. However, a channel of MPEG-4 AVC or VC-1 HD — or multiple SD channels — will fit just fine.

IPTV is made viable by using these two technologies, which are coming of age at the same time. Advanced video coding approximately halves the bandwidth needed for HDTV and advanced xDSL more than doubles the bandwidth capability of existing DSL over twisted pair phone wiring. This benefits the service providers because they can now offer HD and multiple TV support to the customer and still have bandwidth left over for phone and data — the triple play package of bundled services.

Customer premises equipment and middleware

The customer premises equipment is usually a set-top box or a residential gateway. A key difference between IPTV and cable or DTH satellite is that the latter delivers all available channels to the customer at the same time. However, IPTV over a network with restricted bandwidth to the customer can't deliver, for example, 40 HD and 200 SD channels.

Using next-generation compression technology, with approximately 8Mb/s for each HD channel and approximately 1.5Mb/s for each SD channel, only a few channels will fit down a 14Mb/s ADSL2+ pipe. This means that the channel tuning function for IPTV does not reside in the set-top box, as it does for cable or DTH. Instead, channel switching takes place upstream in the network.

Switching can take place at the headend or somewhere else in the network, depending on network topology and the control architecture. In general, hierarchical control architecture is designed to optimize real-time response to the customer's push-of-a-button command on the remote control.

The control architecture that manages how users perceive and accesses available services provides the look and feel of the program viewing guide. It also verifies that users are authorized for the services they are attempting to access, which is commonly called the IPTV middleware or portal.

There are two aspects of the IPTV middleware that communicate with each other. One part resides in the headend or control aggregation points in the network, and the other part resides in the customer premises equipment.

In an IPTV system, when a user pushes a button on the remote, the remote sends a command to the set-top box. The set-top box then receives and interprets that command and translates it into higher level control signaling that gets sent upstream to the network channel-change controller and/or portal server. There, the command gets processed, with the result (like switching to a new channel) sent back down the network to the set-top box and onto the TV.

IPTV is here

IPTV is beyond the testing stage. Systems worldwide are already deployed. In the United States, many of the first tier telco companies will roll out IPTV services in full force in 2006 to better compete with cable and satellite. SBC plans aggressive rollouts to more than 40 metro areas, and Verizon has filed franchise applications in numerous jurisdictions. As content deals are announced, the service offerings are gaining momentum. Expect to see Verizon's FIOS and SBC's Lightspeed service offered in your neighborhood in 2006. **BE**

Matthew Goldman is vice president of technology for TANDBERG Television.

Media General
moves content with Panasonic's P2

BY ARDELL HILL

In spring 2004, Richmond, VA-based broadcast group Media General committed to convert newsgathering operations at its 20 television stations that produce news to Panasonic's DVCPRO P2 series solid-state memory format. (The core products in the series are the AJ-SPX800 camcorder, the new AJ-SPC700 camcorder and the AJ-SPD850 studio recorder.) Since that time, 10 Media General stations have been equipped with the P2 series, and next year we will transition six more stations.

The elimination of moving parts and the ability to transition to a completely file-based content management system were the paramount reasons we are making the transition. Our engineering philosophy is to move towards moving content seamlessly across multiple platforms. The system allows users instant access to file-based video content, which facilitates multiple levels of news production happening simultaneously. It also provides also provides the marketing and production departments at the stations with instant access.

A photographer at KWCH-TV uses the Panasonic AJ-SPX800 DVCPRO P2 camcorder. KWCH-TV in Wichita, KS, is one of 10 Media General stations that have already begun using the camcorders. The station also tested the AJ-PCS060 portable hard drive, which Media General plans to now use in all of its ENG operations.

Out in the field

We now have more than 90 AJ-SPX800 2/3in DVCPRO50/DVCPRO P2 camcorders in the field for daily newsgathering. The image quality is remarkable. Living up to its durability promise, the camera performed well

The camera performed well for our stations covering ... Katrina and Rita.

for our stations covering hurricanes Katrina and Rita.

And every day, crews in the field discover new ways to do their jobs based on the feature set of the camcorders. For example, the B-roll function — the ability to switch instantaneously from a live to a recorded segment in the camera — was an instant hit with all of our users.

The flexibility of the camera system, with its ability to display thumbnail clips and accept electronic In and Out markers, means that our reporters spend less time dealing with the mechanics of video acquisition. This gives them and their photojournalists more time to consider what they're shooting, what they've shot, and how the footage can be constructed into a more coherent, more compelling story.

Each station using the system produces more than 20 hours of news programming a week. All of the group stations have moved to a nonlinear editing environment. Material is edited on Vibrint NewsEdit NLE systems.

The next tapeless step

KWCH-TV in Wichita, KS, tested Panasonic's AJ-PCS060, a portable, 2.5in 60GB hard drive, over the summer. The 1.4lb drive addresses the issue of "Now that I've shot the material, I need to get it off the camera and into a holding device independent of the camera." The drive holds up to 15 of DVCPRO P2's 4GB cards, replacing the need for a multitude of media. The entire contents of one of those cards can be transferred to the internal hard disk drive in about four minutes (in verify off mode).

The P2 store provides quick-to-access transfers, making efficient use of the media cards. And it allows us to better manage media in the field. The hard drive completes the workflow we were looking for when we added the P2 camcorders. We're currently integrating 125 of the drives into our ENG operations.

In terms of ultimate HD production, anything we do in HD will be done in the DVCPRO format. We're just beginning to find opportunities to do localized HD programming and event coverage.

Now, with P2, we continue to realize new benefits in terms of managing video content as files in the new tapeless environment. **BE**

Ardell Hill is senior vice president of broadcast operations for Media General.

Making the change

Media General stations using the Panasonic DVCPRO P2
- WFLA-TV in Tampa, FL
- WKRG-TV in Mobile, AL
- WNCT-TV in Greenville, NC
- WTVQ-TV in Lexington, KY
- WJBF-TV in Augusta, GA
- KWCH-TV in Wichita, KS
- KALB-TV in Alexandria, VA
- WDEF-TV in Chattanooga, TN
- WSPA-TV in Greenville, SC
- WSLS-TV in Roanoke, VA

Media General stations transitioning to the Panasonic DVCPRO P2
- WIAT-TV in Birmingham, AL
- WRBL-TV in Columbus, GA
- WJTV-TV in Jackson, MS
- WJHL-TV in Johnson City, TN
- WBTW-TV in Florence/Myrtle Beach, SC
- WMBB-TV in Panama City, FL

Router integration
with Euphonix digital audio mixing systems

BY DAVE HANSEN, DAVE MCCLURE, ANDREW WILD AND ROGER MAYCOCK

With the increasing complexity of broadcast production, the demands placed upon audio operators and technical engineers have similarly increased. An audio operator may be required to simultaneously check the main audio sources, patch isolated router feeds for tape and mix down pre-production spots.

A complete Euphonix digital audio system is lightweight, making it ideal for trucks and remote applications. Shown here is a System 5-B digital audio mixing console on a Mobile Television Group HDX remote truck.

Similarly, the technical engineers must configure the router control panels as sources become available, and this must happen with a minimum of interruption to tape production. Last-minute changes are inevitable, and in situations where audio router space is limited, entire set-ups may require modification.

To address this, audio installations for trucks and broadcast facilities generally require the specification of two audio systems: the digital audio mixer's router and the panel-controlled router/switcher system. The two systems are nearly identical and differ only in the manner in which they are controlled.

However, despite their similarities, integrators frequently find themselves purchasing separate audio frames from multiple vendors as single systems seldom provide this dual functionality. Furthermore, duplication of sources and interconnection between the two requires large numbers of source distribution amplifiers and additional router I/O. This raises the system's cost, increases complexity and limits the capabilities of both.

Having identified the inefficiencies, Euphonix worked toward a solution. Its digital audio mixing systems can now fully integrate with most router control systems using the ES-Control protocol — supported by models from PESA, NVISION, Pro-Bel, Sony, Grass Valley and Utah Scientific. The result is simpler, more efficient audio systems.

The SH612 MADI router

To achieve maximum flexibility in signal routing, Euphonix consoles use the SH612 MADI router. It has a 2RU form factor that includes redundant power supplies and boots to the last known state in five seconds. The unit can be operated stand-alone, controlled directly from a Euphonix console, or it can be fitted with software allowing control from an ES-Control-capable router controller. It provides 12 MADI inputs and 12 MADI outputs.

In Euphonix routing systems, all studio sources and destinations, as well as console signals, are converted to MADI. MADI (AES10) is a serial digital format that allows 56 digital audio signals (48kHz/24 bit) to be sent down a single 75Ω coax. The SH612 is, therefore, capable of handling routing of up to 672 inputs into 672 outputs.

Because signals are converted to MADI, the original source and destination format becomes transparent for the user. Additionally, the SH612 is based on a TDM backplane, which allows AES/EBU pairs to be separated and reassembled at will. For instance, a camera mic and mono program can be sent to the stereo AES/EBU input of a VTR by simply operating the router panel in the tape room.

Independent control

In basic systems, the SH612 is configured to be controlled by the console. However, in broadcast facilities, where independent console routing is required, an additional SH612-ES is deployed and connected to the router controller. The units are identical except for mode of control.

Low-cost signal distribution

When specifying independent routing systems, it is necessary to duplicate source signals across both systems. In

Euphonix consoles use the SH612, a 2RU MADI routing unit that features a large front-panel control wheel, status lights and sync selector.

many installations, this requires a separate DA for each signal source. Here, the advantages of using MADI as the native audio format become clear. Because MADI is electronically similar to SDI video, it can be run through standard SDI distribution amps. Therefore, a multichannel front-end MADI converter (analog-to-MADI or AES/EBU-to-MADI) can be inexpensively distributed to both routing systems via a single SDI DA.

Considering the number of signal sources in most facilities, the cost savings can be substantial. Furthermore, this guarantees that the required sources for the facility are equally available to both the audio mixer and panel controlled router system.

Simplified configuration

Independent router systems invariably require some level of interconnection. As the audio operator builds isolated feeds in the console, they frequently patch into the facility router, where the facility engineer must associate them with video sources for tape operators and other production personnel. The number of audio router inputs available is usually limited by the installation budget as each interconnection requires purchase of a console output circuit, router input circuit and associated patchbay real estate.

Interconnecting two routing systems merely requires patching one or more console MADI outputs to router MADI inputs via coax cables. A single coax allows 56 console signals to be placed on the router. Two or three coax cables enable the audio operator to make available all significant console outputs (main busses and aux busses) as well as many direct outputs. Manual patching is no longer required, and show setups can be saved and recalled from a file.

Benefits

Digital audio console router integration provides the audio operator and the panel-controlled router operators independent control of every source on the system. The benefits are substantial.

Sharing a single set of audio converters for the mixing console and mobile/facility router can save thousands of dollars. Setups can be stored and recalled, eliminating the need for manual patching.

In addition, the audio operator no longer needs to patch console output busses to the destinations. Console output busses such as main program, aux feeds and IFBs automatically appear as sources on the router. Engineering then has full control of all audio sources from any router control panel.

Finally, the audio console and panel-controlled router share a single set of audio frames — exactly half of what is often procured. A comprehensive Euphonix digital audio system typically weighs less than 500lbs, making the solution perfect for trucks and remote applications. **BE**

Dave Hansen is VP strategic accounts, Dave McClure is product and technical specialist, and Andrew Wild is VP marketing for Euphonix. Roger Maycock is a technical writer.

Archival systems

BY JOHN LUFF

My favorite online dictionary defines *archive* in three relevant ways:

- "A place or collection containing records, documents or other materials of historical interest.
- A long-term storage area, often on magnetic tape, for backup copies of files or for files that are no longer in active use.
- A file containing one or more files in compressed format for more efficient storage and transfer."

The first definition is interesting because it is simply a place. The concept is applicable to the idea of layered storage in that one only cares to know the information has been stored and can be retrieved. The second definition might also be applicable to media content in the context of long-term, perhaps offline, storage. The third definition is not so much a place as it is a methodology for reducing the quantity of digital storage needed.

In this context, it is interesting to think about how various methods of archiving media content fit into these definitions. It is popular today to think of four layers of storage that are relevant to the archiving process. (See Figure 1.)

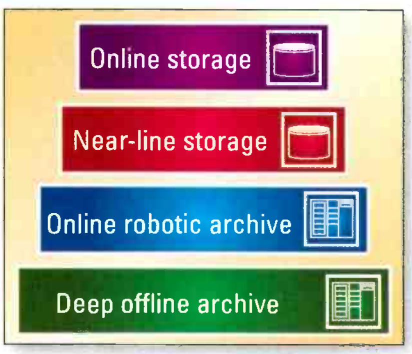


Figure 1. The four layers of archival storage

Online storage

The top layer requires immediate and real-time access. When a command is issued to play or deliver the media, it is immediately executed. Due to cost constraints, the size of this layer is the most restricted. The storage is high in bandwidth and is fault-tolerant. Nothing stands in the way of delivery. An example is broadcast hardware, with a real-time operating system running it, which is equipped with control interfaces and software to facilitate the demands placed on it.

The last layer might be thought of as the removable media from the robotic archive stored on shelves in a deep mine somewhere for long-term preservation purposes.

Near-line storage

The second layer is near-line in the sense that nothing can play directly from it to the release chain. Between the two layers is a software interface that controls the movement of the content to the next layer in the hierarchy. That same software layer must exist between each of the layers. This higher capacity storage might come in the form of inexpensive disk arrays with good fault tolerance that may have high bandwidth, but are constructed in a way to minimize the cost of storage and maximize the ability to interface to other products.

In a broadcast plant, the transfer of content from suppliers might connect directly to this layer of the facility. This is where content conversion takes place and where ingest occurs from live or other sources. It is exclusively file-based and is not aware of the outside real-time world.

Online robotic archive

The third layer is much cheaper storage and often is robotic. Examples include streaming tape, optical (DVD or volumetric storage) or other new technologies that are inexpensive and massive. It is slower than the other layers above it, and it is simply a repository for content. It makes no attempt to convert content to a release format for delivery.

Deep offline storage

The last layer might be thought of as the removable media from the robotic archive stored on shelves in a deep mine somewhere for long-term preservation purposes. It is the least vulnerable because it is not connected online to anything, and it is clearly the slowest because requests might involve transportation by snail-speed systems. It is protected and secure from any intrusion and is the least expensive layer to maintain.

Archival applications

All archive implementations don't need more than two of these layers. The concept, remember, is to collect records and store them. Each of the layers does so with different capabilities, access speed and cost. A station with no news might implement video servers with only a near-line archive

for the sole purpose of increasing the storage capacity without increasing cost dramatically.

The cost of online storage, however, is dropping rapidly. Thus, the line between near-line and large online libraries is a bit blurred. If you think of the functionality differently, you might think of near-line as a functional part of an online system. Its content is likely to almost be available in real time. In some implementations, the near-line can transfer to the online system at speeds far above real time, so it is seamless to the operation.

The goal of archive management software is to extend that seamless capability to deeper layers. The requesting application at the top — broadcast automation, for instance — doesn't care that the archive manager had to move the content to make it available. It simply wants to know that the content is present when it is cued for playback. In this sense, the archive software is, in reality, the archive itself. The user should not have to care how

With the DaletPlus News Library, video and log archive information is instantly accessible online anywhere in a facility.

deep in the stack the archive manager had to go to find the content and how it had to move it.

Suffice it to say, a request for content that has been moved to a limestone mine had better happen with enough warning to load the truck up and deliver it. But in all other cases, the time between request and playout can be thought of as simply a pre-fetch command, meaning an advanced warning to move the content through the stack to the playout level by a certain time.

Do not confuse archive management with media asset management software. An archive manager may not know anything about the content except its name (unique material identification or UMID, perhaps) and location. Media asset management software will likely have a much more rich database of information about the content. It is this rich relational database that makes searching and categorizing possible, something that the archive manager does not necessarily need to be able to do. Archive management software is strong on the certain knowledge of the location of the content and the best way to get it to the final destination.

With this view, the hardware seems to be irrelevant, which clearly is not true. Each manufacturer's system has unique capabilities. Robotic systems can have hundreds of terabytes or petabytes available in a system, which looks to the outside world like it is online except for the speed of access. Volumetric optical storage (holographic storage) can be significantly faster in access times because there is no need to rewind tape or search in a linear fashion through a serial medium. DVD can be inexpensive for modest installations, but it is somewhat limited in write speed.

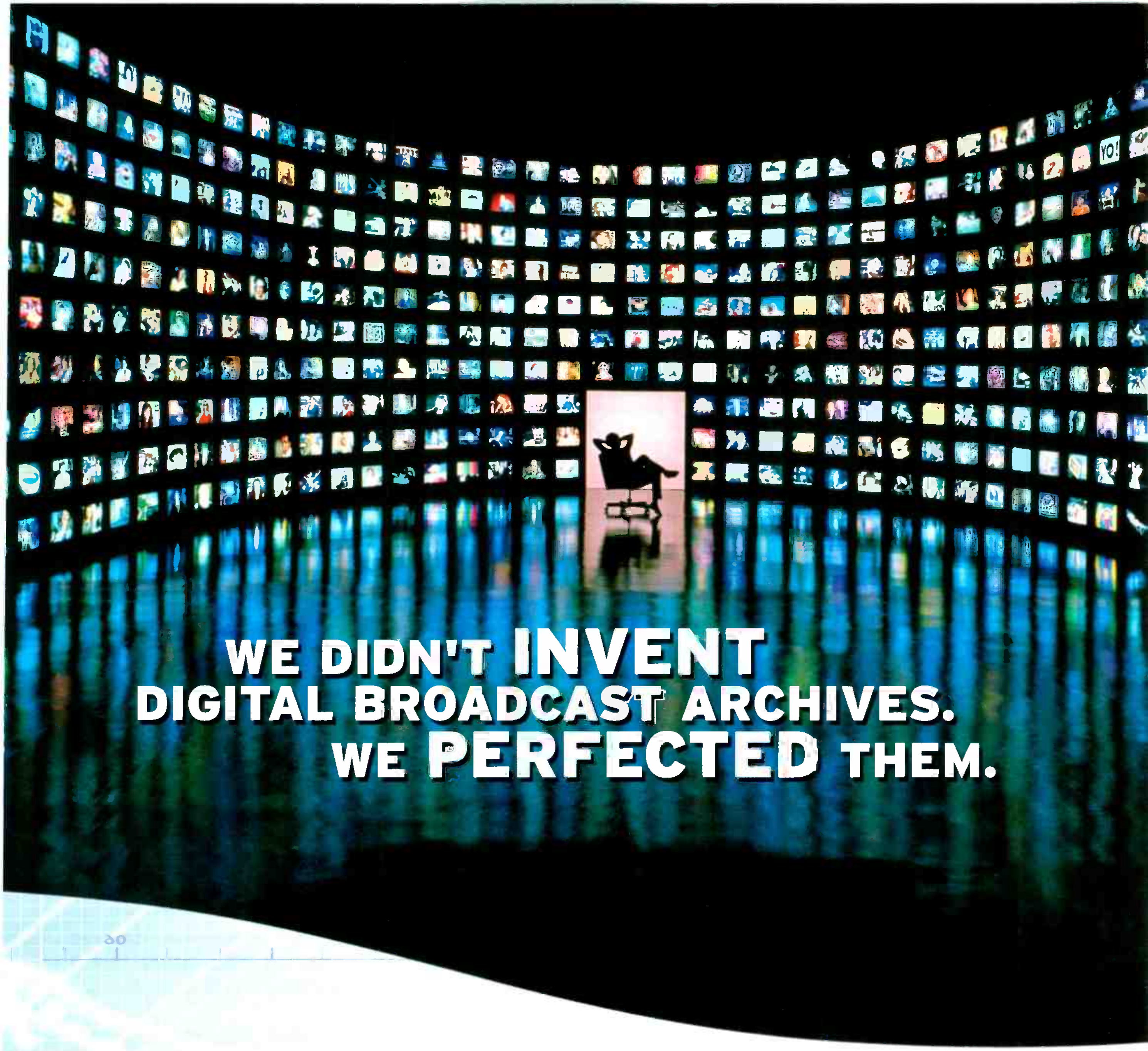
Thus, each technology is applicable in some applications. News might fit better with DVD, massive program libraries with streaming tape and systems with frequent random access needs with volumetric optical storage.

Deciding how to implement a system requires a thoughtful view of the needs of the system, including the throughput needed, access time demands, cost of storage, maintenance and other factors. Avoid giving in to manufacturers who point out that their systems work in all applications. But get used to the concepts soon; they are integral parts of many facilities today and will be in many more soon. **BE**

China Central TV's online robotic archive operation consists of a StorageTek PowderHorn 9310 tape library with five T9840B and five T9940B tape drives.

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

SEND Send questions and comments to: john_luff@primediabusiness.com



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DIVAcomplete@fpdigital.com

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PROGRAMMABLE CONTROLLER

Microfirst Engineering MPC-3200: Real-time automation control and interface equipment; can execute downloaded event schedules, providing a distributed-control automation environment; features a real-time, multitasking, pre-emptive operating system (the WinMOS) that mimics WIN32 API calls; provides the additional abstraction layer to allow existing WIN32 programming skills to be immediately useful.

201-651-9300; *www.microfirst.com*

REMOTE SIGNAL ANALYSIS SOFTWARE

Leader FS3019: Remote HD-SDI and SD-SDI equipment can be checked via a standard Internet connection; performs detailed checks of a broadcast module or a total system, regardless of its location; remote operators can trace and rectify faults back at base; maintenance staff of one broadcast site can supervise the equipment in an entire national or multinational network.

800-695-9300; *www.leaderusa.com*

PRO FLUID VIDEO HEAD

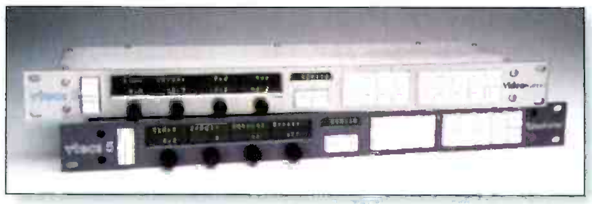
Manfrotto 526: Supports weight loads up to 35.3lb; features Manfrotto's precise fluid drag system, with three step settings for low to high drag levels; includes a no-drag setting for snap-pans and tilts; contains an adjustable spring for camera weights for counterbalance and a built-in 100mm half-ball for adaptability; features a removable pan arm rosette; is available with the 350MVB tripod in a complete video kit.

201-818-9500; *www.bogenimaging.us*

MPEG-4 AVC HD ENCODER

Grass Valley ViBE: Features H.264/MPEG-4 AVC main/High Profile Level 4 compression, including FRext; has CBR and CBR encoding; includes MPEG-1 layer 2, Dolby Digital 2.0 or 5.1 (AC3) and AAC audio compression; features up to 12 stereo audio channels; has advanced preprocessing and noise reduction; offers IP over Gigabit Ethernet output; supports management via embedded Web server, SNMP, or Grass Valley XMS 3500 eXtensible Management System command and control, including redundancy management; fits in a 1U chassis.

503-526-8200; *www.grassvalley.com*



CONTROL PANEL

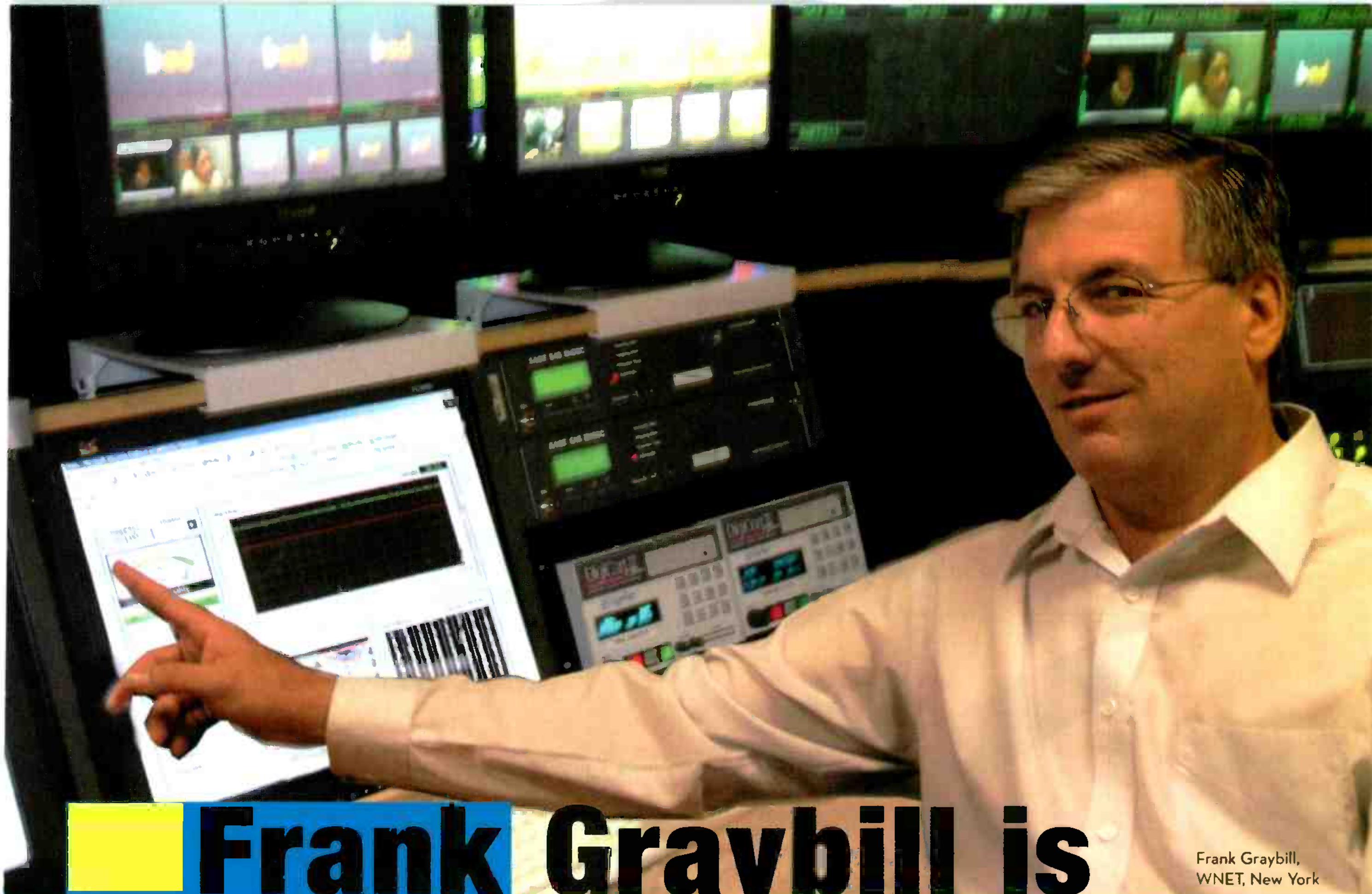
Videoframe VTECS 5: A knob-per-function panel for on-air control of processing amp and frame sync equipment; has a 1RU control panel and SNMP management; designed to work with Leitch's DPS575 and NEO products, Snell & Wilcox's RollNet, and Grass Valley's Gecko, Kameleon and TEN-XL products.

530-477-2000; *www.videoframesystems.com*

SIGNAL QUALITY MANAGER

Leitch Videotek SQM-STM: Provides visual and aural confidence monitoring by streaming analog video and audio to a user-supplied PC and across network or Internet connections, using Leitch's Videotek Remote Management software; continuously monitors the conditions of all common audio and video formats, including analog, digital and MPEG; detects errors in the signal path and pinpoints the exact location of the error.

800-231-9673; *www.leitch.com*



Frank Graybill,
WNET, New York

Frank Graybill is Choosey...

"We needed 8vsb Analyzers for both WNET DT New York and WLIW DT Plainview, NY. I made a list of parameters that we needed to analyze and priced equipment. I thought we'd have to spend $30,000 or more, then we discovered the 8vsb Analyzer from Modulation Sciences for under $10,000."

When WNET Needed 8vsb Analyzers, Frank Picked MSI

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- Bit Error Rates – Raw, pre-RS, & post-RS
- E-mail notification of Alarms
- Fully Web Enabled for Remote Operation
- DVB/ASI and SMPTE 310M TS Outputs

The **msi 4400** delivers accurate real-time data from an antenna at our WNET studios in Manhattan, while at WLIW it takes its signal directly from the transmitter. Our engineers have full access and control of both units from their desks and through remote network connections.

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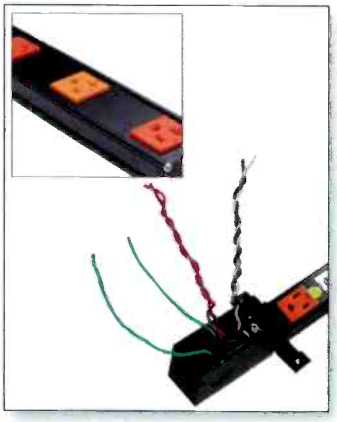
E-mail: sales@modsci.com • Web: www.modsci.com

DIGITAL CONSOLE

Solid State Logic XLogic E Signature Channel: Recreates the sound of the early 1980s E Series SSL console using modern discrete electronic circuits to emulate obsolete components, such as the original E Series Class A VCAs; choose between a selectable transformer drive or Variable Harmonic Drive (VHD) mic amps and the Listen Mic compressor; input section contains two independent Mic pre-amps; complements the SSL XLogic SuperAnalogue channel.

212-315-1111; *www.solid-state-logic.com*



POWER STRIPS

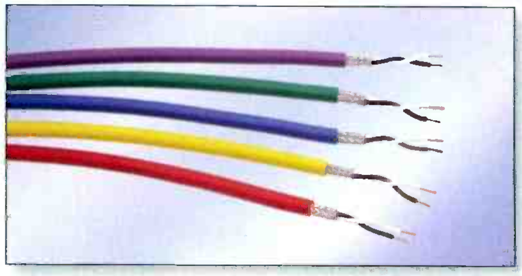
Middle Atlantic Products PDT Series: Can field-configure strips for single- or dual-back circuits, isolated or non-isolated grounding; features a J-Box for easy hardwiring and alternating outlet colors to differentiate circuits; includes corded models in 15A and 20A versions; includes a mounting kit with lances and quick clips.

800-266-7225; *www.middleatlantic.com*

CABLE CONNECTOR

Neutrik OpticalCon: Based on a standard optical LC-Duplex connection; enables up to four copper wires to run power or data signals through it; a special SMPTE-version provides an additional ground-shell contact; features a rugged connection, all-metal housing and heavy-duty cable retention; cables are protected from dust and dirt through automatic sealing covers and gaskets.

732-901 9488; *www.neutrikusa.com*



HIGH-BANDWIDTH MICROPHONE CABLE

Gepco X-Band: Is sonically transparent; has a wide frequency response and RF/EMI noise rejection; uses a video-grade foam dielectric that reduces the capacitance as well as cabling the pairs with a tight and precise twist; conductors are made from finely stranded, oxygen-free copper to maximize conductivity and protect against corrosion.

847-795-9555; *www.gepco.com*

IP VIDEO MONITOR

Path 1 Network Technologies Diagnostic, Analysis and Stream Health (DASH): Detects problems intrinsic with video streams being transported over packet-based networks; when used with the Path 1 Vx8000 IP video gateway, the integrated technologies detect and correct such errors as IP network jitter and packet loss; pinpoints and corrects performance problems quickly; video gateways can be used to apply Pro-MPEG Code of Practice standards-compliant techniques for FEC.

858-450-4220; *www.path1.com*

ACOUSTICAL TREATMENT

Auralex Acoustics AudioTile: Provides blending absorption, diffusion and reflection for acoustical balance; has a 0.81 absorption coefficient at 125Hz max; NRC is between 1.00 and 1.05 depending on installation; foam thicknesses range from 1in to 4in and are built into the patterns, providing varying degrees of absorption at varying frequencies; has unlimited tessellation design patterns.

317-842-2600; *www.auralex.com*

PORTABLE FIELD RECORDER

Sony PCM-D1: Weighs 18.5oz; is free of all drive mechanisms and equipped with sensitive, built-in condenser microphones in an X-Y configuration; is designed with circuits that process stereo sound with no extraneous noise; features 96K-24 bit recording capability, 4GB internal flash memory, removable Memory Stick Pro high-speed storage and a built-in USB 2.0 port for Macintosh and Windows.

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

SERVER

SeaChange Edge Server (ES-4012): Is configured with six 73GB, 147GB or 300GB hot-swappable disk drives; housed in a 2RU chassis that scales from 15 to 370 hours (1.47TB) of multiformat file storage, including MPEG-2, MPEG-2 IMX, DV-25 and DV-50; has redundant, hot-swappable power supplies and RAID-5 content protection.

978-897-0100; *www.schange.com*

LONG-ZOOM PORTABLE LENS

Canon YJ20x8.5B KRS: Features Canon's Internal Focus technology, which enables the front end of the lens to remain stationary as the internal elements move during focusing; includes a horizontal field of view of 54.7 degrees and 72.5 degrees; has a focal length of 8.5mm and a servo zoom speed of 1.2 seconds; weighs 2.58lbs.

800-321-4388; *www.canonbroadcast.com*

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www.thales-bm.com

HEADSET

ULTRASONE HFI-700 HSD: Combines ULTRASONE's S-Logic technology with DPA's 4088 head-worn directional microphone; a DPA 4088 (cardioid) or DPA 4066 (omni) microphone is joined to the headphone with an articulating mount and disconnect; 6ft cable terminates to a fan out with a 1/4in stereo plug for monitoring and a 3-pin female XLR for the microphone.

615-599-4719; *www.ultrasoneusa.com*

PROFESSIONAL SOFTWARE AUDIO CODEC

Dolby Media Producer: Supports all Dolby audio codecs used in mastering DVD video, DVD audio, HD-DVD and Blu-ray Disc formats; supports multichannel non-real-time encoding and file decoding of Dolby Digital Plus, Dolby Digital, Dolby TrueHD and MLP Lossless formats via a user interface; suite comprises Dolby Media Encoder, Dolby Media Decoder and Dolby Media Tools.

415-558-4813; *www.dolby.com*

PORTABLE RECORDER

TASCAM HD-P2: Features stereo recording to CompactFlash media; 44.1kHz to 192kHz recording resolution at 16- or 24-bit; time-stamped Broadcast WAVE file format is imported into DAW software and spotted into projects with sample accuracy; retake button allows user to redo last recording; audio files are continually resaved to safeguard against data loss; comprehensive system and transport control from the front panel or a PS/2 keyboard.

323-726-0303; *www.tascam.com*

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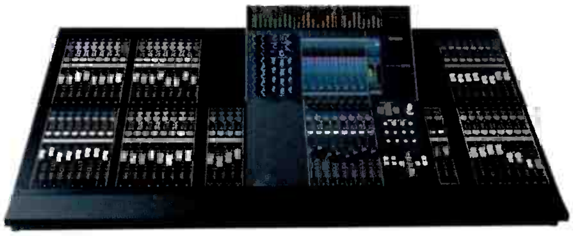

MIXING CONSOLE

Yamaha M7CL: Available in 32- or 48-channel formats; Centralogic interface combines a touch-panel control surface with Yamaha's Selected Channel structure; physical controls are single-function; digital controls can be accessed through two software screens; has four stereo inputs, three mini-YGDAI expansion card slots, 16 mix buses, eight matrix buses, an L-C-R bus, eight DCAs and 16 omni outputs.

714-522-9011; *www.yamaha.com*

MINIATURE AUDIO RECORDER

SONOSAX MINIR82: Measures 4.75in x 3.15in x 1.1in and weighs 1/2lb; is configurable from two to eight tracks with recording capabilities from 44.1kHz to 192kHz at 24 bits; writes standard audio files to either its internal 20GB to 30GB hard disk or to the CompactFlash card; is equipped with two microphone amplifiers with switchable limiters.

+41 21 651 01 01; *www.sonosax.ch*

20A REGULATOR

Furman Sound AR-20 II: Delivers a stable 120V of AC power; filters and purifies AC power; accepts any input voltage from 97V to 141V and transforms it to a constant 120V; is outfitted with Furman's proprietary Series Multi-Stage Protection Plus (SMP+) technology, which combines three filtering and protection circuits; SMP clamps and dissipates damaging transient voltages; protects against prolonged overvoltages.

707-763-1010; *www.furmansound.com*

SET-TOP BOX

Amino AmniNET 124: Supports MPEG-4 AVC/H.264; has an Ethernet input and highly flexible audio and video outputs; delivers interactive digital television via multicast, on-demand video and Internet access.

678-636-6000; *www.aminocom.com*


S
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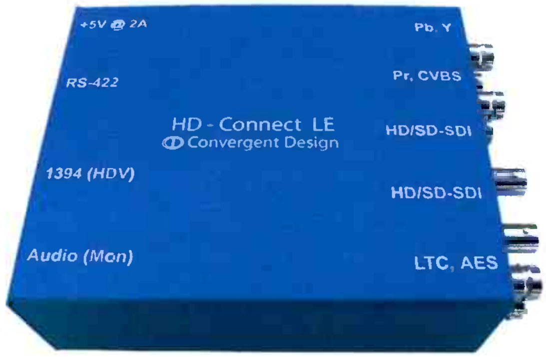
BIDIRECTIONAL CONVERTERS

Blackmagic Design Multibridge Extreme and Multibridge Studio: Instantly switch between HD and SD; feature 4:2:2 and Dual Link 4:4:4 video quality; high-speed PCI Express connection; support Windows XP and Mac OS X.

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



CONVERTER

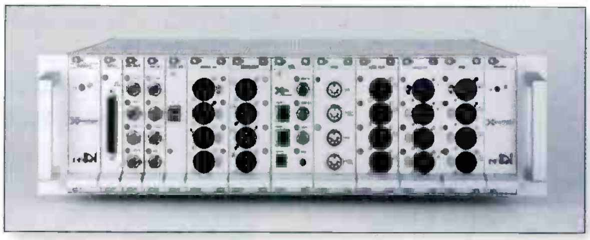
Convergent Design HD-Connect LE: Integrates video, audio, time-code and deck control into one box; offers the features of conversion to HD or SD, allowing users to output to a wide variety of formats; offers two modes of deck control: RS-422 to 1394 and 1394 to RS-422.

720-221-3861; *www.convergent-design.com*

HIGH-RESOLUTION DISPLAY DEVICE

Electronic Visuals i-Pal: Records composite video as MPEG-4 on its internal 20GB hard drive and plays it back through a composite output; can be used as a camera display and recorder to review shots without interfering with the master recording; serves to store and play MPEG-4 films, MP3 music and digital images or can be used as a 20GB pen drive; has a 7in display.

+44 1483 771663; *www.electronic-visuals.com*



OPTICAL NETWORK SYSTEM

Mediornet X-Switch: Transports any signal type via optical fiber, including HD-SDI and mixed formats; native conversion technology is built-in, making signal, sync and time conversions all available within the same platform; can be configured to provide any desired level of channel protection.

954-704-1552; *www.mediornet.com*

EMBEDDER AND DE-EMBEDDER

Network Electronics AV-HD-XMUX: Embeds four AES streams with selectable sample rate conversion, allowing sampling rates from 8kHz to 216kHz; offers comprehensive audio processing functionality, providing group swap, channel shuffle, L/R inversion and variable delay.

+47 33 48 99 99; *www.network-electronics.com*

CONSOLE PLATFORM

Calrec System Plus: Adjusts individual discrete elements via a custom-designed spill panel; uses one fader per surround channel; can use the resources of 2x stereo channels for L/R and Ls/Rs, and 2x mono channels for center and LFE; includes new fader panels; works across Calrec's Alpha, Sigma and Zeta range of consoles.

+44 1422 842159

www.calrec.com

AUTOMATION SYSTEM

Vqual Cerify: Verifies and checks content prior to transmission or use; all aspects are checked, including compliance and correctness to video and audio standards, video formats, resolutions, bit rates and video quality; video in any compressed format can be checked.

+44 117 3101 244

www.vqual.biz

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MINIDV CAMERA

Panasonic Broadcast AG-DVX100B: Is RoHS-compliant; weighs 4lb; allows camera-to-camera time-code sync and user-settable file transfer over IEEE 1394; has remote control of focus and iris (wired) for easier operation when mounted on a jib or tripod; features single-button character off for LCD and EVF displays; improved video S/N for better low-light recording; includes high-resolution LCD (210,000 pixels) and EVF (235,000 pixels) monitors.

201-348-5300

www.panasonic.com/provideo

NEWS PRODUCTION SYSTEM

Quantel Newsbox: Is preconfigured and tested to work straight from the box; features an editing server based on Quantel sQ and Frame Magic technology; the production workstations provide instant access to recorded material for shot selection, editing or reviewing finished stories.

+44 1635 48222

www.quantel.com

TRANSPORT STREAM ANALYZER

Pixelmetrix DVStation-IP Portable: Supports 10Mb/s, 100MB/s and 1000Mb/s Ethernet; sniffs out video traffic on any set of IP address pairs, extracts the MPEG-2 transport stream and performs extensive MPEG-2 verification; is housed in a portable package.

954-472-5445

www.pixelmetrix.com

GRAPHICS AUTOMATION SYSTEM

VertigoXmedia Xmedia Suite: Automatically creates, controls and delivers real-time content to any delivery channel; broadcast-ready graphics can be created directly from a user's desktop, dropped into predefined templates, linked to live data sources and inserted into playlists, without the user needing to write software code; data is normalized through an XML-based interface; system is MOS-complaint.

514-397-0955; *www.vertigoxmedia.com*

SATA RAID STORAGE SYSTEMS

Promise Technology VTrak M200p/M300p/M500p: Feature 3Gb/s speed; include Native Command Queuing (NCQ), staggered spin-up and drive hot swap support; hardware-accelerated iSCSI, Fibre Channel and U320 SCSI host systems; have redundant power supplies and cooling ECC cache memory; reduce 1TB rebuilds from an average 33 hours to less than seven hours.

408-228-1400; *www.promise.com*

LINE ARRAY SPEAKERS

SLS Loudspeakers LS6593S and LS6593A: Are based on a woofer line array mounted on a front panel with a coaxially positioned ribbon tweeter array; woofer array consists of 6in x 5.25in drivers; tweeter arrays consist of 9in x 3in ribbon planar drivers; deliver a frequency response of 80Hz to 20kHz; handle up to 600W of amplifier power.

417-883-4549
www.slsloudspeakers.com

MULTI-APPLICATION CONTROL SURFACE

Euphonix MC Intelligent Application Controller: Serves as a stand-alone product as well as the centerpiece of the System 5-MC console surface; has four levels of control; includes a keyboard and trackball and 56 LCD Smart-Switches that can be programmed to send out keystroke commands; features HUI and Mackie Control protocol and EuCon.

650-855-0400; *www.euphonix.com*

DATA TAPE SYSTEM

Quantum SDLT 600A with DLTxchange: Has Gigabit Ethernet and built-in FTP for network attached archiving; is accessible to any computer anywhere in a facility; features 36MB/s data transfer rates; includes 300GB native Super DLTtape IIA cartridge capacity that allows users to store more than six hours of HD or more than 25 hours of SD on a single cartridge.

949-856-7800; *www.quantum.com*

BI-AMPLIFIED MONITORING SYSTEM

Genelec 8020A: Has a die-cast aluminum minimum diffraction enclosure; incorporates Genelec's advanced Directivity Control Waveguide; each monitor features a 4in bass driver and a 3/4in tweeter; free field frequency response is 66Hz to 20kHz; can be combined with the 7050B Laminar Spiral Enclosure subwoofer.

508-652-0900; *www.genelecusa.com*

HD VIDEO PLAYER

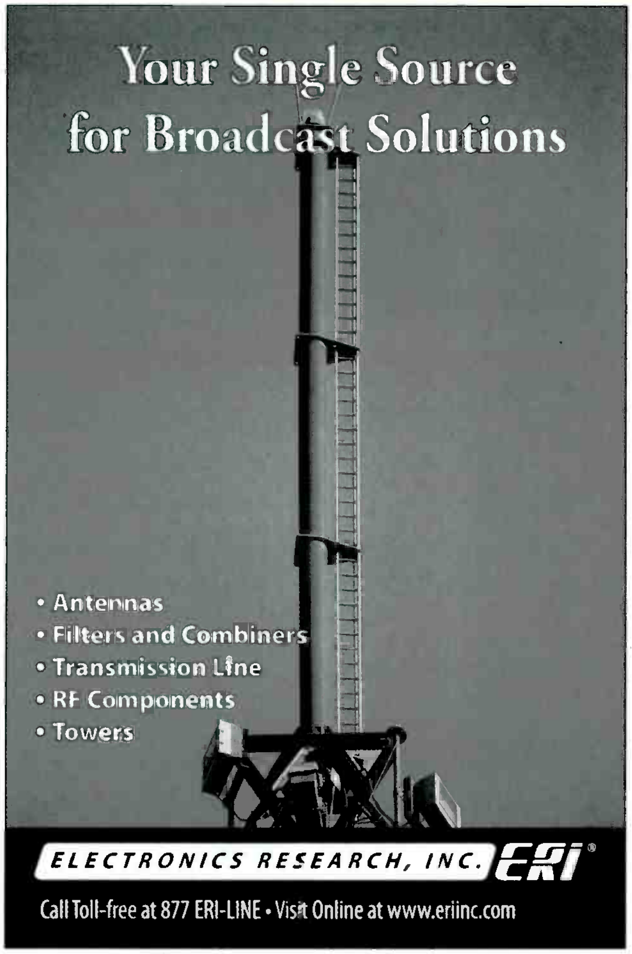
Doremi Labs Nugget: Provides perfect sync with the audio workstation timeline via its frame accurate Sony 9-pin chase mode; features variable speed playback; scrubs in perfect sync within the DAW session; accepts tri-level and bi-level sync; plays SD and HD video from its internal hard drive or directly from a remote server via Gigabit Ethernet.

818-562 1101; *www.doremilabs.com*

DIGITAL AUDIO ANALYZER

Sencore DA795 DigiPro: Analyzes any stereo non-encoded digital audio signal and generates low-noise digital test signals; supports formats including AES/EBU, S/PDIF, Toslink and ADAT at bit depths up to 24 bits and samples at 96kHz; features a transparency test, bit-stream analyzer, lock test, bit-scope, latency test, digital watchdog, jitter meter, clock/sample counter and distortion meter.

800-736-2673; *www.sencore.com*



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KPMR TV 38 Santa Barbara has an immediate opening for a Broadcast Chief Engineer. Qualified candidates should have experience in television and radio broadcast. A FCC 1st class, General Radiotelephone license and or SBE certified is preferred but not required. We are seeking candidates with strong interpersonal and communication skills to work in our station's team environment. Entravision Communications Corporation is an equal opportunity employer. Women and minorities are encouraged to apply.

Job Requirements/Qualifications:
Strong RF (UHF,VHF,FM & AM), experience with broadcast equipment installation, maintenance and repair of studio equipment. Send resume (with cover letter).

Mail to:
Human Resources
KPMR
7000 Hollister Ave
Goleta, CA 92243
(805) 968-8872 fax

Help Wanted

MOBILE UNIT ENGINEERS

nep

NEP Broadcasting is seeking Mobile Unit Engineers of all experience levels to manage and monitor mobile unit broadcast operations at remote sites, perform preventative maintenance, troubleshoot, execute changes and engineering updates on the mobile unit. Degree, training, 3+ years experience in broadcast technology, equipment, facilities, and production or any combination considered. Please send resume and salary history to NEP Broadcasting LLC, hr@nepinc.com, Fax: 412-820-6045, 2 Beta Drive, Pittsburgh, PA 15238. An Equal Opportunity Employer. www.nepinc.com.

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Iowa Public Television is seeking applicants for a Senior Engineer position to work primarily in the Transmitter/Translator area. This position will oversee the operation, repair, maintenance and construction of proposed and existing television equipment at the transmitter/translator sites. Work hours will be varied.

Requirements: Must have extensive knowledge and experience in the operation of transmitters and translators.

Salary Range: $42,203 to $63,876/annually, plus full benefit package.

Closing Date: December 2, 2005

You may request an application form by:

Mail: Human Resources
Iowa Public Television
P.O. Box 6450
Johnston, IA 50131

Telephone: (515)242-3117

Fax: (515)242-4113

Email: Humanresources@iptv.org

Or complete and print an application form from our Web site, www.**iptv.org**

EOE/AAE

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We're currently accepting resumes for:

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Windows server / workstation admin - MSCE, Mac, Linux, Irix skills preferred

SENIOR VIDEO ENGINEER - 47743BR

Camera Shading, QC, Camera Maintenance, Color Correction, Technical Consultant

Please send resumes to:
Jeff Sharpe
Director of Engineering
Fax - 404-878-4014
Email - jeff.sharpe@turner.com

For more information, please visit:
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The Systems Group, a nationally recognized systems integration firm (design/build) is seeking specialized professionals. Located across the river from Manhattan, we are currently under contract for a number of high profile DTV facilities serving top markets in broadcast/cable.

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TSG Human Resources
317 Newark Street
Hoboken, NJ 07030
No phone call or faxes please.

MAINTENANCE ENGINEER

WOWT/UPN Omaha seeks a Maintenance Engineer, preferably with a minimum of five years experience. Please visit www.wowt.com for our posting with full details. WOWT/Gray Television Group, Inc. a drug-free company and requires pre-employment drug testing and background checks. EOE. Send resume to or fill out an application at:

WOWT / Human Resources
3501 Farnam Street
Omaha, NE 68131-3356
Fax (402) 233-7885 or Email hr@wowt.com

SNG/ENG OPERATOR/PHOTOGRAPHER

WOWT Omaha is looking for someone who wants to be where the action is in covering breaking news on location - someone ready to "go" when the alarm sounds - someone with their bag packed...someone who wants to be a part of a winning news team. This person must be able to operate an SNG truck and ENG trucks. The job will also include some photography and editing.

Please visit our website at wowt.com for qualification details. EOE.

Send resume to or fill out an application at:

WOWT / Human Resources
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Editorial Director: Brad Dick, bdick@primediabusiness.com
Editor: World Edition: David Austerberry, editor@broadcastengineeringworld.com
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Australia's finest?

BY PAUL MCGOLDRICK

Swag is an odd word. It can mean a drooping piece of fabric. It can also mean moving unsteadily and being out of control. When used as a noun, however, it becomes really fascinating.

When I was growing up, swag was a negative term meaning services, goods or money obtained illegally. Swagman, in Australian terminology, was a word used to describe a transient who traveled with his swag bag, moving from job to job, with the implicit suggestion that he was really a no-good thief. Now the name is attached to a line of motor homes, bike racks, a hotel, a software developer and even a publisher.

After attending a recent trade show, I left feeling like I was a swagman with my large bag full of goodies.

After attending a recent trade show, I left feeling like I was a swagman with my large bag full of goodies (the current meaning of swag after pop musicians began throwing token, rather commercial, gifts at their fans), all warmly presented to me by organizations and exhibitors. This experience made me contemplate the nature of swag these days.

A sector of my wardrobe — actually in a removal van at this moment — is stuffed with shirts donated over the years. Some are great, but others are a bit dubious and are bad enough that I wouldn't want to be seen wearing them outside the house. Swag CD carrying cases abound at the moment in all sorts of shapes and formats, as do PC mirrors and USB-powered lights to illuminate your laptop keyboard. (How many can you use at once?)

Pens are still big in the giveaway spectrum. If you look in a promotion company's catalog, you will see that the prices for pens range from cheap (and poor quality) up to those that are moderately expensive with, usually, a dramatic increase in quality and life.

What is the poorest swag I have seen this year? A bookmark. No, it wasn't gold-plated or anything — just a cheap paper bookmark.

What else is hot? USB Flash memory is a useful gift, especially for working journalists. It even comes with an extension cable.

I have also received a pen that acts as a cell phone detector with a neon light at the top that flashes quite a distance from an operating cell phone. To extend shelf life, it even came in an entirely metal case — its own little RF cage. Why would anyone need such a thing? It's fun to watch it being used in the supermarket. It's mind-boggling how people cannot even grocery shop without wireless assistance. Maybe flight attendants should be detector-equipped to find those naughty customers using BlackBerries in RF mode in the air.

Another piece of cool swag is a dual dial, dual time zone watch — a nice one with a leather strap. From a design point, you would assume that it would use a single oscillator for the two displays. However, that isn't the case. I set the two dials to read the same time, and I can see the sweeps of the second hands moving slowly away from one another. Shows how cheap the oscillators must be!

At the last show I was at, the most popular piece of swag was a large walking stick with a metal base. I surmised to myself it was not something to easily talk security at the airport into letting you by with. The Transportation Security Administration is a humorless lot.

The weirdest swag I received was at the technical Emmy awards in New York. It was a set of long, tiny spoons from NEC, which were supposedly part of a tea ceremony kit, but they looked like they were for another crushed powder.

What kind of new swag would I like? How about a solar-powered pocket-sized calculator with decent-sized keys? Or the return of a high-quality coffee mug? The last one I got was from Tektronix in 2000. (How do I remember that? Because it says so on the mug.)

My mother always said I would go bad — but a swagman? She would have never guessed. BE

Paul McGoldrick is an industry consultant based on the West Coast.

SEND
Send questions and comments to:
paul_mcgoldrick@primediabusiness.com