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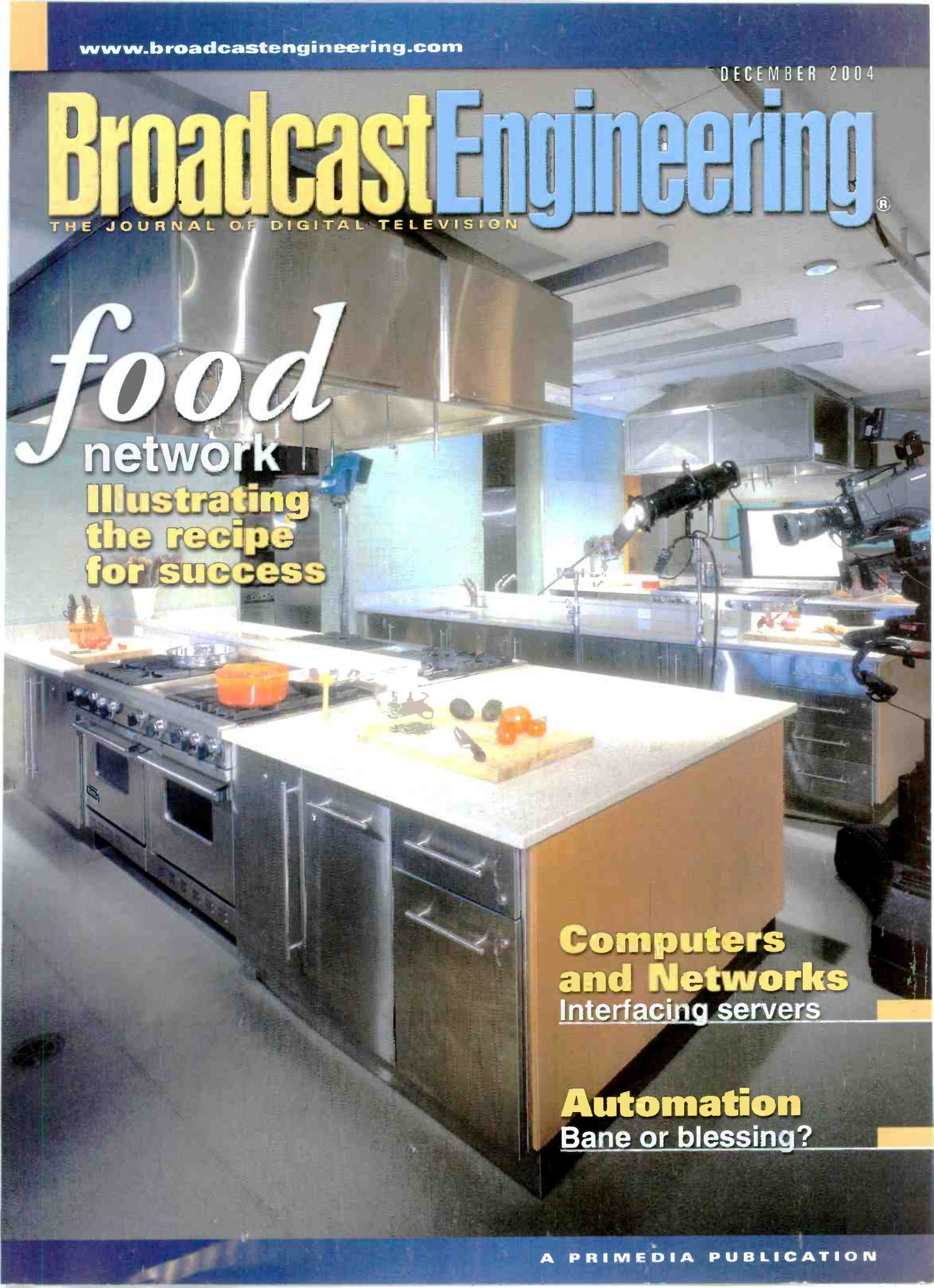
DECEMBER 2004

Broadcast Engineering®

THE JOURNAL OF DIGITAL TELEVISION



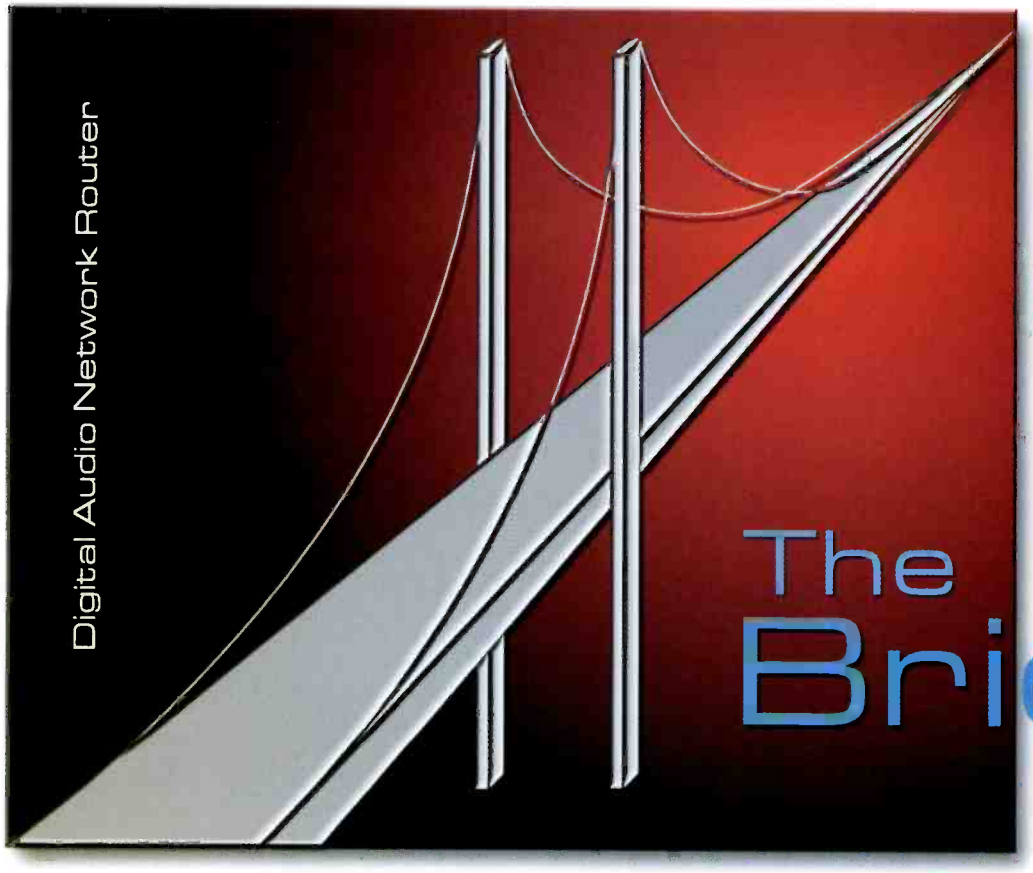
food network

Illustrating the recipe for success

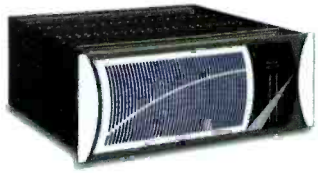
Computers and Networks
Interfacing servers

Automation
Bane or blessing?

A PRIMEDIA PUBLICATION



The Bridge Router can hold all the electronics you'll need for a small console: I/O cards, mix engines, and DSP processors. Naturally it can also have automatic fail-over DSP and CPU cards to keep you on-air. You can expand the system with a simple cage-to-cage interconnect.



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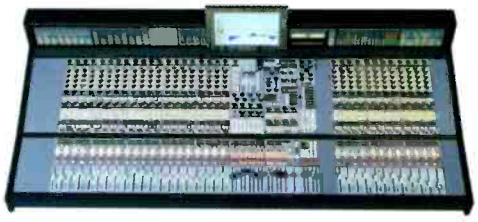

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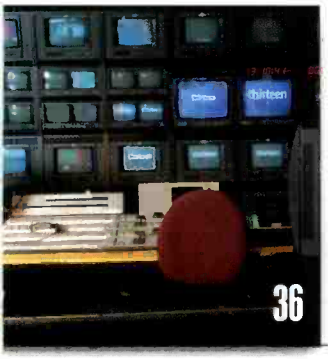

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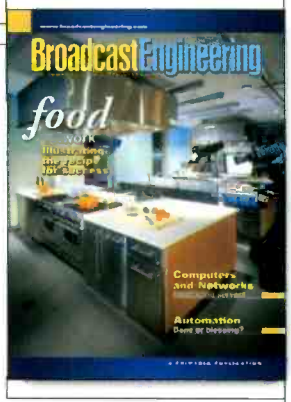

ON THE COVER: Food Network located its new studios in New York's Chelsea Market to provide a unique backdrop for network productions.

(continued on page 8)

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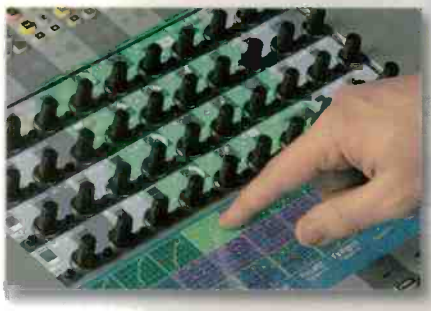
The Studer Vista 8 with its unique, world-leading Vistonics® user interface ensures fast, intuitive console operation – the key to trouble free broadcasts.

The Vistonics concept of "where you look is where you control" marries the familiar feel of analog consoles with the powerful control features found on today's digital consoles.



... and with the extra security of a fully redundant control system

With any live broadcast situation, redundancy is essential to ensure constant 24/7 operation. In addition to RAID drives, redundant power supplies throughout, and reserve DSP that engages automatically as needed, the Vista 8 also offers the security of a second complete control system. In the unlikely event of a control system problem, the operator can switch to this back-up system. Most importantly, operation resumes exactly as before, because all settings are constantly mirrored.

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Freezeframe

Name the winners of the *2003 Broadcast Engineering* Excellence Awards. (Hint: check out our Web site.) You need only list the winners, not runners-up. Readers with correct responses will be entered into a drawing for *Broadcast Engineering* T-shirts. Enter by e-mail. Title your entry "Freezeframe-December" in the subject field and send it to: editor@primediabusiness.com. Correct answers received by Feb. 1, 2005, are eligible to win.

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Tom Duff

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HDTV's killer ap

Bill Gates recently threw a Hollywood party where he touted his company's latest version of the Windows Media Center — the convergence of TV and PC.

Yeah, right. The company's first attempt at a PC-based entertainment system garnered fewer than 500,000 viewers.

How much do you want to bet that while he may talk a good game, Mr. Gates doesn't watch entertainment TV on a small PC screen while sitting at a desk?

Today's PC industry still thinks that people, especially those who work in front of a PC all day, are going to go home and sit in front of ANOTHER PC to watch TV. How many times have the experts told them that's not going to happen?

Okay, so maybe I'm not an expert, but I am a TV viewer and I do sit in front a PC all day. Want to know how I watch TV? In one of two ways: Either by *listening* to a 13in model sitting far away on the kitchen counter while I do other things (in which case I would argue I'm not watching TV at all) or by sitting in my comfortable recliner directly in front of a 57in HDTV with a snack and drink. Now, that's how you watch TV.

Continuing to stoke the PC fire, graphics card company ATI just released its new HDTV PCI receiver card. Some in the media have called the HDTV-on-a-PC approach "HD's killer ap." The PC tuner card comes complete with a "DTV antenna" (as opposed to an *analog* TV antenna?). The card claims to receive HD signals and display them along with stereo audio on your favorite PC.

One *Associated Press* technical writer reviewing the product, was really impressed, saying, "On my standard television, I never noticed the cloud of dust that's kicked up when a receiver catches a football on artificial turf. Or the beads of sweat on a forehead. Or scratches on a helmet. [With HD] It's all there."

The writer also discovered that watching TV on a PC doesn't have all those "hisses and hum so common to standard TV."

What? If this guy is hearing "hisses and hum" on his TV set, it must be an old RCA CT100. (For you younger readers, that was RCA's first color TV set, released in 1954. It contained about 25 tubes.)

The writer did find a few faults with the PC solution. "Oddly, the remote control doesn't have an obvious way of turning on the DTV program. It is possible, however, to program a button to do the job."

I guess he's saying it doesn't have an on/off switch. It's probably behind an icon marked "Start."

One other apparent shortcoming for this so-called "HD killer ap" is that the tuner card won't accept cable or satellite signals.

The writer concludes saying, "Though the included software falls short, the entire package shows there may be a bright, clear future for the entertainment PC. Just this week, Microsoft announced that its Windows Media Center 2005 software will support HDTV. It might just have the resources to do the software right."

Wanna bet?

I don't think broadcasters need fear that their audiences are going to rush to the PC screen to catch the 11 p.m. news.

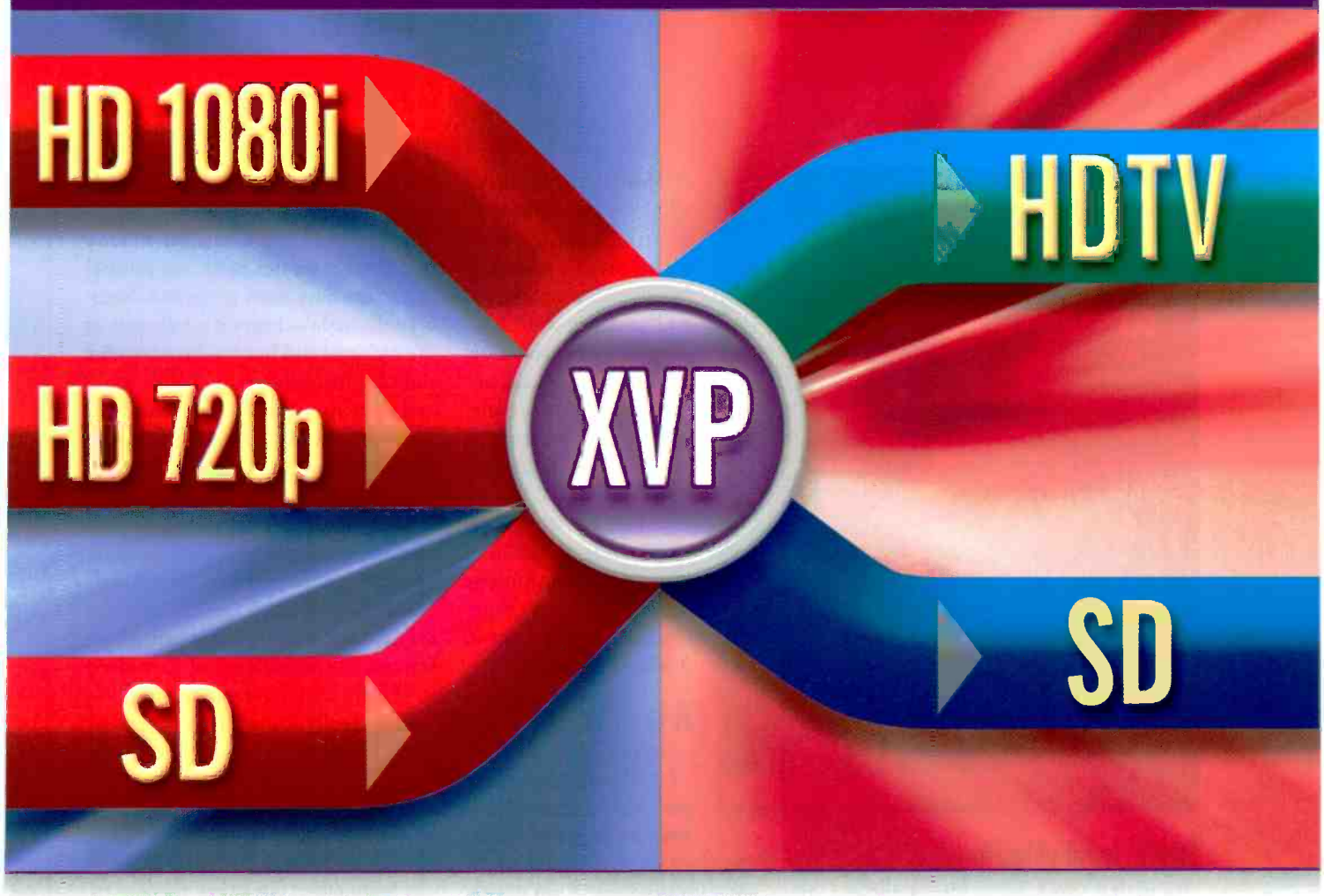
Brad Dick

editorial director

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

IMAGING XVP-801i
UNIVERSAL PROCESSOR UP/DOWN/CROSS CONVERTER

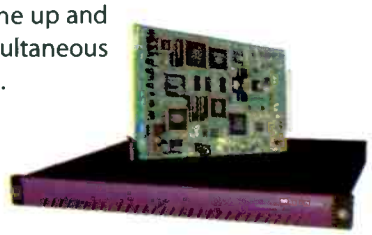
Miranda



Any format in. Your formats out.

If you need to work with multiple HD formats and SD or are running a hybrid HD/SD facility, then you'll really like our new XVP-801i processor card.

It can automatically detect the input video format, and perform the up and down conversion and processing necessary to maintain two simultaneous outputs, one HD and the other SD, in your chosen station formats.



Working in 1080i but receiving material in 720p? No problem, the built in cross version will take care of it.

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Digital legal video level

In digital video, eight bits quantize 256 different levels.

The digital video uses values between 16 and 235 for video 0-100IRE.

Zero through 16 and 235 through 255 are overhead.

You said that the legal values for video are 0-100 (700mV); does that mean that levels higher than 100 are illegal in digital?

Is the -7-0 overhead 100-109IRE only a protection area that we should never use for video?

Is it a good pratice to set the white clipper at 100IRE for a digital camera integrated in a digital studio?

CLAUDE LESSARD

Michael Robin responds:

First, in dealing with component analog video we do not use the IRE notation. That is used strictly with analog composite NTSC. We express analog signal levels in mV. Levels 1 to 16 (-47.19mV to 0mV) and 235 to 254 (700mV to 763.13mV) allow for misadjusted or drifting analog video signal levels, as well as for possible overshoot and undershoot of analog signals. Levels below 1 and above 254 are not digitized, which results in clipping. Setting the camera clipping level to peak white (i.e. 254 or 763.13mV) would be duplicating the following digital equipment function so I don't think it is necessary. However, it would not hurt.

A la carte

Harry,

I read with great interest your article in this month's [September] issue of *Broadcast Engineering*. As a religious program producer, I am greatly concerned at the impact *a la carte* availability would do to the religious programming market. Statistics show that while many enjoy the benefits of religious programming when offered through bundled channel options, few would be willing to pay higher charges for specific channels dedicated to carrying such programming. Not only that, but the higher rates cable outlets charge for such channels would reflect rate increases religious programmers would be forced to pay for such time slot availabilities. Religious programmers have had their hands tied long enough without the further injury of restricted or higher-priced cable outlets.

REV. RON LAMBROS
REHOBOTH BAPTIST CHURCH

Harry Martin responds:

Ron Lambros' comments represent the views of many specialized cable programmers, who feel they will be left behind if the FCC requires a la carte program packaging.

Currently, there is a notice of inquiry outstanding on this issue, but no specific rules have been proposed. Naturally, the cable industry is solidly against the proposal and has produced studies showing that cable rates would go up and diversity would be diminished if it were adopted. On the other hand, Congress has expressed a strong interest in a la carte as a way to reduce cable rates. That is what drove the commission to institute the inquiry proceeding.

Under these circumstances, my crystal ball says that the FCC will delay the matter as long as it can, give it serious consideration but then drop it. Others may have other opinions; no one really knows how this issue will come out. BE

September Freezeframe:

In September, we asked readers to submit nominations for the most unusual, distinguished or confusing names for television-related products.

Winners:

Paul Byers, Sony PetaFile
Frank Felker, CEL Maurice
Tom Cupp, Accom Dveous digital effects; Spider Pod, Scorpion Pod

Test your knowledge!
See the Freezeframe question of the month on page 8 and enter to win a *Broadcast Engineering* T-shirt.
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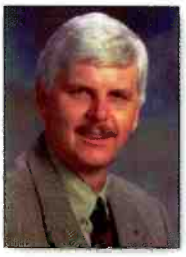
Will your next PC be an affordable DTV?



BY CRAIG BIRKMAIER

It is hard to ignore the reality that TVs and PCs are looking more and more similar as the component technologies from which they are built rapidly converge.

It is also no coincidence that the same companies are increasingly making graphics subsystems for PCs and components for the consumer electronics (CE) industry. In some cases, the same company makes graphics subsystems for TVs and set-top boxes and supplies the tuner chips required to receive ATSC broadcasts and connect to digital cable systems. One such company is ATI Technologies. ATI acquired NxtWave Communications in 2002, about the time NxtWave was claiming they had solved the ATSC reception problem.

As it turns out, over-the-air DTV reception may not have been the most important problem to solve. Reaching an agreement between the CE industry and the cable industry to make new DTV receivers digital cable-ready (DCR) may turn out to be more important in today's marketplace. These industries finally reached an agreement on one-way digital cable compatibility last year. Shortly thereafter, the FCC added the provision that any new DCR set must also include an ATSC receiver.

It is hard to ignore the reality that TVs and PCs are looking more and more similar as their component technologies rapidly converge.

ATI was ready with a single QAM/VSB tuner chip for commercially available integrated DCR HDTVs. Of the 11 CE companies that have announced digital cable-certified HDTV sets, nine rely on ATI's NXT series components.

But this position may soon be challenged if OTA reception turns out to be more important than being digital cable-ready. Several companies have announced intentions to use the fifth-generation ATSC receiver chip developed by LG Electronics. Recently, the Sinclair Broadcast Group announced that they were going to start promoting DTV broadcasts, in large measure because they believe that the fifth-generation receiver has finally made reception of ATSC broadcasts reliable, even in difficult multipath environments. USDTV is currently developing set-top boxes for their subscription DTV service using the new LG chips. Products using the new chips are expected to reach the market next spring.

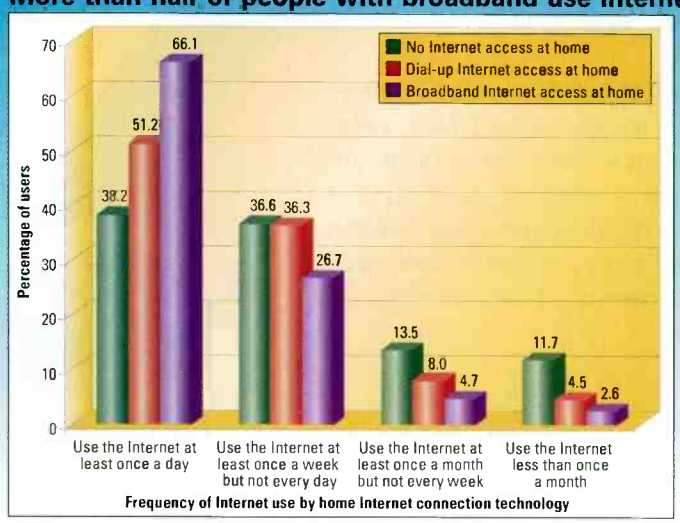
All of this provides digital broadcasters with renewed hope that the DTV transition is finally beginning to move in the right direction. There is even more encouragement when one walks through the aisle of the TV departments in specialty CE and mass-market retailers. There, one can find affordable HDTV receivers, not to mention a rapidly growing number of options for displaying HDTV content. For example, a 30in-screen Sanyo HDTV or a 27in Samsung HDTV with integrated ATSC tuners can be purchased for less than $699.

According to salespeople, however, these are not the sets that most people are buying — and for good reason. They have relatively small screens in

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

Faster Internet equals more frequent use

More than half of people with broadband use Internet daily



SOURCE: U.S. Department of Commerce *www.commerce.gov*

End separation anxiety

Congratulations on your latest audio-post creation. If only the delivery wasn't so complicated.

You know the drill. Generate separate multitrack audio tapes. Hand them off with the videotapes. Then wait—for sync hassles, editing-induced audio artifacts, and maybe even a *one-of-the-tapes-is-missing* call. Talk about audio-post-partum anxiety.

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huge cabinets because they are built around direct view CRTs. By definition, HD is a big screen viewing experience, and that is what most people are buying.

The salespeople will also tell you that consumers are not buying many HD products with integrated DCR/ATSC receivers. As of July, the FCC mandated that 50 percent of all new receivers larger than 36in must include an ATSC receiver. More than two-thirds of the big screen sets ordered by retailers for this Christmas season are still HD-capable monitors without digital tuners.

PC or TV? Sharp's 23in HD-ready TV can be used as a PC display. Apple's G5 iMAC puts the computer and DVD drive inside the display. Photos courtesy Sharp and Apple.

Recently, the Consumer Electronics Association and the Consumer Electronics Retailers Coalition petitioned the FCC to change the next phase of the DTV receiver mandate schedule. The schedule calls for 50 percent of sets between 25in and 36in to include an ATSC tuner starting in July 2005; 100 percent as of July 2006. But the CE industry wants to eliminate the 50 percent requirement and move the date up to March 2006 for 100 percent of sets this size. They reason that, given the choice, consumers will choose the cheaper monitors without digital tuners. While this appears to be a cooperative gesture, in reality it would give the CE industry another year to sell the cheap mid-sized NTSC receivers that still dominate the market in terms of unit volumes.

PC or TV?

LCD panels are all the rage in the world of PCs. The units are slim, the images are sharp and the prices are falling as new manufacturing capacity is ramping up to meet demand. One of those demands is to turn LCD panels into TVs — to replace the smaller sets that are common in U.S. homes. LCD panels are growing wider, both for PC and TV applications. And, when the size reaches 20in or larger, they typically offer HDTV resolution.

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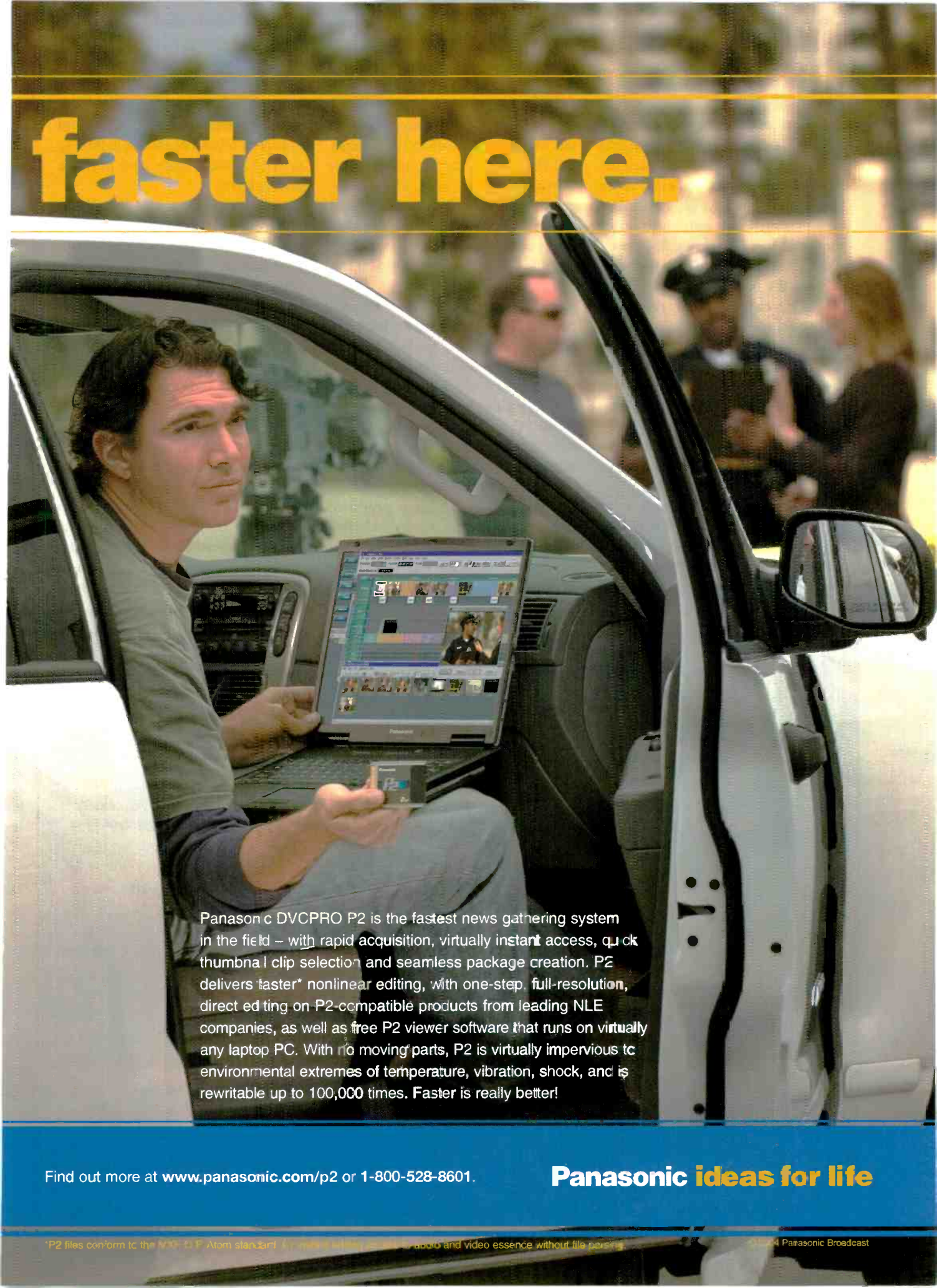
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that the display requirements for a PC and an HDTV are converging, if they have not done so already. The major difference is the distance one sits from the screen. As PC displays grow past 20in, they become large enough to watch comfortably at TV viewing distances.

Microsoft is trying to turn the home PC into the media center that drives the big screen in the family room. You will soon see ads co-sponsored by Microsoft and Intel, promoting the advantages of the Media Center PC as the hub of your home entertainment systems. The purported advantages include the ability to use the PC as a PVR, a DVD recorder/player and a digital jukebox with all of your favorite music and digital photos.

Meanwhile the CE industry is trying to add intelligence to the TV. Several models of HDTV monitors now come with slots for the various flash memory cards used in digital cameras and IEEE 1394 connections for digital camcorders and other components. But the CE industry is moving more slowly toward the kind of total integration being offered by the Media Center PC concept. It's moving even slower toward a computer-style graphical interface to control home entertainment systems.

The CE industry still favors the idea of appliances that turn on instantly, and do not crash or get sick from viruses. And they still want a home entertainment system assembled from multiple components.

The PC industry seems infatuated with the home entertainment opportunity. This is not surprising because the markets for PCs are flat. PCs have become just another mass-produced commodity. Manufacturers including Dell, Gateway and HP now have TV product groups (see Web links). HP is moving aggressively into the CE space with Media Center PCs, TVs and a range of related products, including an HP-branded Apple iPod portable music player.

Apple just announced the Photo iPod, which stores both music and digital photos. The tiny player can hook directly to a TV to present slide shows with music. Ironically, while Apple has been involved in the development of many of the technologies that are common to both CE and PC products (e.g. FireWire [IEEE 1394] and Wi-Fi) the company seems reluctant to push the Media Center concept at this time. Instead, Apple seems to be slowly transforming itself into a CE company, which is less threatening to potential partners in the CE industry.

The Apple G5 iMac and the Sharp IT-23M1U LCD IT-TV demonstrate just how blurred the lines are becoming between PC and TV. The new iMacs look very much like the rows of

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LCD TVs now found in the TV departments of many retailers. The computer is integrated within a 17in or 20 in widescreen LCD display. The displays are about 2in thick. The 20in model offers 1440x900 resolution. About the only thing the new iMac does not include is a TV tuner.

The new Sharp LCD IT-TV takes PC/TV convergence in an interesting new direction. The 23in widescreen panel offers 1366x768 resolution, a built-in analog TV tuner and all of the interfaces needed for video components, including HD sources. The most interesting twist is that it is an instant-on TV that can also be used as a PC monitor. The only thing missing is the PC.

If it is not obvious already, there must be some convergence going on here. The question is: Where is the convergence happening? The Internet has been abuzz lately about this subject. Type the word *convergence* into Google search engine and you will get more than 9 million hits.

PC-centric early adopters are yawning. They have been cobbling together media centers with PVRs and other functions for years. However, mainstream HDTV buyers are skeptical. For the most part, they are just buying monitors with the assumption that the best way to future-proof their purchase is to add tuners and other components that can be replaced easily as the technology evolves.

The PC industry may be barking up the wrong tree by trying to take control of the big screen in the family room. Thanks in part to the proliferation of cheap TVs in our homes, and to the "up close and personal" nature of PCs, we have become a nation of *personal* media consumers. The notion of the family gathering around the electronic hearth during prime time is all but forgotten in a medium that is now driven by highly targeted demographic audiences.

The notion of the family gathering around the electronic hearth during prime time is all but forgotten.

All this makes me wonder if the next PC many folks buy will be their first DTV receiver. BE

Web Links

ATI Technologies
www.ati.com/products/dtv.html
Microsoft Media Center PC
www.microsoft.com/windowsxp/experiencemore/default.mspx
HP TVs
h30015.www3.hp.com/hp_dec/entertainment/meet1.asp
Dell TVs
www1.us.dell.com/content/productscategory.aspx/tvs?c=us&cs=19&l=en&s=dhs
GatewayTVs
www.gateway.com/home/ce/tv_index.shtml
HP Digital Entertainment Systems
www.shopping.hp.com/webapp/shopping/generic_category.do?storeName=storefronts&landing=entertainment&category=entertainment_systems&catLevel=1
Apple iMac
www.apple.com/imac/
Sharp LCD IT-TV
www.sharpsystems.com/products/lcd_monitors/lcd_tv_monitors/it-23m1u/

Craig Birkmaier is a technology consultant at Pcube labs and he hosts and moderates OpenDTV Forum.

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WNYW-TV, New York, NY
WPXI-TV, Pittsburgh, PA
WBNS-TV, Columbus, OH
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BEYOND THE HEADLINES

DTV transition schedule set

BY HARRY C. MARTIN

The deadline for filing FCC Form 381, the Pre-Election Certification Form, was Nov. 5. That was the first step in the DTV conversion plan outlined in the FCC's September DTV Transition Order. This article describes portions of the Transition Order and the important upcoming deadlines.

The commission will require broadcasters to fully implement the Program System and Informational Protocol (PSIP) by Feb. 1, 2005. PSIP is data transmitted with the digital signal that provides the DTV receiver with information about the number of channels being broadcast and the programming on each channel. Also, PSIP transmits the content advisories necessary for the use of the V-chip and to make viewers aware of programming ratings.

For licensees affiliated with the top four networks, which are assigned to the top 100 television markets, permanent, full-power DTV facilities must be operational by July 1, 2005. Those licensees that will be operating DTV facilities on channels other than their originally assigned DTV channels will be required to provide service to at least 100 percent of the viewers specified as receiving NTSC service in the 1997 DTV Table of Allotments. Top 100 network stations not built out by July 1 will lose interference protection beyond their then-current DTV facilities.

All other commercial and noncommercial stations have one additional year – until July 1, 2006 – to complete DTV construction. Those licensees that will not operate on their current digital channels will be required to serve 80 percent of the number of NTSC viewers specified as receiving service in the 1997 DTV Table of Allotments. (While financial hardship waivers will be considered, they will require strong supporting evidence and will undergo strict scrutiny.)

To the extent that viewer numbers come into play, the commission will update the population figures with 2000 census information, but will base the "population served" figures on the facility specified in the 1997 DTV Table of Allotments.

The commission will apply the channel election and build-out requirements to satellite stations. In addition, those licensees with blocked DTV construction permit applications, either due to international concerns or pending maximization applications, will be required to file a checklist application and construct their replication facilities by Aug. 4, 2005. Those licensees will not lose the right to prosecute their pending applications, and the commission will permit licensees to request permission to construct non-checklist facilities by the Aug. 4, 2005, deadline.

The commission eliminated the requirement that licensees air the same programming on their DTV channel as on their NTSC channel. It reasoned that such requirements might impede the development of new digital programming.

The commission eliminated the requirement that licensees air the same programming on their DTV as on their NTSC channel.

The commission adopted requirements that licensees follow the same station ID rules for their DTV station as are applicable to the NTSC station. This information will be included in the PSIP data that is transmitted with the DTV signal.

The commission acknowledged the support of parties for developing rules to permit licensees to place synchronized transmitters throughout their service area to fill in gaps and for more efficient use of the spectrum. The agency also pledged to open a separate fast-track proceeding to address this matter, and directed the staff to adopt conservative standards to process requests on a case-by-case basis in the meantime. BE

Dateline

Television stations in Arkansas, Louisiana and Mississippi must file their renewal applications, biennial ownership reports and EEO program reports on or before Feb. 1, 2005.

Feb. 1, 2005, is the start date for pre-filing renewal announcements for TV stations in Indiana, Kentucky and Tennessee.

Feb. 1, 2005, also is the deadline for DTV stations to fully implement PSIP (see text above).

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

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Compression basics: Impairments

BY MICHAEL ROBIN

The new digital architectures, like MPEG compression, pose a new set of problems and failure modes. The tools developed for the evaluation of analog video are inadequate for the compressed digital world. The multitude of independent factors that contribute to picture quality in the digital and analog domains differ greatly. Among the MPEG variables affecting the picture quality are:

- The data rate.
- The use of I, P and B frames.
- The number and types of frames between I frames.
- The field/frame adaptive prediction.
- The method of motion estimation and compensation.
- The slice size.
- The buffer size.

Intra-frame coding impairments

CCIR Report 1089 proposes a classification of the impairments associated with bit-rate reduction techniques. It is possible to classify the types of impairments associated with intra-frame coding broadly as follows:

- *Slope overload:* The rise time of the original signal cannot be matched and, therefore, edges are blurred.
- *Edge business:* The precise continuity of an edge in the original signal cannot be matched and, therefore, the edges appear noisy.
- *Contouring:* The uniformity or the monotonicity of the original signal cannot be matched and, therefore, a layering effect occurs (contouring effects).
- *Granular noise:* Finely detailed portions of the picture — for example, those below a threshold level — are not available, and the picture has a noisy appearance as a result.
- *Blocking:* The underlying block structure appears.

Inter-frame coding impairments

The following types of impairment may occur due to temporal prediction inaccuracy:

- *Temporal slope overload:* Edges of fast-moving objects cannot be matched and, therefore, become blurred during movement.
- *Granularity and edge busyness:* Fine-detailed areas in movement exhibit granular noise effects and edge business.

The following types of impairment may occur as the result of temporal subsampling:

- *Jerkiness:* The smoothness of movement cannot be matched by the compression system, resulting in discontinuities in moving sequences.
- *Temporal aliasing:* High temporal frequency components are folded back.
- *Loss of resolution in moving pictures:* Spatial resolution is reduced during movement.

Subjective tests

ITU-R BT.500 sets the standard for subjective measurements. It introduces several new concepts detailed below:

- *Double stimulus impairment scale (DSIS):* The observers are shown multiple reference scene/degraded scene pairs. The reference scene is always shown first, followed by the degraded scene. The picture quality is assessed using a five-level impairment grading as follows:
  1 - Very annoying
  2 - Annoying
  3 - Slightly annoying
  4 - Perceptible but not annoying
  5 - Imperceptible
- *Double stimulus continuous quality scale (DSCQS):* The observers are shown multiple scene pairs with the

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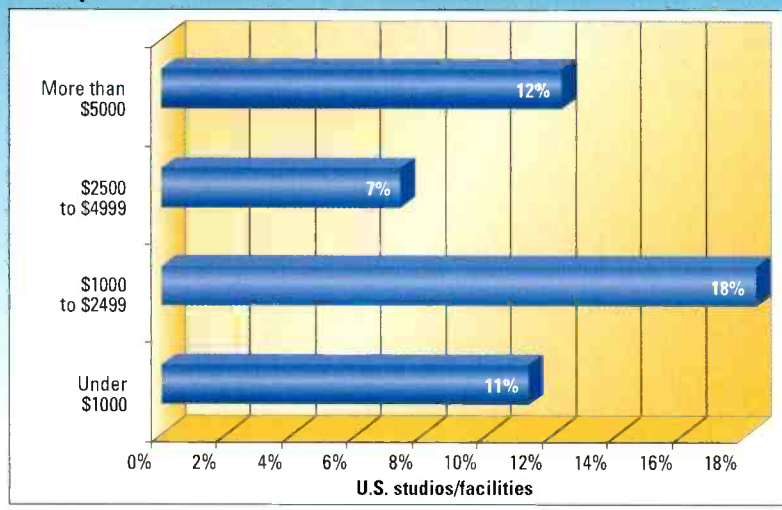

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reference and degraded scenes randomly first. The picture quality is assessed on a continuous quality scale from excellent to bad. Each scene of the pair is assessed separately but with reference to the other scene in the pair. Analysis is based on the difference in rating for each pair rather than the absolute values.

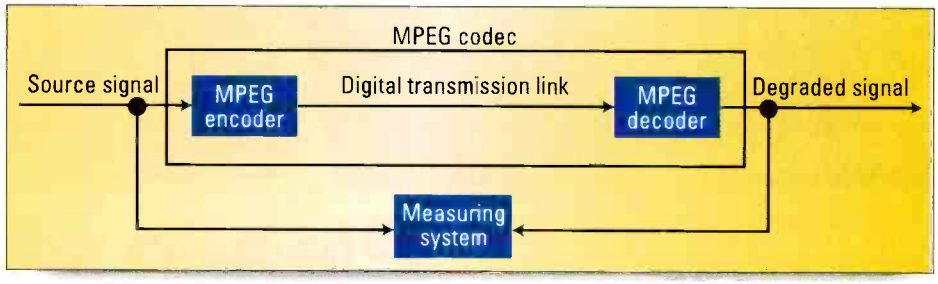

Figure 1. Picture comparison test setup

- *Single stimulus methods:* Multiple scenes are shown separately. There are two approaches:
  - * SS: With no repetition of test scenes.
  - * SSMR: The test scenes are repeated multiple times.

Three different assessment methods are used as follows:

- * Adjectival: The five impairment grading levels are used, but half-grades may also be allowed.
- * Numerical: An 11 grade numerical scale is used.
- * Non-categorical: A continuous scale with no numbers or a large range of 0 to 100 is used.

- *Stimulus comparison method:* This method uses two well-matched and calibrated monitors. The differences between scene pairs are scored in one of two ways:
  - * Adjectival: A seven-grade (+3 to -3 scale) is used. It is labeled as follows:
    - +3 Much better
    - +2 Better
    - +1 Slightly better
    - 0 The same
    - -1 Slightly worse
    - -2 Worse
    - -3 Much worse
  - * Non-categorical: A continuous scale with no numbers is used.
- *Single stimulus continuous quality evaluation (SSCQE):* Instead of separate test scenes, a program is continuously evaluated over a period of 10 to 20 minutes. Data is taken on a continuous scale every few seconds.

Subjective tests work well in development laboratories and pre-purchase system evaluations. Among the advantages of subjective tests are:

- Valid tests results are obtained for both conventional and compressed systems.
- A scalar mean opinion score (MOS) is obtained, which works well over a wide range of still and moving picture applications.

Subjective tests, however, have several important disadvantages. Such tests:

- require the selection and screening of many observers;
- require knowledgeable and meticulous setup and control of equipment and demonstrations;
- require a wide variety of possible methods;
- are time-consuming;
- do not lend themselves to operational monitoring, production testing or troubleshooting; and
- produce variable results.

Objective test concepts

Because, in the end, it is the observer's opinion of picture quality that counts, any objective test system must have a good correlation with subjective test results of the same video system and test sequences. Various manufacturers have developed proprietary objective picture-quality analysis (PQA) methods and equipment. The available devices usually compare a signal before compression with the resulting signal after decompression and assign a quality rating similar to the five-level CCIR quality assessment method. There are three agreed-upon objective methods of picture-quality measurements, resulting in three levels of measurement accuracy:

- *Picture comparison method:* As shown in Figure 1, this approach compares original and degraded source video signals (for instance, SDI 4:2:2@270Mb/s), feeding the input of the system under test (MPEG codec) with the degraded signal obtained at the output of the MPEG codec. This method is accurate because it has complete information about the original and the degraded signal. This obviously requires that the test equipment as well as the codec be available to the test personnel, a situation encountered in development laboratories. This test method could be extrapolated to a test situation where the MPEG encoder and the MPEG decoder are not side-by-side and, indeed, not in the same geographical location. In this hypothetical case, it is obvious that the source signal would have to be made available to the measuring equipment. This would require an additional,

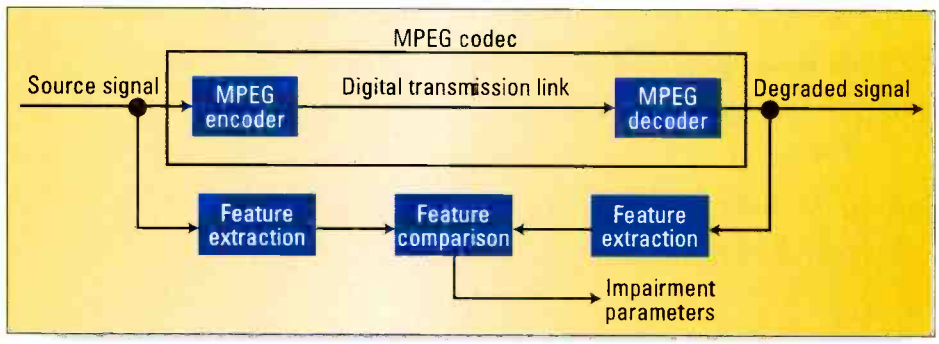

Figure 2. Feature extraction test setup

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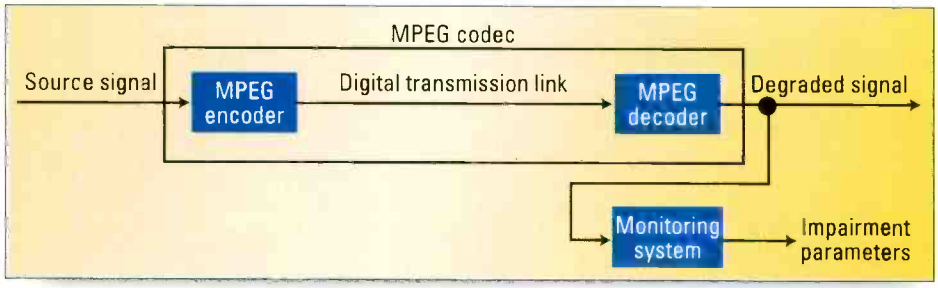

Figure 3. Single-ended test setup

separate signal path that would, by necessity, introduce its own impairments. These impairments would affect the measurement reliability.

• *Feature extraction method:* As shown in Figure 2 on page 26, this approach extracts a reduced amount of data from the input signal and compares it with a similarly reduced amount of data extracted from the degraded signal obtained at the output of the MPEG codec. The test equipment compares the extracted "features" and generates an impairment measurement result. The input feature data (several hundred bytes) can be delivered from a remote location to the measurement site using a low-bandwidth data channel, thus allowing the MPEG encoder and the MPEG decoder to be in separate locations.

• *Single-ended testing method:* As shown in Figure 3, this approach analyzes the received signal for known artifacts and other defects resulting from transmission or the encoding process. Among the impairments tested are "blockiness" resulting from the re-quantizing and variable length coding (VLC) of the discrete cosine transform (DCT) coefficients.

Looking ahead

As more compressed digital systems are installed, the need for fast, accurate and reliable subjective and objective test methods will increase. This need is, and will continue to be, met by ever more sophisticated objective test equipment relying on human vision models to evaluate the picture quality. BE

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

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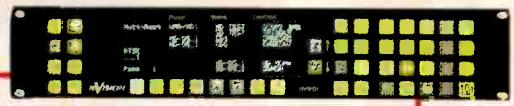

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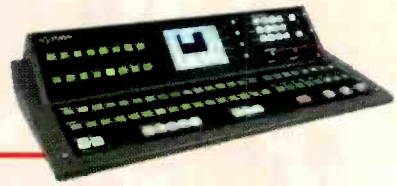

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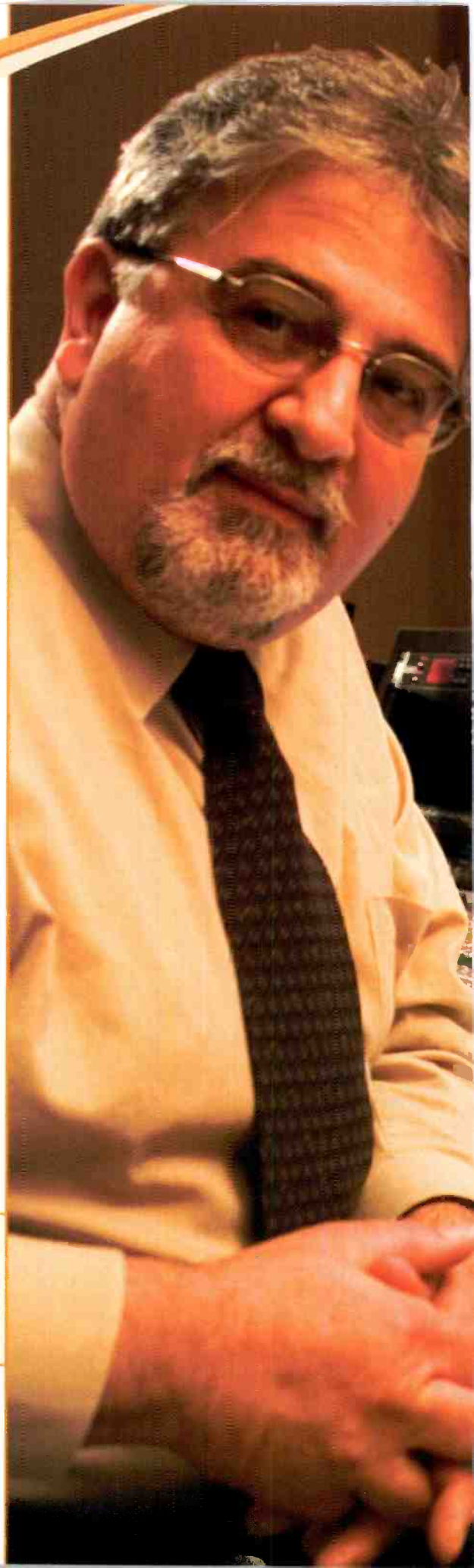

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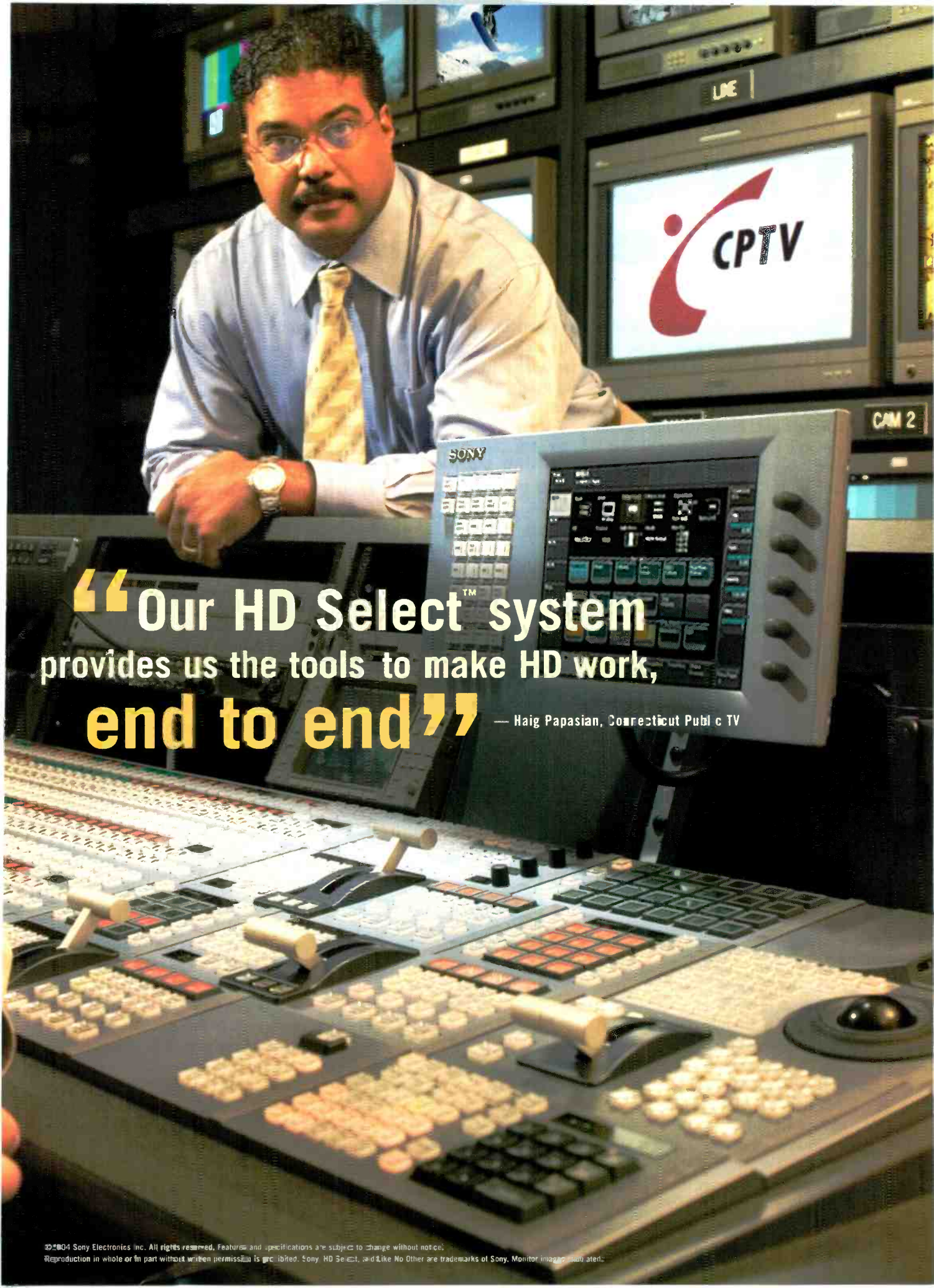

"Our HD Select™ system provides us the tools to make HD work, end to end" — Haig Papasian, Connecticut Public TV

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Video servers

BY BRAD GILMER

If you have video servers in your plant, you probably have not thought about how the video and audio are actually stored in the device. I am no expert on video server internals, but I know that there is a lot happening behind the scenes. And I predict big changes in the not-too-distant future.

First, let's look at the issues behind storing video and audio on disk. Incoming video is isochronous, which means that devices streaming video into a server cannot be told to wait while the server does something else. The server must always be ready to accept an incoming stream. Once it has accepted the stream, the server must continue to accept it at a continuous data rate. And video comes in at high data rates: 270Mb/s for serial digital and approximately 135Mb/s for converted NTSC. These requirements make things interesting for equipment designers.

Servers have to be able to handle a constant stream of high-speed data. However, all computers need time to perform various housekeeping tasks. For example, hard drives used to have to perform an occasional temperature calibration (t-cal) to be sure the heads and the spinning disk were properly aligned. During the t-cal, the hard drives would move the heads to a known physical location. Of course, if the heads were in use at the time, then the drive had to stop writing data during the t-cal. There are many other tasks computers still do regularly, including reading from the keyboard and keeping up with internal clocks. Traditional computer designers generally assume that they can stop the computer momentarily to perform these tasks without the user or application noticing. But this is not the case with a video server.

Unlike traditional computers, video servers cannot be stopped momentarily to perform housekeeping tasks without the application noticing.

To solve this problem, engineers worked closely with disk manufacturers to change the behavior of disks themselves. They altered the microcode (the software on the disk interface itself) to make the disks more video-friendly (no t-cals, for example). They also altered the way the server operating systems worked so that they would not have to put incoming streams on hold as often to perform system tasks. Of course, it was inevitable that the servers would have to perform some system maintenance tasks. Engineers solved this problem in two ways. First, they provided dedicated processors to service the disk storage systems. That way, the processor handling disk I/O would not have to be interrupted to handle other tasks, such as reading input from the server's keyboard. Second, the engineers designed disk buffers that would allow the server to store incoming data in a "bit bucket" so it would not be lost while the system performed essential system tasks.

When servers were designed initially, disk subsystems did not have the throughput to handle video. So some designers put a matched pair of disks on a single storage card and made them look like a single disk. They alternated writing first to one disk and then the other, effectively doubling the available throughput of the disk subsystem. In some cases, they installed a completely separate data bus dedicated to moving high-speed video.

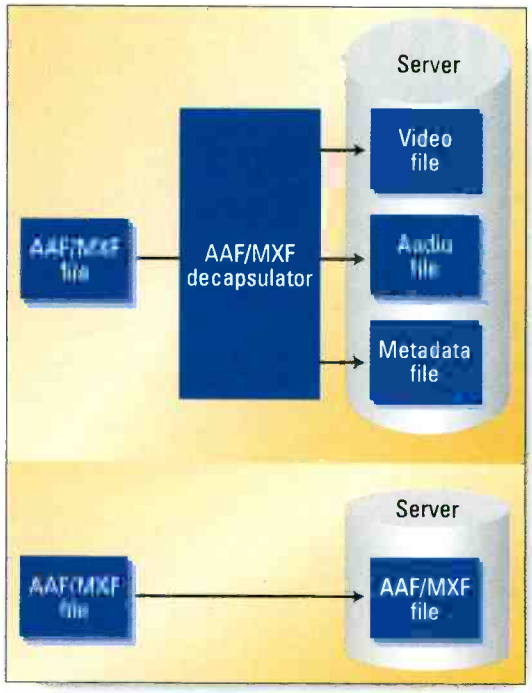
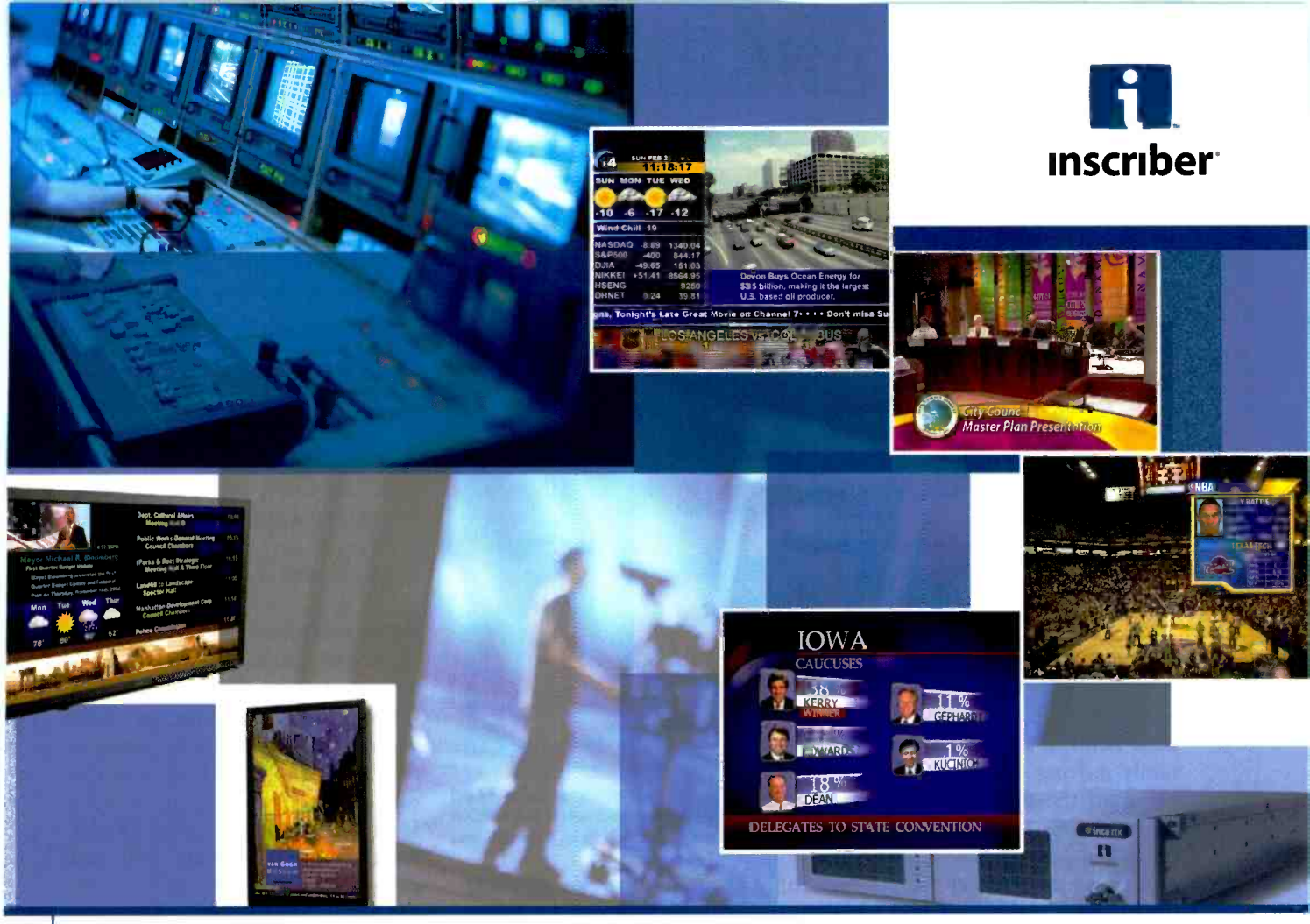


Figure 1. Most servers store video, audio and data internally as separate files, even if they arrive at the input of the server in one file. Next-generation servers may store AAF/MXF files internally as one file.



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The engineers behind these servers were extremely creative. They answered seemingly impossible demands and created a new class of storage device for broadcast. There is no question that video servers have forever changed the way television facilities operate.

That said, video servers were hardly off-the-shelf computers, and users paid quite a bit for the technology that made them possible. Early servers required carefully matched hardware components, optimized microcode in the hard disks and special operating system software.

Fast-forward a few years and today, as you might expect, things have changed dramatically. While video servers are still not exactly off-the-shelf items, manufacturers are certainly moving closer and closer to using off-the-shelf components in their servers. This trend will continue. You will still have to purchase a purpose-built device for storing professional quality video for some time to come, but this device will be built using commodity components and operating systems.

The video server of the future

So, what does the future hold? As disks, processors and computer data buses become faster, manufacturers will not have to spend as much time and effort optimizing and integrating their hardware and software. But users are always demanding ever-increasing functionality, so it is possible that server vendors will have to keep crafting professional server products well into the future.

Here is an example of a new user requirement. The Advanced Authoring Format and the Material eXchange Format (AAF/MXF) used to be viewed only as an import/export model. Manufacturers have typically "hidden" the fact that they take AAF/MXF files apart and store separate video and audio files in their own formats. They then convert these at the edges. (See Figure 1 on page 32.) Few manufacturers expected to store information in their devices as native AAF/MXF. This is not because manufacturers do not want to use AAF/MXF, but rather because their file systems and hardware have been optimized for performance. However, as time goes on, user requirements for increased AAF/MXF functionality are growing. For instance, users are beginning to expect to be able to do the following:

- Store and retrieve AAF/MXF files
- Manipulate AAF/MXF files stored on the server
- Access content stored on a video server as AAF/MXF over high-speed networks
- Archive using AAF/MXF

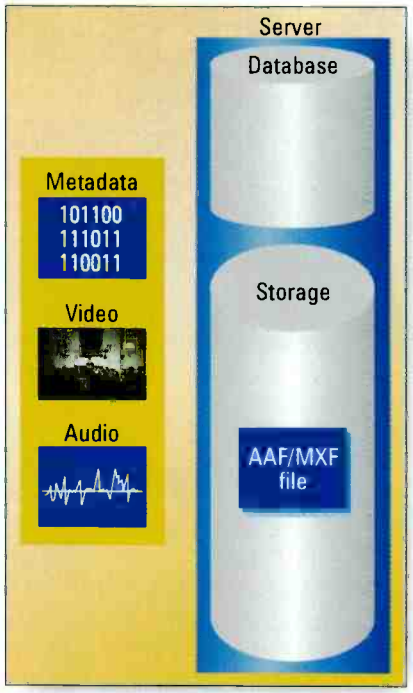

Figure 2. New servers may read metadata associated with AAF/MXF files and store this data in a database.

Manufacturers may soon find dealing AAF/MXF files natively easier than simply converting it back and forth at the edges of their devices. More powerful computers and faster networking speeds are making working with the native AAF/MXF easier. However, these new user requirements push the manufacturers away from commodity products and back into the realm of products specifically produced for the professional teleproduction market.

Data retrieval

Users do not want to store only video and audio. They also want to store information about the video and audio. And of course, storage is only half of the job. Users want to retrieve the information as well. Metadata plays a critical part in locating and retrieving the video and audio information. Searching or retrieving information on a file-by-file basis is difficult, if not impossible. But, manufacturers are creating new video devices that enable users to easily retrieve stored content using metadata contained in the AAF/MXF wrappers. (See Figure 2.) Today's manufacturers are seeing new opportunities to develop products that will help users as they go about their everyday tasks. **BE**

Early servers required carefully matched hardware components, optimized microcode in the hard disks and special operating system software.

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

Send questions and comments to:
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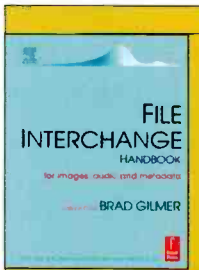

To order Brad Gilmer's book, File Interchange Handbook for Images, Audio and Metadata, from Focal Press, visit www.focalpress.com or call 800-545-2522. The book is also available from most major booksellers.

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The promise of broadband wireless

BY KEITH DOUCET

Broadcasters have long viewed wireless as an attractive alternative for selected applications where the cost of adding licensed bands and/or fiber represents a significant expense and inconvenience. But traditional wireless solutions, while adequate for limited data and voice applications, have presented multiple challenges on the broadcast front.

Cellular communications are too slow and cannot provide the bandwidth to transfer large files. Nor can they supply adequate security. Interference, especially in urban areas, can compromise quality of signals. And line-of-sight constraints have made connections difficult, if not impossible. Satellite and microwave services can deliver the necessary functionality, but they are expensive.

In more recent years, 802-16-compliant broadband wireless technology has resolved many of the signal and performance problems. Technology features available in today's systems now enable broadcasters to embrace unhampered, reliable broadband wireless communications in some of the world's most challenging line-of-sight environments.

Several technology features available in some of the new-generation broadband wireless equipment now allow broadcasters to break the communications gridlock found in other wireless options and achieve the real-time video feed capabilities they need. These features include:

- 802.16 compliance, which enables users to specify quality of service (QoS) parameters for the guaranteed levels in throughput, latency and jitter they require for real-time voice, video and data applications.
- High spectral efficiency, which lets users capitalize on available bandwidth.
- Orthogonal frequency-division multiplex (OFDM) technology, which enables equipment to deliver non-line-of-sight (NLOS) and optical-line-of-sight (OLOS) capabilities in urban and rural areas.
- License-exempt frequencies, which expand access options while reducing costs.
- High bandwidth, which offers the capacity to carry IP Ethernet data at rates as high as 48 Mb/s or concurrently carry a combination of high-speed IP traffic and up to 4 E1/T1 circuits. A single link can simultaneously carry voice, data and video and can easily manage the output of several high-resolution cameras.
- The capability to combine10/100BaseT IP ports and time division multiplexing (TDM) E1/T1 native interfaces, which enables broadcasters to enjoy real-time connectivity for standard computer, private branch exchange (PBX) or voice over Internet protocol (VoIP) equipment simultaneously.
- Extremely low latency, which supports real-time applications, including voice and video.
- Dynamic adaptive modulation and coding techniques, which protect from multipath interference and frequency-specific fading tolerance, and provide error-free links under challenging field conditions.
- Over-the-air encryption, which prevents signal interception and provides security levels not available with 802.11.

With broadband wireless, broadcasters can experience high data throughput and secure connectivity.

With broadband wireless, broadcasters can experience high data throughput and secure connectivity for such applications as contribution feeds, newsgathering, redundancy, distribution feeds and temporary links at major events. Rapid, low-cost setup and tear-down allows for easy relocation when required, and antennas can be mounted on relatively low rooftops or

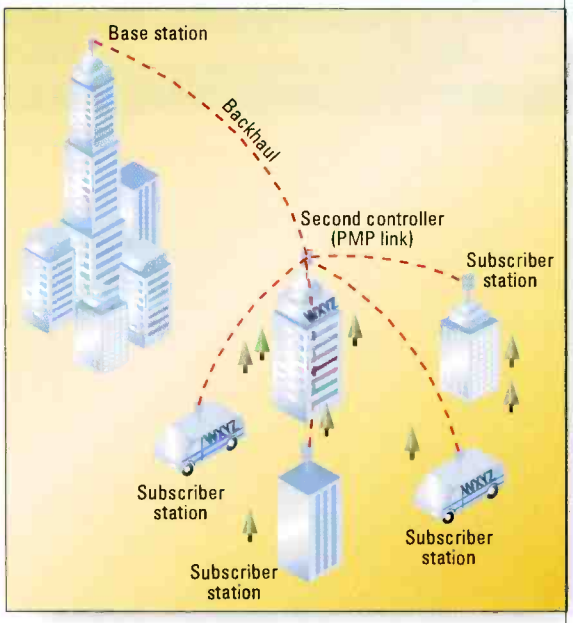

Figure 1. This diagram illustrates the video feed over broadband wireless between the provider and a broadcaster's main production facilities.

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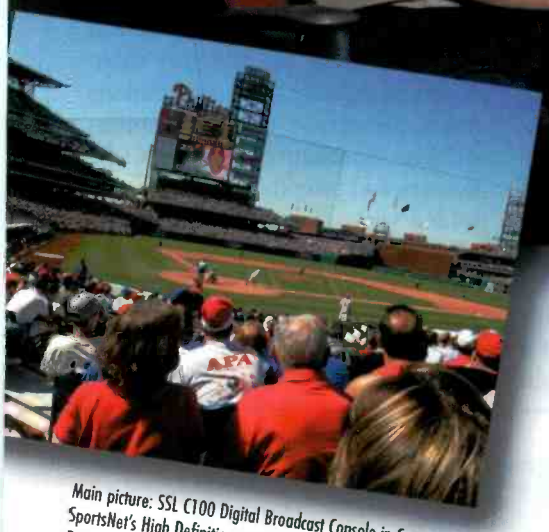

Main picture: SSL C100 Digital Broadcast Console in Comcast SportsNet's High Definition control room. Standing left: Dick Miller, Director of Engineering; standing right: Dave Finocchiaro, Asst. Director of Engineering; seated: Mike Giacalone, Digital Audio Consulting Engineer. Above: Citizens Bank Park, the all-new home of Major League Baseball's Philadelphia Phillies.

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WNET's production facilities connect to a transmitter at the Empire State Building using broadband wireless.

poles – even when line of sight is obstructed. Broadband wireless is the most cost-effective method to provide links over long distances. Equipment can transmit beyond 50mi in a single link, while multiple hop links can be set up to connection locations 125- to 200mi away.

The real-time feed capabilities of each broadband link let broadcasters emulate the full-blown performance of ENG remote units, but at a much lower cost. Camera operators can simply plug their equipment into an encoder, which in turn communicates with the broadband wireless equipment to achieve comparable-quality video images.

For example, a full ENG setup costs a minimum of $200,000 per vehicle. By comparison, a broadband wireless link plus video encoder represents 25 percent of this capital-equipment cost. This capability opens the door for stations with a large contingent of mobile field personnel, limited resources for ENG equipment, or occasional needs. Broadband wireless can, therefore, provide inexpensive portable links to complement an existing fleet or eliminate the need for rentals, which can run up to $1500 a day per vehicle.

An added advantage is that the capacity to run two-way links for video and audio feeds enables reporters in the field to file stories and send and receive scripts for editing. This type of two-way capability has not been achievable to date because, for most wireless options, the return path to remote sites is not as robust as the primary feed. Also, ENG trucks are usually not equipped to provide two-way signals, and cellular simply doesn't have the bandwidth.

Among other cost savings, a broadband wireless solution also reduces reliance on microwave or satellite links. In addition, the low cost of the equipment — and that it can operate over unlicensed bands — makes redundancy for point-to-point (PTP) communications much more affordable. Typically, broadcasters can achieve redundancy with broadband wireless operating over an unlicensed band for about one fourth the cost of traditional broadcast solutions.

Public broadcaster Thirteen/WNET has been exploring the benefits of broadband wireless Having successfully deployed a simple point-to-point voice and data link connecting its transmitter in the Empire State Building with production facilities half a mile away, the station has since been looking into broader-based applications for the broadcast industry. These include using video feeds over broadband wireless as a way to reduce operational costs, to link its sister studios and to deploy cameras in the field at significantly less cost.

In recent pilot applications, the station combined its broadband wireless radio links with video encoders to generate streaming video using an MPEG-4 video feed over IP to the studio. The system used broadband wireless equipment for backhaul functions, acting as a network bridge providing real-time streaming of video from mobile cameras operating within a three-mile radius of the studio under NLOS conditions.

While the broadcast industry has yet to explore the benefits of broadband wireless to its fullest, the technology is already proving to perform successfully in challenging broadcast environments. From simple PTP links for voice and data to more complex point-to-multipoint applications, broadcasters are starting to explore numerous ways to leverage the two-way video streaming capabilities. As applications evolve, broadband wireless promises to deliver significant cost savings to the industry and provide the redundancy needed without compromising performance or quality. **BE**

Keith Doucet is vice president of marketing and product management for Redline Communications.

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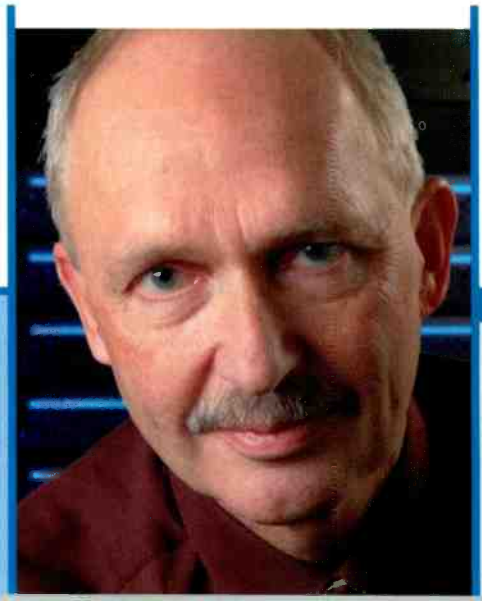

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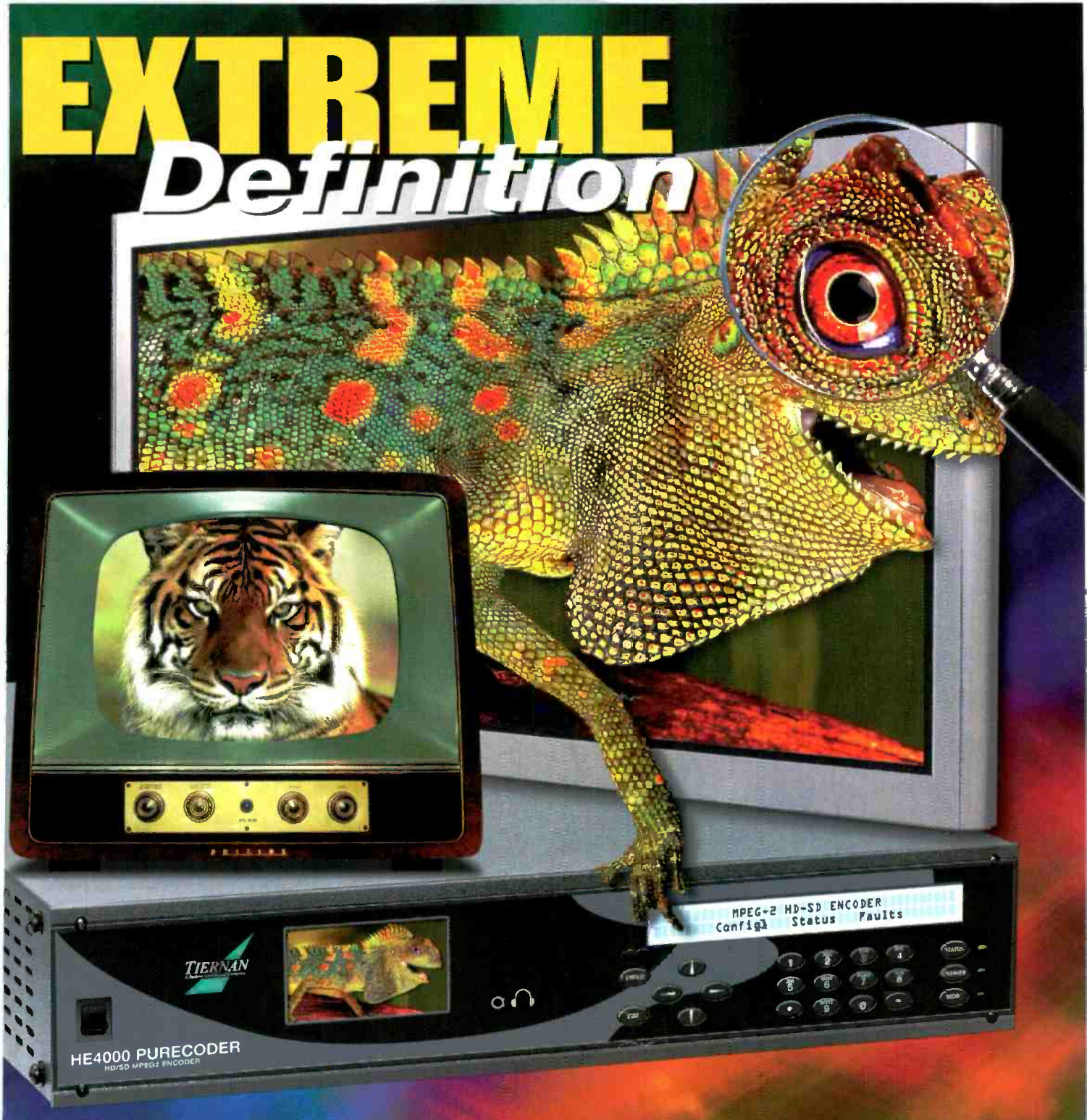

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Studio A in Food Network's new facility in Chelsea Market plays host to as many as 10 episodes of "Emeril Live" in a one-week period 10 times each year. The show employs seven to eight cameras and more than 70 mics.

food network serves up digital production

By Michael Grotticelli

When Food Network out grew its Manhattan facilities two years ago, it decided a move was in order. A new location would give it the space to gather all administrative and technical activities under one roof, as well as a new environment that would support its synergy with food and its aesthetic style.

Food Network, owned by Scripps Networks, found its dream home nestled literally on top of the Chelsea Market international food market. It has combined state-of-the-art broadcast technology with a culinary center to come up with a recipe for efficient digital content creation and future growth.

Leveraging the unique location, producers often incorporate colorful, real-life elements from the market below into their programs. The network installed numerous broadcast service panels (BSPs) at strategic locations throughout various food stores in the market to accommodate cameras on triax, wireless mics, and intercom and IFB applications. For a broadcast production facility dedicated to the cooking of food, it seems a natural fit.

The first ingredient

For the past 18 months, the project team has been busy designing and gutting three floors of a group of four old warehouse buildings in the Chelsea Market complex for the new facility. At the same time, they had to maintain an ongoing, full schedule of production and post production in the NYC facility, which could not be shut down during the transition.

The last nine weeks of the installation were decidedly the most hectic. From June 2004 to the production of the first show in the facility on Aug. 6, the team and systems integrator A.F. Associates oversaw the installation of broadcast equipment from Sony, Thomson Grass Valley and other manufacturers. This short time frame was necessary to accommodate the production of "Emeril Live."

It was quite a challenge to make the new facility architecturally sound and hospitable for digital production. With the help of architectural firm HLW International, the team interconnected five adjacent buildings with steel beam walkways and miles of broadcast, IT, CATV and fiber-optic cabling, while raising the top floor of the main building 30 feet to construct a new 7000sq ft production studio with a steel frame and lighting grid.

Because of the layout of the buildings housing the new facility, the team had to snake broadcast cabling under, through, around and on top of old wooden beams and existing structures. In many cases, they constructed raised flooring over the old wood floors to accommodate the maze of wiring.

Several of Food Network's production activities used to be located in separate facilities throughout NYC. In the new building, the network's creative services department — responsible for on-air promos created on

Macs with Adobe After Effects, Photoshop and other computer programs — is literally down the hall from where the shows are taped. This saves time and improves productivity. Now projects get completed much faster.

Mix up some live-to-tape production

The new facility is mostly digital, except for some legacy analog VTRs and an analog VHS dubbing system, which is interfaced to the digital router. Food Network still works with a number of Betacam SP and other analog formats. The key was to install equipment that would be flexible and allow the network to produce a variety of program types. This includes sending video to the Web, although the Food Network Web site is managed from Scripps' Tennessee operations facility.

The network shoots most of its shows live to tape and records them to switched masters and isolated VTRs. Editors make post-production changes in the new facility's five edit suites: one digital linear and four nonlinear based on Avid Technology edit systems (two Avid DS rooms, one Symphony and one Adrenaline system). GigE LAN connects the edit rooms but, currently, editors cannot access files simultaneously because they all use local storage. The facility will implement new network-attached storage (NAS) solutions combined with broadband WAN connectivity, over the next two years, enabling increased collaboration and file sharing locally and to distant locations.

The network, increasingly moving toward the IT world, chose Sony's IMX format to serve as a bridge. The format allows producers to view MPEG-1 versions of the video footage as needed, then use the actual videotape to edit the shows. They now have 18 IMX decks, five Digital Betacam and a dozen Betacam SP decks for screening and delivery purposes.

Scripps Networks also plans to move to HD production in the near future. That's why it chose eight Thomson Grass Valley LDK 5000 cameras for the new facility. It can upgrade the cameras easily to accommodate HD when the time comes. The network also chose a Grass Valley Kalypso 4M/E production switcher with a 2000-frame clip store. A 4M/E Kalypso control panel is dedicated to the main production studio. A 1M/E switcher control panel in the smaller "flex" production control room allows the operators to have access to the switcher's mix/effects channels from the same frame. Most of the network's shows take two to three M/Es to produce, incorporating limited transitions and wipe effects as well as minimal DVE moves.

A Solid State Logic C100 console, a portable Yamaha mixing board, and other tape decks and audio peripherals in the audio control room provide a generous helping of digital audio for facility productions. Access to a voice-over booth in the post digital audio room is also available.

A good helping of digital audio

A separate digital audio control room connected to the main studio is equipped with a Solid State Logic C100 digital audio console and a portable Yamaha mixing board (contracted as needed for "Emeril Live"). The room also includes the required tape decks, DATs, CDs and other audio peripherals, as well as access to a voice-over booth. Many of the voice-over elements, however, come in from a MUSICAM codec in the post digital audio room through an ISDN connection. An in-house music composer works in the same room, allowing the network to avoid using stock music libraries. The room also offers a full complement of digital audio production gear (such as Avid's Digidesign Pro Tools) and a voice-over booth.

Four Grass Valley Concerto 128x128 matrix frames route audio and video

Food Network's multi-use control room is dedicated to the 7000sq ft main production studio. As part of the design, the director and TD can see and communicate with the program audio mixer through the small window to the far left.

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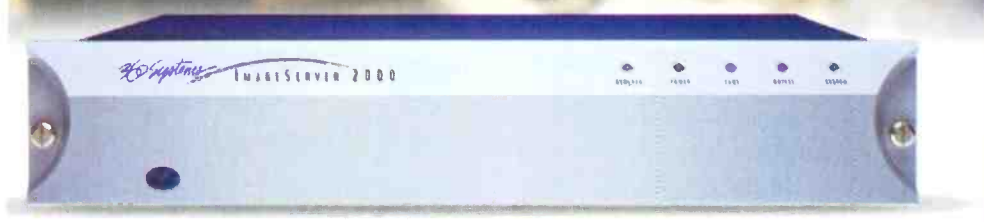

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signals throughout the building. These also can handle HD signals (with the appropriate cards installed), but one is now used for SDI video, two for AES audio, and the fourth for time code and machine control. All are under the control of Grass Valley Encore monitoring and control software. A series of Leitch distribution amplifiers and conversion modules round out the redundant distribution path.

Gigabit Ethernet connectivity over fiber and a CAT-6 cable-based local-area network (VLAN), as well as a CATV system distributed throughout the building, facilitate the monitoring of incoming tapes and feeds. The network plans to install server technology and integrate the multiple Sony IMX decks so that producers can easily browse tapes from their desktops.

Other noteworthy production equipment includes multiple Pinnacle Systems FXDeko II character generators, conversion products from Miranda Technologies and Ikegami CRT monitors in both production control rooms.

The food is the star

Of course, at Food Network, the food is the star. Unusual jib moves and the use of small lipstick cameras (where appropriate) distinguish the look of the network's shows. Network crews have become adept at anticipating the right camera shots with the correct focus and angles to present the food in its best light.

In the new facility's main studio, crews can expand and contract sets as needed. Most of shows shoot about 40 episodes in two weeks, using an average of five cameras and four wireless Sennheiser microphones. "Emeril Live," however, tapes about 10 shows in a one-week period 10 times each year. The shows employ seven to eight cameras and more than 70 mics. The facility also uses an RTS ADAM intercom system for production. Staff can access the intercom through RF operation throughout the building.

Various network and outside producers shoot in a smaller "flex" production studio, which is also available if needed for a particular show. The facility also includes a new state-of-the-art kitchen with eight food-preparation counters, overhead production lighting, and BSPs for easy camera and microphone connectivity. Usually this kitchen area, manned by some 60 full-time culinary staff, is used to prepare dishes behind the scenes. But it can be used as a setting for production of a show if needed.

Programs produced at the facility are shown not only on Food Network, but also on Scripps' various broadcast station properties. The network produces a series of syndicated "food bytes" (short cooking vignettes) on a continual basis for Scripps stations' early-morning shows. It also creates a variety of satellite media tours and commercial programs for outside clients. Scripps has signed several video-on-demand deals with cable operators across the country and produces separate content for DVD.

At Food Network, food is the star, so a state-of-the-art kitchen plays an integral part, not only in food preparation for the network's shows, but also as a backdrop for production as needed.

The sweet taste of digital

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Michael Grotticelli regularly reports on the professional video and broadcast technology industry.

Design team

A.F. Associates(broadcast integrator):
- Ricky Bonstein, VP of op.
- Dave Linick, project mgr.
- John Ciulla, design eng.

HEW International, architect design:
- Keith Hanadel, sr. associate
- Steve Newbold, partner

Scripps Productions:
- Thomas Killoy, VP of op.
- Bill Jarett, VP of eng.
- Gordon Johnson and Sal Mohamed, maintenance engs.

Scripps Networks:
- Pete Crowley, VP, property dev.
- Mark Hale, exec. VP
- Jerry Nantz, CE
- Tim Harty, eng. mgr.

Equipment list

Avid
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New adventures in remote control

BY DON MARKLEY

Those of us who are becoming more gray and feeble will remember the days when remote control systems were limited in capacity and function. They normally required a metallic pair between studio and transmitter with no transformers as DC voltages. They provided a limited number of controls and metering channels (usually 10) and were only used for nondirectional radio transmitters.

The regulatory feeling was that directional radio stations were so unstable that a first-class radio/telephone operator had to be on-site at all times. This wonderful situation put many technical types through college (including your author). There was absolutely nothing to do, so you could do homework on the job. As for TV stations, the commission fully realized that the operation of one of those monsters was roughly like flying a helicopter — one hand on video and the other on black level at all times. How could that possibly be controlled remotely?

Remote control systems in those days depended on stepping relays that, hopefully, would step synchronously at both ends of the system. The samples of the measured parameters were connected much as they are today, except that some transmitters had control circuits that didn't match well with anything. Stations often had to design and construct a relay panel to provide an isolating interface to avoid certain system destruction. Oh, how that has all changed.

Today, not only has the commission determined that directional AM antennas are stable and removed the requirement for a licensed operator to be at the transmitter site, it has eliminated all testing for operators. In addition, TV transmitters have been judged sufficiently stable that they don't need on-site operators either. The result is that remote control systems have become unbelievably complex and capable.

Now, the Internet can provide broadcasters with a high-speed, reasonably secure path for multiple uses. Broadcasters were quick to take advantage of this capability for their transmitter control systems. Earlier systems provided for access to transmitter monitoring and control of a single site from any location through the Internet. That meant the chief operator could access his equipment from the office, home or on the road simply by dialing in with a modem.

Next, systems appeared that allowed technicians to measure the performance of DTV systems and to remotely adjust the necessary precorrection circuitry to maintain proper operation. The ability of those early systems to modify the operating parameters by phone has been carried over into use of the Internet.

Now, operators can use a single control system to access essentially any number of transmitter sites in any location. All they need is an Internet access point. They can use almost any hardware — from a master monitoring system with tons of logging and trend-spotting recording features, to a wireless PDA or cellular browser. This is a bit much for those of us who have only recently convinced our mates that a flashing 12:00 on the VCR

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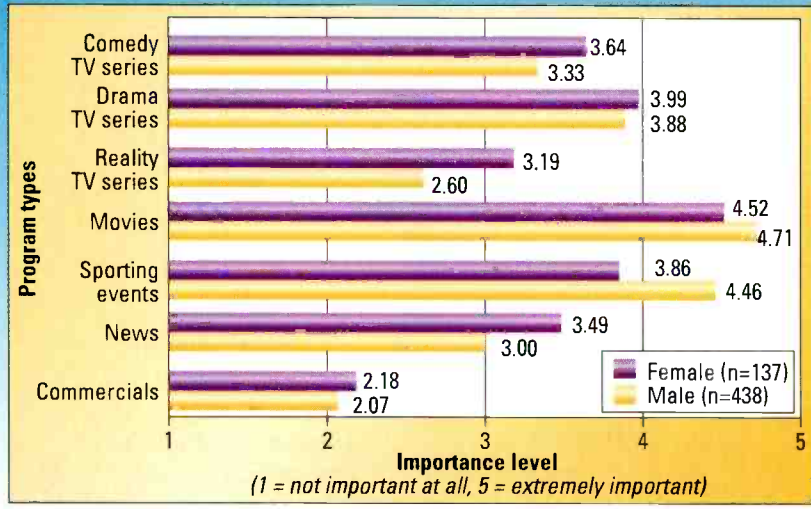

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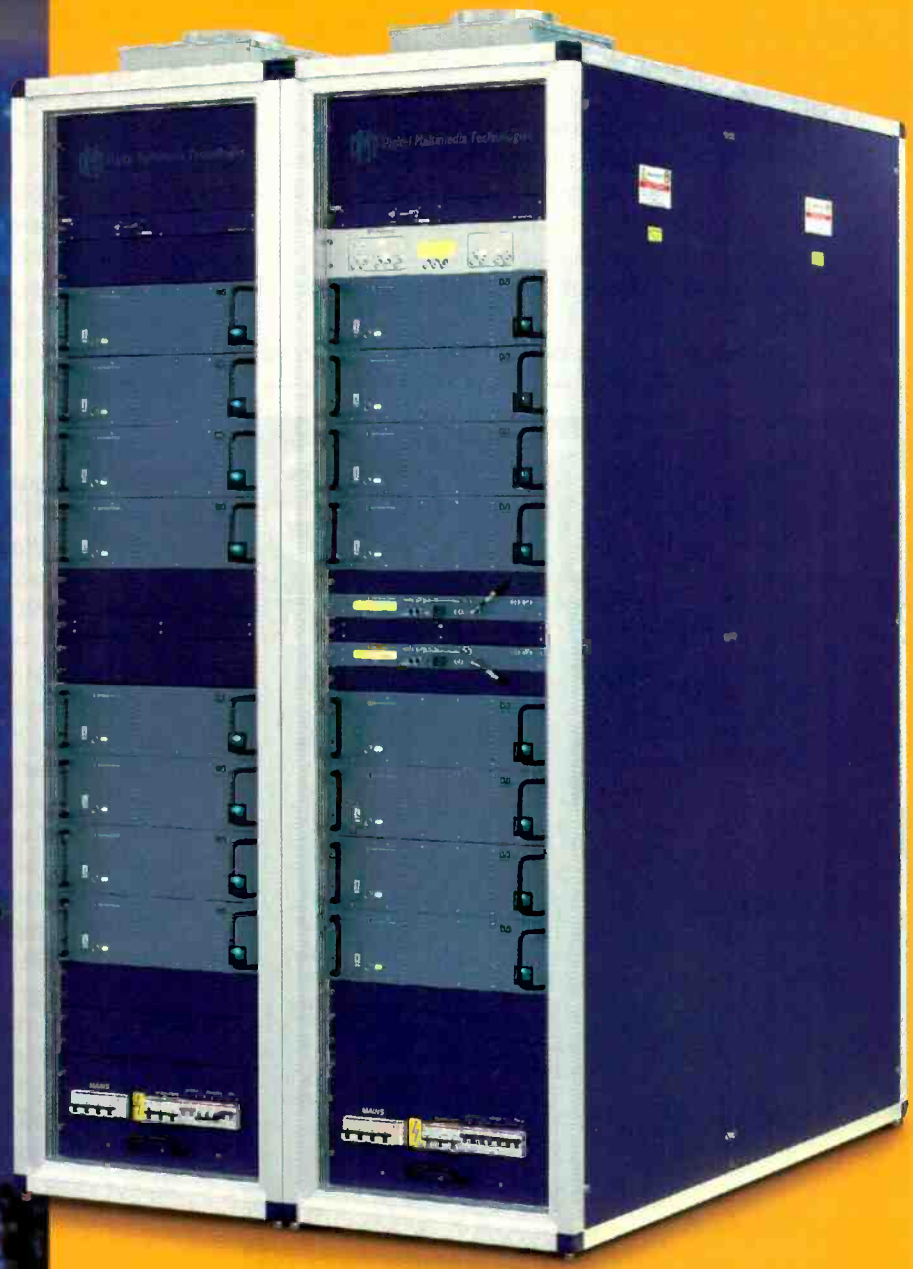

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means that the diagnostics are working properly.

Today's control functionality

The new control systems present the data in just about any format desired. Not only do metered parameters actually appear to be on meters, their values can also be shown in bar graphs and on digital readouts. Towers are actually shown as tower-shaped icons with the lights shown in their proper location, indicating whether they are operating properly. Operators can adjust adaptive correction circuitry remotely and simply download software upgrades from the manufacturer. Transmitters are shown in block diagram form, so alarms or out-of-tolerance conditions appear where they exist in the actual system. Figure 1 shows the base screen of one of these remote control systems.

Figure 1. This remote control system base screen provides access to control (left side), monitoring (center) and metering (right side) functionality. Base Recon screen courtesy Harris.

Not everything in the new systems depends on staff input. For example, staff can be notified of fault conditions by e-mail, pager, cell phone messages or good old-fashioned alarms going off in the studio. Systems can route alarms to more than one person, and alarms can vary with the severity of the fault. For example, switching an STL to the hot standby might be cause to notify the local maintenance technician but not rise to the level of notifying the group director of engineering. On the other hand, a full-blown off-the-air fault would lead to notification of several people to ensure the quickest possible response.

Multiple access levels with different passwords are common. One password can allow the engineer full access to monitor and control everything at the transmitter plant. At the same time, a separate password could limit the operator on duty at the studio to normal monitoring and basic corrective procedures. A third level might allow monitoring only, with no control access at all. Furthermore, many of these systems allow more than one staff member to be in the system at the same time without interfering with the others. Obviously, these systems are protected to a high degree by firewalls and passwords — especially those levels permitting control actions.

The password-protected systems available from some companies will also allow the transmitter manufacturer access to install system upgrades, perform diagnostics when problems exist and make some corrective adjustments. This sometimes leads to snivels from technicians that they don't want anyone else having access to "their" transmitters. Those comments are usually from operators that really don't have much of an idea about how the equipment works in the first place. A good operator is always open to help from the manufacturer — in fact, they probably need such help periodically when new challenges arise.

The new generation of control and monitoring systems offers the ability to monitor and operate all the transmitter plants in a large network from a single control location. These systems allow operators, technicians and supervisory personnel access on an as-needed basis, while blocking others' access. Perhaps more importantly, access to the systems is convenient and fast. Those who need to know what is going on, or think they do, can check on any transmitter in the system using a PDA, even while having dinner. Of course, your guests might consider that rude. BE

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

Send questions and comments to: don_markley@primediabusiness.com

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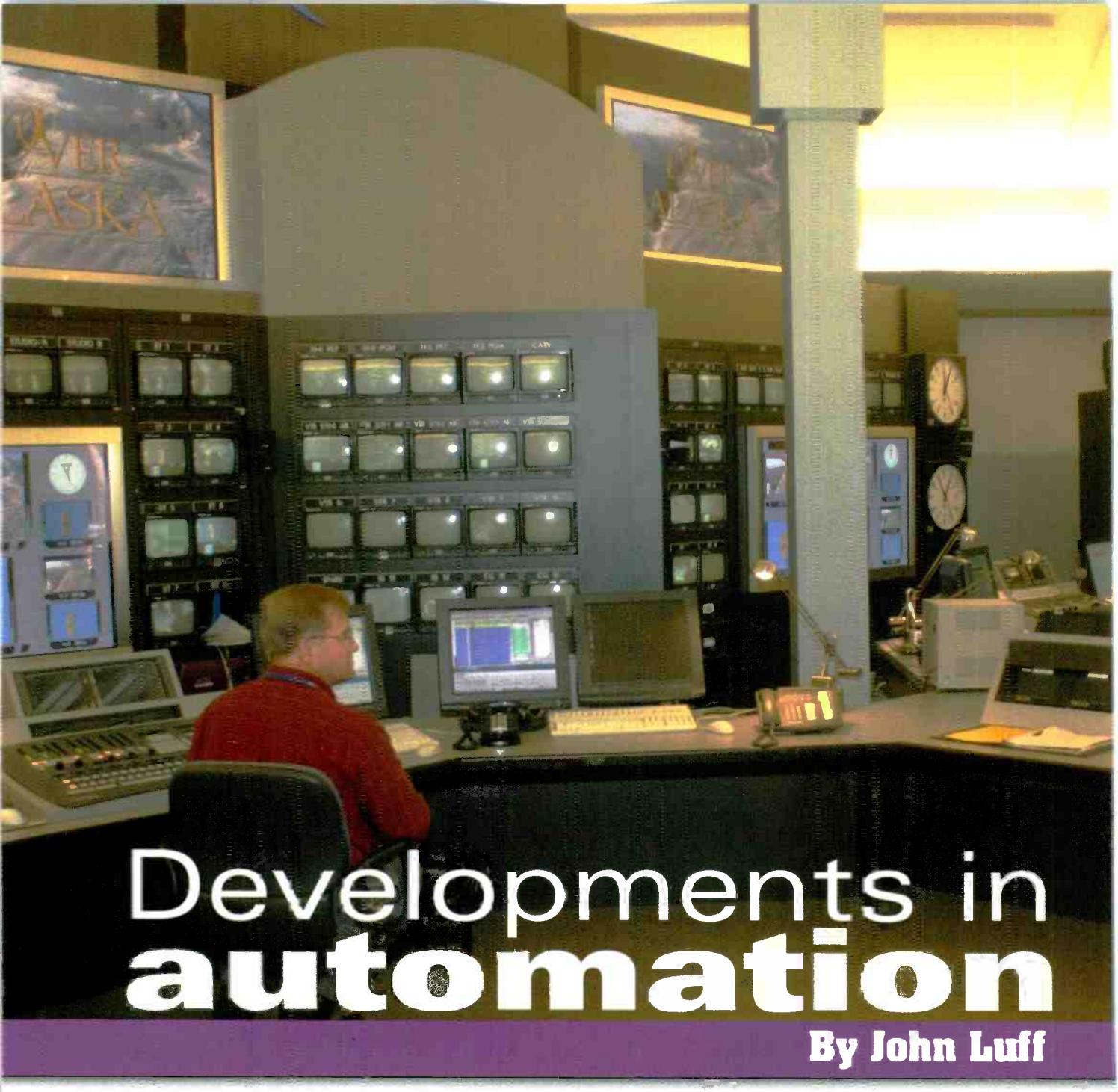

Developments in automation

By John Luff

Automation seems to be a hot topic in our industry. But it's not a new topic. In fact, the first automation system commercially developed and deployed may have been created in 1968 by Broadcast Computer Services (BCS) and deployed at KOOL-TV in Phoenix. The system was an outgrowth of an automated billing system that BCS was developing. It used punch cards to input data to the system, which was not unusual in those days. In 1974 at WTCN-TV in Minneapolis, BCS and Central Dynamics installed a system that provided control of the switcher and also enabled reconciliation back to the traffic system. As a result of those efforts, WTCN touts itself as the first fully automated station in the country.

The way we were

At that time, taped commercials aired from quad VTRs. Much content still played from film chains called islands (perhaps so named because they were huge and needed stable metal plate "islands" beneath them to keep them in alignment). Prerolls were set by an offset on the command and by parking the tape or film several seconds back from the start of media. An instant-start film chain was a luxury, and only the AMPEX AVR-1/ACR-25 quad recorders had near-instant start (about a quarter of a second, nominally five frames). Displays for the automation systems of that period were on ASCII terminals, offering character-mode displays, nominally 80 columns by 25 lines. The comput-

Dennis Raymond (left), WTTW-TV's engineer in charge of broadcast operations, performs program ingest and preps video clips using Sundance Digital's FastBreak Automation system, while broadcast technician Barry Blue (right) operates the main switcher for air operations.

ers were often DEC or IBM systems, and programming them was a bit of an art. Suffice it to say that hard disks, serial control protocols, graphical interfaces and ubiquitous device control were a long way in the future.

Clearly, the roots of automation are still quite relevant today. It is just as true now as it was then: Broadcasters' automation needs are unique and much more complex than most businesses. The root of the complexity is the requirement that things happen in a deterministic manner with absolute precision. We expect no less from an automation system than we would from a human pushing the buttons in master control. The difference, of course, is that the human can assess issues using many sources of data and can process that data rapidly to make decisions about what to do when things go wrong. A machine can only process data by rules set in advance and is unlikely to have the range of options as a human doing the same job.

The result is that we demand highly reliable automation systems that can control a wide variety of devices using a wide range of features to create complex programs. Such devices include program and interstitial sources, routers, master control switchers, keyers, DVEs, still stores, character generators, audio clip players, VTRs, satellite receivers and others.

Broadcasters' automation needs are unique and much more complex than most businesses.

We've come a long way

Computers today have come a long way since the early '70s, so it's not surprising that the range of automation options has expanded proportionately. From the small number of automation pioneers in the '70s, the field has grown to an array of manufacturers of hardware and software solutions in a range of prices. Systems can now control from one to literally hundreds of channels. In the case of cable ad insertion, the number of controlled outputs can reach into the thousands using the SCTE 35 ad-insertion protocol. SCTE 35 is intended to allow a program distributor to issue splice commands to remote edge servers or other commercial-insertion systems by embedding the commands in the distributed signal. Essentially, this approach comprises a large distributed automation system where the central site has no direct, real-time control or status of the changes made on a local level.

Similar paradigms exist in the broadcast industry as well. Both the WB network and FOX use remote splicing and/or insertion regularly to distribute content. By so doing, they allow regional stations to insert commercials at the time of air. This precludes distributing many feeds of the same program with slightly different interstitial content. These networks distribute commands within the compressed MPEG stream to edge servers where the action takes place. In more traditional control, a closed loop is established with commands sent out to the far end. Status and, presumably, monitoring are returned to the central site, where as-run logs are justified to the traffic system.

Device control

Until now, device control has been relegated almost entirely to RS-422 control circuits. Over short distances, the communication is highly reliable and offers sufficient speed for nearly any transaction. A few automation companies make products that speak to a small number of controlled devices, mostly video servers, using TCP/IP over Ethernet. Moving to more generalized network control is extremely attractive. The physical layer is simple, and the control dialect can expand to include complicated commands that require specific acknowledgement/negative acknowledgement (ACK/NAK) messages from the controlled device. It can also show status, which is cumbersome to manage over asynchronous circuits.

Recently, OmniBus and Pinnacle suggested to SMPTE that the Media Object Server (MOS) communication protocol could be the basis for a rich language for sending complex control messages to a wide range of network-aware devices. MOS is an XML-based approach to communication between newsroom automation systems and controlled de-

vices. The concept is that the controlled devices would include a MOS-compliant software interface that would allow them to listen to the dialect for a generalized type of device (character generator, teleprompter, video server, etc.). This would simplify developing control systems and controlled devices because both ends would be writing to a known specification that supports common features and requests. Pinnacle and OmniBus say that MOS could offer a standard method of communication for a broad range of automation-related needs.

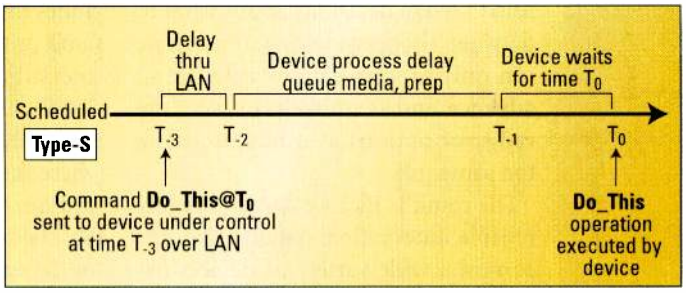

Figure 1. When controlling a device over a LAN using the MOS communication protocol, the process for a command that schedules an event, called a Type-S (schedule) event, might look like this.

Figure 1 shows the process for a command that schedules an event, called a Type-S (schedule) event. Figure 2 shows the process for a command for an event that the automation system requires to be executed immediately, called a Type-N (now) event.

MOS proponents say that it offers precisely the kind of device independence that might allow automation to talk to a class of devices in a known dialect without having to write new interfaces to each and every device as manufacturers release (and later modify) them. This would preclude device manufacturers from debugging interfaces to a large number of automation suppliers. End users might be freed from the need to get certification from the manufacturers of all of their controlled devices before upgrading their automation system. Indeed, if the final system works as well as might be expected, an end user might see a day when he or she could change an automation vendor and know that all of the system's devices will still talk to the new system. That is, perhaps, a lofty goal. But the use of standards in communications between automation and devices has worked well in the past. This was the case when the industry broadly adopted the Louth (now Harris Automation) VDCP protocol for communication with video servers. Just as VDCP opened up a more level playing field and allowed a modicum of standardization, MOS might permit enhanced functionality.

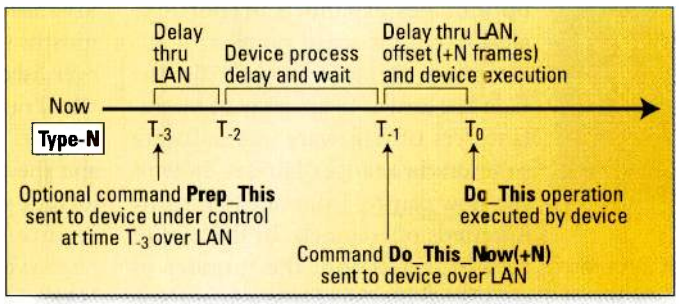

Figure 2. The process for a command that the automation system requires to be executed immediately, called a Type-N (now) event, might look like this.

The proposal suggests that a new profile be established in the MOS protocol to support automation-specific uses. In the past, SMPTE has attempted to create generalized protocols for such uses. Indeed, the ES Buss protocol standardized communications using RS-422 interfaces. ES Buss was never accepted industrywide, though some manufacturers have used it as the basis of their own machine control topology. This time, it seems much more likely that SMPTE can work with MOS due to the base of deployed MOS solutions in a segment of the broadcast industry.

It is also clear that some vendors decided long ago that the services such an approach could offer are so attractive that they warranted proprietary development. A number of vendors have designed device controllers that use IP communication to send commands to localized device control engines that take IP-based commands and translate them into machine language. These interfaces can maintain synchronization using NTP services, even allowing for local-time offsets to ensure that the commands are executed in a deterministic manner over wide-area control networks. The proposal to use MOS as the basis for communication can move these stand-alone control interfaces inside the controlled device, which would then receive standardized commands directly, without translation from IP to RS-422.

This quite recent development shows just how pervasive networks and standardized approaches have become in automation systems. Databases were once proprietary and specific to each installation. Now, off-the-shelf databases like SQL Server hold the playlist and logs for all content of which the automation system is aware. This not only simplifies the job of the code writers developing a system; it also allows backup and restoration plans to use common IT techniques, software and hardware. This enables local support personnel who are familiar with the products to assist in maintaining broadcast automation with less training specific to a "broadcast-only" product. Conversely, if a station would prefer that mission-critical systems like automation be supported by personnel specific to broadcast operations, it is possible to obtain training from a much

broader range of sources than just the automation provider.

The user interface

The user interface is a critical part of the modern automation system. The amount of information that master control operations must have available is staggering. Once a log is processed from traffic and converted for air use, it is likely to have associated with it a number of other lists beyond the air log. These include material dub (content that must be dubbed into a server and prepped for air), satellite record, missing material and purge lists, and perhaps others specific to manufacturers. The lists must present themselves in a way that tells the operator what information is critical at any one moment. A spot that is unavailable might not scroll onto the screen until literally minutes before air, though it may have shown up in numerous other places on dub lists, missing material, etc. The GUI should present the critical information at all times and notify the exceptions in clear and concise ways.

Increasingly, broadcast automation systems are handling more than one channel. Many stations run local news operations on a cable channel, a second station in a duopoly or LMA, or additional channels in a DTV multiplex. The GUI must present multiple channels of information without overloading the operator. The ability to use a second monitor, or to "drill down" when exceptions are noted, is critically important. For instance, the normal display may show multiple horizontal moving timelines monitoring several channels. The display would highlight a segment that has not been found or failed to cue for air, perhaps in yellow an hour before air and in red 10 minutes before it is due to play to air. The operator would move to a separate screen to get more detail and solve the problem. Or he or she might want to get another operator to help from another workstation if the workload is too high.

Integrating automation with other products in master control could preclude operators from having to monitor many screens for potential sources of problems. Integrated monitoring systems using flexible monitor matrices can reconfigure the monitoring to suit the needs of the current operational status of many devices. Take, for instance, a server that has failed to cue a spot. The server might report the exception not only to the control loop connected to automation but also to the master control monitor system, perhaps flashing an icon on the screen to get the operator's attention. It might offer the choice to change to a backup port.

Turns out, the most important component of any station automation solution is people.

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The monitor system can allow the operator to drill down to the problem without having to use a windowed computer interface and without needing to know how many products the GUI displays. The automation monitor screen would be but one of perhaps several tools available to the operator to help solve complex problems. GUI versions of control panels for the master control switcher, high-level block diagrams with hot spots where he or she can drill down to another screen, and other techniques can allow the operator to combine many screens and enhance his or her ability to run the master control.

Jose Estrada, operating engineer at KTVK-TV in Phoenix checks logs against Sundance Digital's Titan.

The operating system

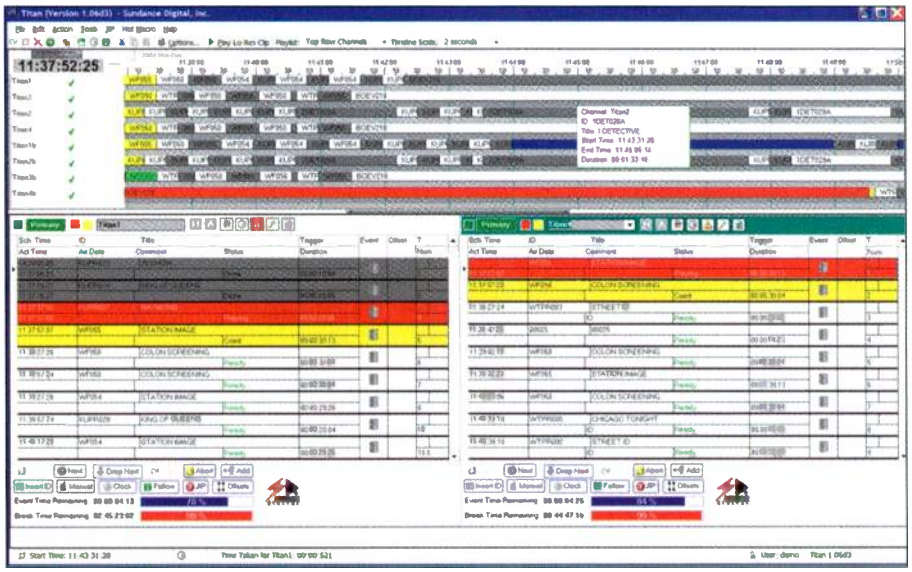
Any discussion of master control and automation would be incomplete without at least a passing reference to the computer operating system. Most of us have had experiences with the "blue screen of death." And the last place you want to see that is in the automation system. Older systems based on Windows 95/98, OS2 or other operating systems that are not designed to run real-time, mission-critical processes clearly are not wise choices for modern, complex automation systems. Unix, Linux and the latest Windows XP products offer much better protection from "excitement," which is the last thing you want to see. A reboot might be a simple cure, but when that takes the automation system offline for 10 minutes, life can be quite challenging. There are things you can do to ensure that uptime exceeds downtime. Keep general office systems on separate computers and off mission-critical networks for automation, router control and other related systems. Use strict version control and don't allow automatic updates to the operating system. You might find the automation company has not even tested current patches for conflicts with its application(s). And never update software on one device in master control (servers, routing, etc.) without checking with the automation company about the new version. The companies are usually clear about what they have certified, and unilateral changes are just not the way to start a good day. Always check first.

The last place you want to see "the blue screen of death" is in the automation system.

The next five years

In the next five years, expect tight integration with asset management, archive, and MXF transfer from spot- and program-delivery service with full metadata support and export to PSIP. Automation is rapidly moving from a machine control engine to facility management and automated, unattended operational capabilities.

Automation has come a long way in the last five years. Systems are more stable, cost less to maintain, and offer advanced features and dazzling user interfaces. Carefully reviewing the growth strategy for your system with potential automation vendors will help keep smiles on everyone's faces and keep make-goods a minor headache. BE



In this on-air management screen under Sundance Digital's Titan automation system, eight playlists are active and running; two are enlarged for closer supervision.

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

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Oops we did it again! The cover of this issue features consoles created for the Food Network by Forecast Consoles.

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Today's cable systems are increasingly digital. Armed with a rank of receivers, multiplexers and remultiplexers, a headend can produce hundreds of channels for delivery to viewers. Photo courtesy Scientific-Atlanta.

Cable distribution of HD

By Jim Boston

If a facility is not actively producing HD content locally, any HD signals coming into the facility are invariably in compressed form. Until recently, technological limitations forced local stations to first convert the incoming compressed HD signals back to baseband SMPTE 292 before performing network distribution functions such as switching between local and network, branding, and EAS insertion. But the onslaught of HD and the continued proliferation of cable networks are pressuring the cable industry to employ new ways of handling an ever-increasing traffic load.

Demands on distribution

The cable industry grew up as an increasingly complex RF reception and distribution system. Coax was the backbone of the system. That technology, plus the television receiver's limitations, restricted the program load these systems could carry. Today, anyone able to obtain satellite transponder space can aspire to become a national network and come calling on the cable companies for distribution. It takes staggering amounts of capital and lobbying to gain access to today's cable distribution chain, but the "wanabes" keep coming. That demand, along with the growing pressure that HD puts on bandwidth, has forced cable infrastructure to evolve.

Cable operators, like terrestrial broadcasters, digitally modulate channels to carry digital data streams.

Evolving technology

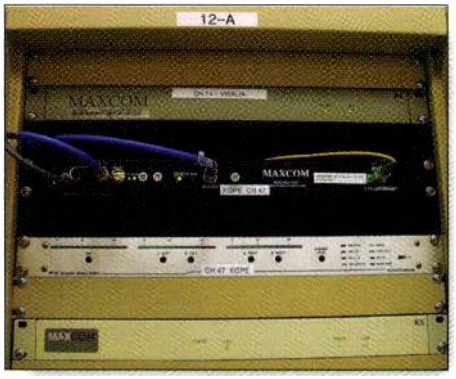
Compression technology has made it possible to pass more programming through the same bandwidth. Fiber technology can increase the available bandwidth in a given path. Receiver technology, in the form of set-top boxes, has allowed cable operators to offer increased programming to viewers. Most cable systems are evolving from mere distribution systems to something resembling WANs. Just as computer technology has pervaded most areas of daily life, telecom technology is pervading the entire television food chain, from acquisition to viewer. There's a good chance that broadcasters will eventually handle their program streams much as the cable folks now do.

Most cable systems are evolving from mere distribution systems to something resembling WANs.

Many of today's rack spaces more closely resemble dense LAN installations than traditional analog distribution centers.

To handle HD from the terrestrial or satellite broadcaster, cable systems have added what is commonly referred to as a "digital tier." This tier is mainly virtual in nature because it still occupies bandwidth (i.e., channels) just as have traditional analog channels. The difference between the two is essentially the same as the difference between terrestrial analog and DTV transmission. Like terrestrial broadcasters, cable operators digitally modulate channels to carry digital data streams. Also like terrestrial broadcasters, these channels can carry more than one program stream. On many cable channels that carry local HD streams, two HD streams occupy each channel. That means that the local affiliates' ABC and CBS HD offerings can travel to the STB on the same channel. The modulation scheme that often facilitates this

throughput is 256 QAM. With a constellation this dense, the operators must monitor the system's carrier-to-noise (C/N) levels closely, meaning cable engineers will have to live with the same concern about how close their digital signals are to the error cliff as do broadcasters.



For a local affiliate, this is the typical entry point into a cable headend. A fiber feed from the local station with SD and HD programs enters at the right end of the Maxcom unit. The center coax is the local station's HD feed wrapped in ASI. The left coax is the baseband NTSC feed from the local station for entry into a traditional analog cable plant.

The bit rate bugaboo

Most broadcasters today have been confronted with MPEG encoders that take SD and/or HD and produce program elementary streams that feed a multiplexer. The multiplexer takes the various streams and interleaves them into a transport stream. The stream travels to a transmit site where it modulates an ATSC carrier using 8-VSB. Early on, most multiplexers commanded encoders to build program streams for insertion into the transport stream using a constant bit rate (CBR). The program stream used a fixed bit rate whether or not the encoder needed that bit rate for good MPEG encoding. Now, many multiplexers command their associated encoders to use a variable bit rate (VBR) based on the complexity of each individual program.

Enter the remultiplexer

The encoder/multiplexer combination has allowed broadcasters to assemble transport streams. But the next entity in the food chain often doesn't want the total package. As satellite transponder usage increasingly has become digitally modulated, cable operators have discovered they need a way to extract the programming and services they want. Rather than decoding and basebanding the entire stream to cull out the desired programming, it is more efficient to keep the programming in the compressed domain. Enter the remultiplexer. This device inventories program services by looking at the program allocation table (PAT) and the program map table (PMT) and filtering out only the desired program streams. It also allows cable operators to add new program services and then generate a new transport stream. Remultiplexers will soon allow cable systems to insert local spots, along with EAS, into digital streams. These boxes are now sophisticated enough to perform local branding, EAS insertion and grooming. Grooming allows the operator to use CBR or VBR techniques to decide how much bandwidth a selected program stream can have, no matter what bandwidth the individual program stream has when it arrives.

These devices can have few or many I/O ports and can be fairly large, allowing cable operators to receive multiple transport streams from a variety of sources for distribution on the necessary channels. From a technical standpoint, there is the increasing realization that, unless there is a compelling reason why a terrestrial transport stream can't be taken apart, it probably will be.

The next entity in the [cable] food chain often doesn't want the total package.

At least one major network is using the cable method of remultiplexing to insert local affiliate programs and ads,

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Here are two generations of cable remultiplexers. The two units on the bottom were state-of-the-art five years ago. The top unit is today's more powerful version.

as well as branding and inserting EAS on the DTV side of the operation. The network suggests that this remultiplexer be installed as the station's final release point. The remultiplexer they use can also be controlled through SCTE 35, a control protocol developed by CableLabs. In the compressed world of MPEG, this remultiplexer acts as the master control release point. In the future, this will even allow the network to automate local affiliate programming.

In the bag

Thus, when it comes to handling HD, cable systems and terrestrial broadcasters will use processing techniques that are similar in many ways. Many broadcasters, and many cable operators, lean toward non-modulated HD pass-through, riding on ASI through the plant. Cable operators have used remultiplexing to route programs from one transport stream to the next, and broadcasters might find they can add this technique to their bag of tricks. If broadcasters keep migrating toward a distribution role, with limited local contribution (in most cases, news), television infrastructure might increasingly resemble cable headend topology. BE

Unless there is a compelling reason why a terrestrial transport stream can't be taken apart, it probably will be.

Jim Boston is an industry consultant based on the West Coast.

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Managing assets with Proximity

BY LUKE TRISTRAM AND SAI KOPPALA

What does media asset management really mean? To broadcasters a media asset is an asset only if it retains value once it has been created. Thus, in simple terms, asset management is the ability to search, locate, repurpose and reuse media over time and across organizations.

Done properly, asset management can deliver enormous efficiency and quality benefits. This requires above all two things: proper integration with the tools that an organization uses to produce, review and distribute media, and the ability to optimize the way people work.

As digital production has become a reality, there has been a widespread adoption of video servers, nonlinear editing systems, template-based graphics and digital newsroom systems. To manage digital content, vendors created databases to hold and distribute the clips and called it asset management.

Proximity's Artbox enables artists and producers to manage all of their work from one interface, resulting in a more efficient and accurate content production workflow.

Unfortunately, the ability to access data inside a vendor's box and transfer it to another vendor's product is limited at best. Stations now realize that the various asset management systems and technologies do not talk to one another, thereby creating incompatible digital islands.

Done properly, asset management can deliver enormous efficiency and quality benefits.

Some of the larger vendors have started touting an end-to-end solution — offering everything from NLE, video servers, asset management and graphics — but that leaves the customer captive to one vendor.

Other vendors, like Proximity, have chosen to offer asset management solutions that can tie the various vendors' equipment together across the entire production cycle. This allows stations to purchase the best equipment for a particular function and tie all the equipment together with an asset management solution that closely replicates existing workflows. Tribune-owned stations, including KWGN-TV in Denver and the NBC O&O stations (NBC "Arthouse"), have taken this approach with news-graphics production.

The platform combines asset management capability with a workflow component and an integration element. Xenostore provides a single media catalog for visibility to all content throughout an organization. The system tracks the order creation, queue management and review and approval of all new graphics. It also can transcode media into the format required by each device.

KWGN recently upgraded its Xenostore graphics management software with Xenotrack workflow software from Proximity. The software enables artists, journalists and producers to store and manage content from a standard Web browser.

The WB-affiliated station uses Proximity software to produce a three-and-a-half hour morning news slot each weekday and for its one-hour nightly newscast seven days a week. The graphics department also leverages the software to move and convert graphics for promotional spots and print ads.

With Xenostore, the station's producers can quickly search to find previously designed graphics for reuse. The database quickly locates desired graphics and places them directly in the newscast, without the need of a designer. Thus, KWGN's designers can now focus their time on new graphics creation and less on administration.

Interfacing all the devices used in the content-creation process and tracking assets through the production process streamline the station's workflow.

The system provides producers/journalists in the newsroom with access to assets. It also offers a standardized method to customize assets and tie them to specific stories. Producers/journalists are able to order

KWGN-TV graphic designer Daniel Tarango shown using Proximity's Xenomax's to search and FTP graphics between multiple vendors' graphics platforms, all from a centralized interface.

new graphics as needed and track the progress of requests. Artists can view all requests for new content on their desktop and electronically assign requests to other artists. Once artists finish creating content, assets are automatically pushed to playout devices and made available for review.

Proximity's newest product, Artbox, is taking this concept further. It manages clips, animations, stills and audio and is targeted at TV promo and news production workflows. Now, artists can manage all of their work from one interface. Artbox integrates format conversion, storage, workflow management and search and retrieval of media into a single device. The content-management module stores media in its native format. Users can search, locate, transfer and transcode media across multiple platforms and formats.

Artbox's workflow-management module introduces the concept of a "project", which gives producers and journalists the ability to associate multiple pieces of artwork that exist in different formats and across multiple devices with a single story.

Workflow efficiencies are quickly realized because, among station groups, small market stations now have access to high-quality graphics created by big market stations. The improved on-screen look has a positive and direct impact on news ratings and revenue.

As asset management solutions become more workflow-centric, they will merge with automation solutions. System redundancy, file backup/mirroring and archiving will become even more critical as digital content grows and stations learn how to re-purpose existing content. Broadcasters want interoperability and flexibility, and they want it on their own terms. **BE**

Luke Tristram is CEO and Sai Koppala is senior vice president of sales, marketing and support for Proximity.

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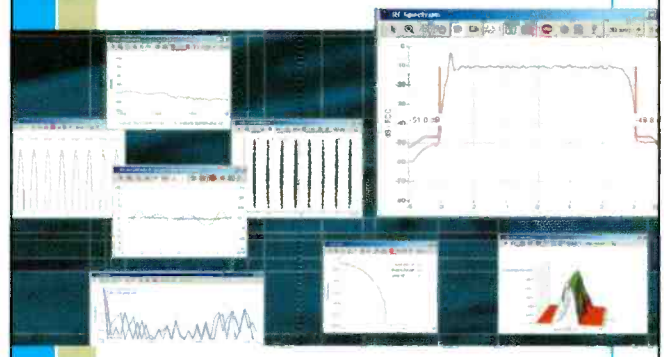

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Triax vs. fiber-optic cable

BY GEORGE HOOVER

As remote television production transitions from SD to HD production, producers and remote facility companies face numerous issues. They must not only design new systems, but also implement the equipment for actual HD production. These issues include deciding among the different options for signal formats (1080i, 720p, 24p), recording formats, aspect ratio conversion, upconversion of existing material, surround sound, and even camera cable.

Faced with all of these choices and decisions, it's good to resolve them as soon in the production process as possible. One decision broadcasters should make early on is which camera cable to use.

There are basically two ways to transmit an HD signal from the camera head to the base station in the truck: SMPTE standard multicore fiber-optic cable or triax. SMPTE fiber uses two single-mode fibers — copper for power and copper pairs for initial startup communications between the camera head and base station. Triax is basically heavy-duty coax with an extra shield. Power and data signals are combined and distributed as one across the copper conductors, riding along with the signal.

Dispelling confusion

NEP Supershooters supplies SD and HD cameras that operate on either fiber or triax. Our staff has been directly involved for some time in the industry debate about the choice to use triax or fiber for remote productions. Let's examine some of the issues.

HD signals from the camera head are essentially uncompressed at 1.5Gb/s. The path from the camera to the base station is one of the few places where HD video has not been compressed. At first glance, this wide bandwidth might seem to suggest that fiber optics is the only way. But, for years, technology has been available to transmit the bandwidth-hungry digital signals from super-slow-motion cameras back to the truck on analog triax. This technology can offers the same ability to transmit HD from the camera to the base station.

One decision broadcasters should make early on is which camera cable to use.

But uncompressed digital transmission over triax is not currently practical over long distances. Using compressed digital signals introduces several seconds of delay because of the encoding process. Because of this, it is not easily implemented for live multicamera HD production.

Practicality and ease of use

NEP Supershooters has found that using triax greatly simplifies setup in HD and that most stadiums and outside venues are currently wired for it.

Laying fiber is costly, from the standpoint of both equipment and labor. With SMPTE fiber cable running seven to eight times the cost of triax, few can afford to install SMPTE fiber and leave it there. So installation and removal are a major financial issue for the producer.

On the other hand, triax is easy to use. An experienced person can fix a piece of triax in a few minutes. If a triax cable gets cut, as it has during the half-time show at every Super Bowl telecast we have done, it can be repaired easily during a commercial break. That's not the case with fiber; the fiber cable must be returned to the shop for retermination.

To protect against the potential of cut fiber cables at an event, we "home run" all the connections on the field to a central point, and use short pieces or "stingers" to the cameras. That way, if a cable is cut on the field, the staff replaces the stinger, not the home run. The real cost of fiber cable is in the termination. A 100ft stinger costs almost what a 1000ft does. With fiber, this gets expensive quickly.

Some stadiums have preinstalled single-mode fiber rather than SMPTE multicore cable. NEP Supershooters has adapters that work around the

Triax cable has a long and reliable history with broadcasters. It's low cost and often the best choice for remotes. Photo courtesy Gepco International.

fiber by breaking out the glass, but this means that the camera must be powered from the closest electrical outlet or generator. It's just one more thing to go wrong if the power plug gets pulled or the generator quits.

The NEP Supershooters truck for World Wrestling Entertainment relies on triax for most broadcasts. This simplifies setup and if cable repairs are needed, they are easy and quick to make.

Going the distance

The HD signals can travel farther on fiber, but triax covers significant distances (up to 2500ft over standard triax) — more than enough for most arena applications. Where longer runs are needed, a single strand of single-mode fiber is the solution. For an auto racing production, we use SD and HD triax cameras on Telecast Fiber Cobras with full camera features. It works well. It's single-mode, single-transfer over fiber, and the pictures are excellent. This method can take the camera out to 10,000ft with no problems.

For the majority of the shows where the cable does not have to go long distances, triax saves time, money and complexity.

There's also the issue of equipment reliability. One of our long-time clients, FOX Sports, has used both fiber and triax for Super Bowl XXVI, FOX NASCAR (including Daytona, where they used both fiber and triax) and the "NFL on Fox." FOX Sports uses triax for most of its telecasts.

Quality counts

As for signal quality, HD cameras on triax won't yield a better picture to the home than would fiber. Ninety-nine percent of our clients request triax.

Ultimately, camera manufacturers need to develop cameras that can operate over triax or fiber. That would allow users to pick the solution that works best for each specific production on a camera-by-camera basis.

Our staff does a lot of talking with customers about our HD triax cameras and how they work, but not much about the cable. In many cases, they don't even think about the cable. NEP Supershooters has been to virtually every arena in the country, and the cable issue has never come up. That's because triax is transparent to what we do.

With fiber-only cameras, there's always the worry about how to get enough of the cable, get it installed in time and make it work. Sometimes it's not feasible to use an HD camera because there is simply no way to get fiber to the desired location.

With triax, there are none of these worries. Besides, you get the same results, in terms of picture quality, whether you use fiber or triax. BE

George Hoover is senior vice president of operations and engineering at NEP Supershooters.

Processing audio

BY JOHN LUFF

Dictionary.com (you have to love a society that never opens books) defines television as "the transmission of visual images of moving and stationary objects, generally with accompanying sound, as electromagnetic waves, and the reconversion of received waves into visual images." The lack of emphasis on audio is pretty striking. To be perfectly honest, our industry seems to take audio almost for granted, unless the sound is missing or unintelligible. From my days in station operations, I remember few complaints about the quality of the video but many about the quality of the audio. It seems interesting to note that we define the industry by the visual image (HDTV, SDTV, etc.) without including anything in the shorthand to indicate if audio is even present.

However broadcasters decide to mix, monitor and route audio, the tools they need are available. Pictured: A Wheatstone TV-80 at WGCL-TV in Atlanta. Photo courtesy DST.

Today we generally think of audio as a stereo pair, for broadcasters transmit most programming in a stereo format. However, there are many examples where that is not true; for instance, stereo is difficult to do well in news programming, and adding spatial imaging to the sound field would bring little improvement for the viewer. Of course, cable industry programming often comes with mono audio, and internationally even more of the world is mono. Multiple-language programming is the common use for multiple channels of sound in other parts of the world.

This level of complexity is not unusual. Our company designed facilities for a major religious organization that handled more than 50 simultaneous translations. With the advent of DTV and surround sound mixing, it has become important to handle multiple channels of program audio plus, of course, Descriptive Video Service (DVS). So, how should one handle the routing, mixing and monitoring? The answer is as complex as the problem.

Routing audio

Though digital video has essentially replaced analog video in system designs these days, it is not as true with audio. The reason might be as fundamental as the fact that microphones are analog, or as simple as the view of audio as the stepchild of video, although a colleague in radio once noted that TV is "radio with a light to read by... ." Fortunately, hybrid analog/digital mixing consoles are reasonably priced these days.

A radio colleague once noted that television is "radio with a light to read by ... ."

Routing also has grown to offer conversion inside the routing switcher, with digital and analog audio signals freely routed to analog and digital outputs in some designs. These routers offer the ability to mix AES digital pairs in a flat matrix that enables broadcasters to map any mono signal from any AES stereo pair into any output. They also allow broadcasters to perform phase inversions, left right swaps and mono sums.

The tools of the trade now allow great flexibility. They are compelling and cost-effective, saving interface and conversion hardware cost, and wiring and system design complexity. Of course, the other edge of the sword is complexity for operators.

Often I am asked whether embedded audio makes sense, and the answer is a resounding ... depends. It depends on the type of facility — whether it is a transmission or production facility — and whether the burden of cost and complexity in the embedding and dis-embedding hardware is more than balanced by the lowered cost for single-level routing.

A SMPTE 259M video signal can carry four groups of embedded audio, each with two pairs. This total of 16 mono signals (eight stereo pairs) should suffice for many purposes, if all hardware supported the full capability of the standard. As in all things, it is not that simple. Not all hardware can handle all four groups (of two channels). Some hardware, such as video mixers and compression hardware, may pass nothing through to its output. Thus, it is prudent for the engineer to look at real-world products when considering a design to be sure

the full range of needed features are really available.

There are other issues with embedding that are slightly more complex than the mere presence or absence of signal. The latency of an embedder for HDTV audio is generally a bit less than 0.5msec. This is not a particularly difficult problem with a single device. However, when the potential exists for several passes through a similar device, and demultiplexers in the same system, it is clear you should carefully consider timing. While the initial short delay certainly will not create a lip sync problem, the total would cause lots of timing issues within a system.

Audio isn't as easy as it sounds. Pictured: A control room designed by Syska Hennessy Group for Mike Post Productions in Burbank, CA.

Then there is cost. Embedding is not a particularly expensive function, but if a system will need many devices for utility purposes, or perhaps for the inputs to an audio console, the cost multiplies quickly. VTRs and some other devices allow simultaneous AES and embedded outputs. Clearly, when a VTR includes an internal dis-embedder (as most do these days), it reduces wiring complexity and could eliminate the need for separate layers of audio routing.

Synchronization

From the start, digital audio and video were not designed to work together, with SMPTE standardizing the video interface and AES doing the audio interface. This brings up the unfortunate problem of synchronization, which is exacerbated greatly because most digital video systems are locked to clocks that are related to the NTSC frame rate (60/1.001Hz or 59.94005994Hz). Of course, audio could be locked to the same clock, or 48kHz/1.001, or 47.952kHz.

Then there is the issue of sample alignment between audio and video. There are 8008 audio samples in every five video frames, a cadence that is not particularly friendly. As a result, it is not possible to cut audio and video cleanly on every video frame without significant processing of the audio signal to assure that truncated samples do not produce clicks, pops or worse.

Just one word about audio routing with digital signals. A synchronous AES router is highly desirable because the switches are made without disruptions in the AES sample cadence. Most manufacturers offer both synchronous and asynchronous switchers, but you should strongly consider the design issues an asynchronous router could present. An asynchronous router does not particularly care where the switch happens and will switch without regard to AES frame boundaries. You might think of it as a patch bay — a brute force switch. A synchronous AES router, on the other hand, will always output a complete and uninterrupted digital audio signal because all inputs are reframed internally, and switches happen on AES frame boundaries.

Broadcasters also can route multichannel digital audio using Dolby E or other multichannel compressed audio systems. This allows eight robust audio signals to be carried in one AES stream, or up to 64 audio channels to be embedded in groups in an SDI signal.

Keeping that much audio straight would certainly be a challenge! Broadcasters need flexible audio monitoring tools to handle all this complexity, which must include tools to verify the format integrity and levels in AES, as well as the content and metadata in compressed audio signals. And you thought audio would be simple! **BE**

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

Send questions and comments to: john_luff@primediabusiness.com

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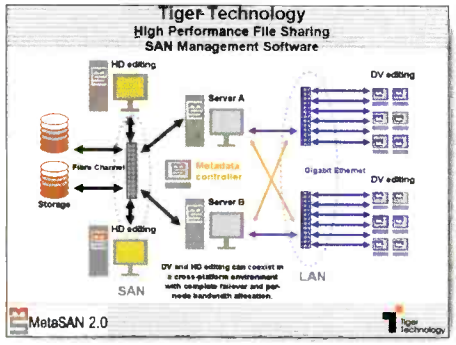

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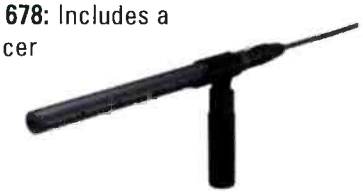

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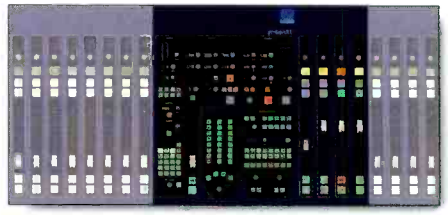

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Problems
with frequency allocation

BY PAUL MCGOLDRICK

Monday-morning quarterbacking is wonderful. It makes it easy for us to see the holes we have dug for ourselves in designing communications systems, especially broadcasting systems.

Join the band

In the 1920s, radio designers grappled with ways to broadcast signals on the medium-wave band. The frequency limitations of the vacuum tubes available during that period restricted radio operation to that band.

Spectrum allocation during television's evolution was also limited to certain frequencies. The lower bands didn't have the required bandwidth. But, during WWII, developments in tank-to-tank communications on the VHF band produced devices that could serve VHF television.

FM radio broadcast, naturally, was slotted in the next space above the TV services. And, as emergency service and aeronautical needs evolved, they were put at frequencies higher again. Need more television bandwidth? Just slap it in a higher slot by filling out the rest of the VHF bands and reaching into UHF.

So, in 80 years, we managed to fill up the first gigahertz of available spectrum. We were able to slot some point-to-point radio systems in there as well and, of course, legacy analog cellular services.

That's a do-over

Here's where the Monday-morning quarterbacking comes in. If you were given the job of spectrum czar, what would you have done differently? First, you probably would have given more consideration to the user than the service provider. In broadcasting, we have always been concerned with putting complexity in the transmitter to make the receivers simpler. But we never thought about where the receiver was.

The vast majority of people watch television in a fixed location (home, office, hospital, etc.). Radio listeners are probably split about half-and-half between listening at a fixed location and listening on a mobile receiver. This justifies a terrestrial radio system that does not employ an onerous amount of spectrum. It's quite possible that the fairly useless medium-wave band, with its restrictive night operations that allow very few all-day, every-day services, would never be started today. Conversely, it's likely that the FM band would be extended down another 20MHz to make room for the many programmers who want and deserve spectrum.

If you were given the job of spectrum czar, what would you have done differently?

With TV, we know where the majority of viewers are. Why would we provide them with a terrestrial broadcast system that is more suited for mobile applications? If we started again today, we would reserve that spectrum for mobile aplications, and feed fixed locations with much higher bandwidth copper cable or fiber. We would probably not offer satellite service, simply because it would be better to reserve that spectrum for more important things. As for transient viewers, we would equip any place that an RV or truck can park with a high-bandwidth spigot. That way, public-service mobile communications could use the existing TV bands. It would relieve those public services from the problems stemming from cellular systems and from insufficient channel allocations for dire emergencies. Witness the utter overload and inter-channel confusion in New York City on Sept. 11.

Obstacles

Just getting the mostly VHF analog channel allocations back from the broadcasters would help dramatically, but the date for that has been shot down again. Senator John McCain was plying a bill that would end analog broadcasting in 2009. NAB pressure killed it. We are now back to the 85 percent digital coverage rule that will push the changeover dates to at least 2011 and, in some communities, to 2020. And worse things are looming. An amendment to McCain's "Save Lives Act" added by Senator Conrad Burns threatens to allow broadcasters to not have to return the spectrum at all. This is bad for the communities that broadcasters serve. It also inhibits technological progress, which is bad for the viewers, the broadcasters and the industry.

Pay it back

Broadcasting, of which I have been a part for many, many years, has had a free ride with spectrum for 80 years. It's time we stop and take a look at the road behind and the road ahead. This is the right time to be grateful for the ride and to give something back. BE

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

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